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Archaeological Investigations at the Magic Mountain Site, Jefferson County, Colorado

Edited by Mark D. Mitchell

Research Contribution 122

PCRG
PaleoCultural Research Group

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With Contributions By
Carl R. Falk
Christopher M. Johnston
Michele L. Koons
Rolfe D. Mandel
Mark D. Mitchell
Kathryn Puseman

2022

PCRG
Paleocultural Research Group

Abstract

The Magic Mountain site, located in a sheltered valley south of Golden, Colorado, is well known for its stratified Holocene archaeological record. For more than 30 years following the 1966 publication of Cynthia Irwin-Williams and Henry Irwin's landmark monograph, data from the site were crucial for systematizing the archaeological record of the South Platte River basin. Although Magic Mountain's importance as a comparative touchstone has diminished in the last 20 years, crucial questions remain about the site's earliest occupations and about its extensive Early Ceramic component. In 2016 the Denver Museum of Nature & Science and Paleocultural Research Group initiated a multi-year, inter-disciplinary public archaeology project at the site designed to better understand its history of occupation and its role in the regional settlement system.

The 2017-2018 crews opened a total of 59 excavation squares distributed among six designated sites areas. Crews excavated a total of about 31 cubic meters of sediment. Using magnetic gradiometry and ground penetrating radar data to guide excavation unit placement, the field team documented 14 American Indian features—mostly basin hearths and earth ovens—all dating to the Early Ceramic period between about 2000 and 1000 B.P. Radiocarbon data indicate frequent, although intermittent, use of the site during this entire period.

Over 25,000 modified stone artifacts were documented during the two field seasons. Over 60 percent of these are from Early Ceramic components, with some evidence of earlier (Archaic) occupations and minimal evidence of post-Early Ceramic use of the site. Raw material data indicate almost an exclusive use of local or near-local materials. Over 500 stone tools were documented, including 72 corner-notched arrow points or arrow point fragments. Only eight pottery sherds were recovered, all likely from the Early Ceramic period.

A variety of species are represented in the faunal data. Many are lower ranked species, like most Early Ceramic sites in the region. Small- to medium-bodied artiodactyls are the most common in the assemblage, most of which are likely deer. Also like many Early Ceramic sites, bison are only minimally represented with four identified specimens. Bone tools and ornaments were also recovered, and ornaments were possibly being manufactured at the site during the Early Ceramic occupations.

Macrofloral analysis indicates a somewhat diverse assemblage of plants were utilized by the Early Ceramic period occupants of the site. These include varieties of cacti, Cheno-am plants, grasses, wild cherries, sunflower, and more. Pine wood was the most common fuel for fires. Radiocarbon dating of features, and the remains within, indicate a greater variety of plants were used during later occupations at the site compared to earlier ones.

This project was paid for in part by a History Colorado – State Historical Fund grant. Additional major funding for the project was provided by the Denver Museum of Nature & Science. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions and policies of History Colorado or the Denver Museum of Nature & Science. Mention of trade names or commercial products does not constitute their endorsement.

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Cover photo: Overview of the Magic Mountain site during the 2018 field season, looking west towards the foothills. © Denver Musuem of Nature and Science.

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Acknowledgments

The Magic Mountain Community Archaeology project was a product of many hands. Fundamental to the work was the support and assistance provided by the City of Golden, Colorado, which owns and manages the site, and Jefferson County Open Space, which manages the adjacent public lands. City of Golden Mayor Marjorie Sloan, Director of Parks, Recreation, and Golf Rod Tarullo, and Parks, Forestry and Cemetery Manager Chad Meinert supported the project from its inception in 2016 and provided outstanding assistance throughout. We received similarly enthusiastic support from Mary Ann Bonnell, Visitor Services and Natural Resources Director for Jeffco Open Space, and Erik Dahlstrand, Jeffco Open Space Buildings and Historic Sites Team Lead. The project would not have been possible without those individuals and the many city and county staff members to contributed.

The project was the brainchild of Michele Koons, Curator of Archaeology at the Denver Museum of Nature & Science (DMNS). Koons approached PCRG Research Director Mark Mitchell in 2015 about developing a collaborative citizen-science project that built on the strengths of both organizations. The resulting collaboration was among the most productive PCRG has undertaken in its 25 years of archaeological field research. Mitchell is especially grateful to Koons for her collegial approach to collaborative research and for her steadfast friendship.

PCRG is grateful to Rolfe Mandel and the University of Kansas Odyssey Archaeological Research Program (KU-Odyssey) for their contributions to the project. Mandel was integral to the project throughout and the addition of the Odyssey crew during the 2018 greatly expanded the scope of the investigation. PCRG also is grateful to Ken Kvamme (University of Arkansas) and Larry Conyers (University of Denver) for conducting the geophysical surveys that were invaluable for planning the excavation program. University of Denver graduate student Brianna Dalessandro conducted additional geophysical surveys that contributed to the archaeological and geoarchaeological analyses.

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We acknowledge the American Indian tribal representatives who participated in the project, including representatives from the Ute Mountain Ute, Southern Cheyenne, Kiowa, Cheyenne River Sioux, and Mandan Hidatsa Arikara Nation who visited the site during the fieldwork and shared their knowledge with the project team. We are grateful to DMNS Senior Curator of Anthropology Chip Colwell for his assistance with tribal outreach.

Numerous volunteers expertly assisted with the daily public tours. Without them the extensive public outreach that was integral to the project would not have been possible. We also thank the many visitors who toured the site for showing us how lucky we are to be able to do what we do, and for demonstrating again that engaged public outreach can spark a life-long passion for archaeology and preservation. We also are grateful to the residents of the Heritage Dells neighborhood for their interest in, and stewardship of, the Magic Mountain site.

We extend our utmost gratitude to all the

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About the Contributors

Carl Falk, formerly with the National Park Service's Midwest Archeological Center and the Department of Anthropology, University of Nebraska-Lincoln, is a co-founder of the Paleocultural Research Group. He has worked in coastal California, northwestern Mexico, the Missouri Ozarks, and throughout the Midwest and Great Plains. Carl's principal interests center on the archaeology and zooarchaeology of village horticulturalists within the Middle Missouri and Central Plains subareas. He has authored and co-authored numerous articles, technical reports, and presentations at regional, national, and international conferences.

Chris Johnston is the Operations Director and a Project Archaeologist for Paleocultural Research Group. Chris began his career as a PCRG undergraduate work-study employee while at the University of Colorado at Boulder. Chris earned his MA from Colorado State University in 2016 where his thesis research was on communal bison hunting at the Roberts Ranch Buffalo Jump (5LR100). He has worked for the USDA Forest Service, in cultural resource management, and as a researcher with PCRG and the Center for Mountain and Plains Archaeology at CSU. Chris served as the Assistant State Archaeologist of Colorado from 2016-2018 where he was the lead instructor for the Program for Avocational Archaeological Certification and managed the statewide archaeological and paleontological permitting system. Chris has research interests in the lithic technology of hunter-gatherers in the Plains and Rocky Mountains, landscape archaeology, and Plains Village archaeology. He has worked on a variety of contract and research projects across the Great Plains and Rocky Mountains and has authored numerous technical reports, journal articles and conference presentations.

Dr. Michele Koons studies ancient complex societies and is especially interested in ancient political dynamics, social networks, and how people of the past interacted with their environment. In her research, Michele uses different geophysical methods and traditional archaeological techniques, such as excavation and pedestrian survey. She also specializes in ceramic analysis and radiocarbon dating. Michele has conducted archaeological research throughout the United States, Peru, Bolivia, Chile, and China. Michele grew up outside of Philadelphia and attended the University of Pittsburgh for her BA. After interning at the Mütter Museum in Philadelphia, she moved to Colorado and worked at the Museo de las Americas in Denver and in cultural resource management in Wyoming. Michele then attended the University of Denver for her MA degree, where she explored the site of Tiwanaku in Bolivia. Michele went on to Harvard University for her PhD and pursued research on the Moche archaeological culture of Peru. While at Harvard, Michele worked at the Peabody Museum and volunteered at the Boston Museum of Science. After defending, she took a postdoctoral position at the Denver Museum of Nature & Science and was hired as curator a year later. Michele currently conducts research in the American Southwest, on Colorado's Front Range, and in Peru. She curates the Museum's archaeological collections from Latin American, North America, and Egypt.

Dr. Rolfe D. Mandel is Senior Scientist, State Geologist, and Executive Director of the Odyssey Geoarchaeological Research Program at the Kansas Geological Survey, and University Distinguished Professor in the Department of Anthropology at the University of Kansas. He has spent 40 years working with archaeologists on projects throughout the United States and eastern Mediterranean. Dr. Mandel is especially interested in soils and landscape evolution, and the effects of geologic processes on the archaeological record. From 1999-2004 Dr. Mandel was Editor-in-Chief of *Geoarchaeology: An International Journal*, and his work has been published in a number of books and professional journals. The Geological Society of America has recognized his achievements with two prestigious awards: the George Rapp Award for outstanding contributions to the interdisciplinary field of archaeological geology, and the 2010 Kirk Bryan Award for Excellence.

Dr. Mark D. Mitchell is the Research Director for Paleocultural Research Group. His research explores the archaeology of two different regions: the Northern Plains in western North Dakota, and the Southern Rocky Mountains in Colorado and New Mexico. Mitchell's Southern Rockies research focuses on American Indian mobility and land use in the San Luis Valley and adjacent mountains. He is particularly interested in how technological and environmental change affected native peoples' economic decisions. Mitchell's Northern Plains research focuses on the political and economic development of post-A.D. 1200 farming villages of the Missouri River valley.

He also studies historic American Indian rock art and the history of archaeology. Mitchell's research has appeared in *Plains Anthropologist*, *Antiquity*, *American Antiquity*, *Southwestern Lore*, *Colorado Archaeology, Quaternary International,* and in a number of book chapters. He is the author of *Crafting History in the Northern Plains: A Political Economy of the Heart River Region, 1400-1750* (University of Arizona Press, 2013) and co-editor of *Across A Great Divide: Continuity and Change in Native North American Societies, 1400-1900* (University of Arizona Press, 2010).

Kathryn Puseman is a macrobotanical expert with over 31 years of experience working with macrofloral remains, charcoal, and wood for archaeological and paleoenvironmental projects. She earned her degree at the University of Colorado, Boulder and has experience with both prehistoric and historic samples from a variety of sites in North and South America, Europe, Asia, and the Pacific Islands. Kathy has also worked with geologists to recover datable material for paleoflood and paleoseismic studies. When she is not looking through a microscope, Kathy enjoys white water rafting and camping with her family.

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Introduction

Michele L. Koons and Mark D. Mitchell

The Magic Mountain site in Golden, Colorado, has served as a cross-roads of culture for millennia. From the mobile hunter-gatherers who lived there for over 9,000 years, to the gold-seekers of the 1860s, to those who bike and hike in the area today, there is a collective awareness that the place is special. The Magic Mountain Community Archaeology Project (MMCAP) taps into that shared sense of place and explores the stories of the people who lived there long ago, while making those stories relevant and tangible to people today.

The MMCAP is a multi-disciplinary public archaeology collaboration between the Denver Museum of Nature & Science (DMNS), Paleocultural Research Group (PCRG), the University of Kansas' Odyssey Archaeological Research Program (KU-Odyssey), other universities, and various local Colorado communities. The DMNS is a national leader in informal science education and field research. As the fourth largest natural history museum in the country with a diverse and talented staff of 500 fulltime employees, the museum is uniquely positioned to execute large-scale research projects with tailored educational and outreach components. Accordingly, the museum recognizes a responsibility for both excellence in research and for leadership in community engagement.

PCRG is a member-supported nonprofit organization that conducts scientific research, trains students, and educates the public on the archaeology and paleoecology of the Great Plains and Southern Rocky Mountains. As an important leader in the region, PCRG broadly disseminates their research findings to professional and public audiences.

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The Odyssey Archaeological Research Program, housed in the Kansas Geological Survey (KGS) at the University of Kansas, was established in 2003. The program's goal is to search for evidence of the earliest people to inhabit the Central Great Plains and western portions of the Midwest, and to gain a better understanding of the late Pleistocene and early Holocene paleoenvironments that affected those people.

The twin goals of the MMCAP were to conduct world-class research at one of the most important archaeological sites on Colorado's Front Range and to make that research, as well as the research experience, accessible to the public. The MMCAP enjoyed two successful field seasons of community-based archaeological fieldwork during 2017 and 2018 and continues to offer outreach opportunities. The project team designed MMCAP to bring the region's shared backyard history into the hands of the public. The team accomplished this through public tours, youth programming, extensive volunteer opportunities for excavating and leading tours, teen internships for students in underserved communities and underrepresented groups, community group partnerships, targeted marketing, and an intertribal meeting day, among many other activities.

As the population of Colorado, and specifically the Denver metropolitan area, increases and puts more pressure on open spaces, it is urgent that projects like the MMCAP help to preserve important sites through education and heritage appreciation. Magic Mountain is located adjacent to the Apex Trailhead, which is managed by Jefferson County and contains a parking lot, public restrooms, and a well-maintained trail system that provides access to a portion of the site. Given its publicly accessible location, the team recognized an excellent opportunity to engage people in the exploration of the human-environmental history of this area going back at least 8,000 years. Overall, the project was designed to research, to teach, and to directly contribute to Colorado's heritage programming through engagement with audiences who will care about and protect the region's historic and ancient places.

The DMNS and the History Colorado – State Historical Fund provided funding to support this project. This report focuses on the scientific research at the site. Koons and others (2021) provide information on the project's community outreach component.

Site Description and Setting

The Magic Mountain site (5JF223), which was listed on the National Register of Historic Places (NRHP) in 1980, has long been recognized as among the most important stratified archaeological sites in northeastern Colorado (Butler 1990; Gilmore 1999, 2008a; Halasi 1979). For decades following the 1966 publication of Cynthia Irwin-Williams and Henry Irwin's landmark monograph on the site, Magic Mountain's well-preserved Middle and Late Holocene record served as a comparative touchstone for systematizing the archaeological record of the South Platte basin.

Originally known as the Apex site, the name was changed to the Magic Mountain site in the late 1950s, when an amusement park of the same name was constructed immediately to the southwest. Prior to the DMNS/PCRG/KU-Odyssey project, the oldest artifacts recovered at the site represent a series of Early Archaic (Mount Albion complex) occupations dated to approximately 6000 B.P., although the precise age of the site's earliest archaeological deposits is uncertain and intact late-Wisconsinan Broadway alluvium may be preserved at the site (Kalasz *et al.* 1995; Kalasz and Shields 1997). The site's richest and most extensive cultural deposits represent multiple Early Ceramic period occupations, which are conventionally dated to between 1800 and 800 B.P.

The site is located in a valley between the Dakota Ridge or Hogback and the eastern flank of the Front Range Mountains (figure 1.1). Extending along the mountain front from southern Wyoming into New Mexico, the Dakota Hogback creates an intermittent series of protected valleys that are most prominent between the Wyoming-Colorado state line and the southern edge of the Denver Basin. In the vicinity of Golden, the valley—commonly called the hogback valley—is bounded on the east by North Table Mountain, South Table Mountain, and the Dakota Ridge and on the west by the Front Range foothills (figures 1.2 and 1.3). Beyond the foothills are the high Rocky Mountains. East of the Dakota Hogback is the Denver Basin and beyond that the Great Plains. Therefore, the hogback valley represents an ecological transition zone between the higher, cooler, wetter montane forests and the lower, warmer, drier grasslands.

The Hogback is formed primarily from Lower Cretaceous and Upper Jurassic formations. Major bedrock units exposed on or underlying the Magic

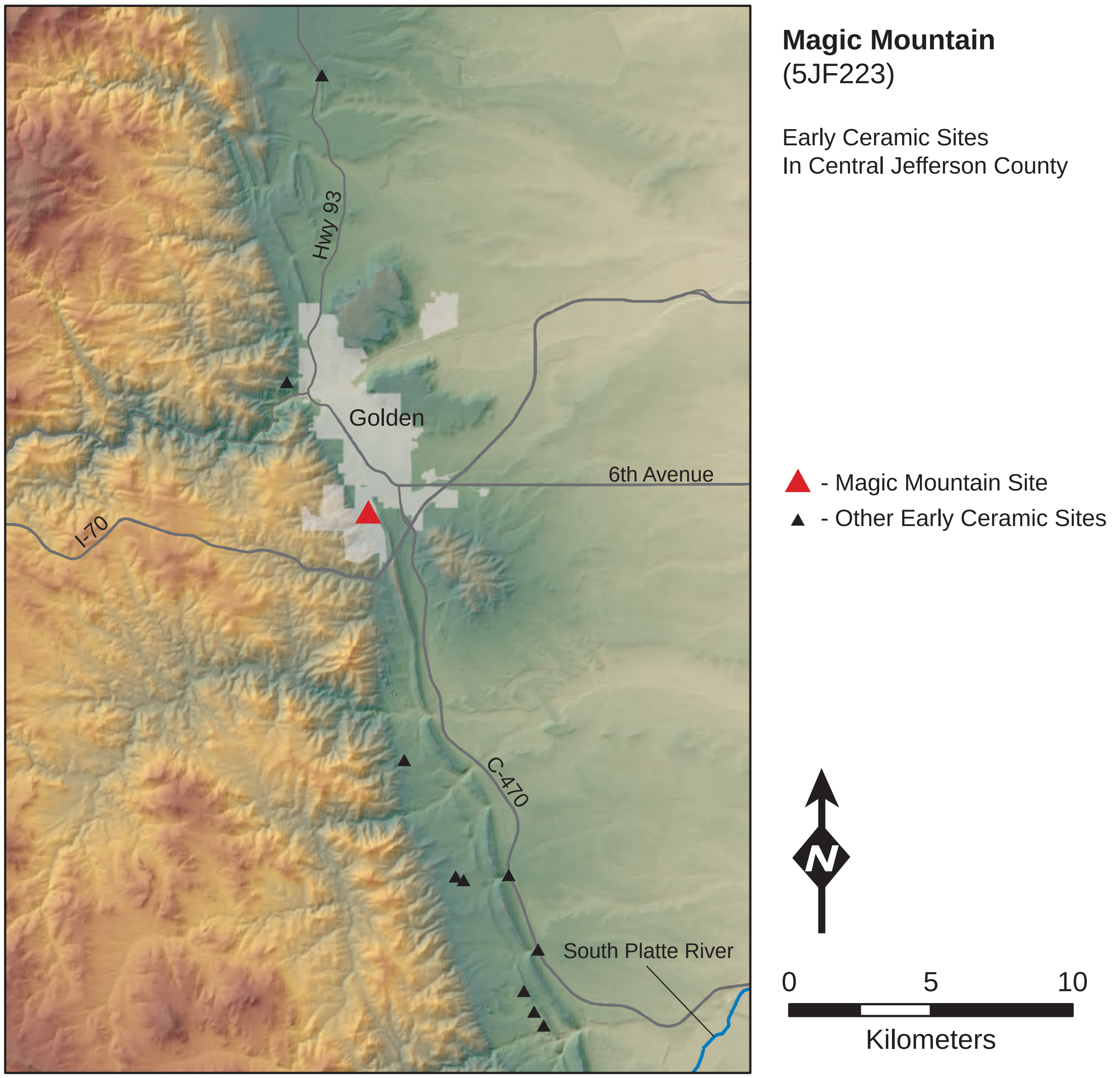


Figure 1.1. Terrain map of Golden, Colorado, showing the location of the Magic Mountain site.

Mountain site itself consist of members of the Lykins Formation of Triassic[?] and Permian age (figure 1.4). From oldest to youngest (west to east), constituent members of the Lykins Formation within the site boundary include the Lyons Sandstone, which forms a low ridge or outcrop; the Bergen Shale, Falcon Limestone, and Harriman Shale, which are buried by colluvium and include siltstones and sandy and crystalline limestones; the Forelle Limestone, a sandy marine limestone that is buried; and the Strain Shale Member, a Permian or possibly Triassic micaceous silty sandstone and siltstone that also is covered by the colluvial apron (Scott 1972).

As currently mapped, the site covers approximately 2.1 ha (5.2 acres); however, the total extent of cultural deposits undoubtedly was larger at one time (figure 1.5). Today, archaeological deposits occur primarily in colluvium and alluvium deposited on the north side of Apex Gulch. The extant portion of the site is located on a south- to southeast-facing slope. Archaeological deposits may once have extended south of Apex Gulch. Unfortunately, decades of landscape modification beginning with the establishment of parking lots for the Magic Mountain amusement park in the 1950s destroyed any archaeological remains in that area. Today, the south side of the gulch contains the paved

Figure 1.2. View to the east from the Magic Mountain site. The Dakota Ridge is visible in the middle distance. The north slope of Green Mountain is visible in the upper right and downtown Denver is visible in the upper left. (Photo taken during the 2018 field season; © Denver Museum of Nature & Science.)

Figure 1.3. View to the west from the Magic Mountain site. Apex Gulch can be seen in the middle distance. The Lyons Sandstone outcrop located on the site's western side is visible on the right side of the image. (Photo taken during the 2018 field season; © Denver Museum of Nature & Science.)

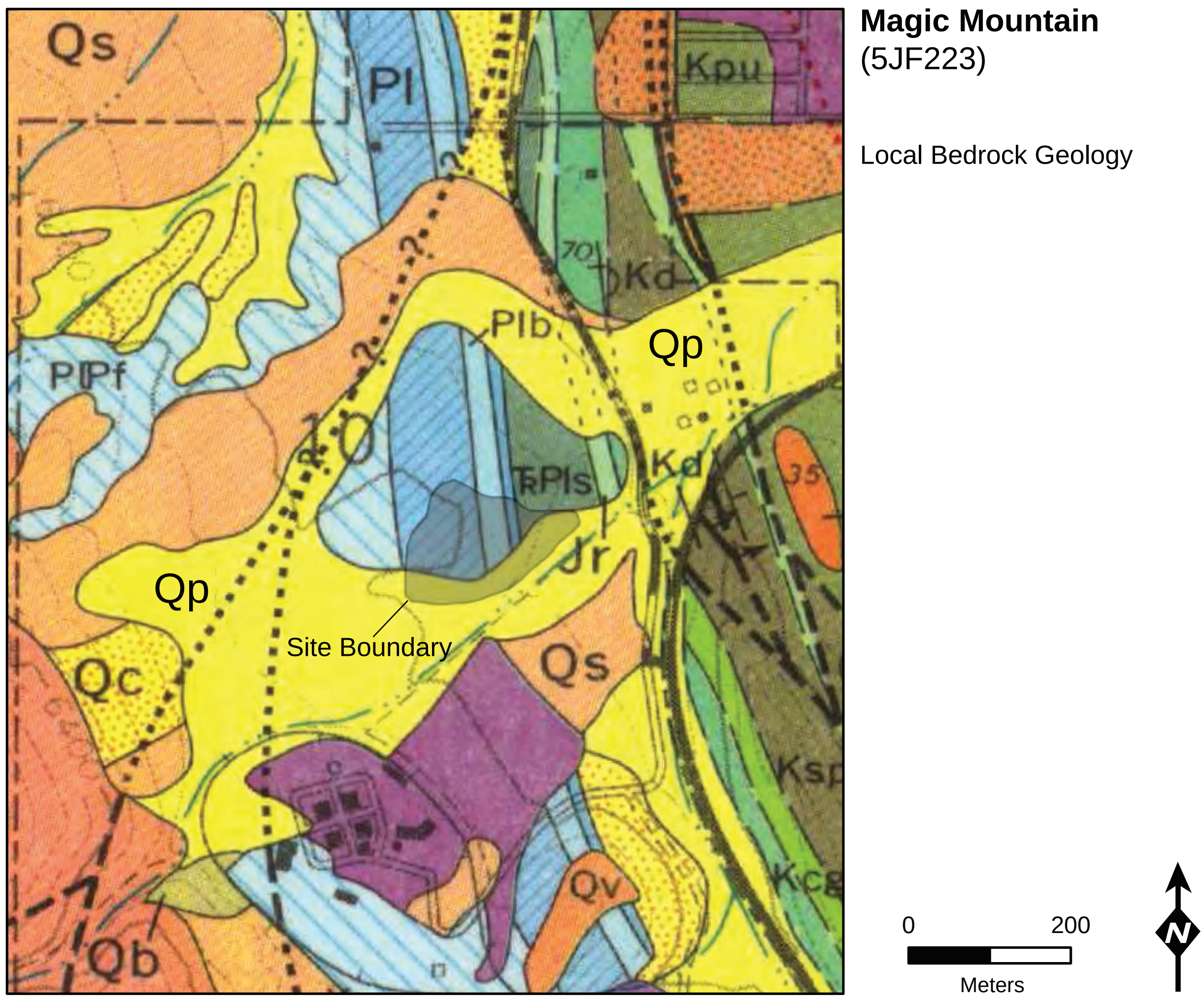


Figure 1.4. Map showing geologic formations in the vicinity of the Magic Mountain site (Scott 1972). (Qc: colluvium; Qp: Piney Creek Alluvium; Qs: Slocum Alluvium; Qv: Verdos Alluvium; PIPf: Fountain Formation; Pl: Lyons Sandstone; Plb: Bergen Shale; Plf: Forelle Limestone; TRPls: Strain Shale; Jr: Ralston Creek Formation; Jm: Morrison Formation; Kly: Lytle Formation; Ksp: South Platte Formation. Purple represents artificial fill.)

parking lot and restrooms for Jefferson County's Apex Trailhead. To the north of the site sits the Heritage Dells neighborhood. The construction of that neighborhood in the 1980s also may have affected the extent of intact archaeological deposits.

During the amusement park construction in the 1950s, Apex Gulch was straightened and channelized. It appears to be perennial today, although the base flow is minimal. A wetland was once present within the site boundaries, immediately west of the Lyons Sandstone outcrop (Irwin-Williams and Irwin 1966). That wetland, which may have been spring-fed, now appears to be dry. Recent development, including modification of the Apex Gulch channel, may have altered the local hydrologic system.

History of Research and Results of Previous Investigations

Homesteaders and miners knew about the site in the 1860s, when the town of Apex was established nearby to supply mines in Central City via the Apex and Gregory Wagon Road. An article from the Rocky Mountain News from the 1860s notes that the site was a lovely place to spend a Sunday afternoon picking up artifacts. The exact location of the town of Apex is unknown, but it is reportedly either to the southwest of the site and beneath one of the parking lots associated with the now defunct Heritage Square Amusement Park (previously the Magic Mountain Amusement Park), or to the east of the site on private property

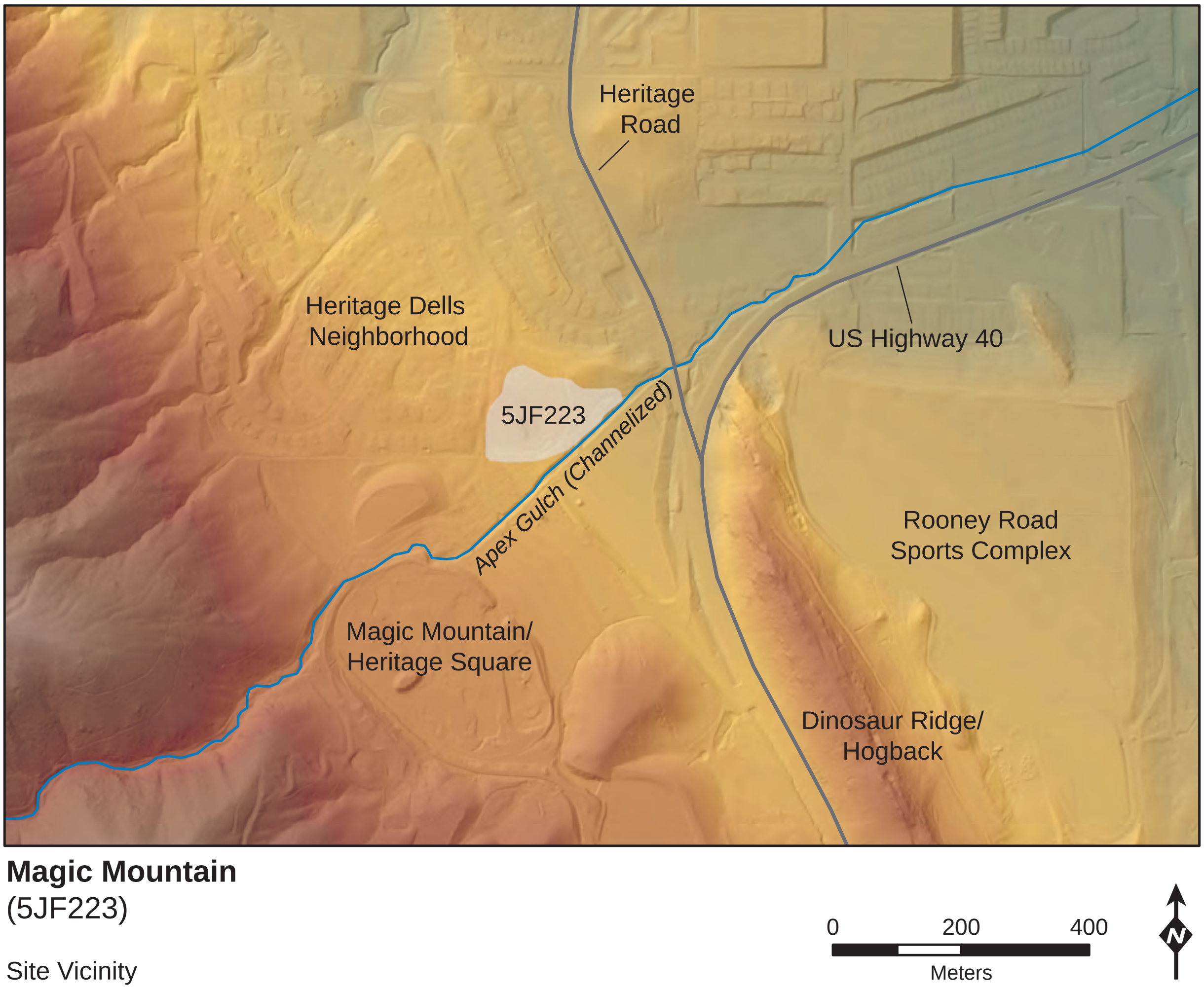


Figure 1.5. Terrain map showing landforms and elements of the built environment in the vicinity of the Magic Mountain site.

across Heritage Road. The site was previously known as the Apex or Apex Gulch site due to its proximity to the eponymous town.

The earliest professional report on the site is in the 1877 Smithsonian Institution Annual Report, which describes it as a camp with great quantities of tools and arrowheads made from diverse local and non-local materials (Cannon 1878, 1889). By as early as the 1920s, the site was described as a “treasure-trove” of artifacts and a “cratered minefield” due to looting (Irwin-Williams and Irwin 1966:19-20). Despite that history of disturbance, intact archaeological deposits were still present at the site when systematic archaeological investigations began in the 1940s.

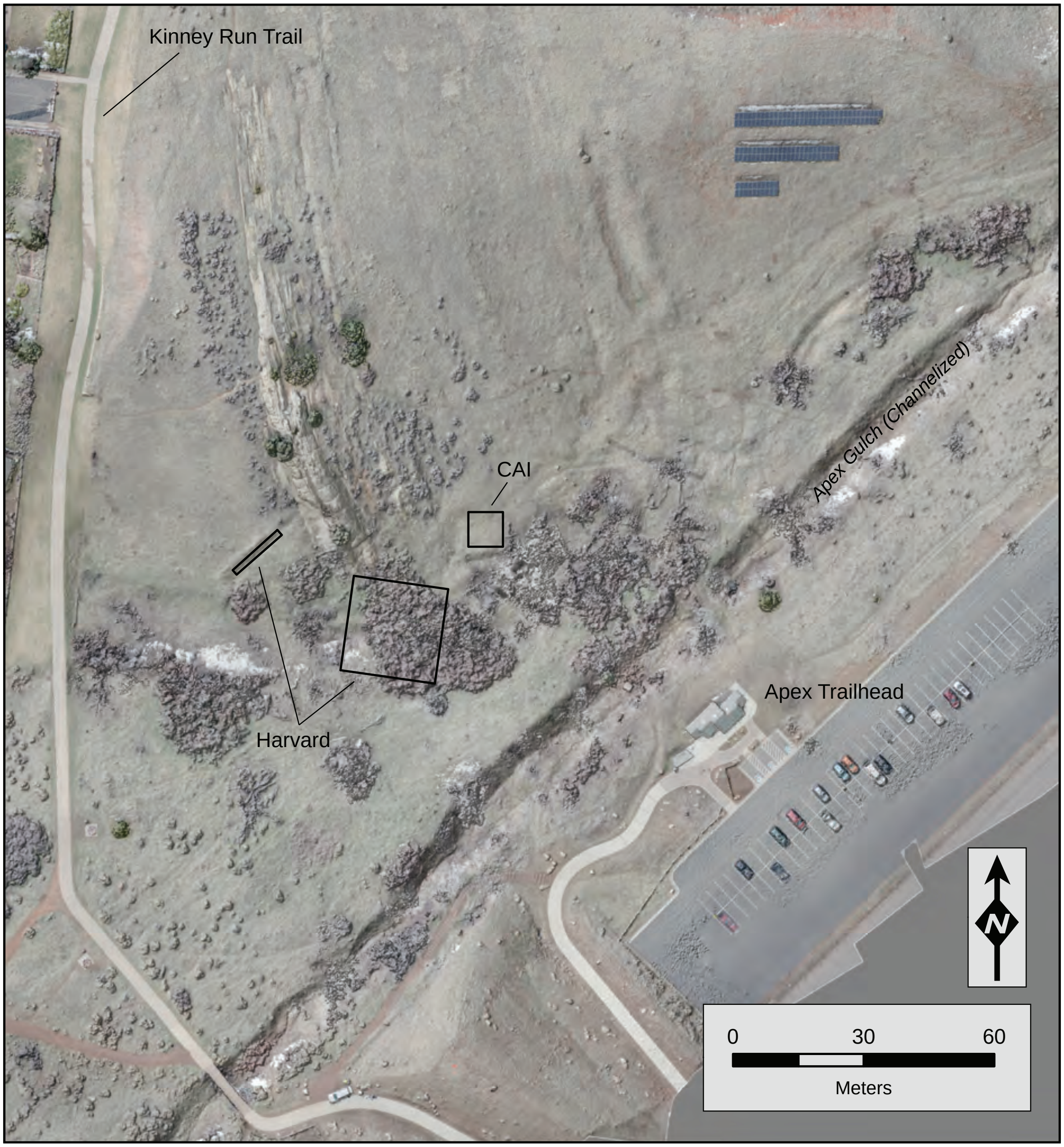
The first artifacts from the site to find their way into a museum were collected by amateur archaeologists Jack Putnam and Robert Akerley in the 1930s. Akerley donated various projectile points, bone tools, and other artifacts in 1936 to the Colorado Natural History Museum, now the DMNS. Akerley’s donation and his account of the site piqued the interest of museum-affiliated archaeologists Betty and Harold Huscher, who decided to conduct the first formal investigations of the site in 1941. The Huscher’s one paragraph report on the site notes that they recovered a burial from below sandstone slabs and metates, as well as a variety of artifacts (Irwin-Williams and Irwin 1966:20; Denver Post, June 20, 1941). The current DMNS collection includes some of the Huscher’s artifacts, but the location of the human remains is not known (Kalasz and Shields 1997:8).

In 1958, the site came to the attention of Cynthia Irwin-Williams and her brother Henry Irwin while they were investigating the nearby LoDaisKa site. After fruitful initial testing, they decided to undertake a larger program, which became the focus of Cynthia Irwin-Williams's Harvard University dissertation research. By that time the property had been purchased by the Magic Mountain theme park (later the Heritage Square Amusement Park), and the Apex site was renamed the Magic Mountain site to acknowledge that association (figure 1.6). The results were published by the Denver Museum of Natural History in a 1966 volume and in Irwin-Williams's Harvard University dissertation (Irwin-Williams 1963; Irwin-Williams and Irwin 1966).

Irwin-Williams and Irwin's work in 1959 and 1960 involved backhoe trenching, auger testing, and block excavation. In addition, J. Hiram Smith and Glenn R. Scott studied the site's geology and stratigraphy and E. H. Brunquist collected plant specimens from the area around the site. Backhoe trenching occurred west of the Lyons Sandstone outcrop; the largest of the trenches remains visible on the surface today. Auger testing occurred along an east-west transect on either side of a trench east of the outcrop that the Magic Mountain Corporation excavated to install a water supply pipe. The main excavation block was located south of the outcrop and consisted of an irregular arrangement of trenches and blocks that incorporated approximately 154 3 x 3-ft squares (129 m^2) (figure 1.7). The 1959 site datum has not been relocated, but figure 1.7 illustrates the approximate location of the Harvard block, based on surface and aerial photographs from the period. Excavation depth varied greatly but reached at least 18 ft in some parts of the block (figure 1.8).

Irwin-Williams and Irwin identified six lithostratigraphic units (Zones A-F) and defined three cultural complexes at Magic Mountain. The most recent complex, which they called Woodland, occurs exclusively in Zone A, the uppermost lithostratigraphic unit. Zone A deposits are also the most extensive at the site.

Figure 1.6. Photograph of the southern edge of the Lyons Sandstone outcrop prior to the Harvard University excavation. A tripod possibly located on the Harvard datum is visible in the left center. Evidence of grading and leveling is visible in the distance. (Photo courtesy Denver Museum of Nature & Science.)



Magic Mountain
(5JF223)

Local Built Environment and Prior Excavations

Figure 1.7. Terrain and photo mosaic map showing the locations of prior excavations at the Magic Mountain site, along with elements of the local built environment.

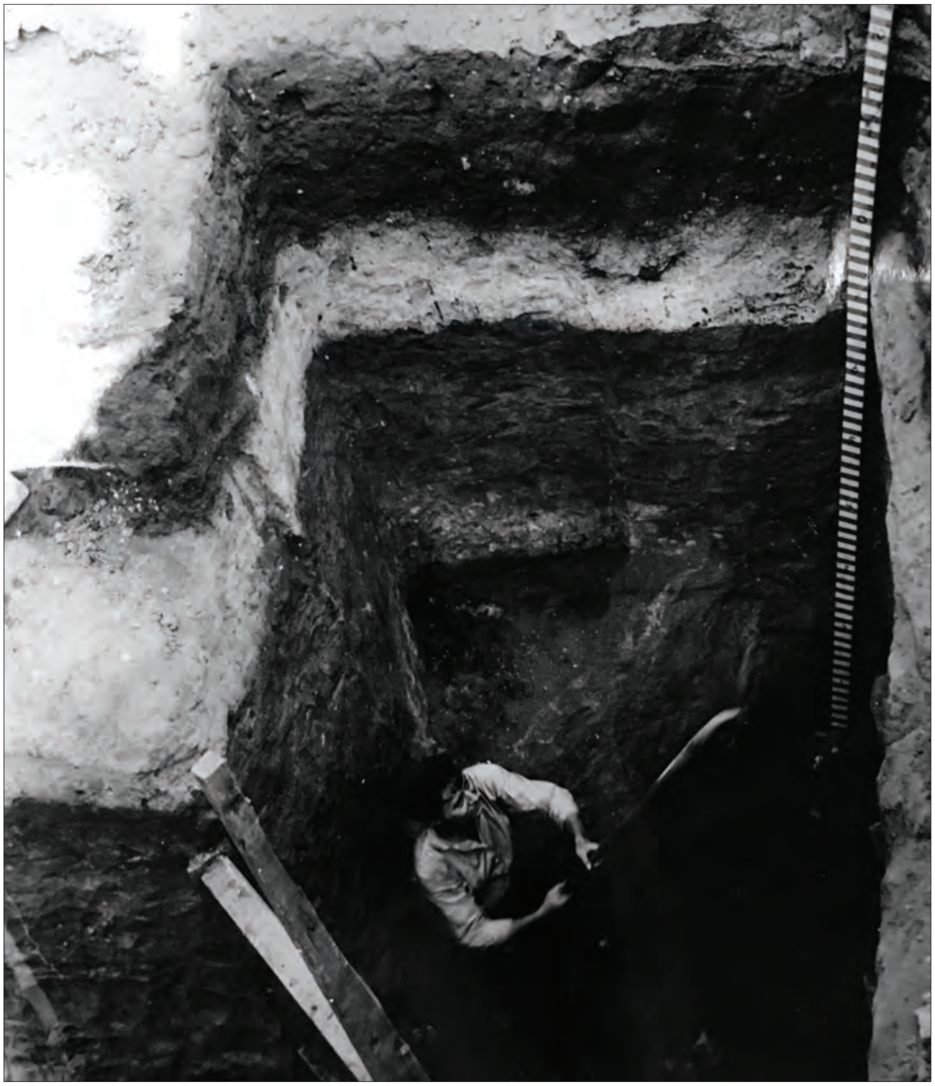


Figure 1.8. Photograph of Cynthia Irwin-Williams working in the deep excavation units opened during the Harvard University project at Magic Mountain. (Photograph courtesy of the Denver Museum of Nature & Science.)

The cultural or temporal affiliations of the sparse materials recovered from underlying Zone B deposits are not known. Artifacts representing the other two defined cultural complexes, which they called the Apex complex and the Magic Mountain complex, occur across multiple zones. Apex complex materials, which likely date primarily to the Middle Archaic period, occurred in Zones C, D, and E, although they were most abundant in Zone D. Materials representing the older Magic Mountain complex, which may date primarily to the Early Archaic period, occurred in Zones D, E, and F. The single radiocarbon date Irwin-Williams and Irwin obtained from the site puts the initiation of Zone E deposition at 4930±250 ^{14}C yr B.P. (Butler [1990] argues that more-recent regional alluvial chronologies permit improved temporal separation of Irwin-Williams and Irwin's stratigraphic units. However, Butler's argument does not account for the fact that specific well-defined projectile points occur in multiple zones.) Irwin-Williams and Irwin also note that a Middle Ceramic period component may have been present at the site, but that deposits dating to that period are no longer present due to looting. Glass beads possibly representing Historic-period American Indian use also occur at the site (Margaret Van Ness, personal communication 2016).

Irwin-Williams and Irwin documented hearths and burials but did not observe architectural features. Numerous flakes and chipped stone tools, including scrapers, knifes, bifaces, cores, and projectiles points of various types were recovered. Ground stone was also found in quantity, especially in the upper levels. They do not mention faunal remains in their report; however, bone tools and beads were recovered.

Seventy-eight pot sherds were also recovered, which are similar to Early Ceramic cordmarked wares documented elsewhere in the South Platte basin. The materials from their excavations are housed at Harvard University's Peabody Museum, although they were never officially accessioned into the collection and so the exact number of artifacts recovered remains unknown. Overall, the multidisciplinary approach to the research, as well as the sheer quantity of new material types, made the 1959-1960 work at Magic Mountain one of the major references for subsequent work in the South Platte basin for more than three decades.

In 1974, students from the Metropolitan State College of Denver (now the Metropolitan State University of Denver), excavated the site under the supervision of Jiri Vondracek. Materials from Vondracek's work were re-located years later at the university and donated to the DMNS. In addition to a single banker's box of artifacts, the materials include some poorly drawn maps by students with no corresponding information. No notes or overall map were found indicating the location of the excavations, rendering this investigation scientifically mute and little more than looting.

In 1978, National Park Service archaeologist William Butler realized that the site was threatened by encroaching development of the Heritage Dells neighborhood. He worked with the state archaeologist and the Colorado Archaeological Society to have the area surveyed to ensure that it remained protected. Magic Mountain was listed on the NRHP in 1980 (Halasi 1979).

By the early 1990s, half of the site was owned by the City of Golden and the other half remained in private ownership. Partnering with the City of Golden, Centennial Archaeology Inc. (CAI), along with volunteers, resumed studies within the city-owned sector of the site in 1994 and 1996. The 1994 project involved test excavations, piston-coring transects, and block excavation. Testing occurred in three locations: west of the Lyons Sandstone outcrop and at two locations south of the outcrop. One of those southern tests was located between Lena Gulch and the marsh channel, while the other was located north of the marsh channel and northeast of the Harvard block. The latter test was then expanded into an 8 x 4-m excavation block. In 1996, the CAI crew further expanded the original 8 x 4-m block to an 8 x 8-m block (figure 1.7). The overall goal was to determine the extent of intact cultural remains and to initiate a public education program that included tours, lectures, and other public outreach efforts (Kalasz *et al.* 1995; Kalasz and Shields 1997).

The CAI crew intended to sample all of the zones or stratigraphic units identified by Irwin-Williams and Irwin. However, owing to the unexpected discovery of two architectural features and to the overall complexity of the deposits, their investigation was primarily confined to Zones A and B and to the site's Early Ceramic component. Both structures proved to be enigmatic and atypical of excavated architectural features known from the South Platte basin. One exhibited a sandstone slab floor and a partial foundation wall. No post molds or interior features were noted. The feature's exact dimensions could not be determined, but likely were roughly 3 by 4 m. The second enclosure consisted of a 9-m-long semicircular alignment of cobbles and boulders. A gap or opening was present in the alignment. A possible interior basin feature was also noted. The CAI investigation produced more than 80,000 artifacts, mainly consisting of flaking debris, chipped and ground stone tools, and bone. The CAI collections were housed at DMNS as of 2001.

Several small projects were undertaken adjacent to Magic Mountain in the past decade. Construction for the Apex Trailhead facilities in 2013 was monitored and one site and one isolated find were recorded (Sanders *et al.* 2014). Both resources comprised a mixture of Indigenous American and European American artifacts. No temporally diagnostic American Indian artifacts were recovered. Materials recovered during monitoring are now housed at the DMNS.

Modifications to the Heritage Road bridge and culvert over Apex Gulch during 2017 prompted a limited testing project that identified archaeological deposits containing flakes, chipped stone tools, and faunal remains as well as historical and modern artifacts and faunal remains (Briggs 2017). Briggs (2017:32) argues that those materials were recovered from "a secondary depositional context of flood-deposited sediments." The project also documented segments of historical and recent roads; however, a report describing the work never was submitted to the Office of Archaeology and Historic Preservation (OAHP) and two of the resource numbers listed in the report differ from those assigned by OAHP.

Environment of the Hogback Valley

Magic Mountain is located on the eastern edge of the Northern Parks and Ranges section (M331I) of the Southern Rocky Mountains Steppe-Open Woodland-Coniferous Forest-Alpine Meadow province (Bailey 2016; Bailey *et al.* 1994; McNab *et al.* 2007). Just east of the site is the Central High Plains section or the Great Plains-Palouse Dry Steppe province. Vegetation within the Northern Parks and Ranges section is complex, reflecting the varied topography of the section, which includes "high mountains, gently rolling parks and valleys, hills, and low mountains" (McNab *et al.* 2007).

Sovell and Panjabi (2021) identify four vegetation communities defined by the Colorado Natural Heritage Program within the vicinity of the site, including the Western Great Plains Foothill and Piedmont Grassland, the Western Great Plains Riparian Woodland and Shrubland, the Rocky Mountain Lower Montane-Foothill Shrubland, and the Invasive Perennial Grassland.

Flora and Fauna

Due to its Plains-foothills ecotone location, Magic Mountain offers direct access to the subsistence resources of multiple ecological communities. There is a greater diversity of flora and fauna than in either the montane ponderosa pine/Douglas fir forest to the west or in the Plains grasslands to the east. Streams in the valley give rise to riparian habitats that include cottonwood, river birch, willow, chokecherry, wild plum, cattails, and hackberry. Ponderosa, pinon pine, juniper, and Douglas fir grow along and near the Dakota Hogback. Mountain mahogany, Gambel oak, and various grasses, including blue grama, buffalo grass, and western wheatgrass, are prominent in the Hogback ecozone. Other native plants include dropseed, sedges, sagebrush, rabbitbrush, yucca, prickly pear cactus, sumac, gooseberry, and currant (Tate 1979 and 1997). Also present are goosefoot, native thistles, and ragweed.

Typical fauna in the region includes mule deer, elk, jackrabbits and cottontails, and many species of rodents, including squirrels, voles, pocket gophers, prairie dogs, and mice. Also present are mountain lions, bobcats, coyotes, skunks, rattlesnakes, bull snakes, golden eagles, hawks, falcons, owls, bats, and many other species of birds, insects and amphibians. Buffalo once roamed the hogback valley (Moore 2000), and black bears are occasionally spotted there today. In the past there likely were grizzly bears as well. Game drives have been reported on North Table Mountain, a broad mesa formed from Tertiary basalt flows (Southwell 1995).

Modern Climate

The Denver region is subject to wide diurnal and annual temperature variations. The hogback valley forms a microclimatic within the greater Denver Basin. Average January temperature in the hogback valley is estimated at -0.6 °C (31° F) and average July temperature is estimated at 23° C (74° F) (Tate 1997). Notably, the hogback valley is warmer than the Plains by six to eight degrees Fahrenheit in winter and three to five in summer. The foothills to the immediate west and the Palmer Divide to the south block cold air from adjacent regions to form this microclimate. The western mountains also create the warming effect of down-slope "Chinook" winds. The region is considered to be semi-arid. Annual rainfall in Golden, Colorado is 47.5 cm (18.7 in), snowfall is 185.4 cm (73 in), and on average there are 242 days of sun. Table 1.1 provides additional climate data from nearby weather stations.

Paleoclimate

Numerous proxy records are available for the ancient climate of South Platte basin. Reconstructions are also available for the Southern Rockies and Rio Grande basin. Tate and Gilmore (1999) and Painter and others (1999) summarize major shifts in regional climate during the Holocene.

Cold and dry glacial conditions persisted until about 14,500 B.P. Temperatures began to rise at the end of the Pleistocene, but mean temperatures were still about 6 to 16 degrees below modern levels prior to about 11,000 B.P. Precipitation increased across the Pleistocene-Holocene transition, possibly prompting renewed mountain glaciation. Painter and others (1999:21) suggest that eastern Colorado supported a combination of open steppe and boreal woodlands. Surface water likely was abundant.

After about 12,000 B.P., a prolonged warming and drying trend began. Grasslands expanded in eastern Colorado. An especially warm and dry period known as the Altithermal or Holocene climatic optimum occurred between about 7500 and 5000 B.P. Shortgrass steppe and sagebrush-yucca communities

Table 1.1. Climate data for four weather stations near the Magic Mountain site (Western Regional Climate Center 2022). Ralston Reservoir and Kassler and located within the Hogback Valley north and south of Magic Mountain, respectively. Parker is located on the rim of the Palmer Divide to the east and Idaho Springs is located in the foothills to the west.

	Weather Station			
Variable	Ralston RSVR	Kassler	Parker 6E	Idaho Springs
Station Code	056816	054452	056326	054234
Period of Record	1978-2016	1918-2016	1922-1997	1893-1974
Elevation (m)	1798	1676	1923	2399
Mean Annual Maximum Temperature (F/C)	63.1/17.3	65.9/18.8	63.2/17.3	57.0/13.9
Mean Annual Minimum Temperature (F/C)	39.0/3.9	36.5/2.5	32.9/0.5	29.7/-1.3
Mean Annual Total Precipitation (in/cm)	18.5/47.0	17.6/44.7	14.3/36.3	15.1/38.4
Mean Annual Total Snowfall (in/cm)	68.0/172.7	73.6/186.9	51.9/131.8	72.0/182.9

dominated the Plains landscape. However, this period was both spatially and temporally complex and, in eastern Colorado, may have been characterized by two periods of drought. Drought conditions began to ease after 5000 B.P. However, variability is evident for the period between 5000 and 3000 B.P. The Triple Lakes glacial advance occurred during that period, suggesting increased effective moisture in some areas. A period of significant drought also occurred during that period (Gilmore 2012).

Gilmore (2008a) compiles data on tree-ring widths, cycles of aeolian deposition, and multiple proxies derived from fen and marsh sediment that encompass the period from about 2860 B.P. to the present. Table 1.2 summarizes the major episodes Gilmore identifies. Gilmore's reconstruction indicates a variety of past climate conditions, although dry and warm or dry and cool conditions dominate.

In Gilmore's reconstruction, a variety of climate conditions occurred during the Early Ceramic period. The opening centuries of the period featured increased effective moisture and cooling temperatures. A sharp drought, which Gilmore calls the Early Ceramic drought, occurred between about 1750 B.P. and 1500 B.P. In addition to cool and dry conditions, the Early Ceramic drought was also characterized by low climate variability. Following the Early Ceramic drought, both effective moisture and temperature increased, although variability remained low. The terminal Early Ceramic was characterized by the beginning of a period of increasing climate variability known as the Medieval Climate Anomaly.

Other Resources

A spring was once present on the site which would have provided year-round access to water. Other nearby springs were also likely active in the past

Table 1.2. Eastern Colorado climate episodes between 2860 B.P. and the present (Gilmore 2008a).

Time Period (^{14}C yr B.P.)	Climate Interval	Description
2860-2200	Generally Dry Conditions and Episodic Drought	Persistently warm and dry across the Plains with significant warm and dry intervals
2200-1900	Terminal Archaic Drought	Warm and dry with high variability; among the most severe periods of drought in Arkansas basin fen record
1900-1750	Increased Effective Moisture and Cooling Temperatures	
1750-1500	Early Ceramic Drought	Cool and dry with low variability
1500-1100	First Millennium Amelioration	Increased effective moisture; increasing temperature from below to above average; low variability
1100-400	Medieval Climate Anomaly	Warm and dry with increased spatial and temporal variability
400-90	Little Ice Age	Increased effective moisture and decreased temperature
90-present	Recent Climate Change	Increased temperature and increasing variability

(Kalasz and Shields 1997). The site also has good access to raw materials. Petrified wood and quartzite, both common for stone tool manufacture at the site, are found in many locations in the hogback valley, as well as on nearby Green Mountain and on the Palmer Divide. However, few ancient quarries have been documented in the region, apart from sources of silicified wood and other materials located on the Palmer Divide (Black 2000; Gilmore 2005; Kalasz and Shields 1997; Voynick 1994). Clay is also readily available nearby. Notably, there is a historical clay pit used for brick and tile manufacture located a half mile east of the site (Stewart and Severson 1994).

Archaeological Context

Magic Mountain is located within the South Platte River basin. However, archaeological data from adjacent regions of Colorado, including the Arkansas River basin to the south and the headwaters of the Colorado River basin to the west, are relevant for understanding the site's archaeology. Accordingly, this brief overview integrates selected data from three of Colorado's five archaeological context regions (table 1.3). Also discussed are data from selected mountains and Plains sites located outside Colorado. Additional data on the South Platte and Arkansas river basins are provided by Greubel and others (2017).

Paleoindian Stage

Although rare overall in North America, some of the best-known Early and Middle Paleoindian sites occur in northeastern Colorado and southeastern Wyoming (Kornfeld *et al.* 2010). Several Clovis sites are located in the South Platte basin in Colorado, including artifact caches and possible mammoth kills (Bamforth 2015; Chenault 1999; Hofman 1996; Stanford 1999). Chenault (1999:Table 4.2) lists 23 Folsom sites and isolated finds from the South Platte basin, among them the Lindenmeier site, one of the largest and most complex known (Andrews *et al.* 2008). Middle Paleoindian Agate Basin and Hell Gap occupations are represented by the Frazier and Jones-Miller sites (Borreson 2002, Slessman 2004; Stanford 1999). Numerous Cody complex sites, including both kill sites and campsites, occur in the South Platte basin (Knell and Muniz 2013).

Evidence also exists for Early and Middle Paleoindian occupancy of the Southern Rockies, although the extent of Late Pleistocene use is a topic of debate (Pitblado 2017). Kornfeld and others (2010) and Frison (1992, 1999) argue for Clovis and Folsom use of upper elevation environments. However, Pitblado (1998, 2003) finds little evidence for Clovis use of high mountain settings. Folsom sites occur sporadically in the Southern Rockies: Middle Park contains several important Folsom sites (Kornfeld 2013), as does the San Luis Valley (Jodry 1999), but there is little evidence for Folsom use of the upper Arkansas River valley, which lies between those two areas (Mitchell 2019). Middle Paleoindian Goshen occupations occur in Middle Park (Kornfeld 2013).

Late Paleoindian Period

Stanford (1999:326) describes the Late Paleoindian technocomplexes of the Plains and Southwest as "the most common, complex, and least understood of the Paleoindian cultures." Kornfeld and others (2010:92-106) assign a variety of mostly lanceolate projectile point types to the Late Paleoindian period, between about 10,000 and 7500 B.P. Several of these types were partially contemporaneous with Cody and several other types, which commonly are assign to the Middle Paleoindian period. However, the most widely recognized Late Paleoindian types in the Central Plains and Southern Rockies commonly exhibit a distinctive parallel-oblique finish flaking technique (Bradley 2010, 2013; Pitblado 2007).

Table 1.3. Chronology of major culture-historical divisions in three Colorado river basins. To simplify comparison, all ages are reported in uncalibrated radiocarbon years before 1950 (^{14}C yr B.P.).

Era, Stage, or Period	Northern Colorado River Basin (Reed and Metcalf 1999)	South Platte River Basin (Gilmore *et al.* 1999)	Arkansas River Basin (Zier and Kalasz 1999)
Paleoindian	~11,500 – 8350	12,000 – 7690	11,500 – 7800
Archaic	8350 – 1950	7500 – 1800	7800 – 1850
Formative/Late Prehistoric/Ceramic	2350 – 650	1850 – 410	1850 –500
Protohistoric	650 – 69	410 – 90	500 – 225

An important aspect of current debates on Late Paleoindian technocomplexes is the distinction that Frison (1992) makes between "foothill-mountain" and "open plains" assemblages. Frison argues that an ecological boundary between these two regions after about 10,000 cal B.P. encouraged upland groups to pursue a broad-spectrum subsistence strategy while lowland groups pursued a bison-oriented strategy. In Frison's account, these two subsistence systems are reflected in different projectile point assemblages in the two regions.

Unfortunately, the term "Foothill/Mountain" has been applied uncritically to certain projectile point types. As Pitblado (2007:333) notes, the term is "a terrific description of a very real late Paleoindian adaptation but a very poor choice of label for a projectile point type." Instead, Pitblado argues that distributions of well-defined projectile types should be used to identify differing land-use patterns and adaptations. Pitblado identifies morphological and metric differences between the two best-known Late Paleoindian point types. Both types, one known as Angostura and the other known as James Allen or sometimes James Allen/Frederick, are lanceolate forms that typically exhibit parallel-oblique flaking, concave bases, and lateral grinding. However, the basal margins of Angostura points generally converge, and the basal concavity is slight. By contrast, James Allen points exhibit slightly convergent to parallel basal margins and a marked basal concavity. Basal "ears" are sometimes present. James Allen points are also more likely than Angostura points to exhibit parallel-oblique finish flaking.

Lanceolate projectile points that could be typed as James Allen occur in the oldest archaeological deposits at several sites in the hogback valley, including the LoDaisKa site (Type L) (Irwin and Irwin 1959).

Archaic Stage

After about 8,500 years ago, the climate of western North American was warmer and dryer than at present and those conditions spurred significant and enduring changes in American Indian lifeways. Mobility decreased and use of local resources increased. Diets changed as harvesting and processing of seeds, roots, and other plant resources intensified. Hunting weaponry shifted from lanceolate styles to a variety of stemmed and notched styles. These changes, taken together, are the hallmarks of the Archaic stage.

A taxonomic system originally developed for the Northwestern Plains is commonly used to organize Archaic stage archaeology in Colorado and adjacent regions. The system divides the Archaic into three sequential periods that are defined primarily by changes in projectile point styles and other technologies and secondarily by changes in climate (Huckell 1996; Kornfeld *et al.* 2010). The first of those three periods, the Early Archaic, witnessed the first intensive use of milling stones for processing plant foods. In some regions, this change began as early as 8500 B.P., although Tate (1999) puts the beginning of the Early Archaic at 7500 B.P. in the South Platte basin. Kornfeld and others (2010) suggest a beginning date for the Early Archaic around 8000 B.P. The Early Archaic largely coincided with the warmest and driest period recorded on the Plains during the Holocene. However, this period of low precipitation and warmer temperatures, commonly known as the Altithermal or Holocene climatic optimum, was spatially and temporally complex (Benedict 1979; Meltzer 1999).

The succeeding Middle Archaic (from 5000 to 3000 B.P. in the South Platte basin) roughly corresponds with the fluorescence of the McKean technocomplex, which is represented by four distinct, but commonly associated, projectile point styles. Middle Archaic climate was generally wetter and cooler than that of the Early Archaic, although the data again point to spatial and temporal variability (Gilmore 2012; Tate and Gilmore 1999; Vierra 2013). The exploitation of plant foods increased during the Middle Archaic (Kornfeld *et al.* 2010).

Climate during the last of the three Archaic periods, the Late Archaic (3000 to 1800 B.P.), was likely drier but with more severe winter storms (Tate and Gilmore 1999). Projectile point styles consist primarily of large corner-notched forms. Small quantities of maize (corn), the first indigenous cultivated plant, began to appear during the Late Archaic in northern New Mexico and eastern Colorado (Vierra 2008; Zier 1999, 2018).

Early Archaic

Technologically, the beginning of the Early Archaic is marked by the appearance of large side-notched dart points (*e.g.* Kornfeld *et al.* 2010:Figure 2.52, Figure 2.53). Large corner-notched dart points also occur in some Early Archaic contexts (Kornfeld *et al.* 2010:109). In Colorado, a distinctive Early Archaic form is the Mount Albion point, a corner-notched to stemmed variety that commonly exhibits a convex base and extensive haft-element grinding (Benedict 2012).

The notably warm and dry conditions associated with the Holocene climatic optimum have led many archaeologists to conclude that American Indians largely abandoned the Plains during the Early Archaic (but see Reeves 1973). Benedict (1979; Benedict and Olson 1978) formalized a model of a climate-induced occupational hiatus in the lowland portions of the South Platte basin. The apparent lack of sites in the Plains, coupled with the better representation of Early Archaic sites in upland settings (Tate 1999; Zier 1999) appears to support the model of regional abandonment during the Altithermal.

Very few Early Archaic sites occur in southeastern Colorado, perhaps reflecting the greater severity of the Altithermal on the Southern Plains (Meltzer 1999; Zier 1999). However, the apparent absence of Early Archaic sites in the Central Plains, including the South Platte basin in Colorado, likely reflects geomorphic rather than land-use factors (Mandel 2006; Meltzer 1999). In some places, downcutting and erosion occurred during the increasingly warm and dry Early Holocene. Elsewhere, sediment accumulated, burying Late Paleoindian and Early Archaic occupations (*e.g.* Anderson *et al.* 2010). Hofman (1996:84) notes that the Early Archaic Spring Creek site is buried under 3 to 4 m of sediment. In Colorado, many Early Archaic components are deeply buried at multi-component sites and only limited data on their material content are available from deep test units. Together, these observations suggest that the distribution of documented Early Archaic sites is strongly affected by what Mandel (2006:43) describes as the "geologic filter."

Clusters of Early Archaic sites occur in the hogback valley on the west side of the Denver Basin and above timberline in the Front Range. Evidence for Early Archaic period occupation is present at Magic Mountain, where it is represented by projectile point types and other artifacts assigned to the Magic Mountain complex that are present in Zones D, E, and F (Irwin-Williams and Irwin 1966:178-190). Irwin-Williams and Irwin (1966:190) regard the Magic Mountain complex as a local technocomplex, that occurs primarily in Colorado's central and northern mountains. "Prismatic flakes [struck] from prepared sub-conical cores" are distinctive elements of the technocomplex (Irwin-Williams and Irwin 1966:178). Diagnostic projectile points include types MM1 through MM4; however, MM1 and MM2 today likely would not be classified as projectiles. MM3 would be classified today as Mount Albion. MM4 is a heterogeneous group that includes dart points exhibiting corner notches or low, wide side-notches.

Early Archaic sites also occur sporadically across the Colorado Piedmont (*e.g.* Anderson *et al.* 2010; Feiler 2001a, 2001b). Interestingly, the distributions of Early Archaic and Middle Archaic sites shown in Tate's (1999:Figure 5-4 and Figure 5-5) maps of the South Platte basin are remarkably similar, although Middle Archaic sites are slightly more abundant. The situation is somewhat different in the Arkansas River basin, where the majority of known Early Archaic sites occur in upland settings (Black 1986, 1995; Buckles 1975; Chambellan *et al.* 1984; Zier and Black 1983; but see also Anderson *et al.* 2013).

In Wyoming, a notable concentration of Early Archaic sites occurs in the Bighorn Basin, which although not in the Plains is nevertheless similarly arid (Kornfeld *et al.* 2010). Numerous Early Archaic sites also occur in buried contexts at lower elevations in western Colorado (Reed and Metcalf 1999). Larmore and Gilmore (2006) also show that the frequencies of Early Archaic sites in the uplands and lowlands are similar.

These site distributions suggest that Early Archaic settlement represents a spatial and temporal re-orientation or re-arrangement of land use, rather than a wholesale abandonment of lowland settings (LaBelle and Pelton 2013; Meltzer 1999).

Echoing Frison's (1992) distinction between foothills-mountain and Plains adaptations for the Late Paleoindian period is an Archaic-stage cultural historical construct known as the Mountain Tradition, which describes a local, year-round, mountain-focused settlement and subsistence system that was distinct from the subsistence practices of groups living in adjacent regions (Black 1991). Black's (1991:4) initial formulation of the Mountain Tradition includes six criteria, which in addition to year-round occupancy of upland environments includes frequent use of split cobble tools, use of microtools, projectile points similar to Great Basin types, short-term dwelling structures in upland settings, and rock art with similarities to Great Basin styles. The Mountain Tradition construct recognizes long-term adaptive continuity in the Southern Rockies, beginning as early as the Late Paleoindian period and certainly by the Early Archaic (Metcalf 2011). Whether that also reflects cultural continuity remains a subject of debate (Stiger 2001), as do the specific attributes that define a mountain adaptation (Reed and Metcalf 1999). In addition, debate continues on whether bearers of "Mountain Tradition" technology shared the high-country with other localized groups (Benedict 2012).

Although architectural features are important elements of the Early Archaic record in the Colorado River basin (Landt and Reed 2014; Pool and Moore 2011; Shields 1998), neither Tate (1999) nor Zier (1999) report domestic architectural features dating to the Early Archaic in the South Platte or Arkansas basins. However, Anderson and others (2013) report on two recently identified Early Archaic basin houses from Las Animas County. Use of communal game drives in the Front Range began at least by the Early Archaic (Benedict and Olson 1978).

Middle Archaic

The Middle Archaic period is largely synonymous with the origin, spread, and termination of the McKean complex (Kornfeld *et al.* 2010; Kornfeld and Todd 1985). Four different projectile point styles are associated with the complex: an eponymous small lanceolate form, a large side- or tri-notched form (Mallory), and two stemmed indented-base forms (Duncan and Hanna). The relationship among these four styles, apart from their frequent but not invariant co-occurrence, is not clear. Kornfeld and others (2010:114) offer several possible explanations and suggest that the apparent association of forms may reflect multiple brief occupations by contemporaneous groups.

The origins of the McKean complex are also unclear. Some researchers argue for a Northwestern Plains origin and subsequent southward spread into Colorado (Larmore 2002). Others reverse that sequence, arguing for a Colorado mountains origin and subsequent northward spread (Benedict 1990; Gilmore 2012). Still others, noting the great antiquity of stemmed indented-base points in the Great Basin, argue for an eastward spread of the complex (Kalasz *et al.* 2003). Evaluations of the various models depend in part on the strength of various hypotheses about the nature of the association among the four primary point styles: one can imagine, for example, that the stemmed indented-base forms (Duncan and Hanna) are in fact older than the eponymous lanceolate form or the Mallory type and therefore represent additions to the McKean complex rather than original constituents. In addition, it is not clear whether non-McKean technocomplexes co-existed with McKean in Colorado and Wyoming during the Middle Archaic period.

As noted previously, the distribution of Middle Archaic sites is similar in some ways to that of Early Archaic sites, although a number of differences are evident. In the South Platte basin, the number of Middle Archaic sites in the mountains appears to be smaller, while the number of sites on the Plains appears to be equal or somewhat greater. However, Middle Archaic surface finds are common and Middle Archaic occupations appear to have been longer and more intensive than Early Archaic occupations. In fact, in terms of occupation span and intensity, Middle Archaic occupations in the South Platte basin are only exceeded by early Late Prehistoric (Early Ceramic) occupations.

Middle Archaic components are notably abundant at sites in the hogback valleys, where they frequently underlie Early Ceramic components. At Magic Mountain, Irwin-Williams and Irwin (1966:190-205) assign Middle Archaic occupations to the Apex complex. Specimens assigned to the Apex complex occur in Zones C through E; in Zones D and E they co-occur with specimens assigned to the Magic Mountain complex. Irwin-Williams and Irwin (1966:190) define a large number of diagnostic projectile points for the Apex complex, in part to isolate stylistic variation within the complex. Many consist of what today would be regarded as stemmed-indented base points that occur in the McKean complex. A few lanceolate points with concave bases—McKean points—occur at Magic Mountain in Zones C and D. Other diagnostic forms assigned to the Apex complex, which are not defined for McKean complex, include a variety of dart points with low, broad, side-notches. Irwin-Williams and Irwin (1966:193) argue that the Apex complex occupation was more extensive than the earlier Magic Mountain complex occupation. They further argue that the site was abandoned "as a permanent habitation for a considerable length of time" following the Apex complex occupation (Irwin-Williams and Irwin 1966:195). Unlike the Magic Mountain complex, which they regarded as a local phenomenon, Irwin-Williams and Irwin (1966:198) connect the Apex complex to the Archaic in the northern Southwest.

In the Arkansas basin, Middle Archaic sites are relatively abundant compared to Early Archaic sites. Middle Archaic sites are located in a wide variety of ecological settings, from mid-elevation mountain valleys, to the Plains-foothills ecotone, to canyons and open steppe in the Plains (Zier 1999). Especially significant are Middle Archaic occupations in rock shelters, including Draper Cave (5CR1), Recon John Shelter (5PE648), Gooseberry Shelter (5PE910), and Wolf Spider Shelter (5LA6197) (Hagar 1976; Hand and Jepson 1996; Zier 1999; Zier and Kalasz 1991). The Dead of Winter site (5LK159) is the most thoroughly investigated high-elevation Middle Archaic occupation in the Arkansas basin (Buckles 1978).

In the Plains, Middle Archaic sites in the Arkansas basin are primarily located near reliable water sources (Zier 1999). Both open and sheltered sites exhibit evidence of regular reoccupation. The diversity of tool types present, along with the frequent occurrence of hearth features, suggests that these sites represent multi-activity residential camps. Floral and faunal inventories point to a broad-spectrum subsistence strategy. Together, assemblage diversity and evidence for reoccupation may reflect a small-group foraging economy; however, the potential for preservation differences between sheltered and open sites complicates interpretations of mobility patterns.

Just one residential structure dating to the Middle Archaic is known from the Arkansas River basin (5LA2190) (Zier 1999). However, Middle Archaic basin houses have been documented immediately north of the Arkansas-South Platte divide in Douglas County, Colorado (Gantt 2007) and post molds possibly associated with an architectural feature have been observed at Dancing Pants Shelter, also located in Douglas County (Tate 1999:134).

Late Archaic Period

Occupation during the Late Archaic (3000 – 1800 B.P.) in all three physiographic sections of the of the South Platte basin, including the Plains, the hogbacks/foothills, and the mountains. The number of dated Late Archaic sites exceeds those dated to each of the prior two periods, suggesting a regional increase in population (Tate 1999:134, 164). A wide variety of site types have been documented, including open and sheltered camps, kill and butchery sites, game drives, and burials.

Large corner-notched dart points, including Pelican Lake and Besant styles, characterize Late Archaic projectile technology. Although the Late Archaic may well be represented at Magic Mountain, several types thought to have been produced during that period occur in Zone B and C deposits. These include corner- and low-side-notched styles designated MM20-23 and MM26 (Irwin-Williams and Irwin 1966). A variety of decorative items also occur in Late Archaic contexts in the hogback valleys.

On the Plains, evidence exists for communal bison procurement, which suggests the development of complex intergroup cooperation and participation (Kornfeld *et al.* 2010). However, while bison remained important—including in or near the hogback valleys (Gilmore and Baugh 1987)—diet breadth appears to have increased during the Late Archaic (Tate 1999:155; Troyer 2014).

In the Arkansas basin, Late Archaic (3000 – 1850 B.P.) sites occur in a wide variety of settings, including in the open steppe, in shallow and deep canyons, in the Plains-foothills ecotone, and in high-elevation valleys. Important Late Archaic rock shelter sites include several that also contain Middle Archaic deposits (Recon John, Gooseberry, and Wolf Spider), as well as Two Deer (5PE8), Carrizo (5LA1053), and Medina (5LA22) (Campbell 1969; Zier 1999). Open sites in steppe and shallow-canyon settings are widespread and common, but few have been intensively investigated. Excavated sites in the mountains include the Runberg site on Cottonwood Pass (Black 1986) and site 5LK199 and the Campion Hotel site southwest of Leadville (Zier 1999).

The broad-spectrum subsistence strategy that began in the Middle Archaic continued into the Late Archaic. Late Archaic faunal and botanical assemblages are somewhat more diverse than Middle Archaic assemblages, but it is unclear whether this reflects increased diet breadth or sampling biases. Maize remains definitely occur at multiple Late Archaic sites, the earliest of which, Gooseberry Shelter, dates to 2600 B.P. However, maize was certainly a minor component of Late Archaic diets and its occurrence did not lead to a real shift in subsistence practices (Zier 1999, 2018).

Few architectural features dating to the Late Archaic have been documented. Among the most enigmatic is a massive rock wall at the Magic Mountain site that may date to the latest Late Archaic or to the earliest Early Ceramic (Kalasz and Shields 1997). Basin houses of similar age may occur at the Box Elder-Tate Hamlet site (Tate 1999:140). Habitation structures dating the Late Archaic in the Arkansas basin include basin houses at the McEndree Ranch site in Baca County (Shields 1980) and at the Veltri site in the upper Purgatoire River valley (Rood 1990).

Nominally, the end of the Late Archaic is demarcated by the introduction of the bow and arrow.

However, the dating of that technological transition has been problematic in both the South Platte and Arkansas basins and therefore a numerical age for the end of the Late Archaic (and the Archaic more broadly) is uncertain. Complicating the analysis is the fact that atlatl technology likely persisted for several centuries following the introduction of the bow. Large corner-notched bifaces may also have been used as knives (Kalasz and Shields 1997). On the assumption that the earliest dated arrow point likely postdates the introduction of the technology, contexts lacking diagnostic points that are somewhat older than 1800 B.P. may be better interpreted in terms of Early Ceramic rather than Late Archaic subsistence and settlement patterns.

Late Prehistoric Stage

Two technological innovations, both of which are clearly visible in the archaeological record, marked the beginning of the Late Prehistoric stage. Arguably the more important of the two was the introduction of the bow and arrow, which eventually supplanted the atlatl and dart as the primary hunting technology. A second technological marker of the Late Prehistoric was the manufacture and use of ceramic cooking vessels. Both innovations affected American Indian mobility strategies and settlement patterns, demography, and diets but the timing, extent, and character of those effects varied from place to place.

Late Prehistoric stage archaeology in eastern Colorado is divided into two or three periods (Gilmore 1999; Kalasz *et al.* 1999; see also Greubel *et al.* 2017). In the South Platte basin, the Early Ceramic period nominally began at about 1850 B.P. and continued until 800 B.P. The succeeding Middle Ceramic spans the period between 800 and 400 B.P. In the Arkansas basin, three periods are defined: the Developmental (1900 – 900 B.P.), the Diversification (900 – 500 B.P.), and the Protohistoric period (600(?)/500 – 225 B.P.). In the South Platte basin, the most recent period of Indigenous American archaeology is classified as a stage (Clark 1999). Only the earlier two Late Prehistoric periods are discussed in this section.

Early Ceramic Period

A plurality of archaeological components in the South Platte basin date to the Early Ceramic (Gilmore 1999:181). An increase in the number of radiocarbon dates—possibly indicating an increase in population, but certainly indicating an increase in the preservation of archaeological remains—began during the later Late Archaic. Early Ceramic sites occur in all portions of the basin, including in high-elevation settings in the Front Range, in the hogback valleys, and in the Plains (figure 1.9). Although the extent of public land—and therefore the opportunities for archaeological inventory and site discovery—certainly skew the distribution of documented sites, what might be described as an Early Ceramic homeland occurs in the hogback valleys of Jefferson County and on the north slope of the Palmer Divide in Douglas County.

Important, well-reported projects focused on the Early Ceramic include those carried out at the Oeškeso site prior to the construction of Rueter-Hess Reservoir (Gantt 2007), the Cass site (Kalasz *et al.* 1992), the Rock Creek site (Gleichman *et al.* 1995; Karhu *et al.* 1997), the Van Ness site (Kalasz *et al.* 1996), the Ridgegate site (Kalasz *et al.* 2008), Magic Mountain (Kalasz *et al.* 1995; Kalasz and Shields 1997), and Caribou Lake (Benedict 1985) as well as other high-elevation sites (Cassells 2000). Also important are new analyses of existing collections and new data from Bayou Gulch (Gilmore *et al*. 2021), Kinney Spring (Perlmutter 2015), and Olson (LaBelle and Pelton 2013). New and ongoing research at Fossil Creek in Larimer County (Jason LaBelle, personal communication 2021) and at multiple sites in Douglas County (Jon Hedland, personal communication 2021) promise new perspectives and new insights on the Early Ceramic record. Other notable Early Ceramic sites include Box Elder-Tate Hamlet, Senac, Valley View, Indian Mountain, George Lindsay Ranch, Dutch Creek, LoDaiska, Scratching Deer, Coney Lake, and others. Multiple Early Ceramic sites have been investigated in the Ken-Caryl Ranch locality including Swallow, Falcon's Nest, Crescent, Bradford House II and III. However, several of these projects remain underreported or unreported. Important multi-site thematic studies include Ellwood (1995, 2002), Gilmore (2008b), Hedland (2019), and Owenby and others (2021).

Small corner-notched arrow points are the hallmark of the Early Ceramic. Some analyses have recognized systematic morphological variations among early arrow points (Gilmore 1999:272-273; Gilmore *et al*. 2021). Potential discriminant variables include blade serration, notch placement and form, distal haft element width, thickness, and other factors. However, the interpretive utility of these patterns has not been consistently demonstrated (Gilmore *et al.*

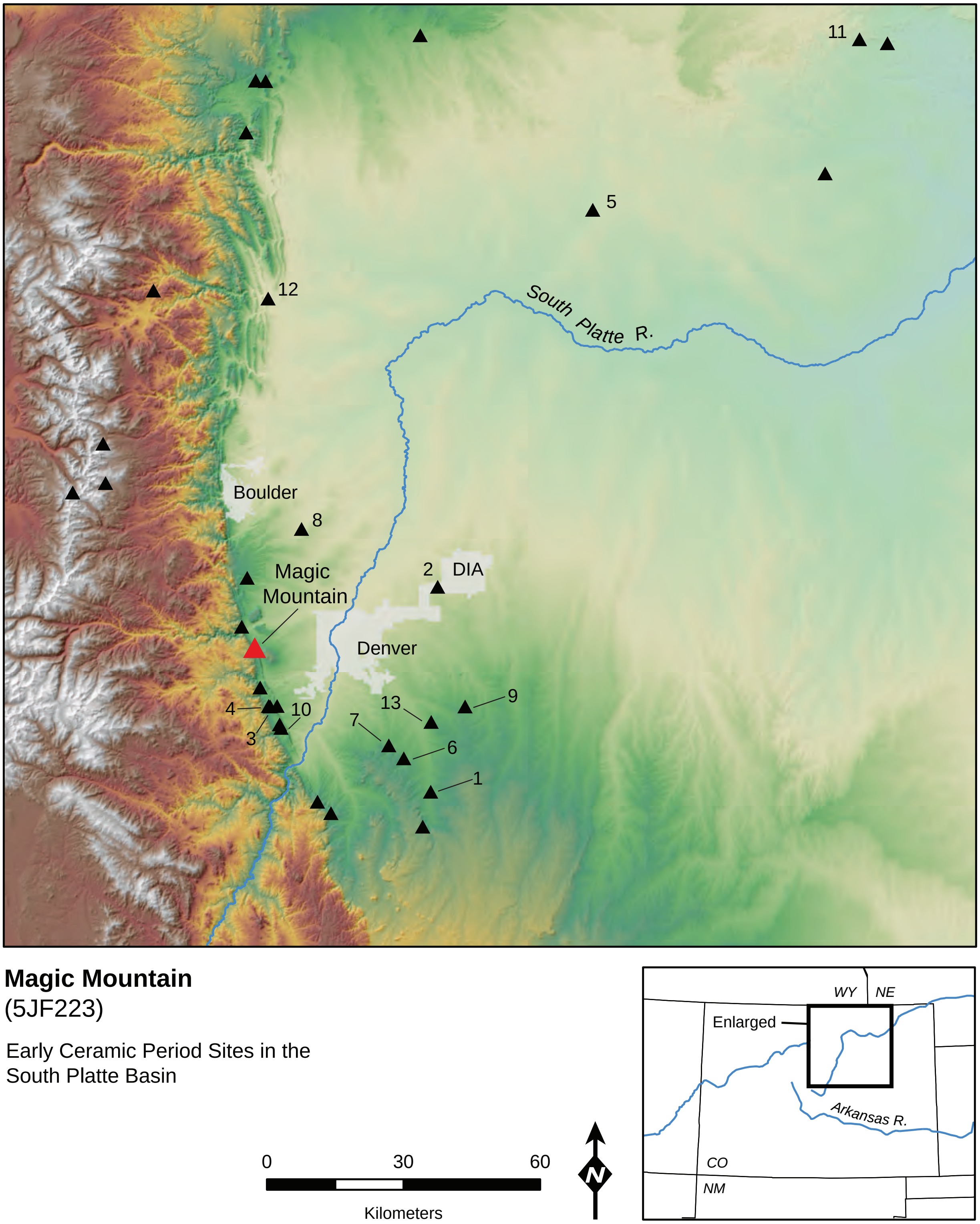


Figure 1.9. Terrain map of the South Platte basin in Colorado showing the locations of sites containing substantial Early Ceramic period components. Numbered sites are discussed in this report. (1: Bayou Gulch; 2: Box Elder-Tate Hamlet; 3: Bradford House II; 4: Bradford House III; 5: Cass; 6: Oeskeso; 7: Ridgegate; 8: Rock Creek; 9: Senac; 10: Swallow; 11: Uhl; 12: Valley View; 13: Van Ness).

2021), nor has their cultural significance. At Magic Mountain, Early Ceramic types associated with the Zone A occupation are primarily MM33 through 38, with MM35 the most abundant (Irwin-Williams and Irwin 1966). Pottery also is diagnostic of the Early Ceramic. However, the extent and nature of the differences between Early Ceramic vessels and Middle Ceramic vessels is an ongoing subject of debate.

Early Ceramic site types in the South Platte basin include open and sheltered residential camps, open and sheltered architectural sites, game drives, logistical camps, limited activity locations, and burials. Communal hunting sites are limited to high-elevation locations, where they often are paired with processing camps. Components located in the hogback valleys commonly reflect intensive occupation—or recurrent reoccupation—of selected portions of the landscape.

The study of large-scale, annual and inter-annual mobility is an important component of archaeological research in Colorado's Front Range and adjacent South Platte basin and several models have been developed for Early Ceramic period mobility strategies. Benedict's (1992) research on high-elevation game drives established a systematic framework for investigating seasonal mobility patterns. A second, less well-developed model, involving movement between the hogback valleys and the Southern Front Range Mountains and South Park, has been proposed by Johnson and others (1997). Both models regard the hogback valleys as a winter homebase. Travel either north and then west or southwest into the mountains occurred during the warm season.

Early Ceramic diets encompassed a wide variety of resources, although overall emphasis likely was on low-ranked species. Bison remains occur in some Early Ceramic faunal assemblages, but small- to medium-sized artiodactyls appear to have been more important resources. Small mammal remains also are common at many Early ceramic sites. Evidence for communal hunting is confined to high-altitude game drives, perhaps reflecting the relative importance of encounter hunting for bow-and-arrow users. Floral assemblages are varied, although the most abundant botanical remains are goosefoot (*Chenopodium* spp.) seeds (Gilmore 1999:269). Also represented are various cacti and weedy annuals. In the Arkansas basin, maize remains are consistently, though not ubiquitously, present (Zier 2018). Maize may also occur in a few South Platte basin macrofloral assemblages (Gilmore 1999:239-240).

Early Ceramic architectural features are far more abundant than Archaic architectural features. However, they are highly varied and include basin houses, spaced-rock rings, stone enclosures, wattle-and-daub structures, and possible lean-tos. Architectural features may have been somewhat more abundant in the Arkansas basin than in the South Platte basin. Developmental period structures occur in rock shelters, but those generally consist only of informal partitions composed of stacked rocks (*e.g.* Campbell 1969; Schiavitti *et al.* 2001). Residential structures at several open sites are more substantial and better documented, including an enclosure and a basin house at the Belwood site (Hunt 1975), and two slab enclosures at the Forgotten site (Loendorf *et al.* 1996).

Middle Ceramic Period

The beginning of the succeeding Middle Ceramic period is marked by the appearance of triangular, side-notched arrow points. New pottery vessel forms—globular vessels with obliterated cord-roughened surface treatment—also mark Middle Ceramic components. In the South Platte basin, Middle Ceramic sites are contemporaneous with—and perhaps connected in complex ways to—the Central Plains tradition Upper Republican phase, representative sites of which occur primarily in Nebraska and Kansas (Roper 2007). In the Arkansas basin, the Diversification period is represented by the Apishapa and Sopris phases (Kalasz *et al.* 1999), contemporaries of the Antelope Creek phase in Texas and the Valdez phase in New Mexico, respectively.

In the South Platte basin, American Indian populations likely peaked at the end of the Early Ceramic or the beginning of the Middle Ceramic (Gilmore 2008a). The population peak in the Arkansas basin may have been a century or so later. However, in both regions population appears to have declined during the Middle Ceramic. With a number of notable exceptions—including Magic Mountain—Middle Ceramic components cooccur with Early Ceramic at sites in the hogback valleys (Gilmore 1999:245). However, Middle Ceramic components commonly are smaller. On the Plains east of the hogback valleys, the Middle Ceramic settlement system appears to have been distinct from earlier occupations and a number of single-component sites have been documented.

Bison appear to have been a more important resource for Middle Ceramic groups than they were for Early Ceramic groups. However, the roster of plant and animal remains associated with Middle Ceramic components is similar to that associated with Early Ceramic components.

Architectural features are an especially important aspect of the Diversification period record in the Arkansas basin. Sopris phase houses are heterogeneous and include both single- and multiple-room structures built from stone masonry, adobe, and jacal. Apishapa phase houses include single- and multiple-room structures built nearly exclusively from vertical slabs. Stone barrier walls or fences also are common, as are walled or partitioned rock shelters.

Although wild resources continued to be the backbone of Diversification period diets, the consumption of maize clearly increased (Zier 2018). Small mammals appear to dominate rock shelter archaeofauna while bison dominate open-site archaeofauna (Kalasz *et al.* 1999:218). Interregional interaction increased during the Diversification period, particularly for Sopris phase communities who maintained regular connections with ancestral Puebloans in the northern Rio Grande.

Protohistoric Period

Relatively few Indigenous American sites dating to the 250 years between about 1500 and 1750 have been documented (Clark 1999; Kalasz *et al.* 1999). Sites dating to the period are widely scattered in the mountains, hogback valleys, and Plains. However, limited archaeological data in combination with ethnographic, linguistic, and historical data indicate occupation of eastern Colorado by a wide variety of American Indian tribal groups, including Apaches, Comanches, Utes, Cheyennes and Arapahos, and others. Glass and metal artifacts manufactured in Europe or the American colonies likely began to appear during the seventeenth century. Some rock art sites in the South Platte basin date to this period. Numerous such sites occur in the Arkansas basin.

Research Context

The study of large-scale, annual and inter-annual mobility is an important component of archaeological research in Colorado's Front Range and adjacent South Platte basin. Archaeologists have long recognized material and technological similarities between high- and low-elevation sites in the region. Benedict's (1992) research on high-elevation game drives established a systematic framework for investigating seasonal mobility that archaeologists working throughout the region have taken up. Data from sites in a variety of settings have been marshaled to evaluate and refine Benedict's contrasting mobility models.

However, Magic Mountain's connections to the regional cultural and ecological landscape have not been investigated. Centennial Archaeology's project laid the groundwork for such a study by arguing that, at least during the Early Ceramic, the site was a base camp that may have been occupied by residentially mobile hunter-gatherers (Kalasz and Shields 1997). However, apart from that general observation, little is known about how the site fits into regional mobility patterns or about its relationships to other sites in the Plains-foothills ecotone. In addition, faunal and botanical data from the site have not been used to model local or regional subsistence practices.

A variety of recent advances in archaeological research provide a robust context for renewed investigation at Magic Mountain. More is now known about the regional archaeological record than was known in the mid-1990s when Centennial carried out their investigation. In some cases, new data and analyses are available for previously unreported or underreported investigations (*e.g.* Perlmutter 2015). New paleoenvironmental data and new demographic reconstructions are also available for the region (*e.g.* Gilmore 2008a; Larmore and Gilmore 2006). Recent lithic sourcing studies in the Southern Front Range may provide additional context for understanding regional mobility patterns (*e.g.* Black 2000; Black and Theis 2015).

Techniques for modeling hunter-gatherer mobility and subsistence practices have advanced greatly during the past 20 years (Kelly 2013) and those methods have been applied successfully to archaeological data from sites in Colorado (*e.g.* Reed 2009a, 2011). An important aspect of that modeling work involves more robust evaluations of site occupation duration and site seasonality (*e.g.* Moore 2011; Reed 2009b).

Taken together, those new data and new analytic methods permit a more robust approach to understanding regional mobility patterns through analyses of new collections—as well as re-analyses of existing collections—from Magic Mountain.

Research Objectives

In the 1990s, the eastern portion of the site was privately owned and inaccessible for research. The site is now owned entirely by the City of Golden, Colorado—a circumstance that has created new research opportunities. In August 2016, DMNS and PCRG began a new research effort at Magic Mountain focused on employing non-invasive methods to the previously unstudied portion of the site. This phase of research included drone photogrammetry to create a digital surface model (DSM) of the site along with geophysical surveys (ground-penetrating radar [GPR] and magnetic gradiometry) to understand what lies below the ground. Excavation during 2017 and 2018 was based on the geophysical results, which indicated many cultural features were present in the previously unstudied portion of the site. The project's overall research goals are threefold:

(1) To increase knowledge about the Early Ceramic period. Although a number of projects have generated data on the Early Ceramic, much of the reporting has been purely descriptive. The Magic Mountain project team aimed to generate data needed to address questions about the chronology and seasonality of site use, the duration and intensity of occupation episodes, and the activities undertaken there.

(2) To document older contexts at the site. The project explored site formation processes and the age and stratigraphic context of the site's oldest archaeological contexts.

(3) To better define Magic Mountain's connections to the larger cultural landscape of the Front Range Mountains and Plains.

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2

Geoarchaeology and Paleoenvironmental Context

Rolfe D. Mandel

This chapter presents the results of the geoarchaeological investigation at the Magic Mountain site. The investigation, which was supported by the University of Kansas Odyssey Archaeological Research Program, focused on the stratigraphy, sedimentology, pedology, and geochronology of the site. Information gleaned from the study provides a soil-stratigraphic context for interpreting the archeological record, and a numerical chronology for the alluvial and colluvial deposits and associated soils at the site. Understanding the pedology of the site is especially important because the cultural deposits are associated with surface and buried soils. Also, recognizing the soil stratigraphy provides a basis for identifying cycles of sedimentation and landscape stability, which in turn is crucial for reconstructing the history of site formation. In addition, the $\delta^{13}C$ values of pedogenic organic matter were determined and used to infer bioclimatic change for the period of record at the site.

Environmental Setting

The Magic Mountain site is located on the boundary between the High Plains to the east and Rocky Mountains to the west and offers direct access to the subsistence resources of multiple ecological communities. The foothills rise precipitously about 0.5 km to the west of the site. A hogback formed primarily from Lower Cretaceous and Upper Jurassic formations forms a discontinuous valley wall several hundred meters to the east. Rolling, open plains occur east of the hogback (Scott 1972). Major bedrock units exposed on-site include

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the Lyons Sandstone (Permian), which forms a 2- to 3-m-high outcrop (figure 2.1). Near-surface bedrock units include the Bergen shale, Forelle Limestone, and Strain Shale members of the Lykins Formation of Permian and possibly Triassic age (figure 1.4).

Apex Gulch, a low-order stream that extends into the foothills, occurs along the southern boundary of the site and flows east, joining Lena Gulch, a tributary of Clear Creek. Clear Creek joins the South Platte River a few kilometers northeast of downtown Denver. Apex Gulch was straightened and channelized in the late 1950s. It appears to be perennial today, although the base flow is minimal. A marsh was present immediately west of the Lyons Sandstone outcrop in the mid-twentieth century. That marsh may have been spring-fed and had an outflow channel that joined Apex Gulch. Currently, the marsh and outflow channel are completely dry. Recent development, including modification of the Apex Gulch channel, may have altered the local hydrologic system.

The Magic Mountain site spans the valley floor of Apex Gulch and extends northward onto a colluvial apron. The valley floor consists of a modern floodplain (T-0) and a low, narrow terrace (T-1) (figure 2.2). The T-0 surface is rippled and littered with well- to sub-rounded cobbles and small boulders. A subtle approximately 1 m-high scarp separates the T-0 surface from the adjacent T-1 surface (figure 2.3). The tread of the T-1 terrace is flat and featureless, and it gradually merges with the toe of a colluvial apron; there is no topographic feature separating the T-1 surface from the colluvial apron. Initially, the surface of the colluvial apron gently rises then quickly steepens to the north (figures 2.2 and 2.4). Much of the Magic Mountain site is located on the toeslope and footslope of the colluvial apron.

Previous Geologic Investigations

In 1958, the Magic Mountain site came to the attention of Cynthia Irwin-Williams and her brother Henry Irwin while they were investigating the nearby LoDaiska site. After fruitful initial testing, they decided to undertake a larger program, which became the focus of Cynthia Irwin-Williams's Harvard University dissertation research. The results were published by the Denver Museum of Natural History in a 1966 volume and in Irwin-Williams's 1963 Harvard dissertation (Irwin-Williams 1963; Irwin-Williams and Irwin 1966).

Irwin-Williams and Irwin's work in 1959 and 1960 involved backhoe trenching, auger testing, and block excavation. In addition, J. Hiram Smith and Glenn R. Scott studied the site's geology and stratigraphy (Smith and Scott 1966). Backhoe trenching occurred west of the Lyons Sandstone outcrop; the largest of the trenches remains visible as a depression on the surface today. Auger testing occurred along an east-west transect on either side of a waterline trench located east of the outcrop. The main excavation block was

Figure 2.1. Photograph of the Lyons Sandstone outcrop. The view is to the west.

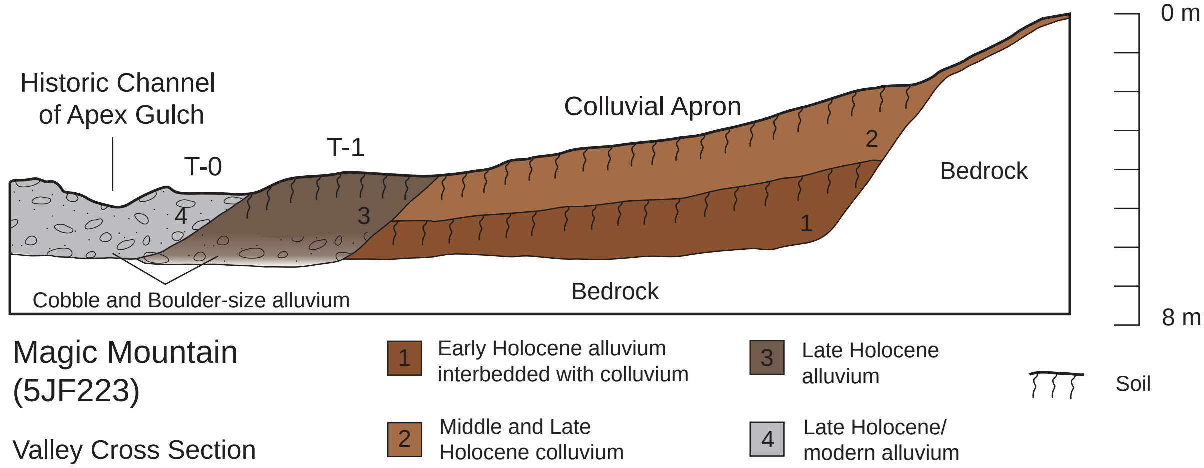

Figure 2.2. Schematic cross-section from the original channel of Apex Gulch up the colluvial apron. Horizontal scale is exaggerated.

located south of the bedrock outcrop and consisted of an irregular arrangement of trenches and blocks that incorporated approximately 154 3 x 3-ft squares (129 m^2). Excavation depth varied greatly but reached at least 18 ft in some parts of the block.

Irwin-Williams and Irwin (1966) identified six cultural zones (A-F) and Smith and Scott (1966) assigned the cultural zones to stratigraphic units. The stratigraphic units were in turn assigned to one of three regional alluvial units: the Piney Creek alluvium, Post-Piney Creek alluvium, or Pre-Piney Creek alluvium. The Piney Creek alluvium is a body of late-Holocene alluvium defined by Hunt (1954) and subsequently identified elsewhere along the Colorado Front Range (see Birkeland *et al.* 1996, 2003; Buckles 1980; Gilmore 2011; Madole 1991; McFaul and Reider 1990; Scott 1963). The most recent, abundant, and extensive cultural complex identified by Irwin-Williams and Irwin (1966) at Magic Mountain, which they designated as Woodland, occurs exclusively in Zone A. Smith and Scott (1966) assigned Zone A to stratigraphic Unit 1, the uppermost stratum. The cultural or temporal affiliations of the sparse materials recovered from underlying Zone B (Unit 2) are unknown. Artifacts representing the other two defined cultural complexes, which they called the Apex complex and the Magic Mountain complex, occur across multiple zones. Apex complex materials, which likely date primarily to the Middle Archaic period, occur in Zones C (Unit 3), D (Unit 4), and E (Unit 5), although they are most abundant in Zone D (Unit 4). Materials representing the older Magic Mountain complex, which may date primarily to the Early Archaic, occur in Zones D (Unit 4), E (Unit 5), and F (Unit 7). Stratigraphic Unit 6 did not yield any cultural materials. The single radiocarbon date Irwin-Williams and Irwin obtained from the site puts the initiation of Unit 5 aggradation at 4930±250 ^{14}C yr B.P.

By the early 1990s, half of the site was owned by the City of Golden and the other half remained in private ownership. Partnering with the City of Golden, Centennial Archaeology Inc. (CAI) studied the city-owned parcel in 1994 and 1996. In addition to archaeological testing and block excavation, the 1994 project involved coring along transects to assess site stratigraphy. Kalasz and others (1995) and Kalasz and Shields (1997) identified four "terrains" with potential to yield cultural materials: (1) a shallow basin upslope and north of the prominent Lyons Sandstone outcrop; (2) an alluvial fill south of the sandstone outcrop and between the Harvard excavation block; (3) alluvium in the Apex Gulch drainage downstream and east of the main excavation block; and (4) alluvium between the spring drainage and Apex Gulch. They identified yellowish-red alluvium in cores taken south of the spring drainage and suggested that it may represent the late Pleistocene Broadway alluvium of Scott (1960, 1963), though there are no radiocarbon ages to support this premise. Two deposits mantle the proposed Broadway alluvium, and Kalasz and others (1995) and Kalasz and Shields (1997) correlate those deposits with early-Holocene geologic units 7 and 6 of Smith and Scott (1966). Also, Kalasz and others (1995) and Kalasz and Shields (1997) note that late-Holocene valley fill appears to be stored downstream

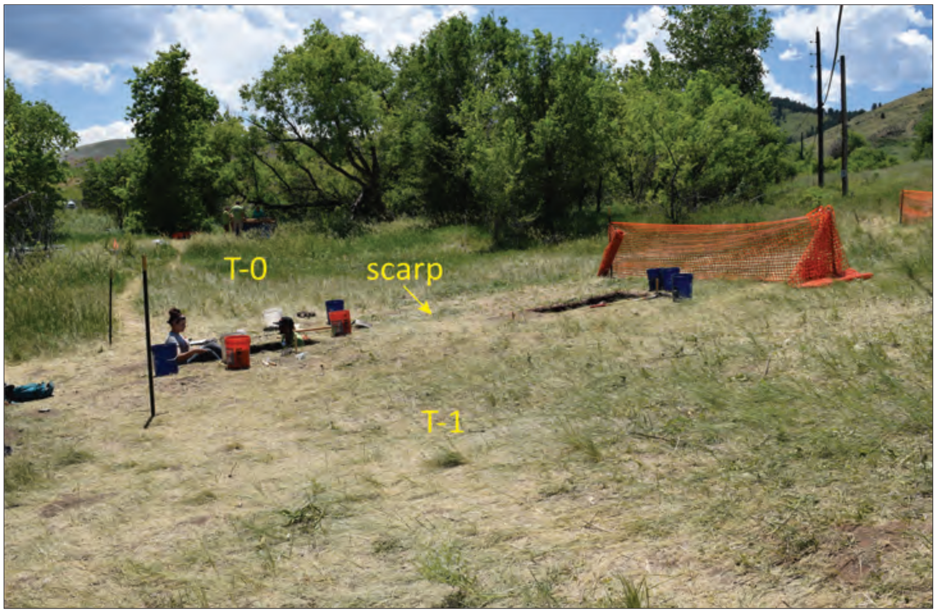

Figure 2.3. Photograph of the modern floodplain (T-0) and low terrace (T-1) of Apex Gulch. A subtle scarp separates the two geomorphic surfaces. The trees are along the abandoned channel of Apex Gulch. The view is to the south.

Figure 2.4. The gently sloping footslope and toeslope of the colluvial apron are in the foreground. Note that the slope of the apron suddenly steepens to the north towards the solar panels.

and east of the main excavation block. They point out that because the fill is dominated by coarse-grained alluvium, including many cobbles, it was deposited under high-energy conditions that would have been unfavorable for the preservation of in situ cultural deposits.

Methodology

As part of the geoarchaeological investigation, all archaeological test units excavated by DMNS and PCRG were inspected and described. Also, in 2017, a Giddings hydraulic soil probe and an Acker Soil Max truck-mounted drill rig were used to collect intact, continuous, 2.5-cm-diameter cores (figure 2.5). Each rig collected three cores on the colluvial apron (figure 2.6), and the cores collected by the Acker rig reached bedrock. All cores were transported to Kansas Geological Survey for analysis.

Detailed descriptions of soil profiles in the cores

Figure 2.5. Coring on the colluvial apron at the Magic Mountain site in November 2017.

and archaeological test units were prepared using standard procedures and terminology outlined by Birkeland (1999) and Scheoneberger and others (2012). Carbonate morphology was defined according to the classification scheme of Birkeland (1999). These basic field methods have proven useful in describing both soils and sediments in geoarchaeological investigations (Holliday 2004; Holliday *et al.* 2017a).

Soils were included in the stratigraphic framework of every profile that was described. Soils are important to the subdivision of Quaternary sediments, whether the soils are at the present land surface or buried (Birkeland 1999; Holliday *et al.* 2017b). After soils were identified and described, they were numbered consecutively, beginning with 1, the modern surface soil, at the top of the profile. Graphic profiles were constructed to visually convey soil, stratigraphic, and chronologic information for all of the geomorphic study sites.

Laboratory Methods

Soil samples collected from archaeological Units 15, 33, and 45 were air dried at the Kansas Geological Survey's Soil Laboratory and mechanically split into equal halves. Next, the split samples were gently ground in a ceramic mortar and passed through a 2-mm sieve to remove coarse fragments.

One split of samples was dried in an oven at 50 degrees C then homogenized with a ceramic mortar and pestle. Next, 20 ml of 0.5 N hydrochloric acid was added to 1 g of soil in order to remove calcium carbonate. After the reaction was complete, 30 ml of distilled water were added to each sample and centrifuged at 4,000 RPMs for five minutes and decanted. The process was repeated to ensure chlorine removal. Decalcified samples were oven-dried at 50 degrees C, pulverized using a synthetic ruby mortar and pestle, weighed, and transferred to glass vials. Calcium carbonate equivalent (CCE), which is the quantity of carbonate in the soil expressed as $CaCO_3$ and as a weight percentage of the less than 2 mm fraction, was calculated.

The decalcified samples were submitted to the University of Kansas W. M. Keck Paleoenvironmental and Environmental Stable Isotope Laboratory (KPESIL) to determine organic carbon (C) content and $\delta\ ^{13}C$ values of the soil organic matter (SOM).

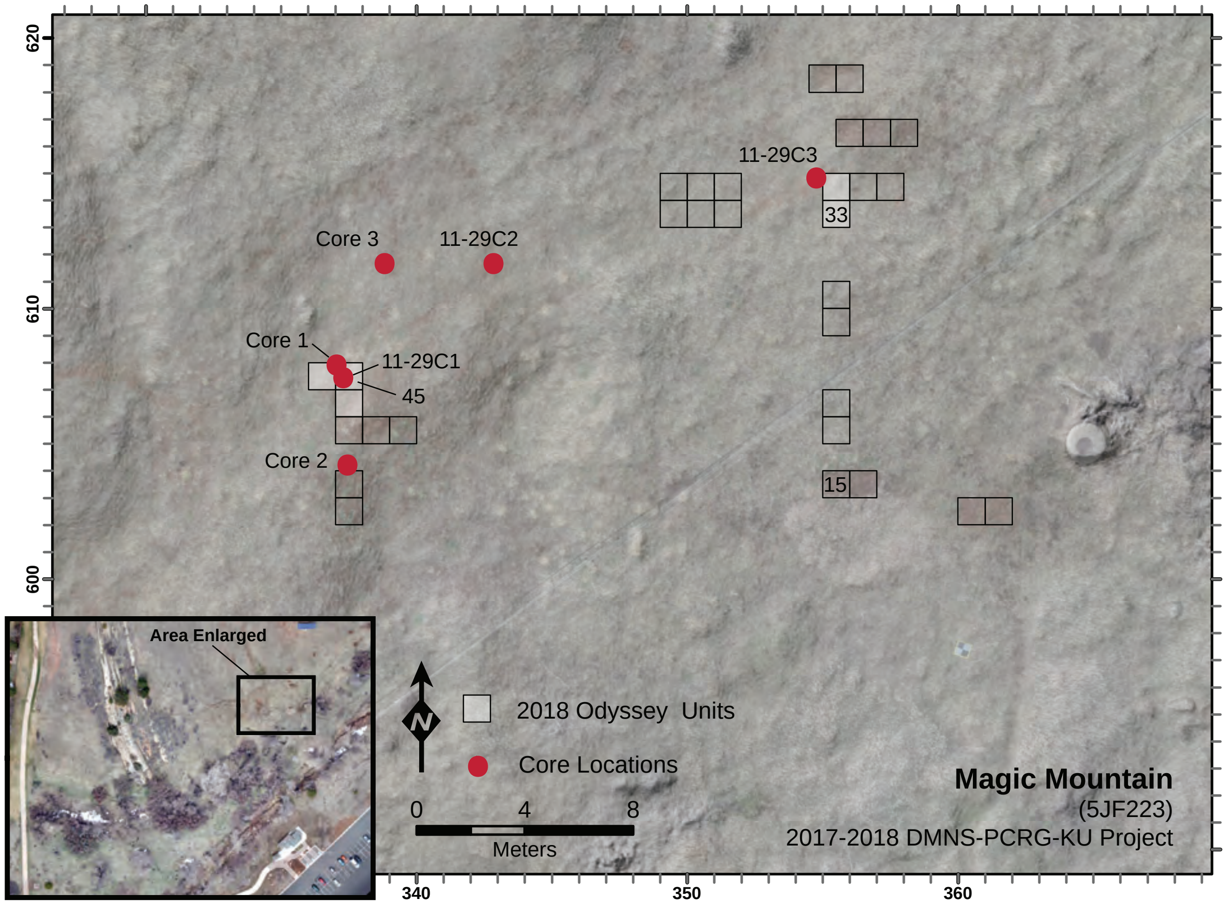

Figure 2.6. Terrain map of the Magic Mountain site showing the locations of excavation units discussed in the text.

The samples were analyzed on a Costech ECS 4010 Elemental Analyzer in conjunction with a series of atropine standards (Costech Code 031042) of known %C. From the analyzed standards, the Costech EAS32 software generates a calibration curve measuring area (Vs) versus weight (mg C). Knowing the carbon content of the standard and noting individual sample weights along with measured voltages, the software is then able to generate relative %C content for each analyzed sample. Typical standard calibration R^2 values are better than 0.9998.

Raw $\delta^{13}C$ values were obtained through high-temperature combustion with the Costech ECS4010 elemental combustion system in conjunction with a ThermoFinnigan MAT253 isotope ratio mass spectrometer at KPESIL. International standards used to calibrate $\delta^{13}C$ values were NIST USGS-24 (graphite) #8541, IAEA-600 (caffeine), and NIST ANU (sucrose) #8542. A pre-calibrated internal standard (DORM-2 dogfish muscle; National Research Council of Canada) was used in the $\delta^{13}C$ calibration curve, as well as for percent carbon (%C) determination. The precision of reported $\delta^{13}C$ values is based on a linear correction of observed values versus expected values of the standards. Typical standard calibration curves yield an R^2 of 0.9994 or greater.

The second split of samples was retained for particle-size analysis at the Kansas Geological Survey's Soil Laboratory. The grain-size distribution of these samples was determined using a slightly modified version of the pipette method (Gee and Bauder 1986). The samples were dispersed in a sodium hexametaphosphate solution and shaken on a reciprocal shaker overnight. Silt and clay aliquots were drawn from the appropriate pipette depth based on particle-size settling velocity, oven dried, and weighed to the nearest milligram. The results, presented as weight percentages, total to 100 percent of the less than 2 mm mineral fraction. The silt fractions were subdivided as follows: coarse silt (50-

20m), medium silt (20-5m), and fine silt (5-2m). Loess standards were used for inter-run comparisons of grain-size data.

Six soil samples, all from buried paleosols exposed in archaeological Units 33 and 45, were collected for AMS radiocarbon dating of soil organic matter (SOM). The soil samples were transferred to the Kansas Geological Survey's Soil and Geoarchaeology Laboratory, where they were disaggregated, passed through a 1.00-mm sieve, and inspected for artifacts, roots, and rootlets. No artifacts were discovered, but numerous roots and rootlets were found and removed. The samples were submitted to DirectAMS for radiocarbon dating. The samples were decalcified and the SOM assayed. In the text of this chapter, radiocarbon ages are reported in uncalibrated years before present (^{14}C yr B.P.). However, all radiocarbon ages were calibrated (see table 2.1), and the ages were corrected for isotopic fractionation. Also, the ages were rounded using the Stuiver and Polach (1977) protocol.

Results of Investigations

Colluvial Apron

The cores collected on the colluvial apron in 2017 demonstrated that a package of colluvium and alluvium 2 to 3 m thick is draped over bedrock in the central portion of the site. The cores also revealed the presence of a well-expressed buried paleosol (Soil 2) developed in alluvium in the lower half of the sediment package. To sample that buried soil, the Odyssey team initially excavated a total of 2,323 liters of sediment in Unit 45 (figure 2.7). The excavation was terminated at bedrock.

In Unit 45, a 28-cm-thick mantle of modern landfill mantles the surface soil (Soil 1) (figures 2.8 and 2.9). Soil 1 has a well-expressed A-AB-Bt-BC profile developed in a 93-cm-thick unit of matrix-supported colluvium with sandy loam texture (table 2.2). The Bt and BC horizons are moderately to strongly oxidized, with reddish brown (5YR 4/3 and 4/4) matrix colors. Although oxidation played a role in reddening the soil, the local parent material is mostly derived from reddish bedrock and certainly influenced soil color. Sand content is consistently high throughout Soil 1, ranging between 72 and 81 percent, and CCE is low (2 to 3 percent) (figure 2.9). Also, granules and angular pebbles are scattered through the fine-grained matrix of the soil and comprise about 15-20 percent of the volume of the colluvium.

The top of Soil 2 was recorded at a depth of 121 cm below the land surface. Soil 2 has a thick, well-expressed Ak-ABk-Btk-BCk profile with stage I+ to II carbonate morphology. The upper 44 cm of Soil 2 is developed in alluvium with common lenses of pebbly colluvium. Below a depth of 165 cm, Soil 2 is developed in silty residuum of the Bergen Shale (3BCkb horizon). In other words, Soil 2 is welded to the residuum. The transition from Soil 1 to Soil 2 is marked by a significant reduction in sand content (declines from 72 to 58 percent) accompanied by increases in silt and clay contents, and a dramatic increase in CCE (figure 2.9). Also, organic carbon (C) increases from 0.54 to 0.87 percent across the boundary between Soils 1 and 2 (see figure 2.15 and table 2.5 in the Stable Carbon Isotope section). The CCE remains high (7 to 8 percent) in the 2Btk1b and Btk2b horizons, and increases to about 16 percent in the weathered, calcareous residuum represented by the 3BCkb horizon. Soil 2 is strongly oxidized, with mostly reddish brown (5YR 4/4, dry) and yellowish red (5YR 4/6, dry) matrix colors. Like Soil 1, the

Table 2.1. Radiocarbon ages for Units 33 and 45.

Locality	Material Dated[1]	Sample Depth (cmbs)	^{14}C Age (yr B.P.)	Cal. Age Range[2] (yr B.P.)	Median Cal. Age (yr B.P.)	Laboratory No.
Unit 45	SOM	121-131	6045±50	6746-7151	6893	D-AMS-031016
Unit 45	SOM	132-142	6260±40	7018-7265	7199	D-AMS-031017
Unit 45	SOM	139-149	6340±35	7165-7411	7263	D-AMS-031018
Unit 33	SOM	180-190	7625±40	8366-8520	8413	D-AMS-031019
Unit 33	SOM	198-208	8110±40	8813-9264	9057	D-AMS-031020
Unit 33	SOM	210-220	7955±70	8602-8998	8813	D-AMS-031021

[1]SOM=Soil organic matter

[2]Calibration to calendar years (2 sigma) was performed with CALIB 8.2 using calibration dataset IntCal13 (Stuvier *et al*. 2022).

Note: The radiocarbon ages were rounded using the Stuiver and Polach (1977) protocol.

Figure 2.7. Photograph of Unit 45. The view is to the north.

Figure 2.8. Photograph of the north wall of Unit 45.

reddish matrix color is a product of weathering and the color of the parent materials.

Three bulk soil samples were collected from Soil 2 for radiocarbon dating. Soil organic matter from the upper 10 cm of the 2Akb horizon, upper 10 cm of the 2ABkb horizon, and upper 10 cm of the 2Btk1b horizon yielded AMS radiocarbon ages of 6045±50, 6260±40, and 6340±35 ^{14}C yr B.P., respectively (figures 2.8 and 2.9). These ages indicate that aggradation of the alluvium was underway sometime before *ca*. 6350 ^{14}C yr B.P., and that the surface of the mid-Holocene floodplain of Apex Gulch in the area of Unit 45 was stable by at least *ca*. 6350 ^{14}C yr B.P., thereby allowing soil development. In the area of Unit 45, Soil 2 was buried by colluvium soon after *ca*. 6050 ^{14}C yr B.P. These ages indicate that Early and Middle Archaic cultural deposits may occur in buried contexts in the area of Unit 45.

A second deep excavation block, consisting of two 1 m^2 excavation units (33 and 34), was opened east of Unit 45 (figure 2.6). Work in that block exposed a buried soil (Soil 2) 180 cm below the land surface (figures 2.9, 2.10 and 2.11). To fully expose and sample that buried soil, a total of 3,513 liters of sediment were removed from Units 33 and 34.

Two strata were recorded in the west wall of Unit 33: a 180-cm-thick top stratum consisting of matrix-supported colluvium, and a 50-cm-thick bottom

Table 2.2. Description of the north wall of Unit 45, Magic Mountain site.

Landform: Colluvial apron
Slope: 2-3%
Date Described: July 12, 2018
Described by: Rolfe D. Mandel
Remarks: Soil organic matter from the upper 10 cm of the 2Akb horizon, upper 10 cm of the 2ABkb horizon, and upper 10 cm of the 2Btk1b horizon yielded AMS radiocarbon ages (uncalibrated) of 6045±50, 6260±40, and 6340±35 B.P., respectively.

Depth (cmbs)	Soil Horizon	Description
0-13	- - -	Spoil Unit 1 (modern fill)
13-28	- - -	Spoil Unit 2 (modern fill)
		Soil 1
		Colluvium
28-40	A	Dark brown (7.5YR 3/2) loamy sand, very dark brown (7.5YR 2.5/2) moist; weak fine granular structure; hard, friable; common (15-20%) granules and fine, angular pebbles scattered through the matrix; many worm casts and open worm and insect burrows; many fine and very fine roots; gradual smooth boundary.
40-47	AB	Dark brown (7.5YR 3/3) loamy sand, very dark brown (7.5YR 2.5/3) moist; weak fine subangular blocky structure; hard, friable; common (15-20%) granules and fine, angular pebbles scattered through the matrix; many worm casts and open worm and insect burrows; many fine and very fine roots; common fine and very fine pores; gradual smooth boundary.
47-59	Bt1	Reddish brown (5YR 4/3) sandy loam, dark reddish brown (5YR 3/3) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; hard, friable; common distinct, discontinuous brown (7.5YR 4/2) clay films on ped faces; common (15-20%) granules and fine angular pebbles scattered through the matrix; few worm casts and open worm and insect burrows; common fine and very fine roots; many fine and very fine pores; gradual smooth boundary.
59-75	Bt2	Reddish brown (5YR 4/4) sandy loam, dark reddish brown (5YR 3/4) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; hard, friable; common (15-20%) distinct, discontinuous brown (7.5YR 4/2) clay films on ped faces; common granules and fine, angular pebbles scattered through the matrix; few worm casts and open worm and insect burrows; few fine and very fine roots; many fine and very fine pores; gradual smooth boundary.
75-121	BC	Reddish brown (5YR 4/4) sandy loam, dark reddish brown (5YR 3/4) moist; very weak fine and very fine subangular blocky structure; soft, very friable; common (15-20%) granules and many fine, angular pebbles scattered through the matrix; few fine and very fine roots; many fine and very fine pores; abrupt irregular boundary.
		Soil 2
		Alluvium Interbedded with Colluvium
121-132	2Akb	Brown (7.5YR 4/3) sandy loam, dark brown (7.5YR 3/3) moist; weak fine subangular blocky structure parting to weak fine granular; hard, friable; many films and threads of calcium carbonate (10-15%); hard, friable; few fine and very fine roots; common fine and very fine pores; gradual smooth boundary.
132-139	2ABkb	Brown (7.5YR 4/3) sandy loam, dark brown (7.5YR 3/3) moist; weak medium prismatic structure parting to weak medium and coarse granular; hard, friable; many films and threads of calcium carbonate (10-15%); hard, friable; few lenses of angular pebbles; few fine and very fine roots; common fine and very fine pores; gradual smooth boundary.

Table 2.2. Description of the north wall of Unit 45, Magic Mountain site (*continued*).

Depth (cmbs)	Soil Horizon	Description
139-151	2Btk1b	Reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; moderate medium prismatic structure parting to moderate fine prismatic; hard, friable; common distinct continuous dark reddish brown (5YR 4/2) clay films on ped faces; many films and threads and common fine and very fine soft masses of calcium carbonate (20-25%); few angular cobbles and lenses of angular pebbles; few fine and very fine roots; many fine and very fine pores; gradual smooth boundary.
151-165	2Btk2b	Yellowish red (5YR 4/6) loam, reddish brown (5YR 4/4) moist; moderate medium prismatic structure parting to moderate fine prismatic; hard, friable; common distinct continuous dark reddish brown (5YR 4/2) clay films on ped faces; many films and threads and common fine and very fine soft masses of calcium carbonate (20-25%); few angular cobbles and lenses of angular pebbles; few fine and very fine roots; many fine and very fine pores; gradual smooth boundary.
165-200	3BCkb	Residuum - Weathered Bergen Shale. Red (2.5YR 4/6) silt loam, reddish brown (2.5YR 4/4) moist; very weak fine subangular blocky structure parting to very weak very fine subangular blocky; hard, friable; many films and threads of calcium carbonate (10%); common fragments of Bergen Shale.

stratum consisting of alluvium interbedded with colluvium (figure 2.9). The surface soil (Soil 1) in the top stratum has a well-expressed A-BA-Bw-Bt-Btk-BCk profile (table 2.3). Carbonate morphology does not exceed stage I in the lower 23 cm of Soil 1, but CCE increases dramatically from about 3 percent at the top of the Bt horizon to 23 percent in the middle of Btk horizon, then declines to about 16 percent in the BCk horizon. Sand content is high (72 to 75 percent) in the upper 67 cm of Soil 1, but steadily decreases with depth to 19 percent as silt content increases to the bottom of the Btk horizon. Soil matrix colors are mostly brown (7.5YR 4/4, dry), reddish brown (5YR 4/4, dry), and yellowish red (5YR 4/6, dry). The colluvium consists mostly of sandy loam and loam with granules and angular pebbles (15-20 percent by volume) scattered through the fine-grained matrix.

The top of Soil 2 was recorded at a depth of 180 cm below the land surface and is marked by a distinct increase in organic carbon (C) content (see figure 2.14 and table 2.5 in the Stable Carbon Isotope section). Soil 2 is represented by an oxidized, well-expressed Btk horizon (2Btk1b + 2Btk2b + 2Btk3b) with stage II carbonate morphology; the A horizon was stripped off by erosion before the soil was buried. Soil matrix colors are reddish brown (5YR 4/4, dry) and yellowish red (5YR 4/6, dry). The proportion of sand, silt, and clay is fairly uniform with depth in Soil 2, but CCE fluctuates before declining to about 7 percent in the 2Btk3b horizon.

Soil organic matter from the upper 10 cm of the 2Btk1b horizon, upper 10 cm of the 2Btk2b horizon, and upper 10 cm of the 2Btk3b horizon yielded AMS radiocarbon ages of 7625±40, 8110±40, and 7954±70 ^{14}C yr B.P., respectively. Based on these ages, in the area of Unit 33, aggradation of the alluvium was underway before *ca*. 8000 ^{14}C yr B.P., and the former surface represented by Soil 2 was stable by at least *ca*. 8000 ^{14}C yr B.P. Soil 2 was buried by colluvium sometime after *ca*. 7625 ^{14}C yr B.P. Hence, in the area of excavation Unit 33, there is high potential for Early Archaic cultural deposits on and within Soil 2, and moderate potential for Late Paleoindian cultural deposits within and below Soil 2. In sum, Soil 2 represents a buried Late Paleoindian to Early Archaic landscape.

The radiocarbon ages described above raise a question: Is Soil 2 in the two excavation blocks the same soil (from a soil-stratigraphic perspective), even though the radiocarbon ages determined on SOM from Soil 2 in Unit 45 are significantly younger compared to the ages determined on SOM from Soil 2 in Unit 33? Based on morphological properties, Soil 2 in the two excavation units may be the same soil, and the difference in the radiocarbon ages can be explained as follows. Given that Soil 2 in Unit 33 is deeply truncated—the A and AB horizons were stripped off—the organic carbon that was dated came from deep within the Btk horizon of the soil. In a strongly developed soil, such as Soil 2, radiocarbon ages determined on soil organic matter from the B horizon typically are much older than ages determined

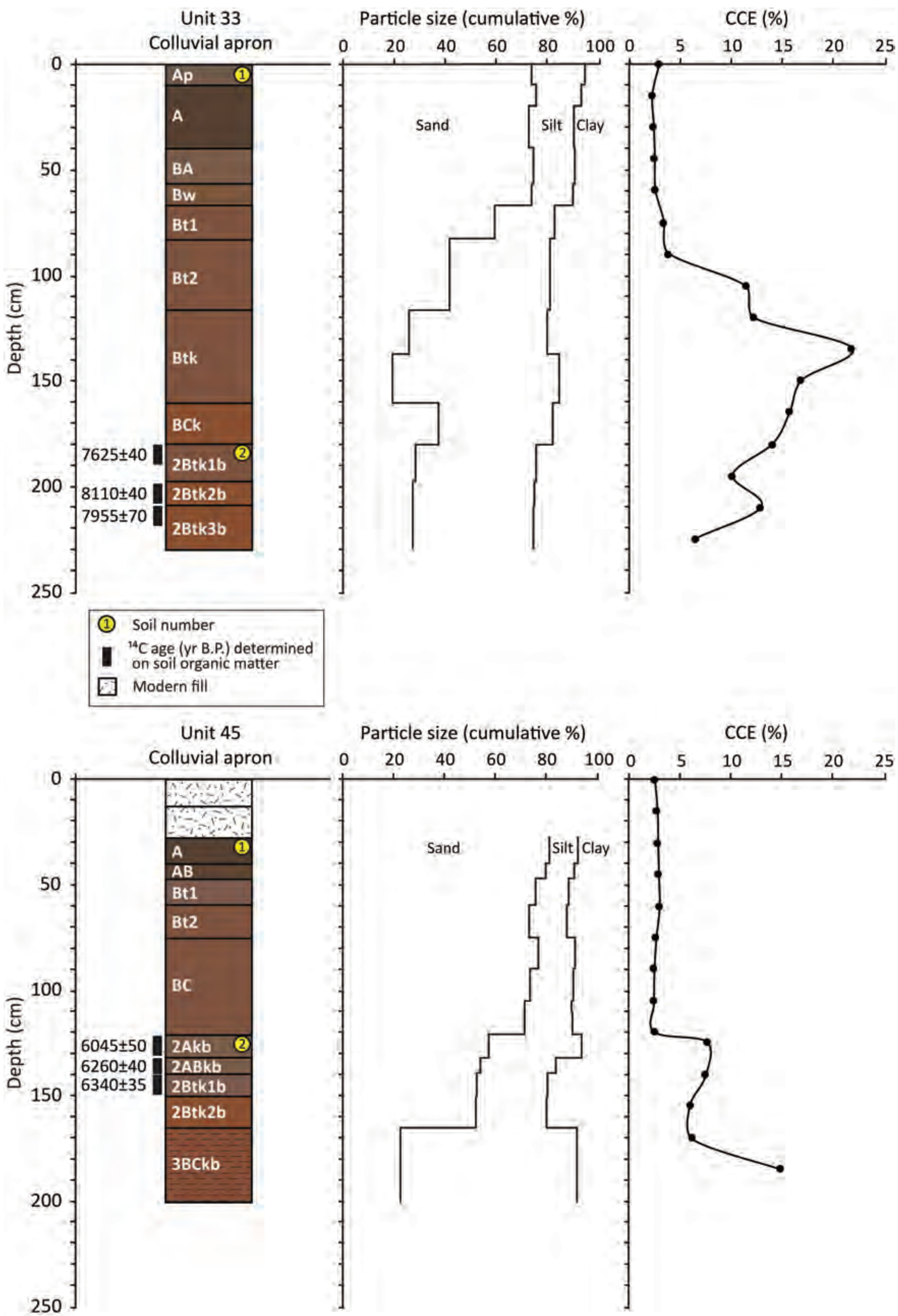

Figure 2.9. Diagrams showing the soil stratigraphy and horizonation, radiocarbon ages, particle-size distribution, and calcium carbonate equivalent (CCE) in archaeological test units 33 and 45.

Figure 2.10. Photograph of the west wall of Unit 33.

Figure 2.11. Photograph of the lower half of the west wall of Unit 33.

on soil organic matter from the A horizon (Holliday 2004:181-184). Hence, a comparison of radiocarbon ages determined on soil organic matter from Soil 2 in the two excavation units should reveal older ages in Unit 33 compared to Unit 45, which is what was recorded. However, the possibility that Soil 2 in Unit 33 is developed in an older fill compared to Soil 2 in Unit 45 cannot be completely ruled out.

No stone tools were recorded within or directly above Soil 2 in Units 33 and 45. However, there were 43 pieces of flaking debris within and directly above Soil 2 in Unit 45, including eight flakes that the analysts noted had a calcium carbonate coating., plus nine small bone fragments, including three small (size class G4) burned bone fragments. Soil 2 in Unit 33 contained only five flakes, with another 10 directly above it. Soil 2 also contained 25 bone fragments, including two burned specimens, and a portion of a left scapula from a *Odocoileus* sp. that is unburned and does not have any tool marks. There is also a metacarpal from a wood rat (*Neotoma* sp.) but it is unknown if this specimen is associated with cultural deposits or is intrusive.

T-1 Terrace

Valley fill beneath the T-1 terrace was examined in archaeological Units 15 and 16 in the southern area of the site (figure 2.6). A total of 2,181 liters of sediment were removed from Units 15 and 16. The west wall of Unit 15 was described (figure 2.12 and table 2.4), and soil samples were collected from the wall for grain-size analysis and determination of organic carbon content.

Unit 15 exposed the T-1 fill to a depth of 165 cm below the surface. The modern soil that developed in the fine-grained fill is characterized by a weakly expressed A-AB-Bw-BC-C profile (figure 2.13). The A horizon is 53 cm thick and consists of very dark grayish brown (10YR 3/2, dry) loamy sand. Because the A horizon is overthickened, it is defined as a cumulic soil. Cumulic soils receive influxes of parent material while pedogenesis is occurring, but the rate of sedimentation is so slow that soil development keeps up with deposition (Nikiforoff 1949; Birkeland 1999:165; Mandel 2008; Mandel and Bettis 2001). The Bw horizon is only 29 cm thick, consists of brown (7.5YR 4/2, dry) loamy sand, and has weak structure. Brown (7.5YR 4/2, dry) loamy sand comprising the BC horizon grades downward to massive brown

Table 2.3. Description of the west wall of Unit 33, Magic Mountain site.

Landform: Colluvial apron
Slope: 2-3%
Date Described: July 12, 2018
Described by: Rolfe D. Mandel
Remarks: Soil organic matter from the upper 10 cm of the 2Btk1b horizon, upper 10 cm of the 2Btk2b horizon, and upper 10 cm of the 2Btk3b horizon yielded AMS radiocarbon ages (uncalibrated) of 7625±40, 8110±40, and 7954±70 B.P., respectively.

Depth (cmbs)	Soil Horizon	Description
		Soil 1
		Colluvium
0-10	Ap	Brown (7.5YR 4/2) sandy loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; hard, friable; common (15-20%) granules and fine, angular pebbles scattered through the matrix; many worm casts and open worm and insect burrows; many fine and very fine roots; abrupt smooth boundary.
10-40	A	Dark brown (7.5YR 3/2) sandy loam, very dark brown (7.5YR 2.5/2) moist; hard, friable; common (15-20%) granules and fine, angular pebbles scattered through the matrix; many worm casts and open worm and insect burrows; many fine and very fine roots; gradual smooth boundary.
40-57	BA	Brown (7.5YR 4/3) sandy loam, dark brown (7.5YR 3/3) moist; weak fine subangular blocky structure; hard, friable; common (15-20%) granules and fine, angular pebbles scattered through the matrix; many worm casts and open worm and insect burrows; many fine and very fine roots; gradual smooth boundary.
57-67	Bw	Brown (7.5YR 4/4) sandy loam, dark brown (7.5YR 3/4) moist; weak fine subangular blocky structure; hard, friable; common (15-20%) granules and fine, angular pebbles scattered through the matrix; many worm casts and open worm and insect burrows; many fine and very fine roots; common fine and very fine pores; gradual smooth boundary.
67-83	Bt1	Reddish brown (5YR 4/4) sandy loam, dark reddish brown (5YR 3/4) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; hard, friable; common distinct, discontinuous brown (7.5YR 4/2) clay films on ped faces; common (15-20%) granules and fine angular pebbles scattered through the matrix; few worm casts and open worm and insect burrows; common fine and very fine roots; many fine and very fine pores; gradual smooth boundary.
83-117	Bt2	Reddish brown (5YR 4/4) to yellowish red (5YR 4/6) loam, dark reddish brown (5YR 3/4) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; hard, friable; common distinct, discontinuous brown (7.5YR 4/2) clay films on ped faces; common (15-20%) granules and fine, angular pebbles scattered through the matrix; few worm casts and open worm and insect burrows; few fine and very fine roots; many fine and very fine pores; gradual smooth boundary.
117-160	Btk	Reddish brown (5YR 4/4) to yellowish red (5YR 4/6) silt loam, dark reddish brown (5YR 3/4) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; hard, friable; common distinct, discontinuous brown (7.5YR 4/2) clay films on ped faces; common fine films and fine soft masses of calcium carbonate (5-6%); common (15-20%) granules and fine, angular pebbles scattered through the matrix; few worm casts and open worm and insect burrows; few fine and very fine roots; many fine and very fine pores; gradual smooth boundary.
160-180	BCk	Yellowish red (5YR 4/6) loam, reddish brown (5YR 4/4) moist; very weak fine and very fine subangular blocky structure; slightly hard, very friable; common fine films and fine soft masses of calcium carbonate (5-6%); common (15-20%) granules and many (20-25%) fine, angular pebbles scattered through the matrix; few fine and very fine roots; many fine and very fine pores; abrupt irregular boundary.

Table 2.3. Description of the west wall of Unit 33, Magic Mountain site (*continued*).

Depth (cmbs)	Soil Horizon	Description
		Soil 2
		Alluvium Interbedded with Colluvium
180-198	2Btk1b	Reddish brown (5YR 4/4) loam, dark reddish brown (7.5YR 3/4) moist; moderate medium prismatic structure parting to moderate fine prismatic; hard, friable; many distinct continuous dark reddish brown (5YR 4/2) clay films on ped faces; many films and threads and common fine and very fine soft masses of calcium carbonate (20-25%); few angular cobbles and lenses of angular pebbles; few fine and very fine roots; many fine and very fine pores; gradual smooth boundary.
198-210	2Btk2b	Yellowish red (5YR 4/6) loam, dark reddish brown (5YR 3/4) moist; moderate medium prismatic structure parting to moderate fine prismatic; hard, friable; many distinct continuous dark reddish brown (5YR 4/2) clay films on ped faces; many films and threads and common fine and very fine soft masses of calcium carbonate (20-25%); few angular cobbles and lenses of angular pebbles; few fine and very fine roots; many fine and very fine pores; gradual smooth boundary.
210-230	2Btk3b	Yellowish red (5YR 4/6) loam, dark reddish brown (5YR 3/4) moist; moderate medium prismatic structure parting to moderate fine prismatic; hard, friable; common distinct continuous dark reddish brown (5YR 4/2) clay films on ped faces; many films and threads and common fine and very fine soft masses of calcium carbonate (20-25%); few angular cobbles and lenses of angular pebbles; few fine and very fine roots; many fine and very fine pores.

Figure 2.12. Photograph of the west wall of Unit 15. The upper and lower radiocarbon ages were determined on charcoal and bison bone, respectively.

(7.5YR 5/2, dry) loamy sand comprising the C horizon. Siliceous granules and pebbles are common throughout the upper 135 cm of the T-1 fill, and channel lag deposits consisting of cobbles and small boulders were intercepted at a depth of 135 cm and comprise the 2C horizon. No buried soils were recorded in the T-1 fill.

Grain-size analysis revealed that the fine-grained alluvium comprising the T-1 fill is remarkably homogenous, with the sand content ranging from 77 to 80 percent (figure 2.13). The field texture of the alluvium suggests that the sand fraction is predominantly very fine sand. Also, unlike the soils developed in the colluvium and alluvium beneath the adjacent colluvial apron, the soil developed in the T-1 fill is not oxidized, but instead is melanized or darkened by decomposed organic matter. Organic carbon content is especially high in the cumulic A horizon, ranging from 1.68 to 0.87 percent, and remains high (0.65 to 0.57 percent) in the subsoil (figure 2.13). Based on its lithology, landscape position, and age (see below), the T-1 fill is equivalent to the Piney Creek alluvium identified by Smith and Scott (1966) at the Magic Mountain site.

A fragment of a bison tibia collected at a depth of 126 cm below the T-1 surface yielded a radiocarbon age of 3540±30 ^{14}Cyr B.P. Although the bone was

Table 2.4. Description of the west wall of Unit 15.

Landform: T-1 terrace
Slope: 1%
Date Described: July 13, 2018
Described by: Rolfe D. Mandel
Remarks: Bone collected at a depth of 126 cm yielded a radiocarbon age of 3540±30, and charcoal from a concentration of fire-cracked rocks (Feature 7) at a depth of 25-35 cm in adjacent test Unit 25 yielded a radiocarbon age of 1405±40 B.P.

Depth (cmbs)	Soil Horizon	Description
0-53	A	Very dark grayish brown (10YR 3/2) loamy sand, very dark brown (10YR 2/2) moist; moderate medium granular structure; hard, friable; many granules and fine pebbles scattered through the matrix; many worm casts and open worm and insect burrows; many fine and very fine roots; gradual smooth boundary.
53-63	AB	Dark grayish brown (10YR 4/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure parting to moderate medium and coarse granular; hard, friable; many granules and fine pebbles scattered through the matrix; many worm casts and open worm and insect burrows; many fine and very fine roots; gradual smooth boundary.
63-92	Bw	Brown (7.5YR 4/2) loamy sand, dark brown (7.5YR 3/2) moist; weak medium prismatic structure parting to weak fine subangular blocky; hard, friable; many granules and fine pebbles scattered through the matrix; many worm casts and open worm and insect burrows; many fine and very fine roots; gradual smooth boundary.
92-104	BC	Brown (7.5YR 4/2) loamy sand, dark brown (7.5YR 3/2) moist; very weak medium prismatic structure parting to very weak fine subangular blocky; slightly hard, very friable; many granules and fine pebbles scattered through the matrix; common worm casts and open worm and insect burrows; common fine and very fine roots; gradual smooth boundary.
104-135	C	Brown (7.5YR 5/2) loamy sand, brown (7.5YR 4/2) moist; massive; soft, very friable to loose; many granules and fine pebbles scattered through the matrix; few worm casts and open worm and insect burrows; common fine and very fine roots; abrupt irregular boundary.
135-165	2C	Cobbles and small boulders comprising channel lag; coarse micaceous sand between the large clasts; single grain; loose.

not associated with a distinct cultural component, a large amount of flaking debris was recorded in the level that yielded the bone. Also, charcoal from a large concentration of fire-cracked rocks (Feature 7) in Unit 25, located 6.5 m east of Unit 15, yielded a radiocarbon age of 1405±40 ^{14}C yr B.P. Based on these ages, nearly all of the fine-grained alluvium comprising the T-1 fill at the Magic Mountain site aggraded between *ca*. 3,700 and 1,400 years ago.

Stable Carbon Isotopes

Stable carbon isotope analysis of organic carbon in soils has been successfully used in many paleoenvironmental studies (see summaries in Murphy and Mandel [2012] and Nordt [2001]). To understand the theory behind this analytical technique, the ecology of C_3 and C_4 plants must be considered. During photosynthesis, C_4 plants discriminate less against $^{13}CO^2$ than C_3 plants (O'Leary 1981; Vogel 1980). This difference in carbon isotope fractionation results in a characteristic carbon isotope ratio in plant tissue that serves as an indicator for the occurrence of C_3 and C_4 photosynthesis (Nordt 1993:52). The $\delta^{13}C$ values, or the difference between the $^{13}C/^{12}C$ ratio and a known standard, are expressed in parts per thousand (‰). Cerling and others (1997) demonstrated that the $\delta^{13}C$ value of C_3 plant species range from -30 to -22‰, with a mean of -27‰, whereas the $\delta^{13}C$ values of C_4 plant species range from -14 to -10‰, with a mean of -12.5‰. Values between -22‰ and -14‰ represent a mixed plant community consisting of both C_3 and C_4 grasses (Cerling *et al.* 1997). Thus, C_3 and C_4 plant species

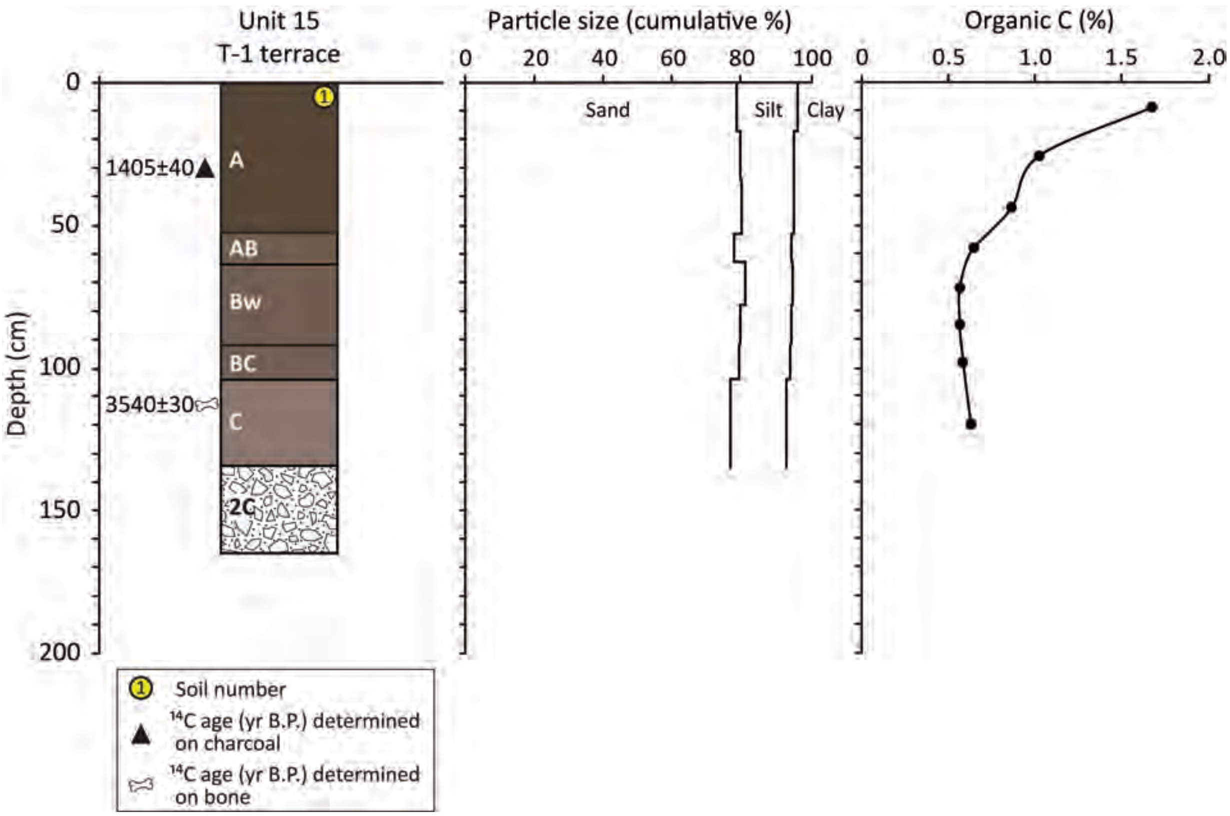

Figure 2.13. Diagram showing the soil horizonation, radiocarbon ages, and particle-size distribution in Unit 15.

have distinct, non-overlapping $\delta^{13}C$ values and differ from each other by approximately 8‰.

Nearly all trees, shrubs, forbs, and cool-season grasses are C_3 species. Hence, forests and most other temperate plant communities are dominated by C_3 species. Plants with the C_4 photosynthetic pathway are common in warm, semiarid environments with high light intensity, such as grasslands, savannas, deserts, and salt marshes. Studies have shown that the proportions of C_4 species and C_4 biomass in a given plant community are strongly related to temperature (Boutton *et al.* 1980; Terri and Stowe 1976; Tieszen *et al.* 1979). These relationships are invaluable in paleoecological studies when the relative proportions of C_3 and C_4 species can be reconstructed (Nordt *et al.* 1994).

There is little change in the carbon isotope composition of plant litter as it decomposes and is incorporated into the soil organic matter (Melillo *et al.* 1989; Nadelhoffer and Fry 1988). Consequently, the isotope composition of soil organic matter reflects the dominant species (C_3 vs. C_4) in the plant community that contributed the organic matter. The stable carbon isotope composition of soil organic matter in surface and buried soils may, therefore, be used to infer vegetation change (Nordt *et al.* 1994). Going one step further, the stable carbon isotope values can also be used to reconstruct climate.

At the Magic Mountain site, soils samples were collected mostly at 5 cm intervals in the profiles of test Units 33 and 45. The $\delta^{13}C$ values and organic carbon contents of the samples were determined on those samples.

The $\delta^{13}C$ values determined on organic carbon from the soils exposed in Unit 33 range from -25.7 to -21.0‰ (figure 2.14 and table 2.5). Hence, the difference between the maximum and minimum $\delta^{13}C$ value is 4.7‰. The most negative value (-25.7‰) occurs in the upper 5 cm of the surface soil (Soil 1), and the least negative value (-21.0‰) occurs in the Btk horizon of Soil 1.

Identifying the point at which changes in the $\delta^{13}C$ values reflect actual changes in vegetation composition (C_3 vs. C_4) is difficult (Cyr *et al.* 2011). According to Krull and Skjemstad (2003), changes between 1 and 3‰ are related to inherent soil processes, whereas

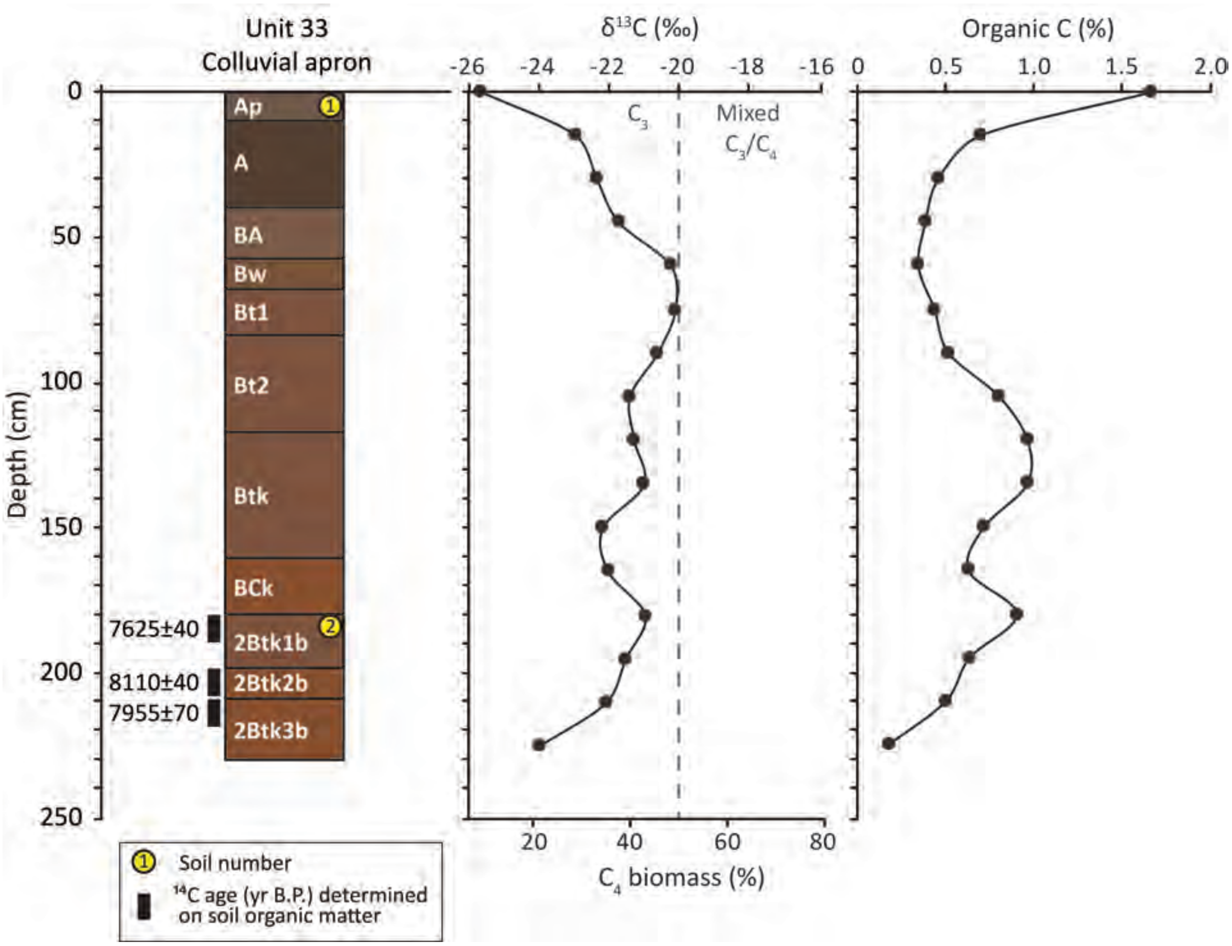

Figure 2.14. Stable carbon isotope and organic carbon (C) data for Unit 33.

differences exceeding 3‰ result from changes in the contribution of C_3 and C_4 vegetation. Ehleringer *et al.* (2000), however, noted that changes as slight as 1‰ may be caused by environmental stress. A 1 to 3‰ shift in the $\delta^{13}C$ values may reflect increased fractionation against ^{12}C by C_3 plants due to changes in respiration rates during drought, but may also represent small increases in C_4 plants within a C_3-dominated community.

The most distinct $\delta^{13}C$ shift in Unit 33 occurs at the boundary between Soils 1 and 2 (figure 2.14). Going from the bottom of Soil 2 upward, the $\delta^{13}C$ values steadily become less negative, ranging from -24.0‰ in the lower 5 cm of the 2Btk3b horizon to -21.0‰ in the upper 5 cm of the 2Btk1b horizon. This represents a 3‰ shift between *ca*. 8000 ^{14}C yr B.P. and 7600 ^{14}C yr B.P. and indicates an increase in organic matter contributed by C_4 grasses (from 21 to 43 percent) and presumably an increase in summer temperatures for that period. Immediately above the boundary between Soils 2 and 1, there is a slight negative shift to -22.0‰, indicating a slight increase in organic matter contributed by C_3 plants. $\delta^{13}C$ values increase from -22.0‰ upward through Soil 1 to a peak of -20.0‰ at the top of the Bw horizon, representing an increase in C_4 biomass from 35 to 49 percent (figure 2.14). The next major shift in $\delta^{13}C$ values occurs in the BA horizon of Soil 1, with a strong trend towards increasingly negative $\delta^{13}C$ values that continues upward to the modern land surface. Clearly, that shift points to an increase in the contribution of organic matter by C_3 plants (C_4 biomass decreased from 49 to 10 percent) as the upper 50 cm of the colluvium aggraded.

In general, the stable carbon isotope record in Unit 45 is similar to the record in Unit 33 (figure 2.15). It is important to note, however, that whereas Soil 2 lacks an A horizon in Unit 33 because of erosion before burial, the A horizon of Soil 2 appears to be largely intact in Unit 45. Hence, there is a more complete

Table 2.5. Stable carbon isotope and organic carbon data for Excavation Units 33 and 45.

Unit	Soil Horizon	Depth (cm)	$\delta^{13}C$ (‰)	Organic C%
33	Ap	0-5	-25.7	1.67
	A	15-20	-23.0	0.70
	A	30-35	-22.4	0.46
	BA	45-50	-21.7	0.39
	Bw	60-65	-20.2	0.35
	Bt1	75-80	-20.1	0.44
	Bt2	90-95	-20.6	0.52
	Bt2	105-110	-21.4	0.81
	Btk	120-125	-21.3	0.97
	Btk	135-140	-21.0	0.97
	Btk	150-155	-22.2	0.72
	BCk	165-170	-22.0	0.64
	2Btk1b	180-185	-21.0	0.91
	2Btk1b	195-200	-21.5	0.64
	2Btk2b	210-215	-22.1	0.51
	2Btk3b	225	-24.0	0.19
45	Spoil	0-5	-20.6	0.73
	Spoil	15-20	-18.4	0.59
	A	30-35	-18.0	0.53
	AB/Bt1	45-50	-18.4	0.44
	Bt2	60-65	-18.5	0.54
	BC	75-80	-19.5	0.47
	BC	90-95	-19.0	0.54
	BC	105-110	-18.5	0.52
	BC	120-121	-18.6	0.54
	2Akb	125-130	-20.1	0.87
	2Btk1b	140-145	-21.1	0.65
	2Btk2b	155-160	-21.4	0.30
	3BCkb	170-175	-21.3	0.32
	3BCkb	185-190	-22.0	0.26

$\delta^{13}C$ record for Soil 2 in Unit 45 compared to Unit 33. In Unit 45, going from the bottom of Soil 2 upward, the $\delta^{13}C$ values steadily become less negative, ranging from -22.0‰ near the bottom of the 3BCkb horizon to -18.7‰ in the lower 2 cm of the BC horizon of Soil 1. This represents a 3.3‰ shift that began before *ca*. 6350 ^{14}C yr B.P. and continued until soon after *ca*. 6000 ^{14}C yr B.P. Such a shift indicates an increase in contributions of organic matter by C_4 grasses (from 35 to 60 percent), and presumably a warming trend, similar to the trend inferred from $\delta^{13}C$ values for Soil 2 in Unit 33. Although there is a slight shift towards a less negative $\delta^{13}C$ value (-18.6‰) in the lower 5 cm of the BC horizon of Soil 1, the $\delta^{13}C$ values determined on samples from Soil 1 remain fairly consistent, mostly ranging from -19.0‰ to -18.0‰ (60 to 64 percent C_4 biomass) (figure 2.15 and table 2.3).

In sum, assuming that an approximately 3‰ change in the $\delta^{13}C$ values reflects actual changes in the vegetation community, the stable carbon isotope record at the Magic Mountain site indicates that C_4 grasses became an increasingly more significant component of the plant community (up to 49 percent C_4 biomass) from *ca*. 8000 to 6000 ^{14}C yr B.P. This pattern suggests that summer temperatures increased, probably representing the Altithermal, during that period, and peaked around 6000 ^{14}C yr B.P. In Unit 33, the $\delta^{13}C$ values indicate a mixed C_3/C_4 plant community during most of the time that the colluvial apron aggraded above Soil 2, though the amount of organic matter contributed by C_3 plants increased as the upper 50 cm of the colluvium aggraded. In Unit 45, the $\delta^{13}C$ values also indicate a mixed C_3/C_4 plant community (up to 64 percent C_4 biomass) during the time that the colluvial apron aggraded above Soil 2, but there is no shift towards greater contributions of organic matter by C_3 plants in the upper 50 cm of the colluvium. Discrepancies in the $\delta^{13}C$ records for the upper 50 cm of Soil 1 in Units 33 and 45 may be attributed to the local spatial pattern of C_3 and C_4 plants on the landscape. In a mixed plant community characterized by a mosaic of grasses and trees, it is not unusual to have variations in $\delta^{13}C$ values over short distances. Ongoing phytolith analysis, combined with $\delta^{13}C$ analysis of soil organic matter in cores collected across the site, should help better define bioclimatic changes at the Magic Mountain site for the period of record.

Summary and Conclusions

The landscape at the Magic Mountain site consists of a complex mosaic of alluvial and colluvial landform sediment assemblages. Specifically, most of the site is associated with a colluvial apron on the north side Apex Gulch. Coring and archaeological testing revealed that the upper 1 to 2 m of the apron consists of poorly sorted sediment typical of colluvium. Surface soils with reddish matrix colors and well-expressed A-AB-Bt-BC or A-AB-Bw-Bt-Btk-BCk profiles are developed in the colluvium. The colluvium mantles fine-grained alluvium interbedded with colluvium. The alluvial unit is 2 to 3 m thick and mantles weathered Bergen Shale. In the area of test Unit 45, a buried paleosol with an Ak-ABk-Btk-BCk is developed in the alluvium. However, in the area of test Unit 33, a buried paleosol that formed in the

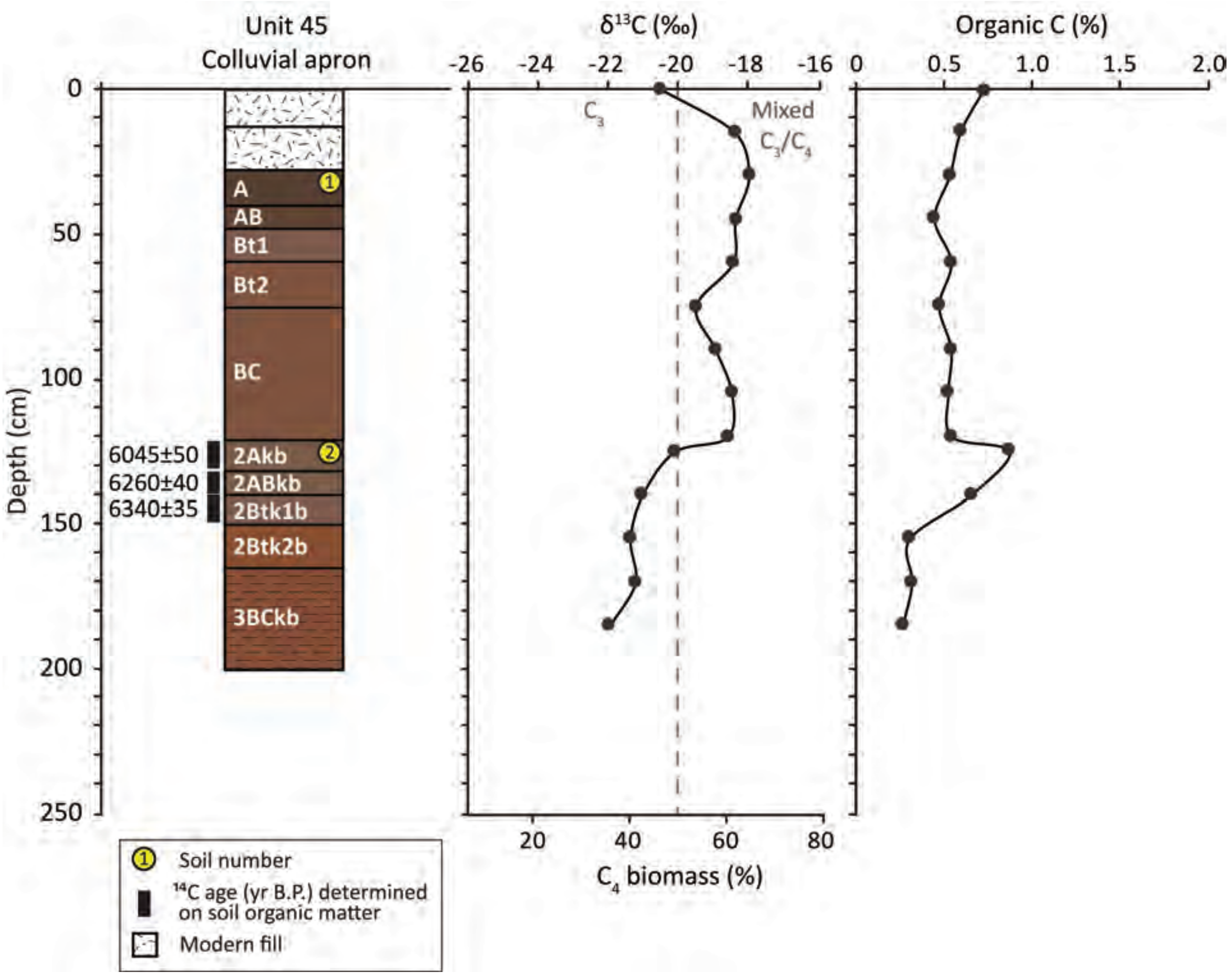

Figure 2.15. Stable carbon isotope and organic carbon (C) data for Unit 45.

alluvium is deeply truncated and only represented by Btk horizons. Matrix colors of the paleosol observed in both units are mostly reddish brown (5YR 4/4, dry) and yellowish red (5YR 4/6, dry).

The geoarchaeological investigationdetermined that colluviation and alluviation were the dominant site formation processes at Magic Mountain, and that both processes generally favored the preservation of the cultural deposits. Although limited exposure and sampling of Archaic cultural deposits at Magic Mountain precludes a thorough understanding of the processes that created and affected that portion of the archaeological record, the geoarchaeological investigation and archaeological testing revealed that gradual accumulation of sediment on the footslope and toeslope of the colluvial apron during the late Holocene resulted in burial of Early Ceramic features and artifacts that comprise most of the archaeological record at the site. On the low, gently sloping toeslope of the colluvial apron, the Early Ceramic cultural deposits are buried in or beneath the thick, cumulic A horizon of the surface soil (See Figure 3.38 in Chapter 3). On the higher and steeper footslope of the colluvial apron, the cultural deposits are at shallower depths compared to those beneath the toeslope and typically are within the lower portion of the comparatively thin A horizon and the upper portions of the BA, Bw, or Bt horizons of the surface soil. In Area 5, which is on highest and steepest portion of the footslope, the A horizon has been completely stripped off by erosion. Regardless of the landscape position, once the cultural deposits were buried, most stayed in place, though bioturbation affected the vertical and horizontal integrity of some artifacts and charcoal. Also, a few Early Ceramic cultural features were affected by surface erosion, indicating that sedimentation was interrupted by periods of minor erosion.

Based on a suite of radiocarbon ages determined on SOM from the buried paleosols, the alluvium beneath the colluvial apron aggraded during the early Holocene and perhaps as early as the terminal Pleistocene. The landscape was relatively stable between *ca*. 8000 and 6000 ^{14}C yr B.P., allowing soils with stages I+ to II carbonate morphology to develop in the alluvium. Secondary carbonate accumulation in those soils may indicate relatively dry climatic conditions during the period of pedogenesis (see Tanner 2010). Landscape instability and concomitant erosion soon after 6000 ^{14}C yr B.P. triggered colluvial processes on steep slopes, resulting in burial of the early Holocene alluvium beneath the colluvial apron. Also, it is likely that this episode of mid-Holocene erosion accounts for the truncation of the paleosol in Unit 33. Colluvial processes continued into the late Holocene, but slowed by *ca*. 2,000 years ago, resulting in shallow burial of Early Ceramic cultural deposits (chapter 3).

Apex Gulch experienced downcutting sometime between *ca*. 6000 and 3500 ^{14}C yr B.P., but aggradation of the T-1 fill was underway soon before 3500 ^{14}C yr B.P. Aggradation continued until about 1400 ^{14}C yr B.P., but at a very slow rate, resulting in the formation of an overthickened cumulic A horizon. However, soon after 1400 ^{14}C yr B.P., aggradation paused on the former late Holocene floodplain (now the T-1 terrace), allowing a soil with a weakly expressed A-AB-Bw-BC-C profile to develop in the fine-grained alluvium. Downcutting after ca. 1400 ^{14}C yr B.P. transformed the late Holocene floodplain into a terrace (T-1). Sometime after that period of incision, coarse-grained alluvium mostly consisting of cobbles and small boulders accumulated on the modern floodplain (T-0) of Apex Gulch. That accumulation may in part be due to the mechanical channelization of Apex Gulch during the late 1950s.

The stable carbon isotope record at the Magic Mountain site indicates that C_4 grasses became an increasingly more significant component of the plant community (up to 49 percent C_4 biomass) from *ca*. 8000 to 6000 ^{14}C yr B.P. This pattern suggests that summer temperatures increased, probably representing the Altithermal, during that period, and peaked around 6000 ^{14}C yr B.P. After reaching that peak, summer temperatures remained relatively warm through the late Holocene. However, δ^{13}C values determined on organic carbon from the upper 50 cm of Soil 1 in Unit 33 suggest a cooling trend during the past 2000 years, though local spatial variability in vegetation (trees and C_3 grasses vs. C_4 grasses) cannot be ruled out.

From an archaeological perspective, the results of the geoarchaeological investigation indicate that there is high potential for buried Early and Middle Archaic cultural deposits beneath the surface of the colluvial apron in the portion of the Magic Mountain site investigated during 2017 and 2018 by DMNS/PCRG/KU crews. Those cultural materials are likely to be associated with the buried paleosol (Soil 2) developed in alluvium beneath the colluvial apron. Also, based on the radiocarbon ages determine on SOM from Soil 2 in Unit 33, Paleoindian cultural deposits may occur deeper in Soil 2 or below that paleosol.

Based on a radiocarbon age of *ca*. 3500 ^{14}C yr B.P. determined on bone near the bottom of the T-1 fill, only Late Archaic and younger cultural deposits will occur in situ beneath the T-1 terrace. The development of an overthickened A horizon in the upper 50 cm of the T-1 fill favors the occurrence of stratified cultural deposits (see Mandel and Bettis 2001).

In sum, the geoarchaeological investigation identified temporal and spatial patterns of erosion, alluviation, and colluviation that may have produced differential preservation and visibility of past human activity at the Magic Mountain site. Recognizing those patterns facilitates distinguishing the effects of geomorphic processes from those of human choices in the archaeological record. Also, because the temporal and spatial patterns of the landform sediment assemblages determine the spatial and temporal patterns of the archaeological record at the site, the success of strategies for future archaeological sampling depends in large part on the level of understanding of those patterns and application of subsurface discovery methods that are adjusted to them.

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3

Fieldwork Results, Feature Analysis, and Analytic Units

Mark D. Mitchell

Geophysical, archaeological, and geoarchaeological fieldwork at Magic Mountain occurred over the course of three field seasons. Initial geophysical surveys were conducted during 2016 and supplementary geophysical data were collected in 2017 and 2018. The excavation program began in 2017 and continued into 2018. Geoarchaeological description and sampling occurred in conjunction with the two-year excavation program. Additional geoarchaeological sampling took place during the fall of 2017. Results of the geoarchaeological investigation are reported in chapter 2; this chapter describes the results of the archaeological investigation, along with selected results of the geophysical surveys.

Denver Museum of Nature & Science (DMNS) Curator of Archaeology Michele Koons and Paleocultural Research Group (PCRG) Research Director Mark Mitchell jointly supervised the archaeological field investigation. During 2017, they were assisted by PCRG crew chiefs Jen Deats, Amy Nelson, and Britni Rockwell. Additional field supervision during the 2017 field season was provided by Chris Johnston (then Colorado Assistant State Archaeologist). Graduate student field assistants during 2017 included Brianna Dalessandro, Ryan Baker, and Kristen Hall from the University of Denver, and Meghan Dudley from the University of Oklahoma.

During the 2018 field season, Mitchell and Koons were again assisted by Chris Johnston (PCRG Project Archaeologist) and PCRG crew chiefs Amy Nelson and Britni Rockwell. Additional assistance was provided by DMNS Research Assistant Erin Baxter and PCRG Crew Chief Talle Hogrefe. The

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DMNS/PCRG project team was joined during 2018 by a field crew from the University of Kansas's Odyssey Archaeological Research Program (KU-Odyssey), which included Josh Collins, Frank Conrad, Paige Englert, and Laura Krische.

Rolfe Mandel (Kansas Geological Survey and University of Kansas) carried out the geoarchaeological investigation during 2017 and 2018. Ken Kvamme (University of Arkansas) conducted magnetic gradiometry surveys during 2016 and 2018, and Larry Conyers (University of Denver) conducted ground-penetrating radar surveys during 2016.

Forty-seven people participated in the fieldwork during 2017. During the 2018 field season, 87 people participated in the work. Together, participants devoted 9,529 person-hours (1,191 person-days) to the field effort. Appendix A provides a list of all participants in the fieldwork.

Field Methods

Horizontal and vertical controls for the fieldwork were provided by a local northing and easting grid system oriented to true north, which was 8° 15' west of magnetic north when the grid was established in 2016. Six permanent datums were established (table 3.1; figure 3.1). Each of the three master datums (D1, D2, and D5) consists of a 3-in aluminum cap set on a 2-ft steel rod embedded in an approximately 30 x 30 x 10-cm block of poured concrete. The three backsight datums (D3, D4, and D6) each consists of a 1.5-in aluminum cap set on a 2-ft steel rod. The height of the backsight datums above the modern ground surface varies from about 5 to 15 cm. The master datum (D1) was assigned an arbitrary position of 600.000NE300.00, Z100.000. A tripod-mounted Brunton Pocket Transit was used to measure the azimuth from D1 to D3, the primary backsight, which was 315.0° true. A CST/Berger CST-205 total station was then used to measure the locations of the remaining datums. The local grid coordinates presented in table 3.1 represent mean values of at least three total station measurements. A mapping-grade GPS receiver was used to determine the UTM (NAD83) location of each datum.

Excavation unit corners were set by a combination of total station stake-out and local triangulation. As the fieldwork progressed, excavation squares were added by triangulation, using points initially established with the total station. Vertical control within each small block of contiguous squares was provided by one or more local datums (subdatums) consisting of temporary wooden stakes placed in strategic locations adjacent to the excavation units. The total station was used to measure local datum elevations relative to the master datum. Each subdatum was assigned a unique alphabetical designation. All excavation depths were measured from strings tied to the subdatum stakes. Excavation depths measured from local datum stakes in this manner were recorded as datum depths (DD). Subdatum depths as well as site grid elevations are reported in this chapter. Table 3.2 lists subdatum elevations along with the excavation squares associated with each subdatum.

An on-site, provenience- and recovery-method-based field catalog was maintained during the project. Catalog numbers were assigned to each arbitrary general and feature level when excavation began, and all objects recovered during screening of that level were grouped under that number. Individual catalog numbers also were assigned to each piece-plotted artifact or specimen, to each constant-volume waterscreen sample, and to each bulk feature fill sample. Recovery methods are discussed later in the "Excavation Methods" section.

Excavation Unit and Area Designations

Table 3.1 Local grid and UTM locations of six permanent site datums.

	Local Grid (m)			UTM (NAD83; Zone 13N)		
Datum Number	Northing	Easting	Elevation	Northing	Easting	Ellipsoid Height
1 (Master)	600.000	300.000	100.000	4396370.967±0.263	481961.308±0.385	1868.675±0.387
2 (West)	589.272	245.172	106.918	4396361.613±0.367	481906.665±0.427	1876.273±0.529
3 (D1 Backsight)	626.551	273.451	106.059	4396397.578±0.210	481935.499±0.294	1874.967±0.300
4 (D2 Backsight)	610.810	247.306	111.192	4396382.555±0.267	481908.601±0.319	1880.911±0.391
5 (East)	636.923	345.574	93.909	4396406.302±0.206	482007.521±0.320	1863.287±0.292
6 (D5 Backsight)	640.945	368.639	91.599	4396410.599±0.311	482031.730±0.445	1859.927±0.451

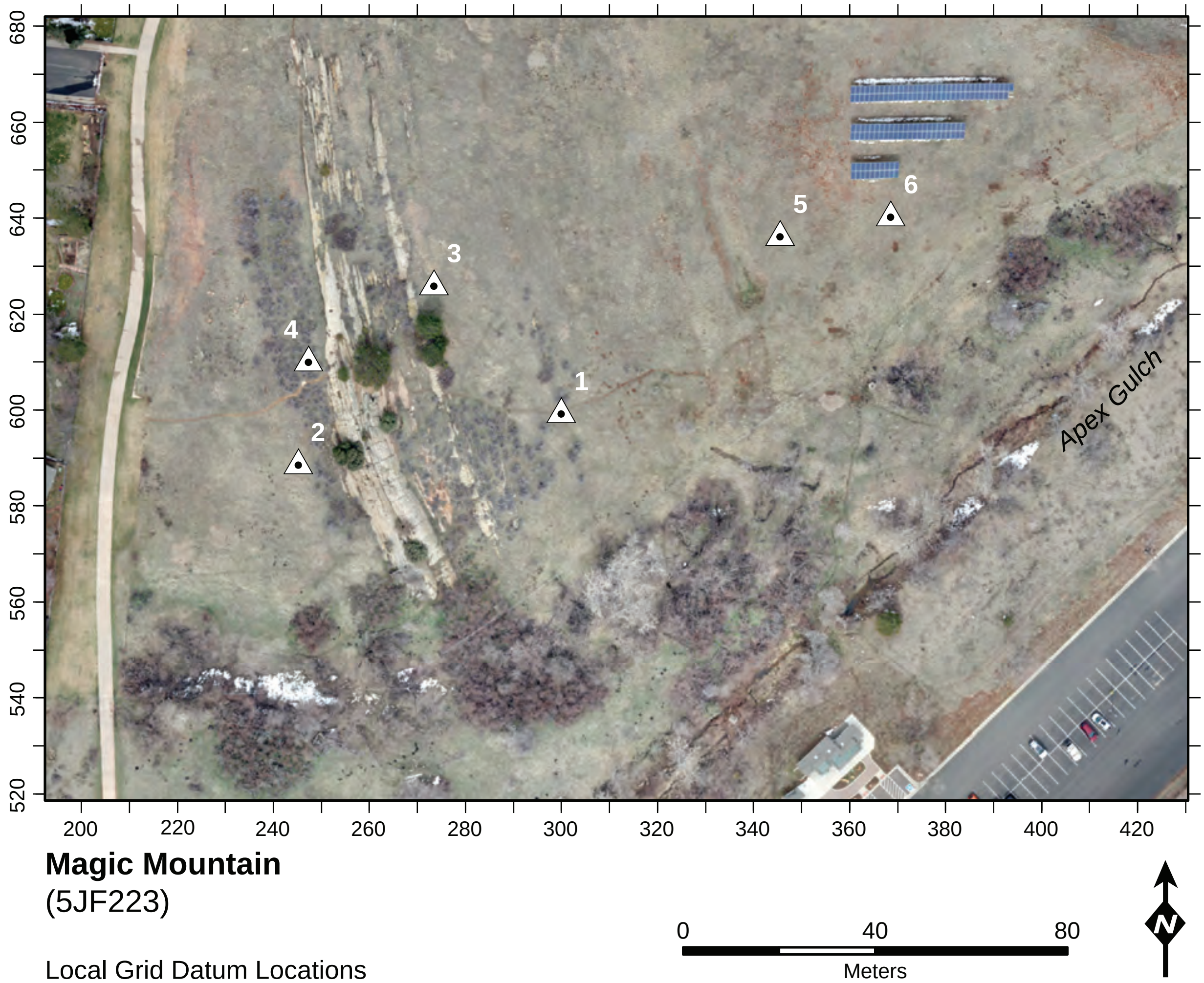


Figure 3.1. Air photo mosaic showing the locations of six permanent site datums.

Each 1 x 1-m excavation square was assigned a unique numerical designation. Numbers were assigned sequentially as units were opened. The first units opened during the 2017 field season were laid out in 1 x 2-m pairs; however, individual 1 x 1-m units mostly were excavated separately. During 2018, additional paired units were established and 1 x 1-m squares were added to the 2017 excavation blocks.

The site was partitioned into seven field areas to facilitate assignment of catalog numbers. Separate blocks of catalog numbers were designated for each of the seven areas, with numbers from 1000 to 1999 designated for Area 1, numbers from 2000 to 2999 designated for Area 2, and so forth. Figure 3.2 illustrates the locations of the seven field investigation areas defined before excavation began in 2017. The distributions of geophysical anomalies identified during the initial 2016 magnetic and ground-penetrating radar (GPR) surveys were used to define the boundaries of the field areas.

Several area boundaries were adjusted slightly for the 2018 field season (figure 3.3). However, catalog numbers assigned to levels, plots, and samples from each excavation square or 1 x 2-m blocks were drawn from just one number block. For example, all of the catalog numbers assigned to proveniences in Unit 38 were drawn from the 3000s block.

During 2017, excavation occurred in Field Areas 3, 4, 5, 6, and 7. During the 2018 season, excavation occurred in Field Areas 2, 3, 4, and 7. No excavation units were opened in Field Area 1.

In addition to the boundaries of the 2018 field areas, figure 3.3 also illustrates the boundaries of the numbered areas discussed in this report. The field areas and report areas are largely congruent. However, to facilitate the presentation of results, data

Table 3.2. Elevation and other data on excavation unit subdatums.

Excavation Year	Subdatum	Elevation (m)	Associated Excavation Units
2017	A	93.45	1, 2
	B	93.50	3, 4, 18
	C	91.95	5, 6, 19
	D	91.35	7, 8, 17
	E	90.80	9, 10
	F	89.60	11, 12
	G	88.70	13, 14, 28
	H	90.85	15, 16
	I	93.30	20
	J	91.90	21
	K	91.55	22, 23
	L	90.20	24, 25
	M	91.95	26, 27
2018	R	91.05	29, 30
	S	91.25	31, 32
	T	91.45	33, 34
	U	91.90	35, 36, 37, 38
	V	91.05	41, 42, 43, 55
	W	91.20	43, 44, 51
	X	93.40	4, 45, 46
	Y	98.65	47, 48, 54
	Z	98.20	49, 50
	AA	91.40	52, 53
	BB	99.05	56
	CC	91.30	57, 58
	DD	91.70	59, 60
	EE	92.35	61

from several excavation units originally assigned to Field Areas 3 and 7 are presented in the Area 4 section of the report.

Excavation Methods

Excavation levels varied in thickness. The target depth of the first general level in each unit was determined by the slope of the modern surface within the unit and the relationship between the subdatum elevation and the elevation of the surface. After the first level, most units were excavated in arbitrary 10-cm-thick levels. In some cases, a decision was made to excavate arbitrary levels of 5- or 20-cm in thickness depending on the stratigraphy observed in individual units. Excavation levels were classified either as general levels (GL), which includes all materials recovered from an excavation level within an excavation unit, or as feature levels (FL), which only includes materials from a defined cultural feature.

Sediment processing methods depended on sample type and archaeological context. General level samples were screened in the field through ¼-in hardware cloth. Artifacts, animal bones, and other materials were picked from the screen by hand and bagged by catalog number. Feature level samples also were screened and picked in the field, but through ⅛-in mesh rather than ¼-in mesh hardware cloth. Bulk samples, which were floated in the lab, were also collected from most of the excavated features.

Constant volume samples were taken from every general level in each unit, apart from the first. Fifteen percent by volume of the sampled levels was segregated during excavation and waterscreened in the field through 1/16-in mesh hardware cloth. To measure sample volume, lines were scribed on 5-gal sediment transport buckets at a depth equivalent to 15 liters of unconsolidated sediment. The entire screen content of each waterscreen sample was retained for later processing in the lab; waterscreen samples were not sorted or picked in the field.

Small amounts of burned rock were picked from dryscreened samples in the field and retained in the collection. However, most burned rock from general levels was counted and weighed in the field and returned to the excavation units before they were backfilled. All excavated stones were carefully examined by a crew chief to segregate burned from unburned specimens. All burned and unburned specimens also were inspected for modification by pecking, pounding, or grinding. Modified pieces were retained in the collection.

Excavation was primarily carried out with trowels and other small hand tools. During the 2018 field season, water was pumped into some units and allowed to infiltrate over night to increase the speed and ease of hand excavation during the following day. Excavation data were recorded on level forms designed for the project. In addition to basic provenience data, the forms include spaces for excavators to write short narratives describing the sediment and artifacts observed and to discuss problems or unusual situations encountered during the excavation of each GL or FL. Excavators drew plan maps of the base of each GL or FL and digital photographs were taken of the work in progress as well as of the bases of representative levels. All features were photographed during the course of the excavation and when excavation was complete. At least one profile was drawn and photographed

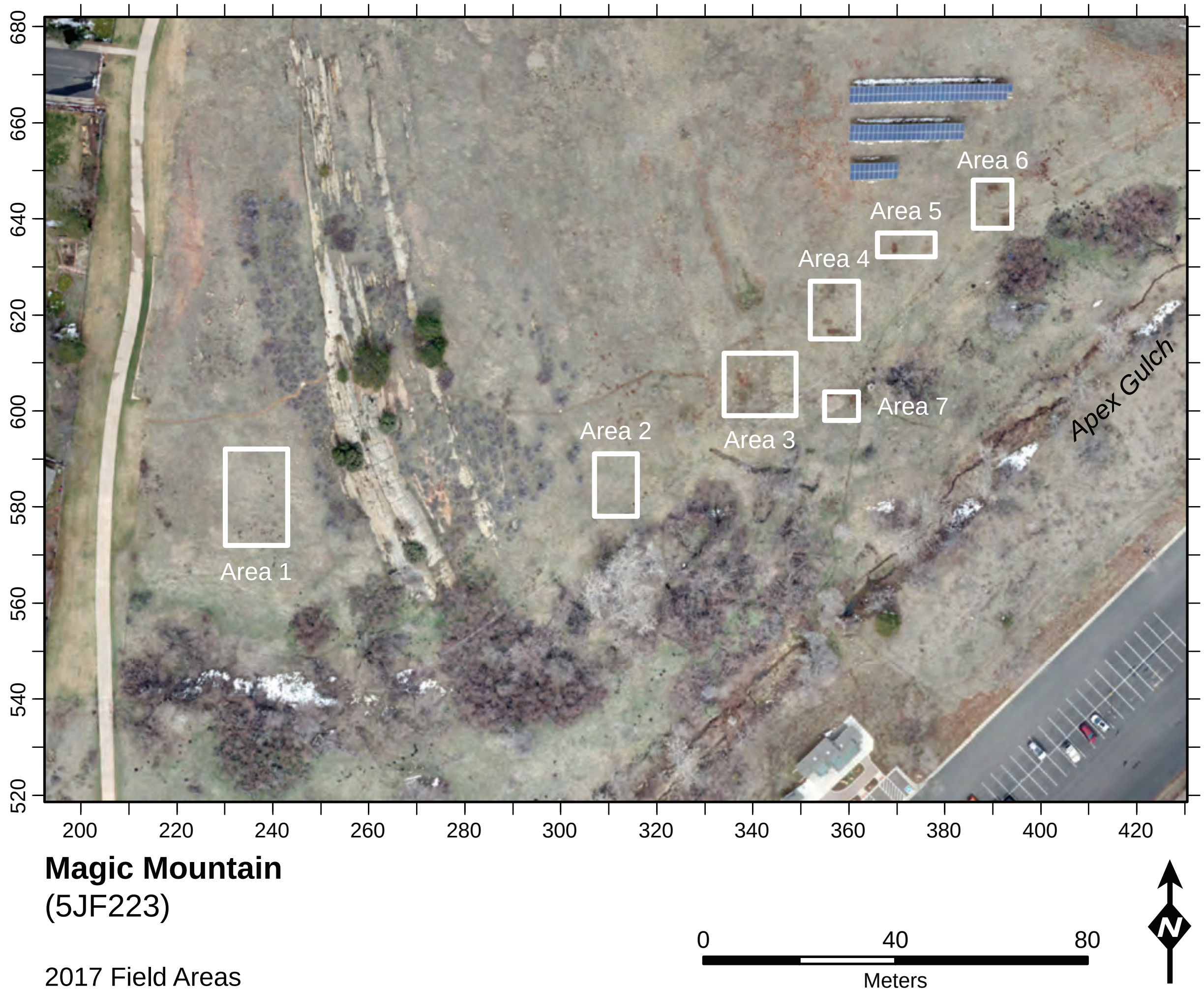


Figure 3.2. Air photo mosaic showing the locations of seven excavation areas defined prior to the 2017 field season.

for each excavation unit. All excavation units were backfilled at the end of each field season.

Excavation Unit Selection

Excavation unit placement was determined primarily by the results of multiple magnetic gradiometry surveys. An initial magnetic survey was conducted in 2016, during which three non-contiguous areas amounting to 0.37 ha (0.91 acres) were surveyed (Kvamme 2016). The largest of the three areas encompassed the portion of the site where most of the 2017 and 2018 excavation work took place (figure 3.4). A second magnetic survey was carried out in 2018. That survey produced high-resolution (25-cm transect) data on two blocks that together encompassed 800 m^2 (0.08 hectares or 0.2 acres). Figure 3.5 compares the 2016 and 2018 magnetic datasets for Area 2 and illustrates the greater precision—and superior interpretability—of the 25-cm data collected in 2018. Kvamme (2016) and Kvamme (2006) provide additional discussion on the methods used to generate the magnetic datasets.

GPR data were used to determine excavation unit locations in Area 3 (Dalessandro and Conyers 2017; see also Conyers 2018). Colorado School of Mines graduate students also carried out multiple geophysical surveys; however, data obtained during those surveys were not used in the design of the archaeological field investigation (Hansen *et al.* 2018).

The placement of excavation units also was based on data from eight deep sediment cores collected during 2017. A trailer-mounted soil sampler was first used to obtain three 3-in cores in Area 3. Subsequently,

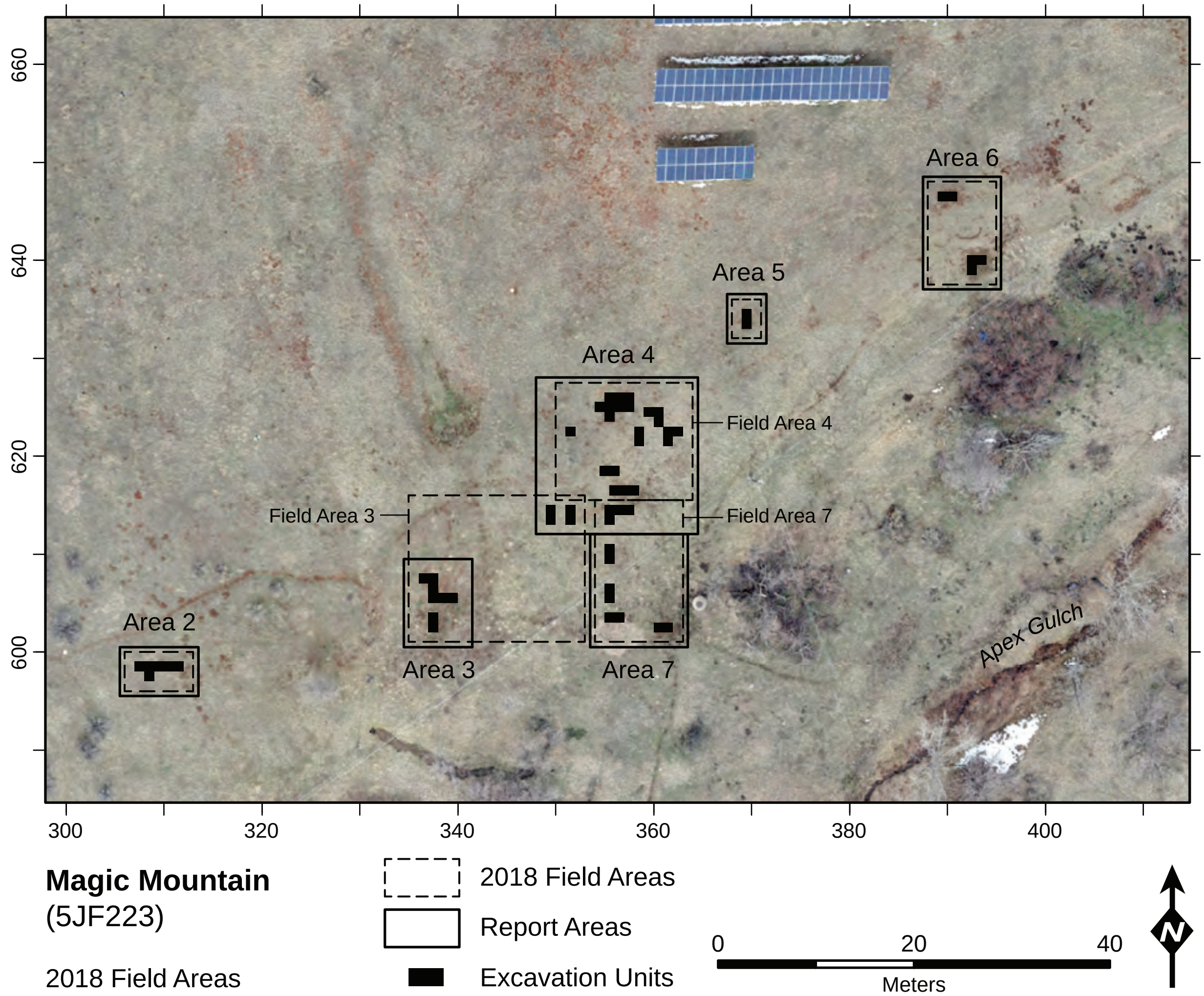


Figure 3.3. Air photo mosaic showing the locations of 2018 field areas and report areas.

a truck-mounted drill rig was used to collect five 4-in cores from Areas 3, 4, and 6. Methods and results of the coring program are discussed in chapter 2.

A 1-in soil probe was used—mostly unsuccessfully—to investigate selected magnetic anomalies prior to excavation. A GIS was used to identify the grid coordinates of anomalies of interest. Reel tapes or the total station were then used to stake out coring locations on the ground. However, the stoniness of the colluvial slope effectively precluded penetration of the coring tool deeper than a maximum of about 20 cm.

Monopole magnetic anomalies selected for coring or excavation included those with well-defined perimeters—especially those exhibiting bilateral symmetry—that measured between about 4 and 9 nanoteslas (nT) in magnetic intensity and from 75 to 200 cm in maximum dimension. Anomalies exhibiting magnetic intensities below about 3.5 nT could represent cultural features but could also represent animal burrows, secondary deposition of A horizon sediment, or other natural features of the soil. Apparent monopole anomalies with intensities greater than about 10 nT may represent buried ferrous objects oriented in a manner that obscures the negative pole of what otherwise would be a dipolar anomaly. Also visible in the magnetic data are a number of dipoles exhibiting intensities as high as ±200 nT.

Discrete magnetic anomalies could not be identified on the abandoned floodplain of Apex Gulch. In that portion of the site, bouldery granitic alluvium redeposited on the surface during the channelization of Apex Gulch yielded a complex jumble of dipolar anomalies ranging in intensity from ±10 to ±75 nT.

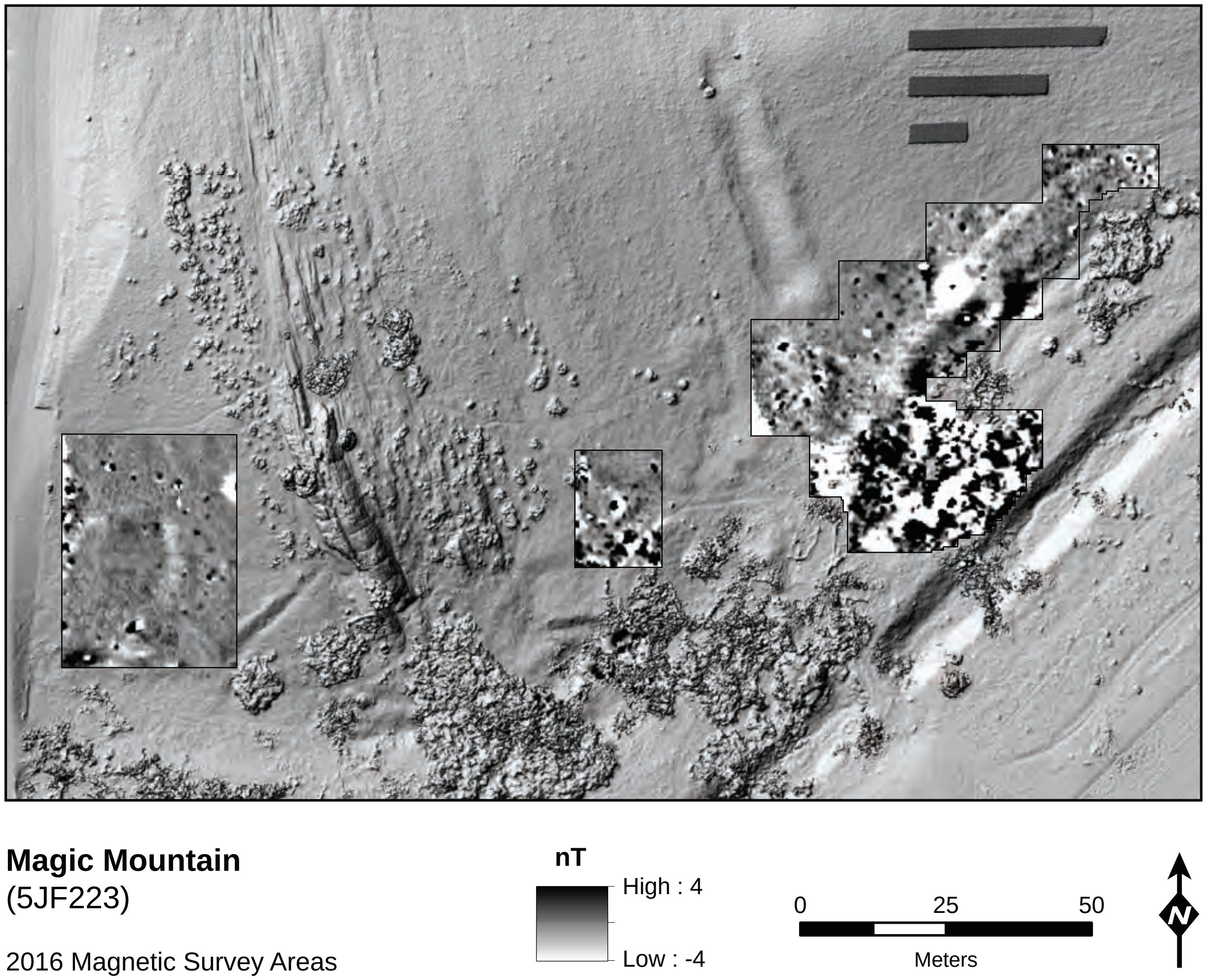


Figure 3.4. Digital terrain model image illustrating the distribution of magnetic gradiometry survey areas.

Using these magnetic intensity and size criteria, a total of 30 monopole anomalies were identified in the 2016 magnetic gradiometer data. Eighteen of those were selected as priority anomalies for the 2017 field investigation. Similar criteria were applied to the 2018 magnetic data; however, those data were collected immediately prior to the field session and decisions about which anomalies to investigate were made using preliminary, field-processed data.

Feature Sample Bias

The inventory of features identified and sampled during the 2017-2018 DMNS/PCRG/KU-Odyssey field investigation was strongly affected by the project's field methods. Because excavation unit placement was determined by the distribution of discrete magnetic monopole anomalies, the inventory of features identified consists of those that are highly magnetic. At Magic Mountain, highly magnetic features comprise those that are filled with burned granitic rocks. Undoubtedly, cultural features filled with only slightly magnetic or with non-magnetic materials also occur at Magic Mountain. However, features of that type were essentially invisible to the project's field methods. In fact, the only feature identified during the project that lacked burned rocks in its fill (Feature 2) was located within the magnetic umbra of Feature 3, a large rock-filled basin.

Excavation Results

Crews opened a 59 excavation squares distributed among six designated site areas (table 3.3; figure 3.6). Approximately half of the fieldwork occurred in Area 4. A total of 15 cultural features were identified and

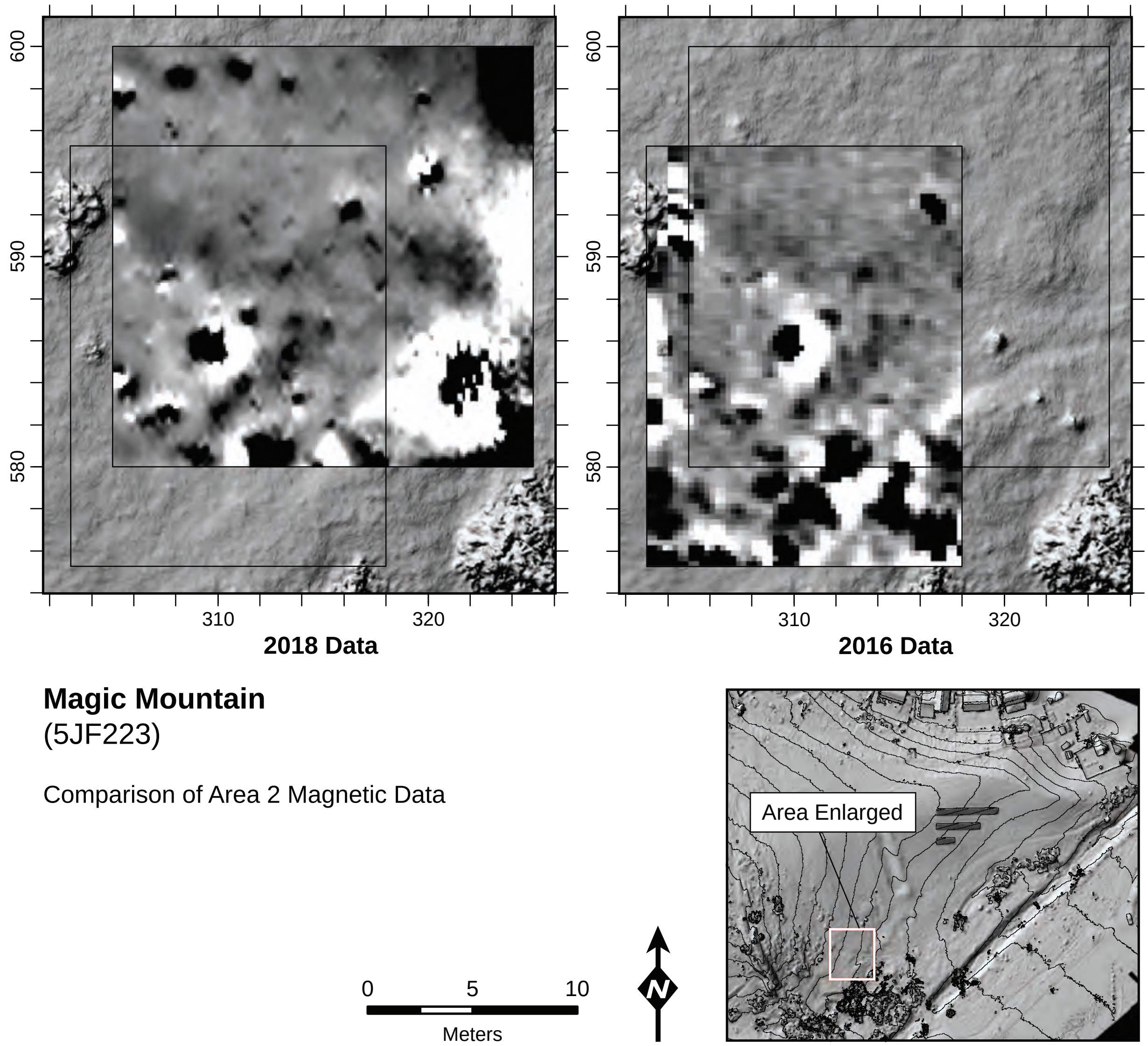


Figure 3.5. Comparison of magnetic gradiometry data collected during 2016 (right) with magnetic data collected during 208 (left).

sampled. Fourteen of the features were associated with the American Indian occupation of the site, while one was associated with a recent occupation. Subsurface cultural features were documented in each of the investigated site areas, apart from Area 5 (table 3.4). A total of 954 catalog numbers were assigned during the field investigation. Table 3.5 tallies counts of catalog numbers assigned to excavated contexts, organized by site area and sample type.

Major Findings

This section presents an area-by-area discussion of excavation objectives, workflow, and results. Included are descriptions of the strata and horizons observed and the cultural features encountered. Also included is a summary of near-surface site stratigraphy. Additional data on and analysis of soil horizons and stratigraphic units are presented in chapter 2. Additional feature data are presented later in this chapter in the "Feature Analysis" section.

Area 2

A preliminary magnetic gradiometry survey was conducted in Area 2 during 2016 and during 2017

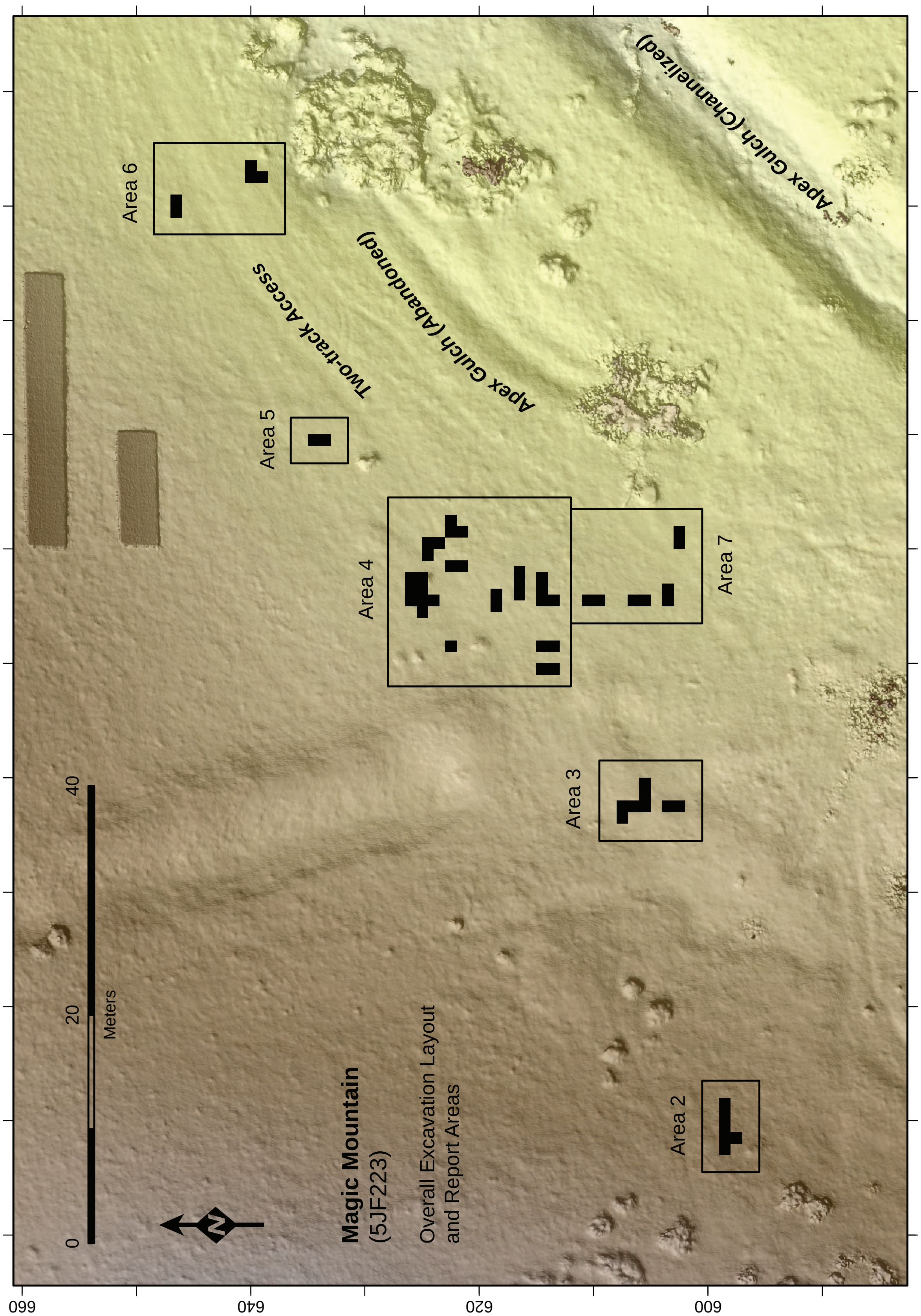


Figure 3.6. Digital terrain model showing the locations of 59 excavation units opened during the 2017-2018 DMNS/PCRG/KU-Odyssey fieldwork.

Table 3.3. Excavation volume data organized by site area.

Report Area	Number of Squares	Excavated Volume (liters)
2	6	1,857
3	8	6,606
4	30	15,127
5	2	390
6	5	1,497
7	8	5,482
Total	59	30,959

Table 3.4. Distribution of cultural features among report areas.

Report Area	Number of American Indian Features	Number of Recent Features
2	1	
3	2	
4	8	1
6	1	
7	2	
Total	14	1

attempts were made to core selected magnetic anomalies. In 2018, high-resolution magnetic data were collected and used to position the Area 2 excavation block, which comprised six excavation squares located on the colluvial apron roughly 40 m east of the Lyons Sandstone outcrop (figure 3.7).

The primary goal of excavation in Area 2 was to determine the ages, and sample the contents of, buried cultural features. Two magnetic anomalies were selected for investigation. One was a well-defined circular monopole centered on 598.6NE308.2 with a maximum magnetic intensity of 13.7 nT. Units 48 and 56 were placed over this anomaly, which proved to be a rock-filled pit designated Feature 10.

The second anomaly, which exhibited a maximum intensity of 10.8 nT but was less well defined, was centered on 598.9NE311.0. Units 49 and 50 were placed over that anomaly. Scattered burned rocks were observed in both of those units, but an intact feature was not identified.

Several other discrete monopole anomalies with magnetic intensities ranging from about 4 to 20 nT were identified in the Area 2 magnetic data collected in 2018 but were not investigated. Large dipolar anomalies representing buried ferrous objects were identified on the southern and eastern edges of the 2018 geophysical survey block. A similar distribution of iron objects was observed in the Area 2 magnetic data collected in 2016 (Kvamme 2016).

Excavation began in Units 47 and 48 (a north-south 1 x 2-m block) and Units 49 and 50 (an east-west 1 x 2-m block) (figure 3.8). Because the modern surface slopes to the east and south, Units 54 and 56 were added to provide stratigraphic context. A total of about 1.8 m^3 of sediment was excavated in Area 2.

Area 2 Strata and Features

Figure 3.9 illustrates the strata and horizons exposed in Area 2. The uppermost stratum consists of the modern soil, which has formed in colluvium consisting primarily of sand derived from weathering of the adjacent Lyons Sandstone outcrop. Below that is an older sand stratum that disconformably overlies Feature 10, a rock-filled basin. Feature 10 originated near the top of a buried but weakly developed soil that consists of a thin A horizon and two Bw horizons

Table 3.5. Crosstabulation of catalog numbers assigned to excavated contexts according to report area and sample type. A single catalog number also was assigned to a surface-collected artifact.

Report Area	Sample Type						Total
	General Level	Feature Level	Constant Volume	Piece Plot	Bulk Sediment	Miscellaneous Sediment Sample	
2	22	1	8	14	1		46
3	58	3	53	118	2		234
4	155	13	111	234	11	4	528
5	5		5				10
6	18	1	15	10	3		47
7	33	3	15	36	1		88
Total	291	21	207	412	18	4	953

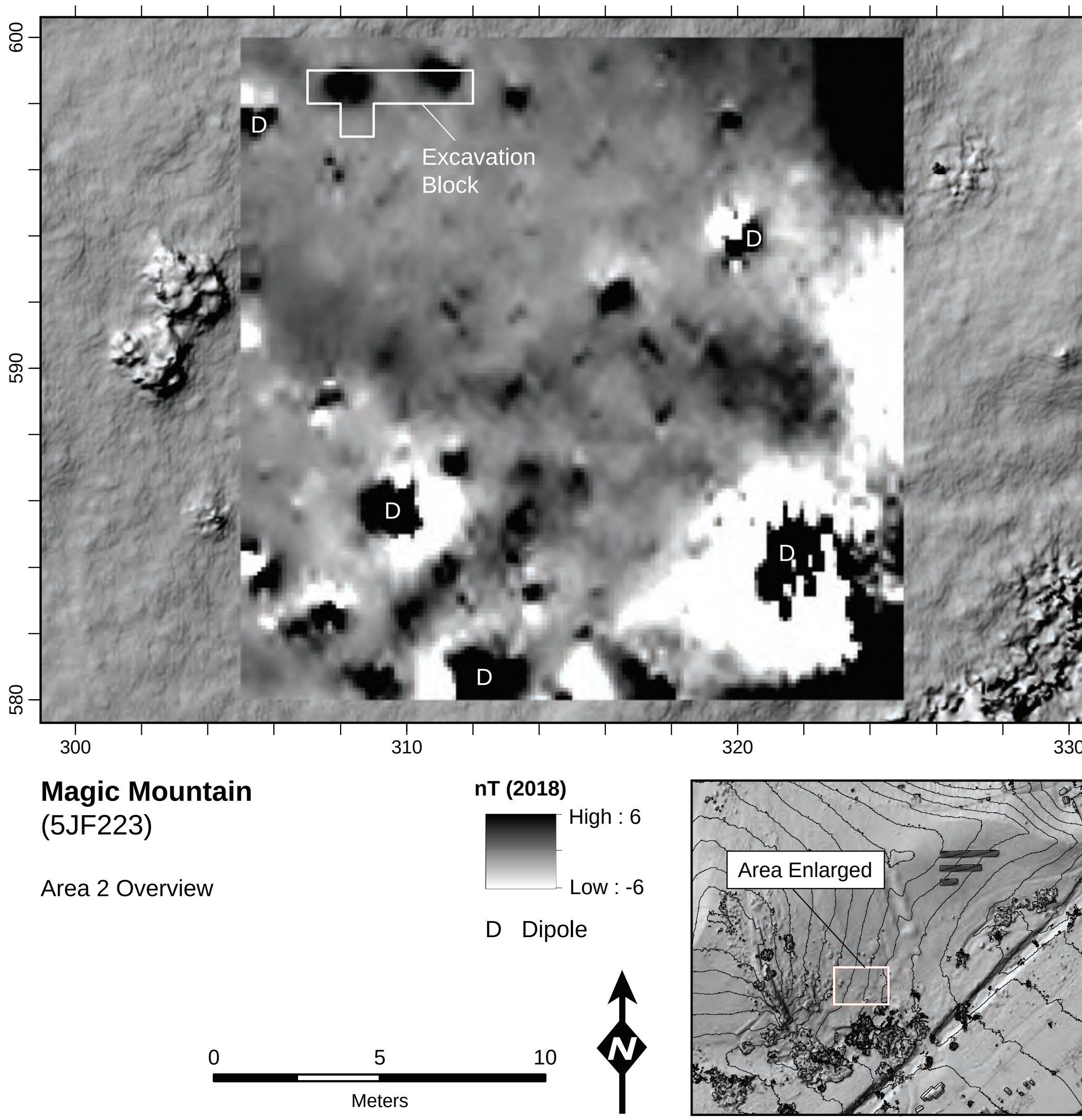


Figure 3.7. Magnetic and terrain map showing the location of excavation units in Area 2.

formed in sandy colluvium. Coarse sand and gravel are more common in the buried soil than they are in the overlying strata. The margin of a deep rill or channel filled with recent colluvium was exposed in the west profile of Unit 56. Animal burrows are present throughout the deposits.

Feature 10 was a shallow, slightly asymmetrical basin filled with burned rocks. The perimeter was moderately difficult to define, particularly on the feature's western edge, because the color and texture of the fill differed only slightly from the color and texture of the A horizon sediment into which it had been excavated. The perimeter illustrated in figure 3.8 primarily corresponds to the distribution of burned stones. Feature 10 was 115 cm long (east-west) and more than 85 cm wide (north-south); the maximum original diameter is estimated to have been 115 cm. The depth of the feature was about 18 cm. (Due to the slope, the maximum thickness from the top of the basin on the west to the floor of the basin on the east was 22 cm.) Approximately three-quarters of Feature 10 was excavated.

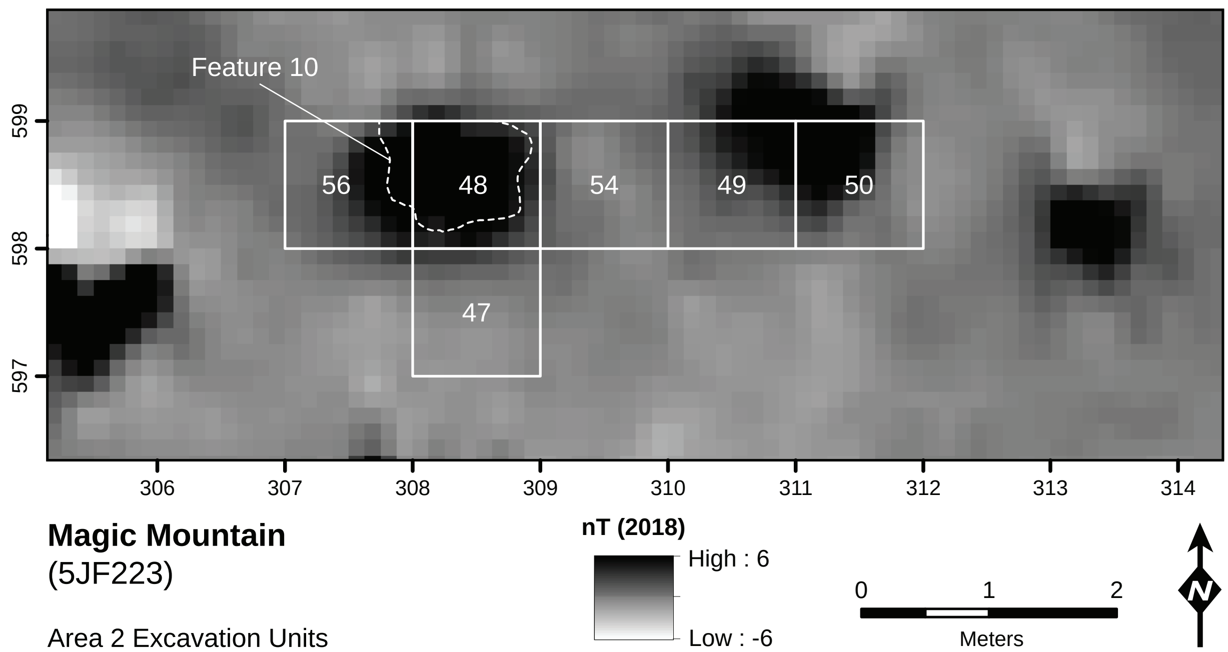


Figure 3.8. Magnetic map showing the locations of excavation units and cultural features in Area 2.

The original upper surface of the feature sloped down to the east, roughly parallel to slope of the contemporaneous ground surface. On the west, a portion of the feature's upper surface was stripped away by post-occupation surface erosion prior to burial. Although the basin was entirely filled with burned rocks, the lowest layer of stones—which rested directly on the floor of the excavated basin—

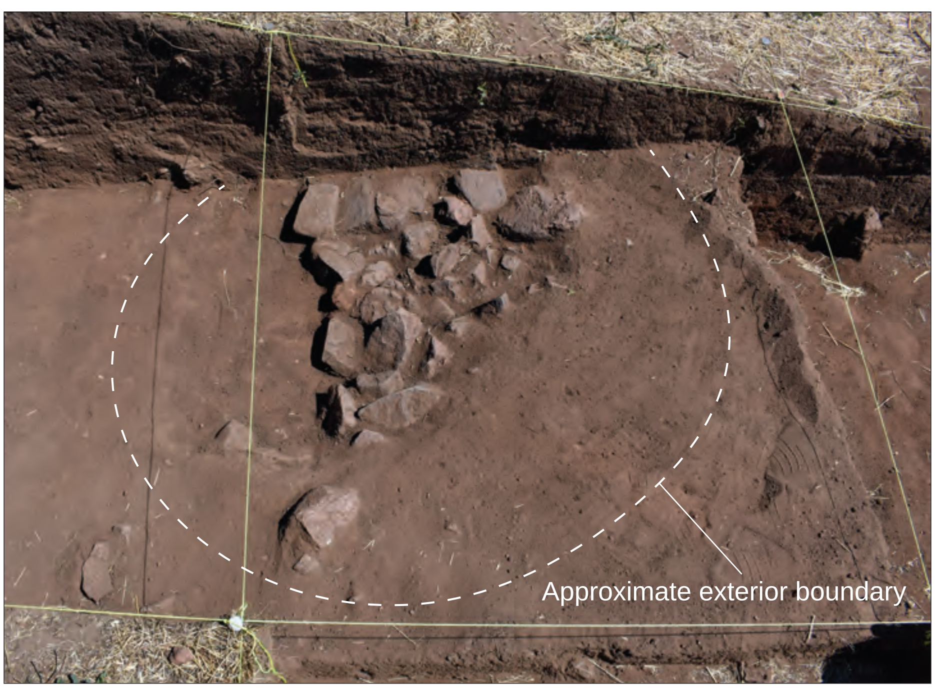


Figure 3.10. Photograph of Feature 10 during excavation showing a portion of the tightly interlocking lens of burned rocks and the feature's approximate final boundary.

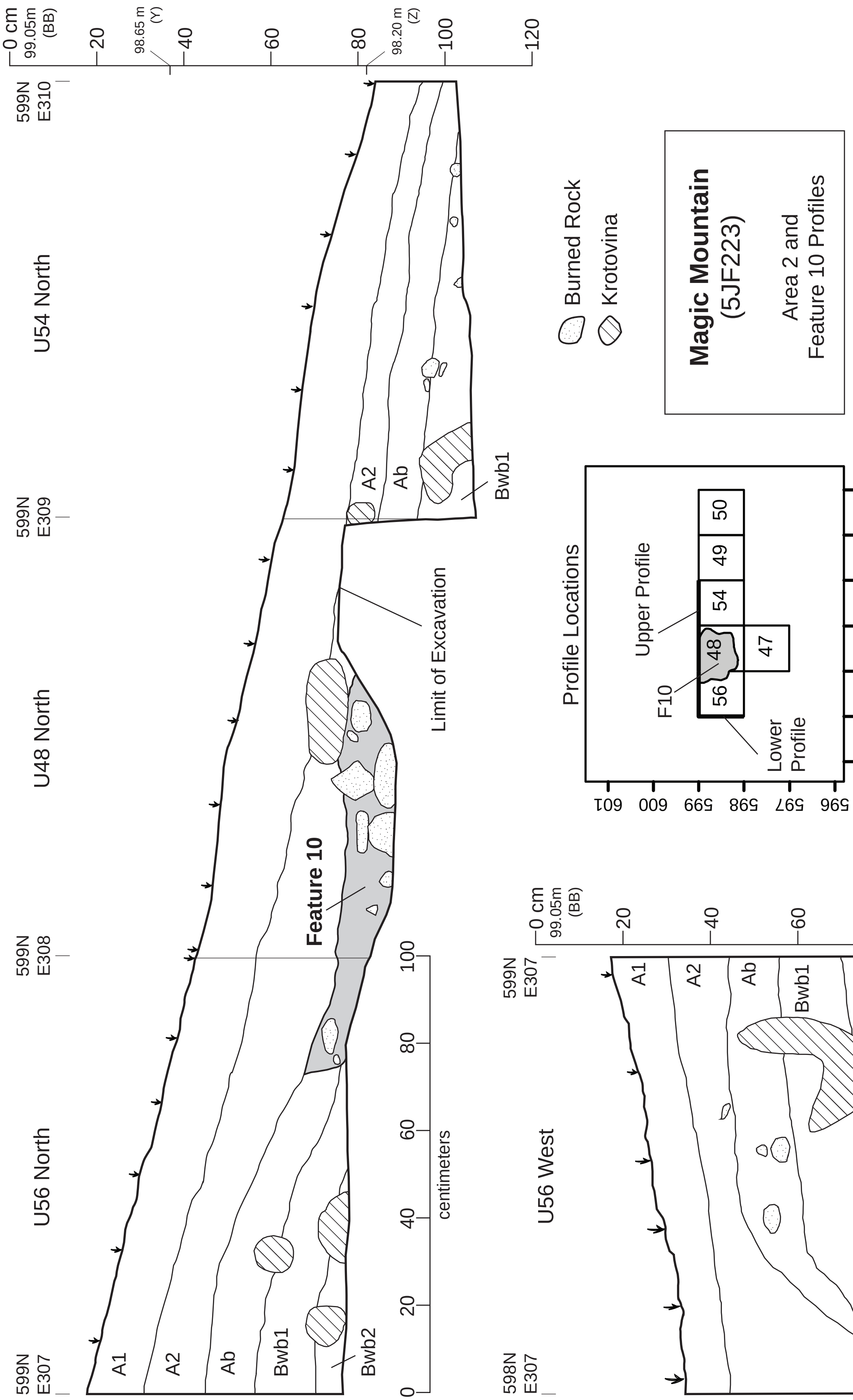


Figure 3.9. Illustration of soil horizons and features exposed in Area 2.

were tightly interlocking in a manner indicating that they had been intentionally placed (figure 3.10).

Area 3

GPR and magnetic gradiometry surveys were conducted in Area 3 during 2016 and the results of those surveys were used to position the six excavation units opened during 2017 (figure 3.11). Two additional excavation units were opened during 2018 to continue and expand the work that had begun during 2017.

The primary goal of the 2017 excavation effort was to investigate a possible Early Ceramic period architectural feature identified in the GPR data. The aim of additional work carried out during 2018 was to sample the deep colluvial and alluvial deposits first exposed during 2017.

Preliminary analysis of GPR data collected during 2016 by Conyers and his graduate students suggested

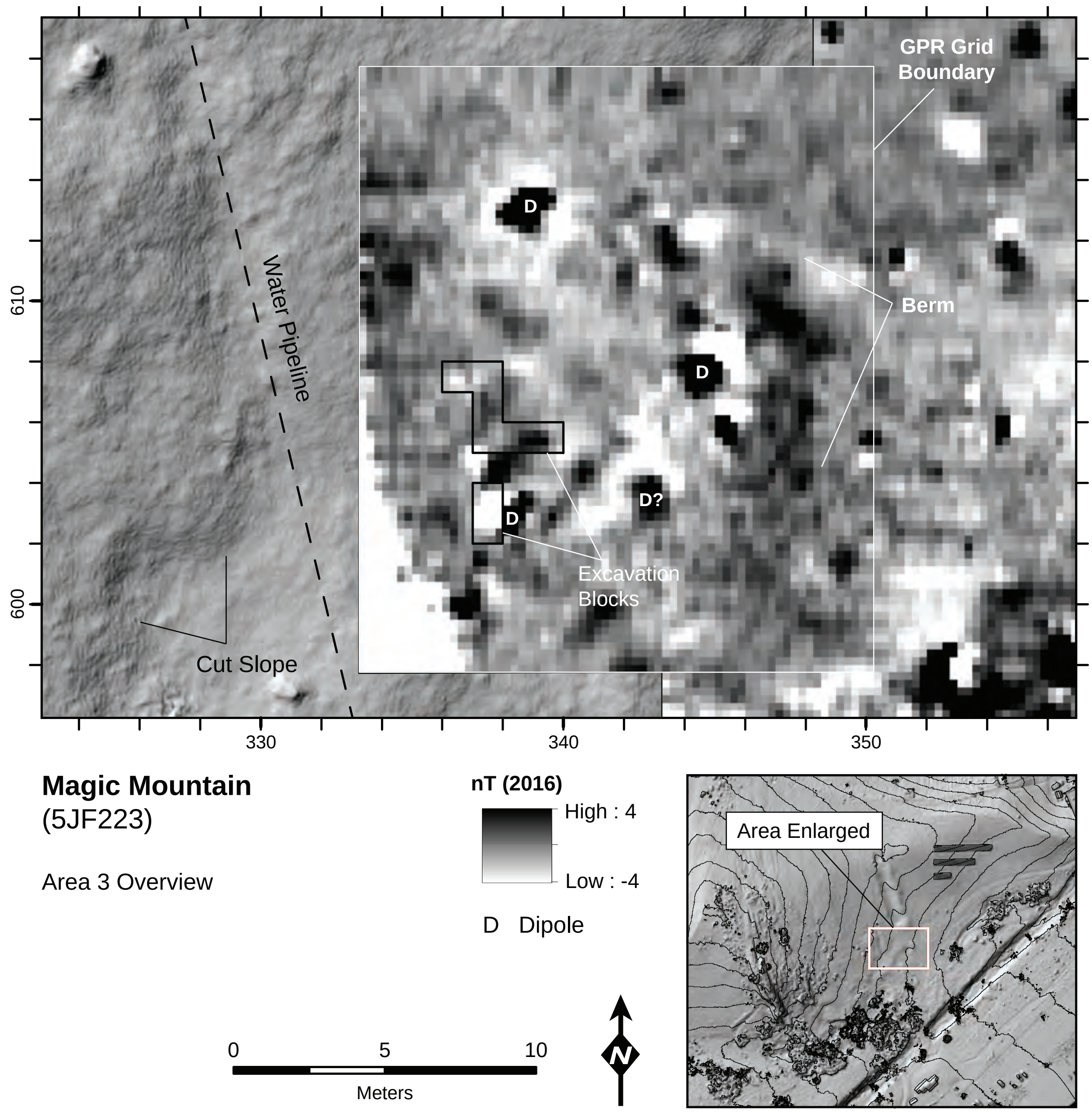


Figure 3.11. Magnetic and terrain map of Area 3 showing surface features and excavation units.

that a semi-subterranean architectural feature or basin house might be present in Area 3 (Dalessandro and Conyers 2017; see also Conyers 2018). Magnetic data for Area 3 are complex (Kvamme 2016). Several large dipolar anomalies exhibiting magnetic intensity values between 15 and 105 nT are located within and adjacent to the excavation units. Monopole anomalies in Area 3 are not well defined and exhibit intensities between about 3 and 10 nT. A variety of recent surface disturbances are present in Area 3, including a water pipeline trench (the magnetic halo of the buried pipe is partially visible in the magnetic data), a shallow swale surrounded by a low mounded berm, and a cut surface.

Placement of the first four units opened in Area 3 (Units 1 through 4) was determined by the initial results of the GPR survey (figure 3.12). Units 18 and 20 were added to provide additional stratigraphic context. Excavation data obtained during 2017 showed that an architectural feature was not present, although two rock-filled hearths—Features 4 and 5—were identified and sampled. Excavation in Unit 4 also revealed the presence of fine-grained deposits more than 140 cm thick. Artifacts and faunal remains were present within those deep deposits, although sparse. A two-phase coring program was undertaken in Area 3 following the 2017 field season. Based on the coring results, Units 45 and 46 were opened during 2018 to further investigate those deep deposits. Additional excavation also occurred in Unit 4 during 2018. Data on the core samples and on the deeply buried strata and horizons exposed Area 3 during 2018 are presented in chapter 2. The total volume of sediment excavated in Area 3 was 6.6 m^3.

<u>Area 3 Strata and Features</u>

Figure 3.13 illustrates the near-surface stratigraphic units and soil horizons exposed in Units 1, 2, and 18. Two strata representing spoil from recent disturbances cap intact archaeological deposits in this part of the site. Both spoil strata consist of mottled sediment containing recent metal and glass artifacts, along with a moderately dense concentration of artifacts associated with the site's indigenous occupation. The lower of the two spoil strata contains abundant small

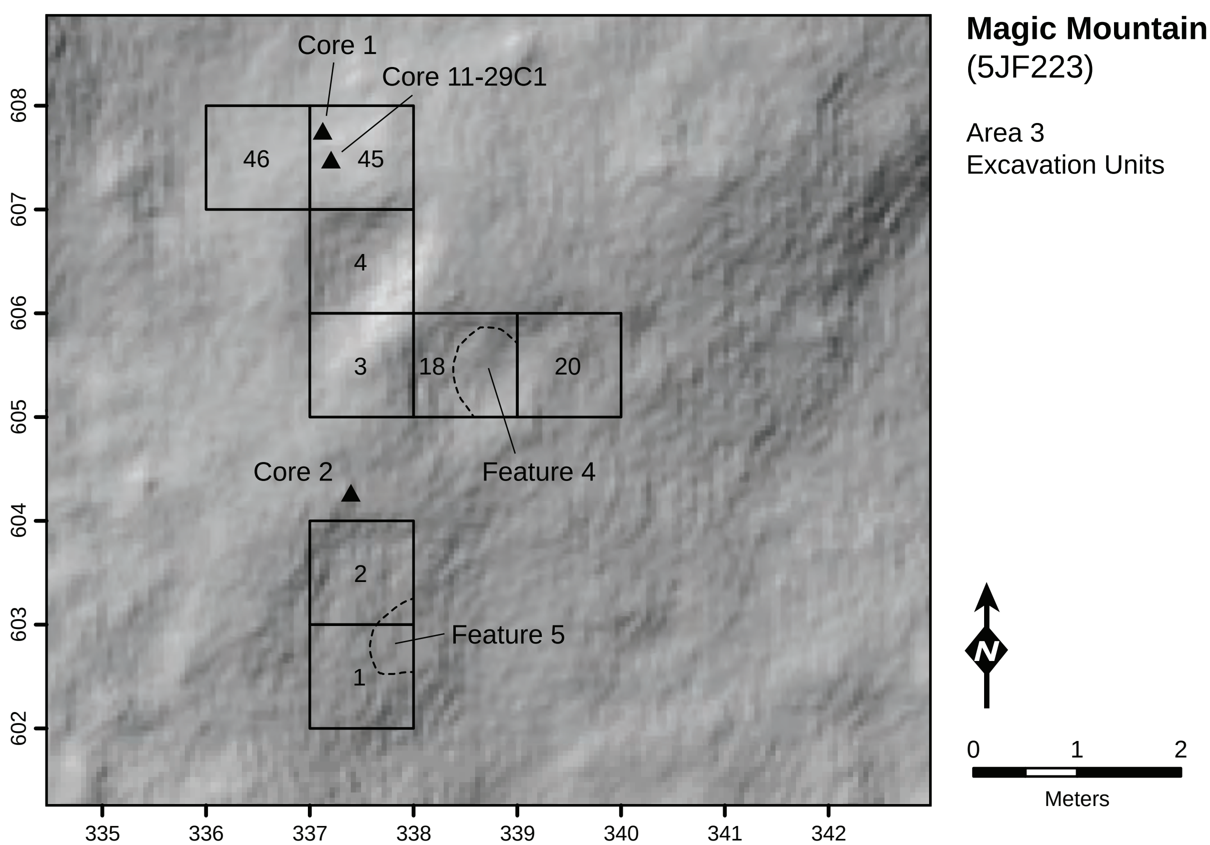


Figure 3.12. Terrain map showing the locations of excavation units, core samples, and cultural features in Area 3.

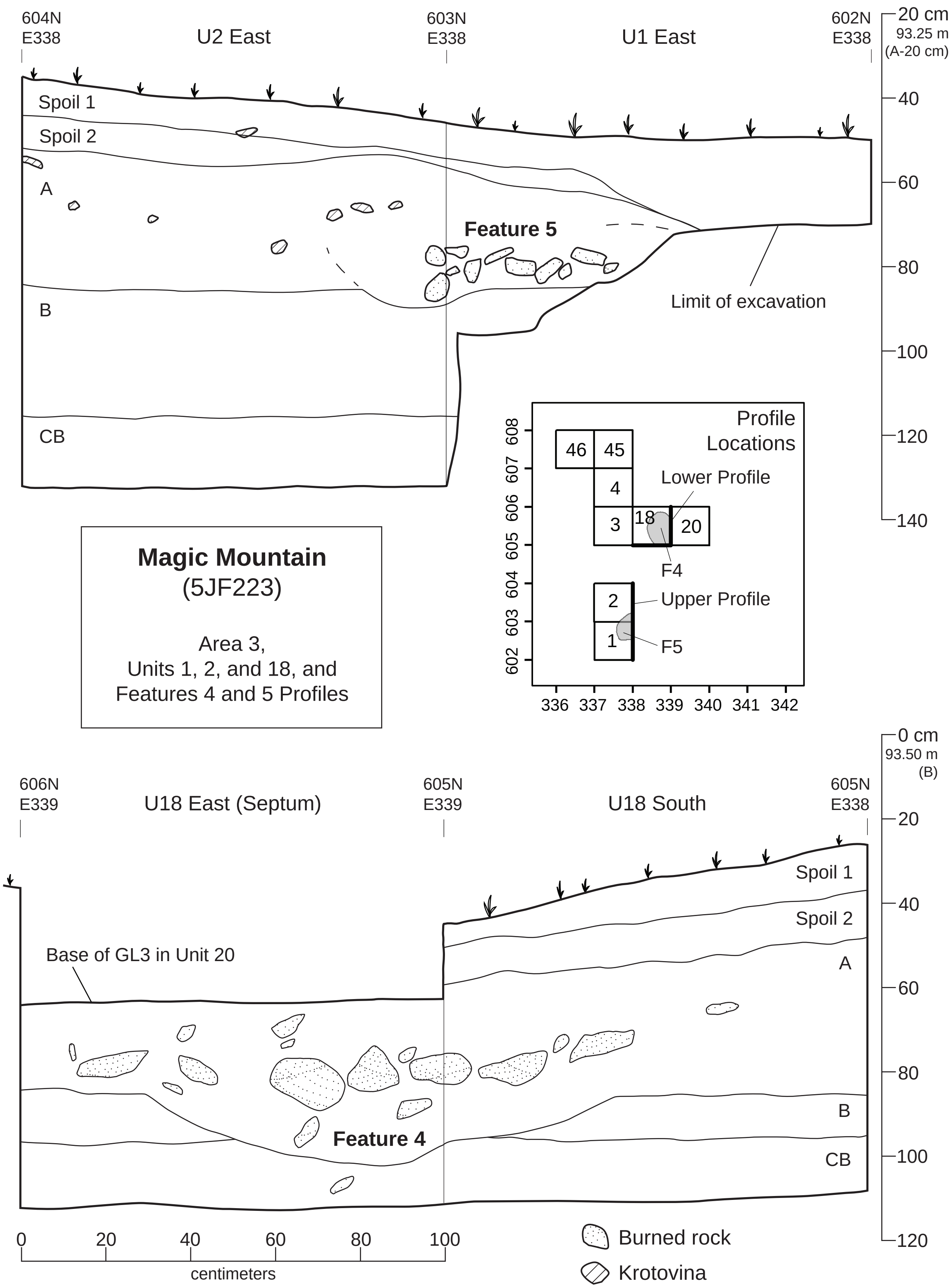


Figure 3.13. Illustration of soil horizons and cultural featues exposed in Area 3.

Figure 3.14. Photograph of the west profile of Unit 4 showing spoil strata overlying intact archaeological deposits.

rip-up clasts representing deeply buried colluvium, which likely were brought to the surface during the excavation of the nearby waterline trench or the cut surface (figure 3.14). The upper spoil stratum includes a mixture of redeposited sediment and recent sheetwash. These strata are the only significant disturbed zones observed at Magic Mountain during the 2017-2018 excavation effort.

Beneath the spoil strata is an overthickened A horizon containing abundant indigenous artifacts, charcoal, and burned rocks. Features 4 and 5 both originated within this horizon. Both features were cut into B horizon sediment.

Feature 4, located in Unit 18, was an irregular, steep-sided pit filled with a mixture of large, burned cobbles and charcoal-stained sediment. The feature's origin was difficult to define because the color and texture of the fill was similar to the color and texture of the surrounding cumulic A horizon, which also contained abundant charcoal fragments, American Indian artifacts, and non-feature burned rock. The tops of rocks definitely associated with Feature 4 occurred within GL5 at about 65 cm DD (92.85 m). The upper section of Feature 4 was similarly difficult to define. The lower section, below about 85 cm DD (92.65 m), was more easily defined owing to the contrast between the feature fill and surrounding B horizon sediment. However, the floor of the feature was penetrated on the southern edge during excavation and so the total excavated volume includes an unknown amount of B horizon sediment that predates the feature.

The excavated portion of Feature 4 was more than 85 cm long (north-south) and 62 cm wide (east-west). Assuming that the feature was roughly symmetrical, the original plan dimensions are estimated to have been 75 cm southwest-northeast and 100 cm southeast-northwest. The pit's maximum depth was approximately 35 cm. Roughly half of the feature was excavated.

Large, burned rocks were located throughout the feature but concentrated in its upper half, especially on the northern edge. The maximum dimension of the largest stones was about 20 cm. Feature 4 lacked a tightly packed basal layer of burned stones (figure 3.15).

Feature 5, located in Units 1 and 2, was a small, shallow basin tightly packed with burned rocks. Many of the burned stones consisted of recycled fragments of ground stone tools. As was true for Feature 4, the origin and upper perimeter of Feature 5 were difficult to define. Burned rocks appeared to have been concentrated in the middle of the feature both vertically and horizontally. The excavated portion of Feature 5 was 70 cm north-south and more than 42 cm east-west. Assuming that the feature was roughly symmetrical, the original plan dimensions are estimated to have been 90 cm southwest-northeast and 65 cm southeast-northwest. The maximum depth was 17 cm. Only the western half was excavated.

The feature's burned rock layer was continuous and tightly interlocked, although burned rocks did not extend to the edges of the basin and were located several centimeters above the floor of the basin (figure 3.16). That arrangement suggests that they

Figure 3.15. Photograph of excavation in progress in Feature 4, showing the size and distribution of burned rocks in the fill.

Figure 3.16. Photograph of Feature 5 after excavation.

served as the heating element of an earth oven that was operated later in the feature's use-life.

Stratigraphic data from Area 3 demonstrate that the overthickened and partially anthropogenic A horizon containing Early Ceramic period artifacts began forming before Features 4 and 5 were constructed and used. Thus, neither of these features was associated with the earliest Early Ceramic period occupation of the site.

Area 4

Area 4, which comprised 30 excavation squares, was the primary focus of the field investigation at Magic Mountain (figure 3.17). A preliminary magnetic survey was carried out in 2016 and additional high-resolution magnetic data were collected in 2018. During 2017, the primary objectives for work in Area 4 were to investigate selected magnetic anomalies and to determine the ages and stratigraphic contexts of identified cultural features. During 2018, the aims of the fieldwork were expanded to include investigation of a possible Early Ceramic architectural feature first identified during 2017. Sampling of deep colluvial and alluvial deposits first identified during the 2017 coring program also was undertaken during 2018.

The 2016 magnetic data revealed a series of discrete monopole anomalies with maximum intensities close to 7 nT (table 3.6). Three were selected for excavation during 2017 and all three proved to represent rock-filled hearths. Four additional monopole anomalies were selected for excavation during 2018, based on the results of the high-resolution magnetic re-survey. Three of those anomalies also proved to represent rock-filled hearths. Several other weaker magnetic anomalies visible in the magnetic data were not investigated. Magnetic dipoles also occur in Area 4, the largest and most pronounced of which exhibits a maximum intensity of ±200 nT.

Eleven excavation squares were opened during 2017, beginning with three 1 x 2-m blocks (Units 5 and 6, Units 7 and 8, and Units 22 and 23) (figure 3.18). Additional excavation squares were added to provide stratigraphic context. Three magnetic anomalies were targeted, and four cultural features were identified, including Features 1, 2, 3, and 6.

Nineteen additional squares were opened in Area 4 during 2018 (figure 3.19). Six squares on the southern end of Area 4 (Units 33 through 38) were opened to obtain geoarchaeological data. Two additional squares (Units 57 and 58) were added to improve access to the deep excavation in Unit 33. Horizons and strata observed in that unit are discussed in chapter 2. The other 11 squares were opened to investigate a possible Early Ceramic architectural feature and to sample selected magnetic anomalies. Four anomalies were targeted. Three of the four represented pits or basins filled with burned rocks (Features 12, 13,

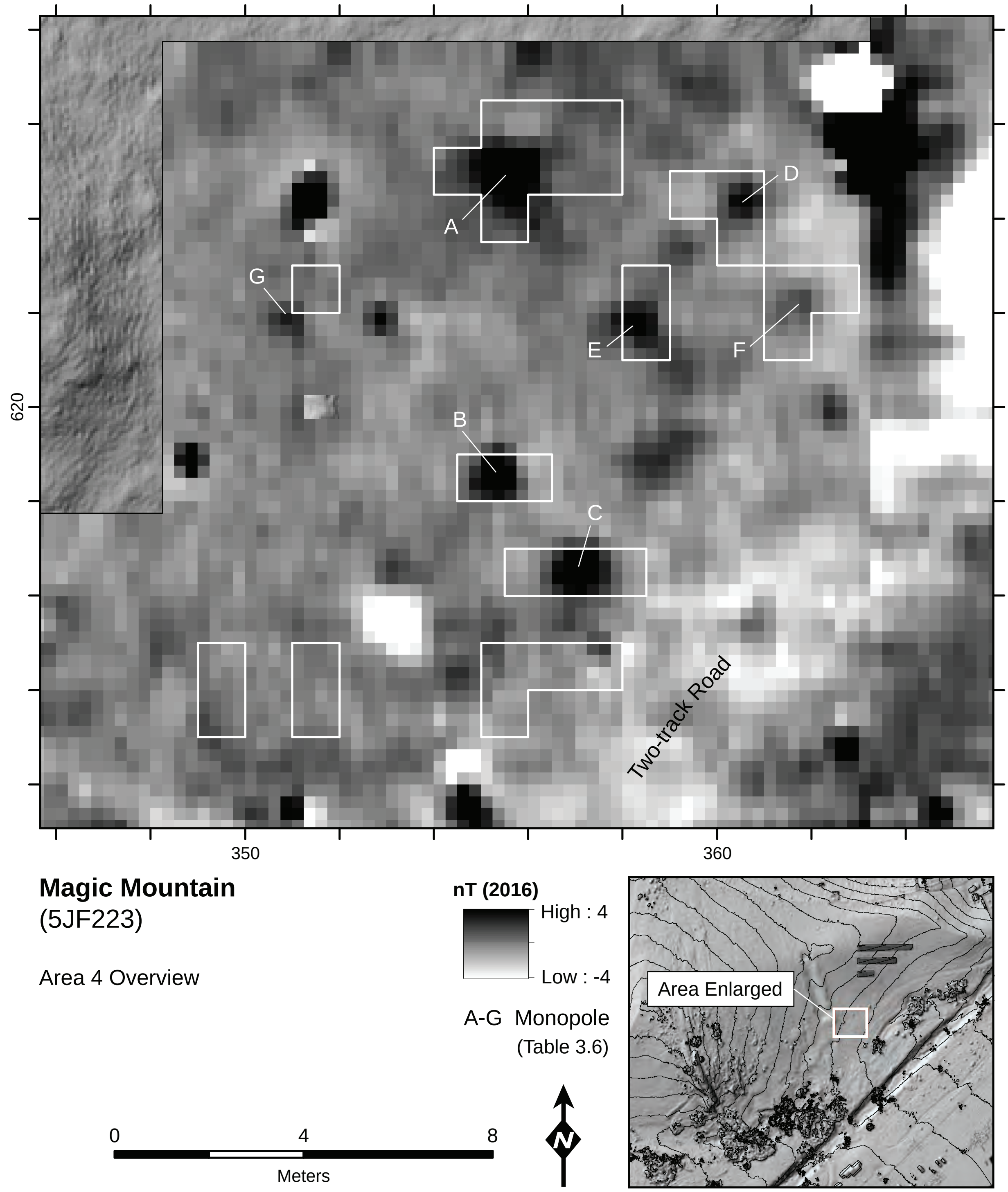


Figure 3.17. Magnetic map of Area 4 showing the locations of sampled magnetic anomalies and excavation units.

Table 3.6. Spatial and magnetic intensity data on monopole anomalies targeted in Area 4.

		Maximum Magnetic Intensity (nT)			
Figure 3.17 Reference	Anomaly Centroid	2016 Data	2018 Data	Feature No.	Field Year
A	625.0NE355.5	7.2	-	3	2017
B	618.7NE355.4	7.4	-	6	2017
C	616.6NE357.1	7.0	-	1	2017
D	624.4NE360.6	4.4	9.0	13	2018
E	621.8NE358.4	4.7	8.9	14	2018
F	622.3NE361.9	1.7	5.6	12	2018
G	622.1NE351.3	3.1	9.8	-	2018

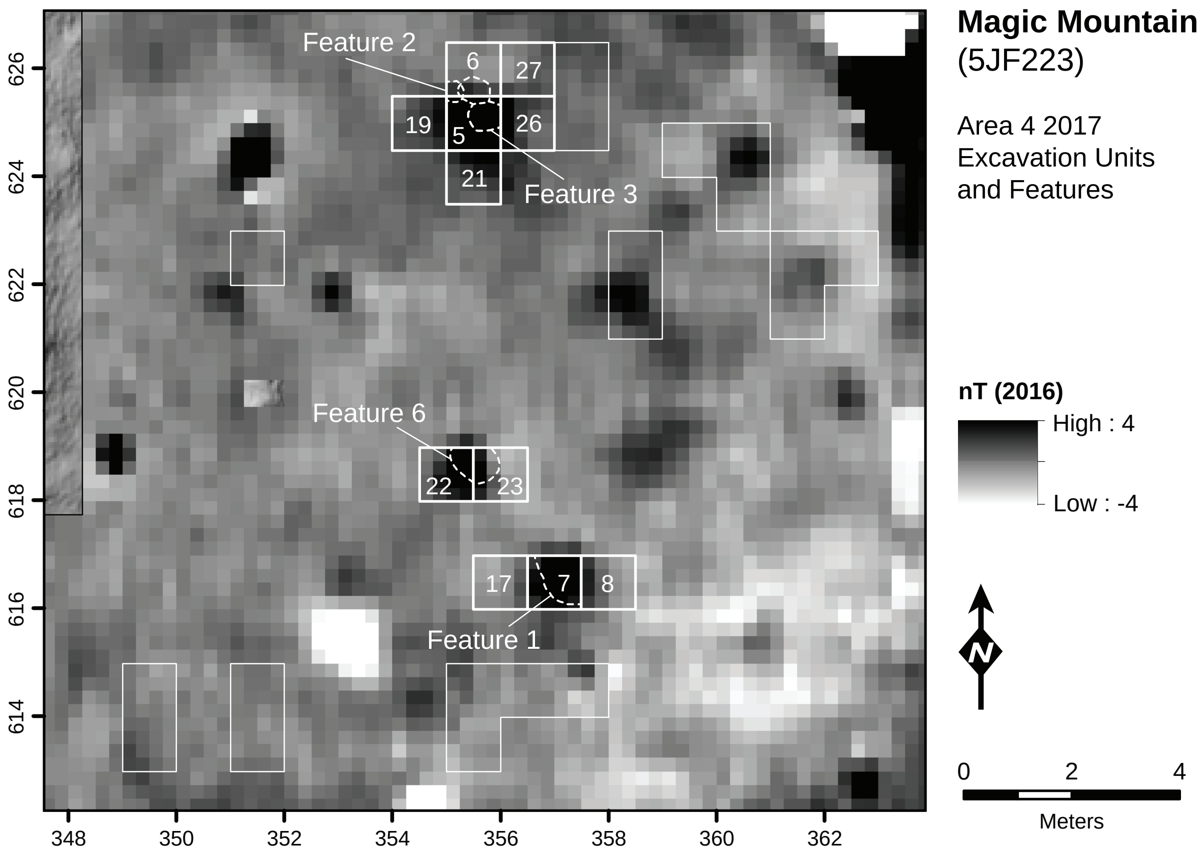


Figure 3.18. Magnetic map showing the locations of excavation units and cultural features exposed during 2017.

and 14). No feature was associated with the fourth targeted anomaly (in Unit 61). A feature that was not obviously associated with a magnetic anomaly also was identified (Feature 15). The total volume of sediment excavated in Area 4 during 2017 and 2018 was about 15.1 m^3.

Area 4 Strata and Features (2017)

Soil horizons and strata exposed in Units 7, 8, and 17, along with the stratigraphic position of Feature 1, are shown in Figure 3.20. The uppermost horizon consists of recent colluvium (Ap). Beneath that is an A horizon partitioned into an A1 and A2 that together are about 40 cm thick. An AB horizon occurs below that. The deepest horizons, which only were exposed in Unit 7, consist of two Bt horizons.

The top of **Feature 1**, a large rock-filled basin, occurred in the lower portion of the AB horizon**.** The upper surface of the feature dips to the east and south, parallel to the trend of subsurface horizons and the modern surface. The tops of the feature's uppermost

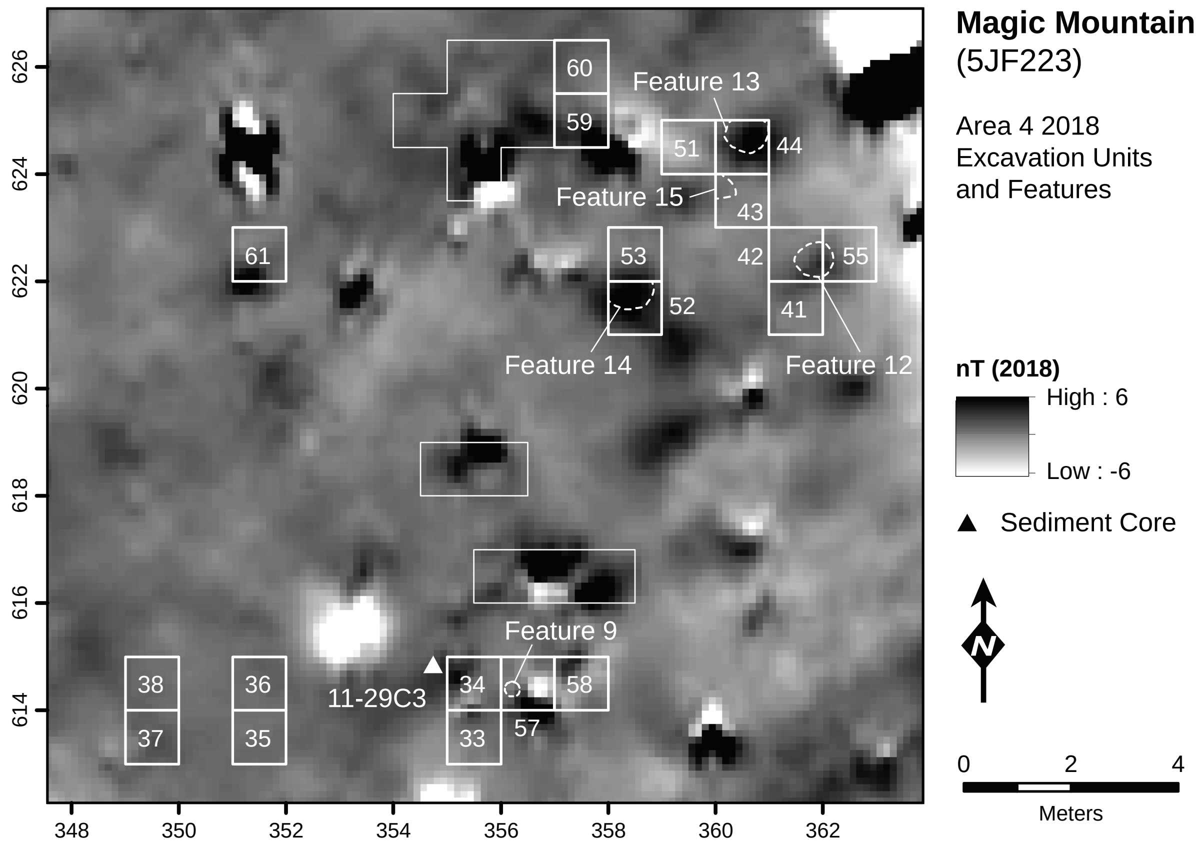


Figure 3.19. Magnetic map showing the locations of excavation units and cultural features exposed during 2018.

burned rocks extended above the feature's fill, indicating that sheetwash erosion had stripped away a portion of the fill prior to burial. The lower portion of the feature had been excavated into the underlying Bt1 horizon.

The excavated portion of Feature 1 measured 90 cm north-south and 85 cm east-west. Roughly three-quarters of the feature was exposed in Unit 7. Based on the shape and extent of the excavated portion, Feature 1 likely was slightly oblong in plan and is estimated to have been roughly 120 cm northwest-southeast and about 90 cm northeast-southwest. The feature's maximum depth was 22 cm.

The upper fill consisted of a continuous distribution of tightly packed burned rocks, which varied in size from about 5 cm to a maximum of about 20 cm. By contrast, the floor of the feature exhibited two basins, separated by a low rounded sill (figure 3.21). The lower fill comprised a mixture of burned rocks and charcoal-stained sediment. Several large krotovina intruded the lower portion of the feature. The oblong and slightly bi-lobed plan suggest that the feature may have been reconstructed at least once.

A block comprised of six excavation squares (Units 5, 6, 19, 21, 26, and 27) was opened to investigate a large monopole anomaly on the north side of Area 4 that measured 7.2 nT in maximum intensity. (Two additional squares were added to the block during the 2018 fieldwork.) Figure 3.22 illustrates the horizons and strata exposed during 2017. The uppermost horizon consists of an Ap roughly 6 cm thick. Below that are two A horizons (A1 and A2). The lower A2 horizon contains numerous American Indian artifacts along with charcoal, burned rock, and animal bones. The A2 horizon is irregularly mottled, suggesting that it incorporates partially disaggregated rip-up clasts derived from the underlying Bt horizon. A cut in the upper surface of the Bt horizon is visible in the north wall of Unit 19 in figure 3.22. Elsewhere in the block, the A2 horizon disconformably overlies the truncated upper surface of the Bt horizon. The truncated upper surface of the Bt suggested that it could represent the floor of a shallow basin house. However, no post molds or other interior architectural features were identified during the 2017 fieldwork. Apart from the cut observed on the west side of Unit 19, the

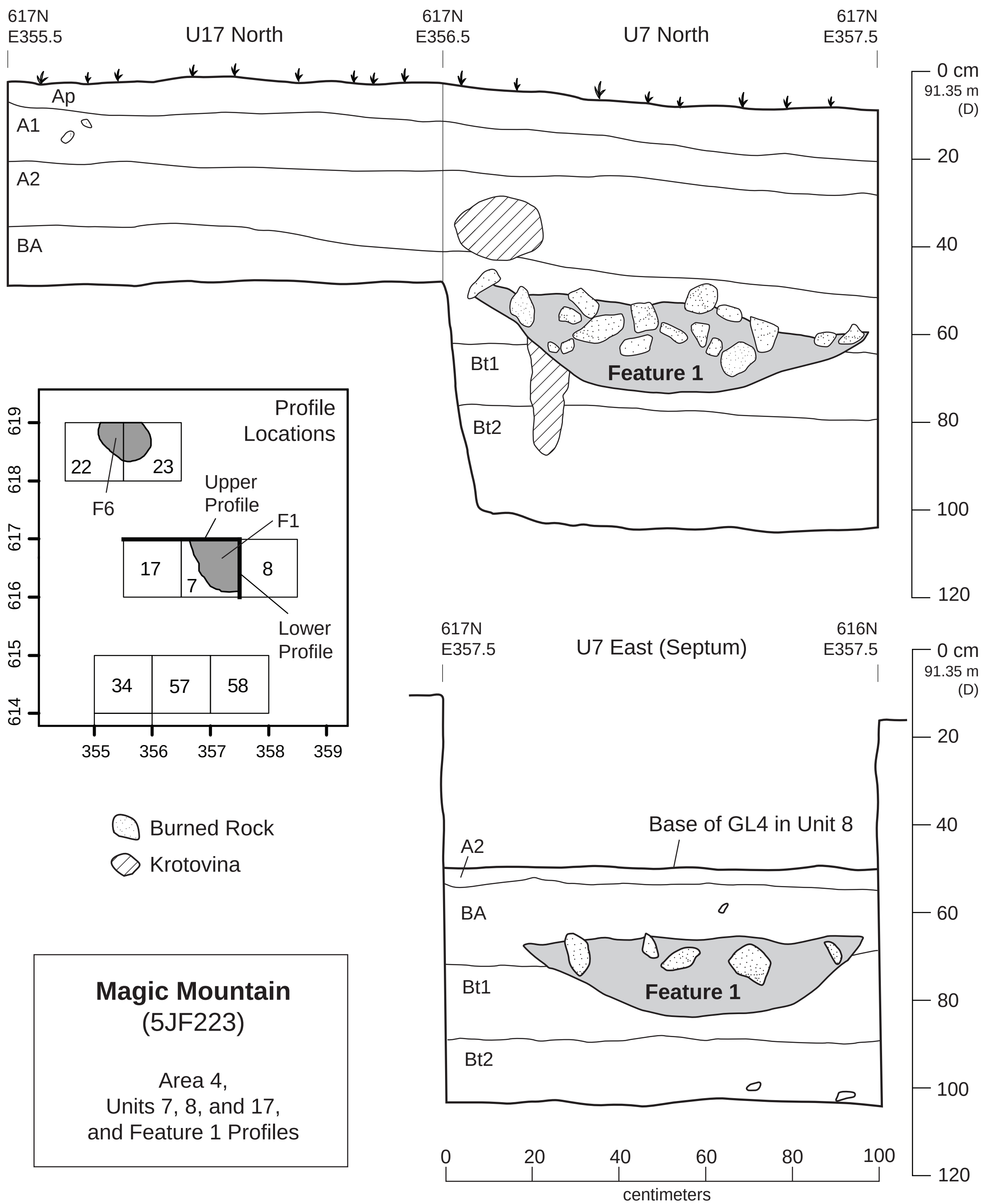


Figure 3.20. Illustration of soil horizons and cultural features exposed in Units 7, 8, and 17 in Area 4.

Figure 3.21. Photograph of Feature 1 after excavation. Note the low sill in the floor that separates the feature's southeast basin from its northwest basin.

exterior perimeter of the basin also was not defined. Additional data on this topic were collected during 2018 and are described later in this chapter.

Regardless, the A2 horizon in this part of Area 4 can be regarded as partially anthropogenic: it has been locally enriched by the addition of organic waste as well as sediment displaced from deeper horizons during the excavation of pits or other features.

The anomaly targeted in this block proved to represent at least two cultural features, including a small, slightly undercut pit (Feature 2) and a complex bi-lobed pit filled with burned rocks and artifacts (Feature 3).

Feature 2 originated at the surface cut into the Bt horizon at 49 cm DD (91.46 m or about 35-40 cm SD). A slab millingstone had been inverted directly over the feature (figure 3.23). A matching handstone also was placed over the feature. Numerous artifacts and bone fragments occurred on the truncated surface of the Bt horizon into which Feature 2 had been cut.

The pit was straight sided on the south and slightly undercut on the north. The exposed portion of the pit measured 50 cm north-south and 30 cm east-west. The original diameter of the pit is estimated to have been 50 cm. The maximum depth was 15 cm. About three-quarters of the pit was exposed in Units 5 and 6. All of the fill, which primarily consisted of dark gray to black sediment, was collected for flotation. Several burned rocks occurred at the base of the pit.

Feature 3, an irregular pit filled with burned rock and earth that containing the remains of at least two earth ovens, also originated at the surface cut into the Bt horizon at about 50 cm DD (91.45 m). The perimeter of the feature's upper section (designated FL1 in Unit 6 and FL2 in Unit 5) was irregular and somewhat difficult to define, suggesting that it had been disturbed either during the latest uses of the feature or after it was no longer in use. The upper fill consisted of gray sediment containing scattered artifacts, bones, burned rock, and chunks of charcoal. The pit was better defined in FL3 (60-80 cm DD or 91.35-91.15 m in both Unit 5 and Unit 6), which contained a larger number of burned rocks along with artifacts and bones. At the base of FL3 a continuous layer of tightly interlocking burned rocks filling two adjacent sub-basins was encountered (figure 3.24). The remainder of Feature 3 was excavated as FL4 (80-100 cm DD or 91.15-90.95 m).

Feature 3 was built and reused on multiple occasions. The deepest portion of the feature (FL4) represented two separate but adjacent pits. Both were deep and slightly oblong. Feature 3-North was 60 cm east-west and 50 cm north-south, while Feature 3-South was 55 cm north-south and somewhat more than 60 cm east-west. The final use of the southern lobe appeared to predate that of the northern lobe. The upper portions of Feature 3 (especially FL1 [in Unit 6] and FL2 [in Unit 5]) likely represent the jumbled remnants of multiple episodes of feature use.

Overall, the excavated portion of Feature 3 measured 110 cm north-south and more than 70 cm east-west. The original dimensions are estimated to have been 115 cm northwest-southeast and 70 cm southwest-northeast. The maximum depth was 50 cm. Roughly three-quarters of Feature 3 was exposed in Units 5 and 6.

The northern lobe of Feature 3 underlies the eastern edge of Feature 2, indicating that Feature 2 postdates Feature 3.

Figure 3.25 illustrates soil horizons and strata exposed in Units 22 and 23, along with the stratigraphic position of Feature 6. Also shown in figure 3.25 are horizons and strata exposed in Unit 36, located to the southwest of Feature 6, and Unit 61, located to the northwest of Feature 6. Soil horizons exposed in these units are analogous to those exposed in Units 7, 8, and 18 (figure 3.20), although differences reflecting landscape position are evident among them. Horizons exposed in Unit 36 are similar to those exposed in Units 7, 8, and 17: an Ap (0-12 cm), an A (12-26 cm), an AB (26-40 cm), and a Bt

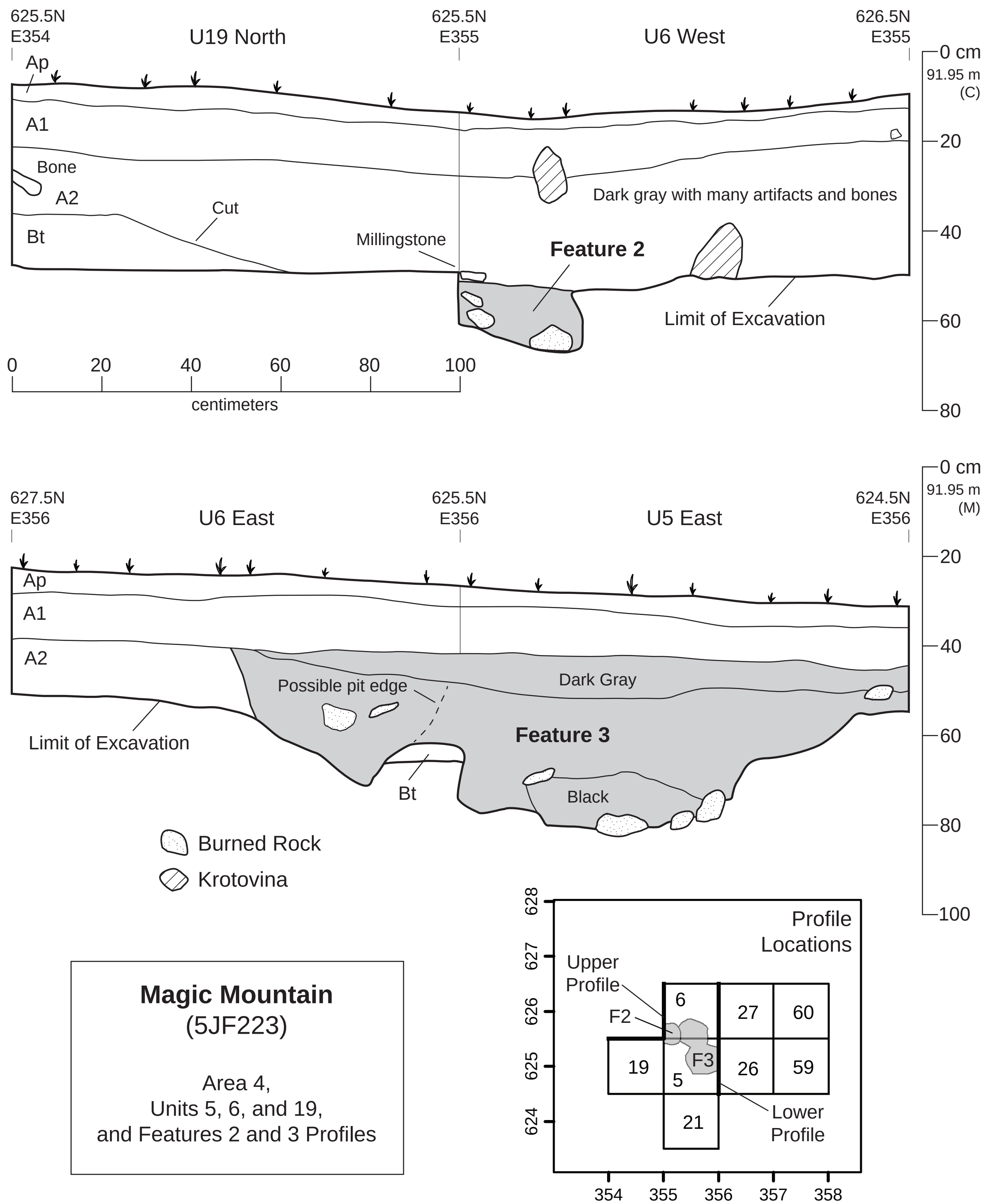


Figure 3.22. Illustration of soil horizons and cultural features exposed in Units 5, 6, and 19 in Area 4.

Figure 3.23. Photograph of GL4 in Units 5 and 6. The overturned millingstone covers Feature 2.

Figure 3.24. Photograph of Feature 3 after excavation.

(below 40 cm). Hand coring indicated that the upper Bt horizon likely was about 35 to 38 cm thick. Unit 36 and the Units 7, 8, and 17 block occur on a common contour. In Units 22 and 23, located on a slightly higher contour, the AB horizon is missing. In those units, a somewhat thicker A horizon directly overlies a thinner Bt horizon. A second Bt horizon was also exposed in Units 22 and 23. In Unit 61, located even higher on the slope, the A horizon is thinner than the analogous horizon exposed in Units 22 and 23.

Feature 6 was the deflated remnants of a shallow, rock-filled basin. The tops of the burned rocks filling the feature occurred in the A horizon. However, the feature's matrix had been almost entirely removed by sheetwash erosion prior to burial; only a few flakes and bone fragments remained. The tightly packed rocks in the center of the feature retained their original position and orientation, but some of the stones on the feature's top and perimeter likely had been displaced downslope. The feature's observed condition suggests that most of the fill had been stripped away by erosion after it was no longer in use. However, the base of the feature, which was cut into the Bt1 horizon, was visible in the north profile of Units 22 and 23.

Feature 6 was slightly oblong. The distribution of apparently in-place stones suggests that the feature originally was about 70 cm northeast-southwest and more than 75 cm northwest-southeast. About three-quarters of the feature was exposed in Units 22 and 23. The estimated original depth was about 22 cm. The burned rocks present in Feature 6 were comparatively large; the maximum dimensions of the larger stones ranged from about 15 to 25 cm. As was the case for Feature 1, tightly packed stones primarily occurred in the middle of the feature. Judging by the preserved profile, the lower portion of the feature contained fewer stones and more sediment.

Although Feature 6 and Feature 1 occurred at two different depths (14 to 16 cm below the modern ground surface in the case of Feature 6 compared to 46 cm below the modern surface in the case of Feature 1), and were separated by just 2 m, their soil stratigraphic positions were similar. The bases of both were cut into the upper Bt horizon. Feature 1 originated near the base of the overlying AB horizon while Feature 6 originated in the middle of the overlying A horizon. These data suggest that a slope break, possibly representing an eroded terrace riser, occurred between Feature 6 and Feature 1. If so, both the riser and the adjacent treads were subsequently mantled by colluvium.

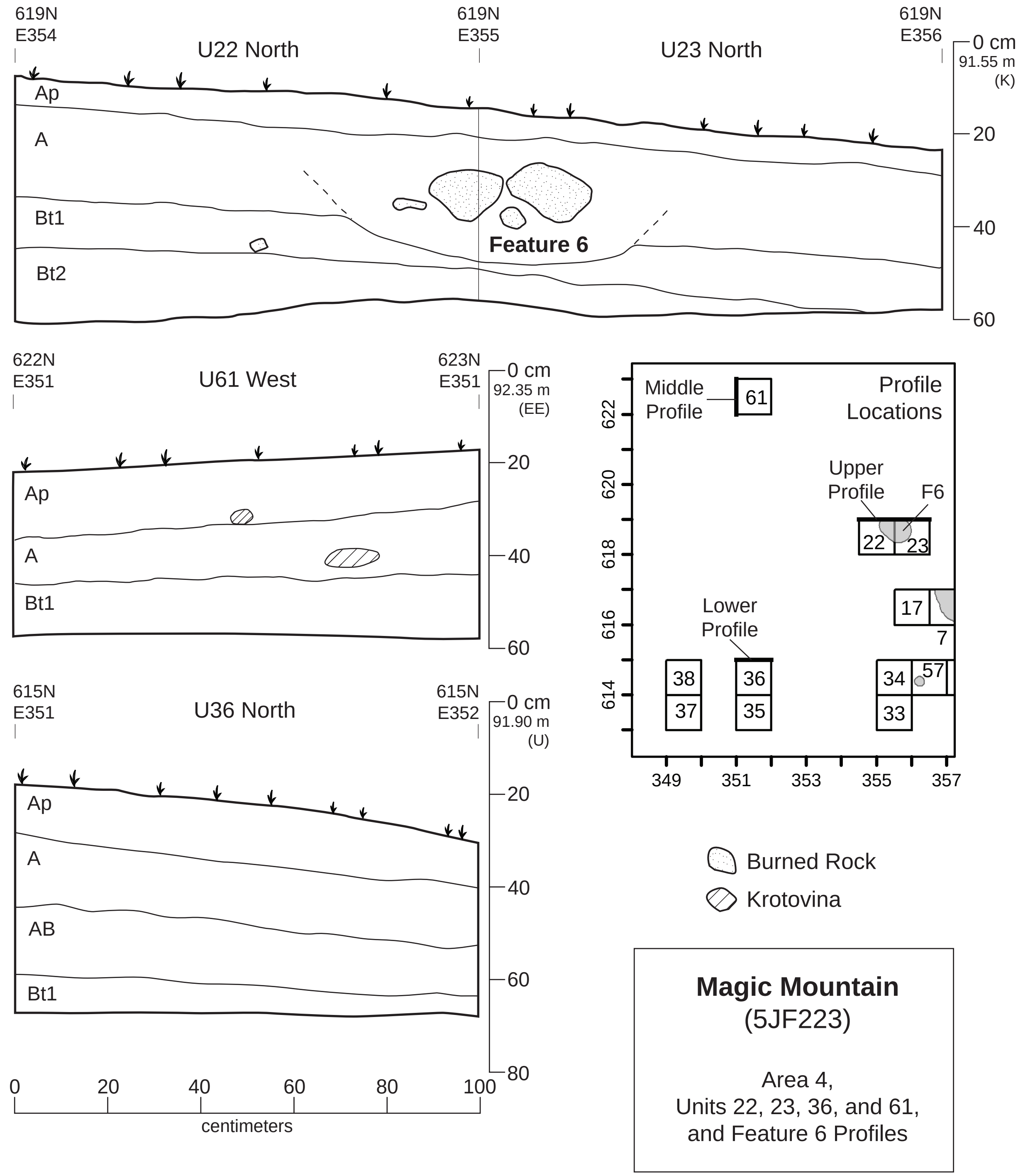


Figure 3.25. Illustration of soil horizons and cultural features exposed in Units 22, 23, 36 and 61 in Area 4.

Area 4 Strata and Features (2018)

Figures 3.26 and 3.27 illustrate soil horizons exposed in Area 4 during 2018. The positions of Features 13 and 14 also are illustrated. These units were located slightly lower on the colluvial apron than the six-unit block containing Features 2 and 3, but slightly higher than the three-unit block containing Feature 1. As is true across the site, the uppermost horizon is an Ap that varies in thickness from about 6 to 10 cm. Below the Ap is an A horizon comprised of two units that together vary in thickness from about 20 to more than 35 cm. The lower A2 horizon contains abundant American Indian artifacts, animal bones, charcoal, and burned rock and corresponds to the anthropogenically enriched horizon observed elsewhere in Area 4 and in Area 3. The underlying AB horizon is 9 to 15 cm thick. Where the lower boundary of the AB is exposed in Units 44, 52, and 53 it overlies a Bt horizon that is at least 10 cm thick.

The upper surface of the AB horizon is partially cut away on the western side of Unit 51. In that area, the A2 horizon disconformably overly the Bt horizon, as was the case in Units 5, 6, and 19. If the cut in Unit 51 represents the eastern edge of a basin and the cut in Unit 19 represents the western edge, then the basin would have been about 5 m wide. However, no interior post molds were observed during 2018, nor were other traces of the basin's perimeter. The available evidence suggests that the cut only was made on the uphill side, creating a relatively level workspace rather than a basin. If present, a superstructure covering that workspace likely was ephemeral.

Four pits filled with sediment and burned rock (Features 12 through 15) were identified and sampled in Area 4 during 2018. A recent post mold (Feature 9) also was identified in Area 4 during 2018.

Feature 12 was a small basin filled with a mixture of burned rocks and charcoal-stained sediment that originated within the thick, anthropogenically enriched A2 horizon at a depth of about 50 cm DD (90.55 m). Feature 12 was slightly oblong in plan and measured 72 cm east-west, 65 cm north-south, and 20 cm deep. The pit extended into Unit 55 and was entirely excavated.

Burned rocks were concentrated—but not tightly interlocked—near the top and on the southern and eastern sides of the feature (figure 3.28). Rocks varied in size from 10 to 15 cm in maximum dimension. The lower portion of the fill consisted primarily of charcoal-stained sediment.

Feature 13 was an approximately circular rock-filled basin that originated at the top of the AB horizon in Unit 44. The upper surface of the feature dips slight to the east, parallel to the local dip of the soil horizons and the modern surface. The sides of the basin were steeply sloping, and the floor was approximately flat. Rocks entirely filled the basin and were tightly packed and interlocking. Cobbles present in the fill mostly were angular and varied in size. The largest measured about 20 cm in maximum dimension, although most were 5 to 7 cm in maximum dimension. The upper surface of the rock bed was slightly dished, with the tops of rocks in the center at a slightly lower elevation than the tops of rocks on the perimeter. Interstitial fill consisted primarily of dark brown to black charcoal-stained sediment. Numerous chunks of charcoal also were present.

Scattered burned stones occurred on the use surface adjacent to Feature 13, suggesting that the feature's upper surface may have been slightly deflated or disturbed prior to burial. Numerous artifacts and bone fragments also occur on the adjacent surface and in the A2 strata above the surface and the feature.

The excavated portion of Feature 13 measured 80 cm east-west and 60 cm north-south. About three-quarters of the feature was excavated; the original diameter is estimated to have been 80 cm. The maximum depth was 22 cm.

Feature 14 was a large, shallow basin with gently sloping sides that originated at the upper surface of an Ab (paleosol) horizon in Units 52 and 53. This buried A horizon was not observed elsewhere in Area 4. It may have been stripped away during the period of occupation.

The top of the feature occurred at a depth of approximately 48 cm DD (90.92 m); however separate excavation of feature fill only began at 60 cm DD (90.80 m) and only in the feature's southern half in Unit 52. The excavated portion of the approximately circular feature measured 55 north-south and 85 east-west. Based on the distribution of rocks visible in both Unit 52 and in Unit 53, the original diameter of Feature 14 is estimated to have been 100 cm. The maximum depth was approximately 25 cm.

The fill of Feature 14 incorporated numerous angular cobbles up to about 15 cm in maximum dimension. The largest rocks occurred at the top of the feature, while smaller rocks occurred closer to the bottom. However, the rocks were not tightly packed or interlocking. The upper surface of the feature was difficult to define in part because the color and content

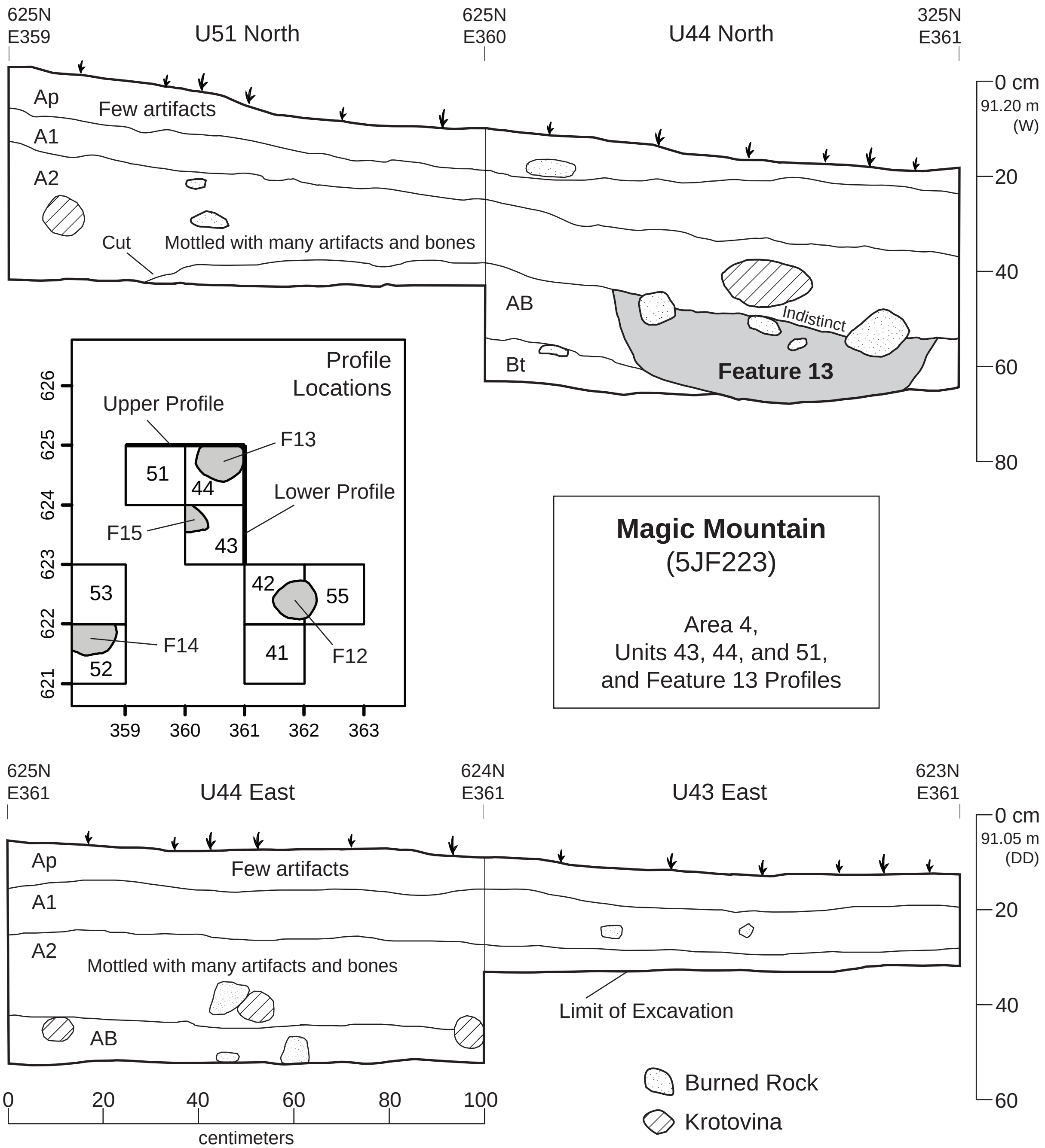


Figure 3.26. Illustration of soil horizons and cultural features exposed in Units 43, 44, and 51 in Area 4.

of the overlying artifact-rich A2 horizon was similar to the upper fill of the feature. The fill on the floor of the basin primarily consisted of charcoal-stained sediment. Charcoal was unevenly distributed in the fill; a concentrated charcoal lens roughly 12 cm thick occurred in the middle of the feature.

Feature 15 was a shallow basin with sloping sides. The feature's origin appeared to have been slightly higher than that of Feature 13 and within the lower portion of the A2 horizon at a depth of approximately 46 cm (90.75 m [two different subdatums were used during the excavation of Feature 15]). The feature's upper surface was indistinct owing to its origin in the A2 horizon; the origin may have been somewhat higher, based on the distribution of burned rocks visible in the west profile of Unit 43.

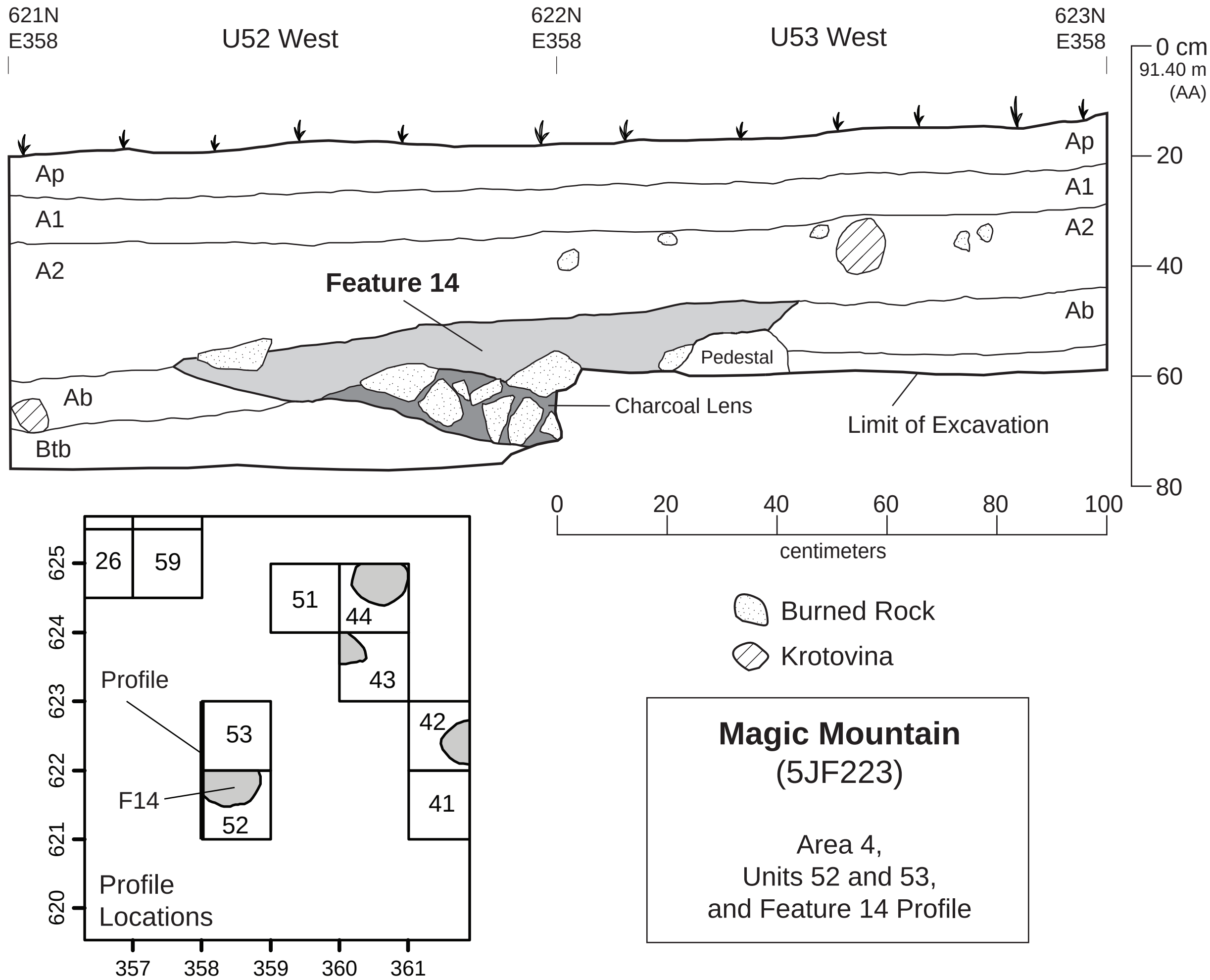


Figure 3.27. Illustration of soil horizons and cultural features exposed in Units 52 and 53 in Area 4.

The mapped perimeter was confined entirely to the northwest quadrant of Unit 43. A scatter of burned rocks around the feature's upper edge may indicate that the feature was disturbed prior to burial. Alternatively, some rocks present in the southwest quadrant of Unit 44 may also have been located within the excavated basin. The perimeter was difficult to define because the feature's fill was similar in color and content to the surrounding A2 and AB horizons.

The maximum dimension of the rocks within the mapped perimeter was about 10 cm; however, most measured 4 to 6 cm in maximum dimension. Numerous rocks were present, but they were not tightly packed or interlocking.

Roughly half of the feature was excavated. The exposed plan dimensions were 40 cm east-west and 45 cm north-south. The maximum excavated depth was 8 cm. The original dimensions are not estimated, owing to uncertainty about the feature's extent and origin and to the asymmetry of the feature's mapped perimeter.

One recent feature also was identified during 2018. **Feature 9** was a post mold that measured 28 cm in diameter and 15 cm in depth. The top of the feature was observed at a depth of 10 cm below the modern ground surface (18 cm DD or 91.12 m), within or at the base of the Ap horizon. The fill contained fragments of treated wood, along with clods of decomposed bedrock, charcoal, and a few lithic flakes. Feature 9 likely dates to the middle of the twentieth century and is not discussed further in this chapter.

Areas 5 and 6

A magnetic gradiometry survey was conducted in Areas 5 and 6 during 2016 and three small excavation

Figure 3.28. Two photographs of Feature 12. Top: The upper surface of Feature 12 prior to excavation. Bottom: Feature 12 after excavation.

blocks were opened in those areas during 2017 (figure 3.29). The primary objectives for work in both areas were to identify and sample buried cultural features and to document soil horizons and stratigraphic relationships in that part of the site.

A variety of recent surface features are visible in the magnetic data for Areas 5 and 6. A curving strip or zone of reduced magnetism roughly 3.5 m wide represents the modern two-track access road located north of the abandoned channel of Apex Gulch. A massive dipolar anomaly that exhibits a magnetic intensity of about ±200 nT located in Area 5 represents the location of an anchor pin for a power-pole guy wire. Smaller dipoles that exhibit intensities between about ±10 and ±100 nT are scattered across Area 6, both north and south of the two-track road.

Work in Area 5 was confined to a single 1 x 2-m block oriented north-south (Units 9 and 10). The block was placed over an apparent monopole anomaly with a maximum intensity of 11.8 nT and a diameter of just over 100 cm. However, a cultural feature was not identified in the block and only a few artifacts were recovered. The soil horizons exposed in Units 9 and 10 consist of a truncated AB and a Bt; surface erosion has stripped away the A horizon and the upper portion of the AB horizon in this part of the site. The targeted magnetic anomaly may have been produced by a ferrous object. No additional excavation was carried out in Area 5. The total volume of sediment removed from Area 5 was about 0.4 m^3.

Two small blocks were opened in Area 6 (figure 3.30). Units 11 and 12, a 1 x 2-m block oriented east-west, was placed over a somewhat amorphous monopole anomaly located immediately north of the two-track road. Maximum magnetic intensity of the monopole, which measured roughly 175 cm north-south and 100 cm east-west, was 5.9 nT. Soil horizons exposed in this block include a surficial Ap horizon roughly 9 cm thick, an 11-cm thick A horizon, an 8-cm-thick AB horizon, and a Bt horizon more than 7 cm thick. A cultural feature was not identified. Recovered artifacts included a small number of lithic flakes along with historical glass fragments and ceramic sherds. The targeted monopole may have represented slightly organically enriched and thickened A horizon sediment due to recent sheetwash deposition.

A second Area 6 block was opened south of the two-track road. Excavation began in Units 13 and 14, an east-west oriented 1 x 2-m block, which were placed over a moderately well-defined monopole with a maximum magnetic intensity of 5.2 nT and a diameter of about 100 cm. Unit 28 was added to the block to provide additional stratigraphic context. Approximately 1.5 m^3 of sediment was excavated from Area 6.

<u>Area 6 Strata and Features</u>

Figure 3.31 illustrates the soil horizons and strata exposed in the southern block of Area 6. The uppermost stratum consists of recently deposited colluvium that likely represents material eroded from the adjacent two-track road. Below that is a 12-cm thick A horizon, a 22-cm thick AB horizon, and a Bt horizon that is more than 10 cm thick.

Feature 8, a shallow, rock-filled basin hearth, was identified at the base of the AB horizon. The

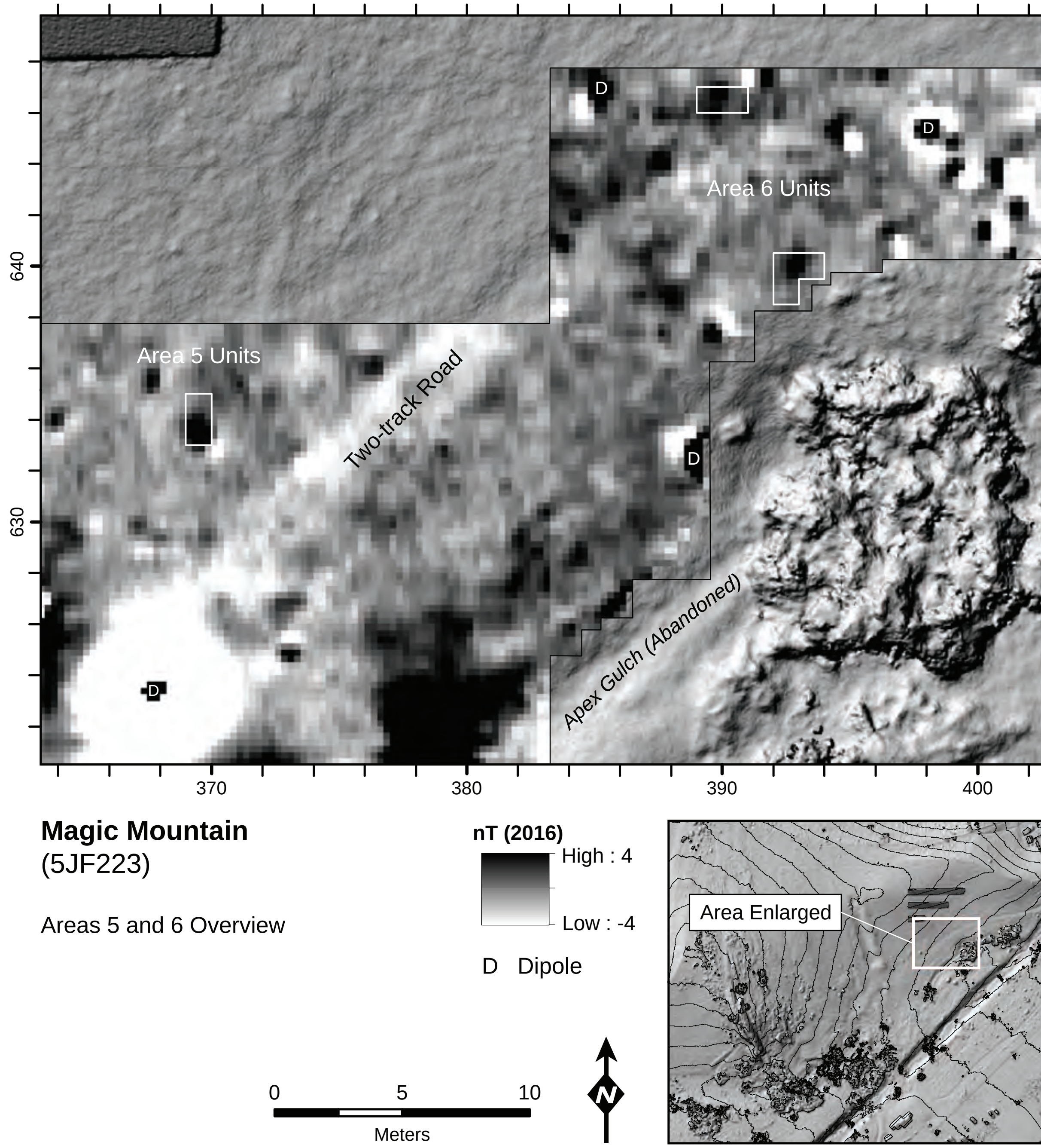


Figure 3.29. Magnetic map showing the locations of magnetic anomalies and excavation units in Areas 5 and 6.

excavated basin was greater than 95 cm wide (east-west); however, excavation was incomplete and so the feature's actual width was somewhat greater. The north-south width of Feature 8 was greater than 70 cm and the maximum depth was 11 cm. Because excavation of the exposed portion of the basin was incomplete, insufficient data are available to estimate its original maximum dimensions.

A dense but not tightly interlocking layer of lightly burned stones lined the bottom of the basin (figure 3.32). Feature 8 appears to have been partially deflated prior to burial by colluvium, a circumstance that made the top and edges of the basin difficult to define. The color and texture of the fill differed only slightly from the color and texture of the overlying AB horizon.

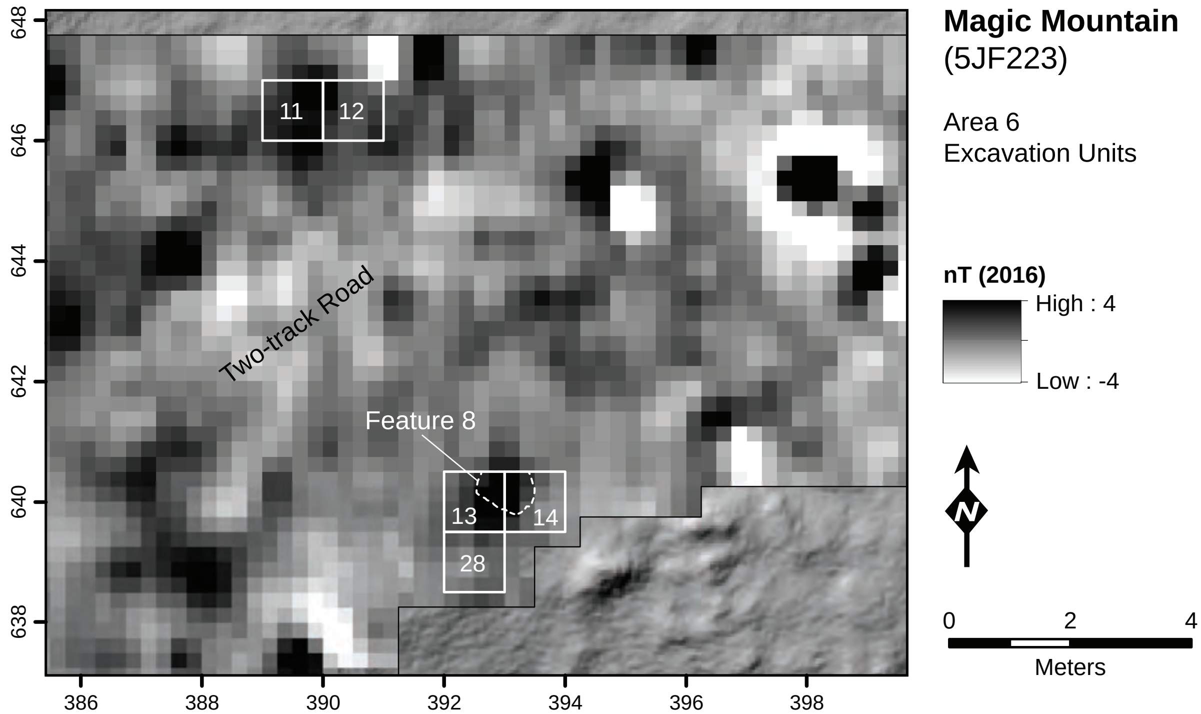


Figure 3.30. Magnetic map showing the locations of excavation units and cultural features in Area 6.

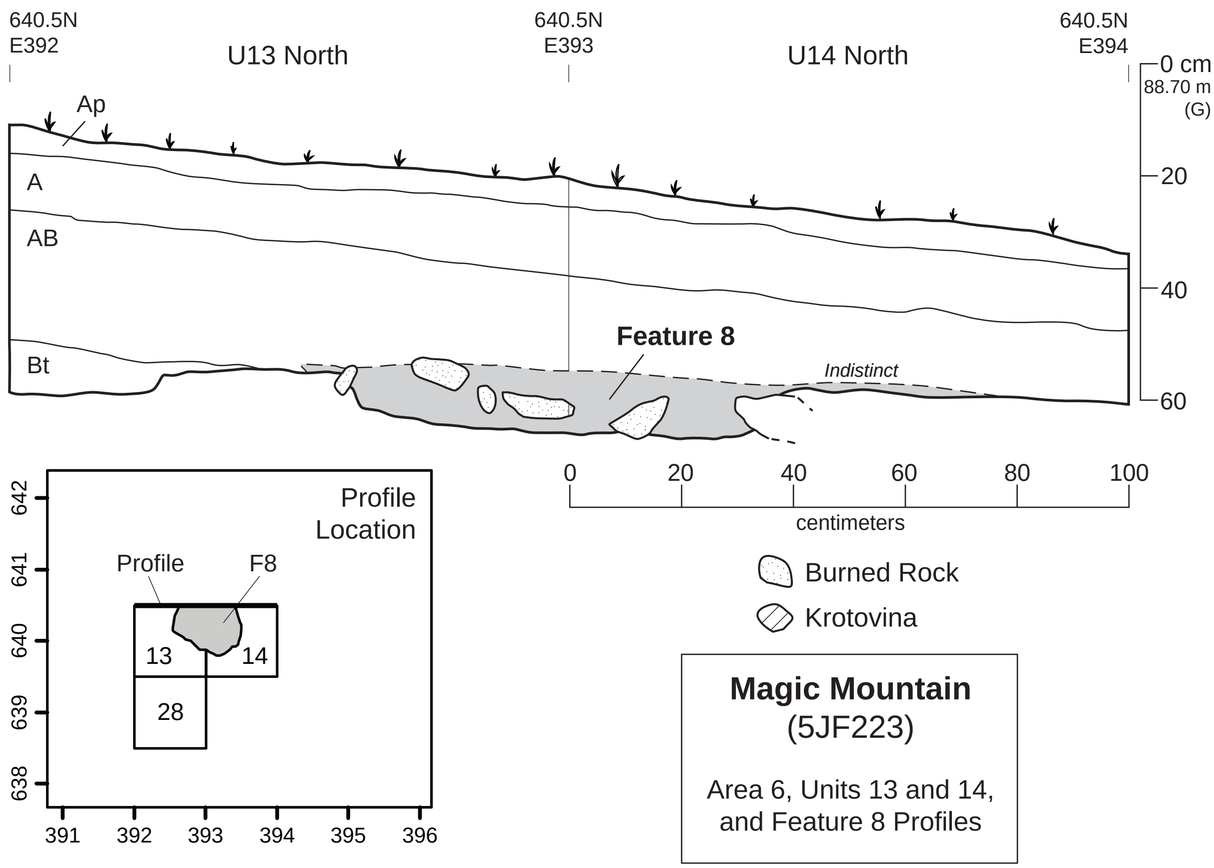


Figure 3.31. Illustration of soil horizons and cultural features exposed in Units 13 and 14 in Area 6.

Figure 3.32. Photograph of Feature 8 prior to excavation.

Area 7

The 2016 magnetic gradiometry and GPR surveys included Area 7 and excavation occurred there in 2017 and 2018. During 2017, the primary aim was to investigate alluvial deposits within and adjacent to the abandoned channel of Apex Gulch. Additional excavation squares were opened in 2018 as a part of the project's community engagement effort (Koons *et al.* 2021).

Magnetic data from Area 7 are complex (figure 3.33). On the southern edge of Area 7, near-surface boulders redeposited on the surface by the channelization of Apex Gulch have produced a jumble of large dipolar anomalies with intensities ranging from about ±10 to ±75 nT. The slope immediately north of the abandoned historic channel of Apex Gulch contains several possible dipoles, although they are small and exhibit intensities less than about ±7 nT. Magnetic variations in this area may primarily reflect local enrichment or depletion of organic material due to sheetwash and bioturbation.

A total of four 1 x 2-m blocks were opened in Area 7 (figure 3.34). Two blocks (Units 15, 16, 24, and 25) were opened in 2017 and two additional blocks (Units 29 through 32) were opened in 2018. The total volume of sediment excavated in Area 7 was about 5.5 m^3.

Area 7 Strata and Features

Figures 3.35 and 3.36 illustrate the near-surface horizons and strata observed in Area 7. Two distinct sequences are present. On the northern end of Area 7, the uppermost horizons consist of an Ap (sheetwash) and relatively thick modern A horizon (figure 3.35). Feature 11 originated in the lower portion of the A horizon and was excavated into the underlying BA horizon. Chapter 2 presents additional data on soil horizons and strata observed in Unit 33, located 2 m north of Feature 11.

On the southern end of Area 7, close to the abandoned channel of Apex Gulch, a deep soil exhibiting an overthickened A horizon is present (figure 3.36). Feature 7 occurred in the lower portion of the A1 horizon, suggesting that the upper surface of the A2 represents a temporarily stable surface. Additional data on the soil horizons and strata observed in this part of the site are presented in chapter 2.

Feature 7 was a large concentration of burned rocks. A shallow basin roughly 5 cm deep was observed at the base of the concentration in the south profile of Unit 25. However, most of the rocks were scattered on the ancient surface as a single layer. Small concentrations or piles of burned rocks within the feature may represent individual dumping events. The width of the feature was greater than 100 cm north-south and the length was greater than 155 cm east-west. The overall extent of the feature could not be determined. The feature's maximum thickness was approximately 23 cm.

Feature 11 was a small, rock-filled basin with relatively steep sides (figure 3.37). Approximately one-quarter of the slightly elliptical feature was exposed in Unit 32; the exposed portion measured 60 cm north-south and 50 cm east-west. The original dimensions of Feature 11 are estimated to have been 100 cm east-west and 120 cm north-south. The maximum original depth of the pit was about 20 cm; however, feature excavation began about 3 cm below the pit's origin. Burned rocks and charcoal-stained sediment were concentrated in the middle of the feature. The deepest portion of the basin was filled with dark brown sediment containing relatively few artifacts.

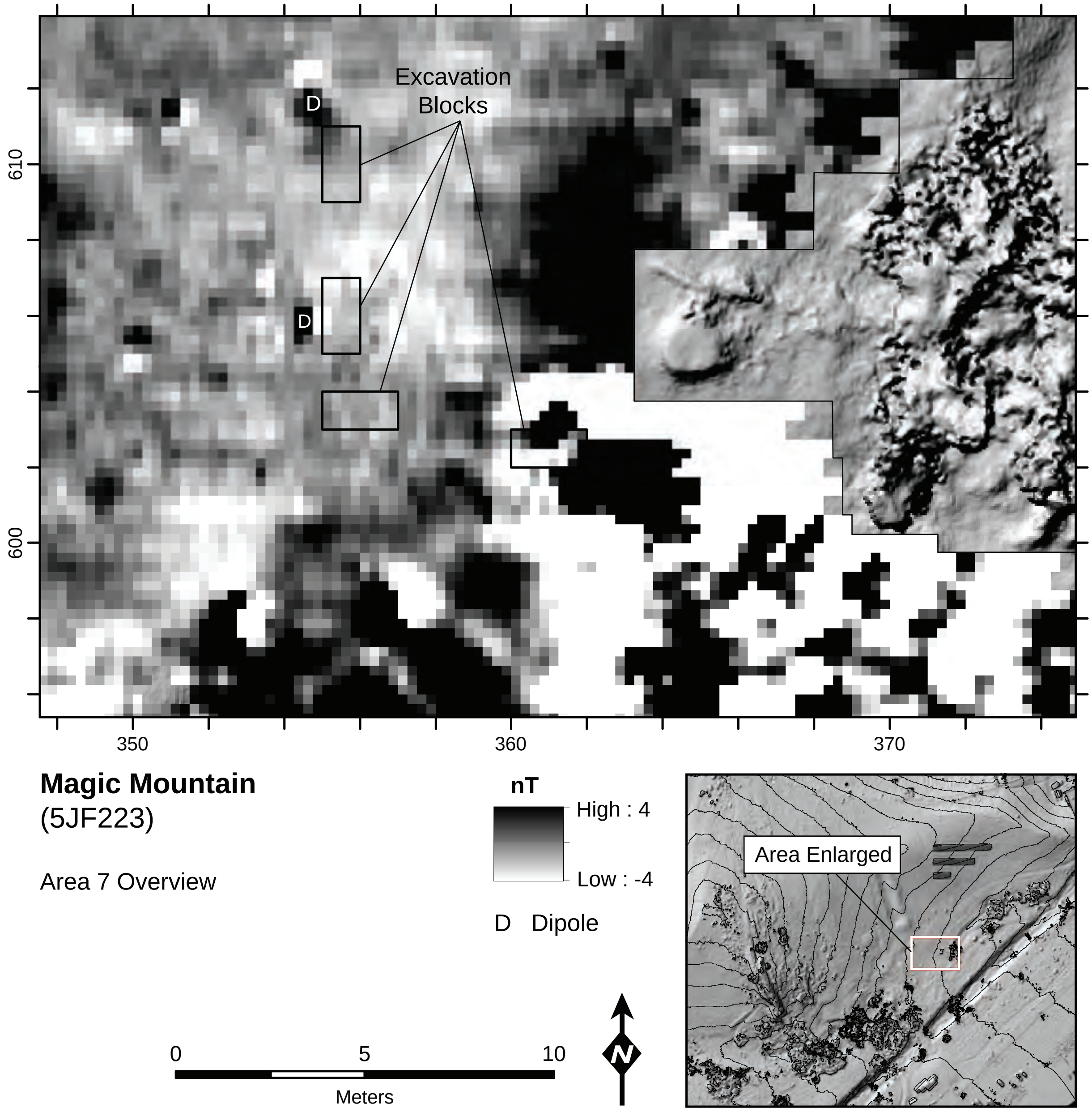


Figure 3.33. Magnetic map showing the locations of magnetic anomalies and excavation units in Area 7.

Stratigraphic Summary

A single near-surface soil stratigraphic sequence was exposed during the 2017-2018 DMNS/PCRG/KU-Odyssey project in Areas 3 through 7. That sequence comprises the modern soil that has formed in colluvium. However, the number, thickness, and character of observed horizons varies depending on landscape position.

A surficial Ap horizon roughly 6 to 10 cm thick was observed in all excavation units, apart from those in Area 3 where the uppermost stratigraphic unit consists of displaced sediment. Although there is no evidence that the portion of the site investigated by the DMNS/PCRG/KU-Odyssey team was plowed, it likely was used as a pasture during much of the twentieth century. The Ap horizon is relatively fine-grained, lighter in color than the A horizon below it, and contains few artifacts. These data suggest that it may partly comprise A horizon sediment displaced by slopewash. Trampling and vegetation removal by livestock likely promoted the transport and

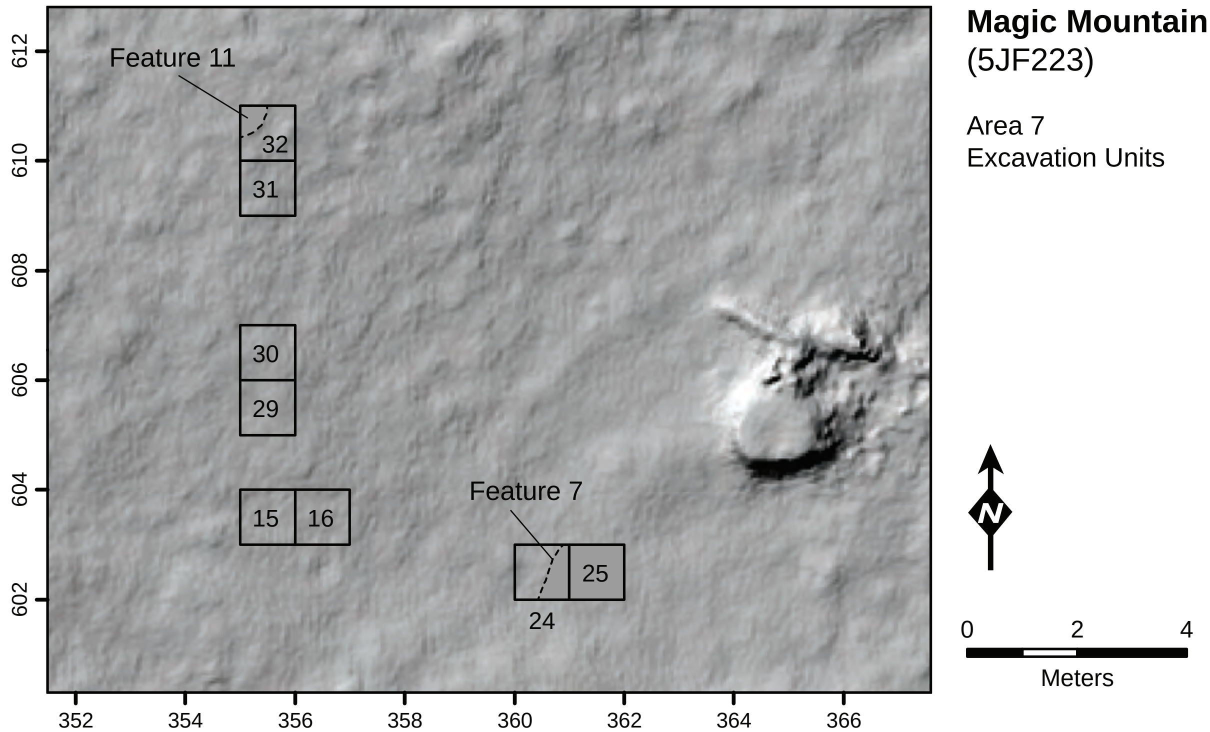


Figure 3.34. Terrain map showing the locations of cultural features and excavation units in Area 7.

homogenization of sediment on the site's surface. Ap horizon sediment may also have been augmented by recent aeolian deposition. The fact that the Feature 9 post mold appeared to originate near the base of the Ap horizon suggests that it is relatively recent.

Beneath the Ap horizon is an A horizon that varies in thickness from as much as 40 cm to as little as 15 cm. The A horizon generally can be subdivided into an upper A1 and a lower A2. The A horizon is thickest close to the abandoned channel of Apex Gulch (figure 3.38[c]) and thins upslope toward the northern side of Area 4 (figure 3.38[a]). Intermediate thicknesses were observed in mid-slope locations (figure 3.38[b]). AB (or BA or AC) horizons also were observed in some mid- and upper-slope locations. Slopewash is responsible for the incremental accumulation of sediment on the lower portion of the colluvial apron and the cumulic character of A horizon in that portion of the site. Now-buried terrace surfaces may also occur on some mid- to -lower slope locations flanking the Apex Gulch channel, based on seemingly abrupt differences in A horizon thickness observed in closely spaced excavation units.

One or two Bt horizons also were observed in most excavation units. Artifacts occur in B horizon sediment, but all of the documented American Indian cultural features originated within the AB or the lower A horizon.

Where present, the upper portion of the A horizon (A1) contains only a modest number of artifacts. By contrast, apparent anthropogenic enrichment of the lower A horizon (A2) was observed in Areas 3 and 4. Animal bones, charcoal, burned rocks, and artifacts are especially abundant in these portions of the site. Combined with sediment accumulation during the period of occupation, repeated reuse of these mid-slope locations resulted in the emplacement of an especially rich cultural horizon.

In the northern part of Area 4, this anthropogenic A2 horizon lies discomformably on a surface cut into the underlying upper Bt horizon (figure 3.39). In this area, the contact between the A2 and the Bt is abrupt, and partially disaggregated B horizon rip-up clasts occur along with abundant artifacts and animal bones within the A2 horizon. Sloping cuts into the surface of the B horizon were observed in Units 19 and 51. A similar disconformity and truncated surface was not observed elsewhere during the 2017-2018 field investigation. The resulting excavated surface may represent an ephemeral architectural feature or a leveled workspace.

A slightly different sequence was exposed in

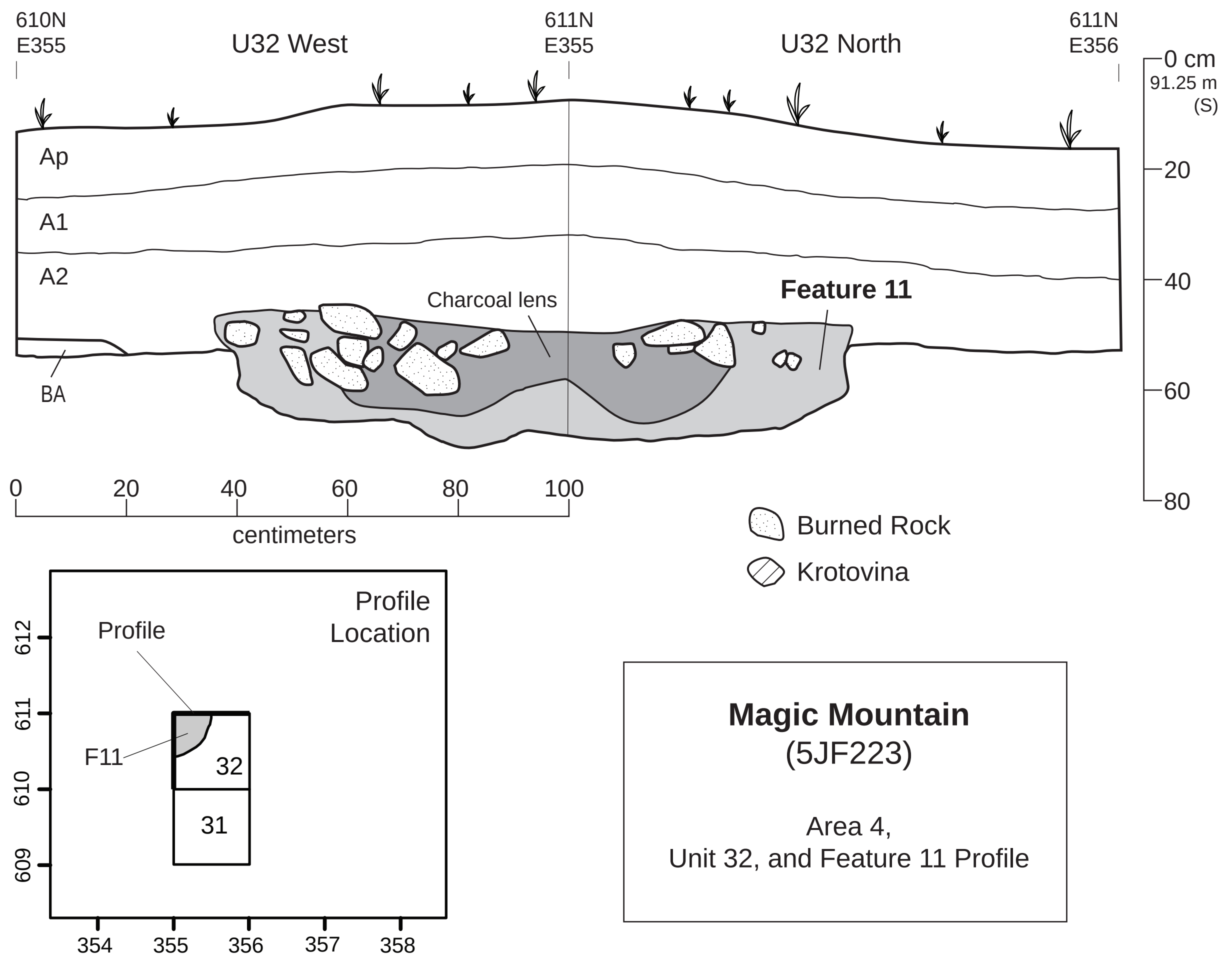


Figure 3.35. Illustration of soil horizons and cultural features exposed in Unit 32, Area 7.

Area 2. In that part of the site, the modern soil is represented by two A horizons formed in aeolian and colluvial deposits. As is true in Areas 3 through 7, the sediment in which the modern soil has formed may have been emplaced relatively recently. Beneath the modern soil is a weakly developed soil formed in sandy colluvium. Two color B horizons were exposed beneath the A horizon. The feature identified in Area 2 originated near the top of the buried soil.

Additional data on soil horizons and site stratigraphy are presented in chapter 2.

Feature Analysis

Fourteen cultural features associated with the Indigenous American occupancy of Magic Mountain were identified and sampled during the 2017-2018 field investigation (figure 3.40; table 3.4). Twelve of the 14 consisted of excavated basins filled with burned rock. The sizes and sections of those basins varied, as did the distributions of burned rock within them.

The following analysis is partitioned into three topics, including the types, sizes, and morphological characteristics of the sampled features; the content of the features; and the ages and use histories of the features. The final section of the analysis summarizes and integrates these three datasets.

Feature Morphology

Table 3.7 presents data on the types and sizes of documented features, along with data on feature disturbance and reuse. The feature inventory includes three basic types: pits filled with burned rock, a storage pit, and a burned rock concentration. The fill of the former two can be regarded as contained deposits that occur within an excavated pit or basin. Contained deposits commonly exhibit little evidence of trampling

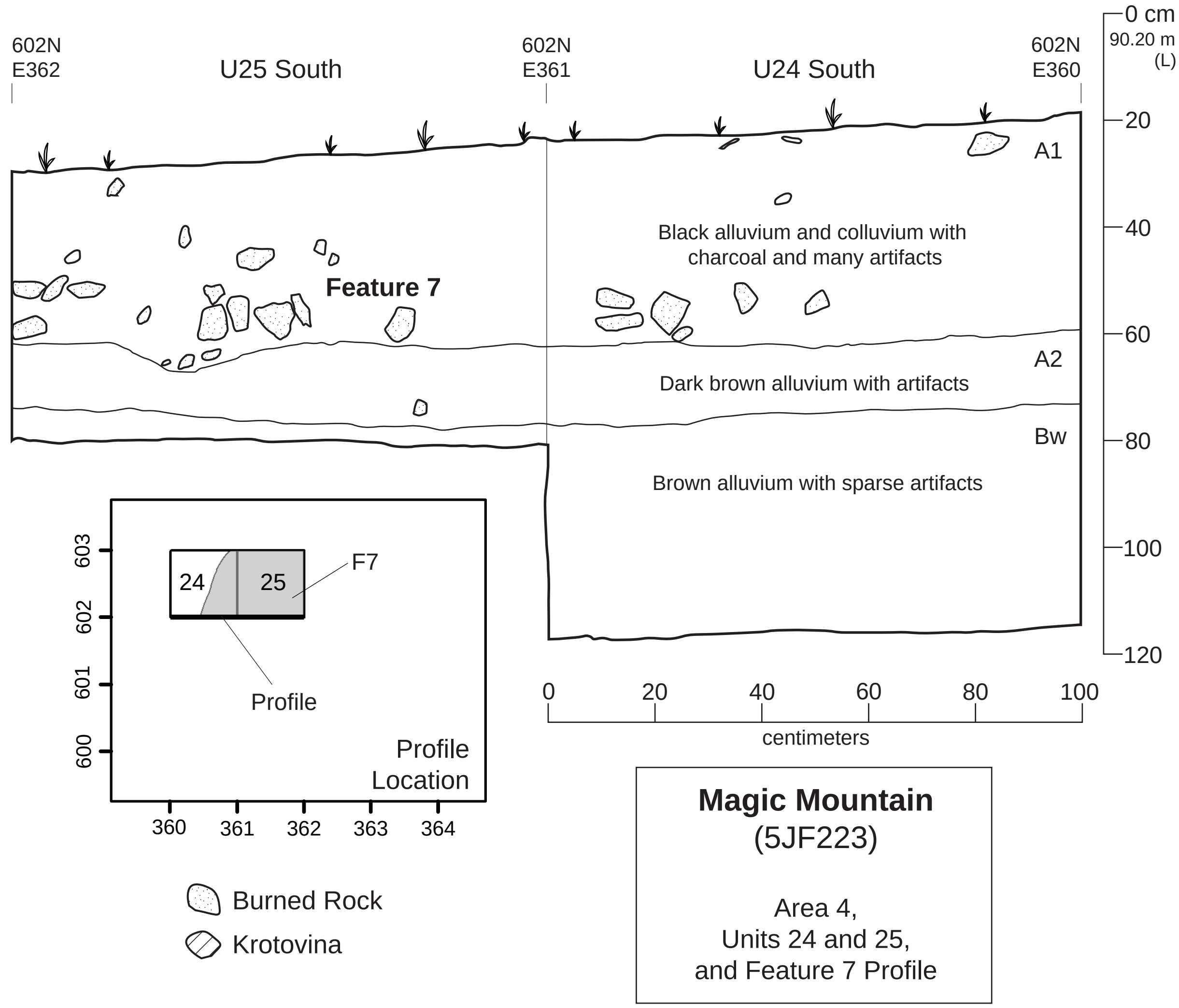
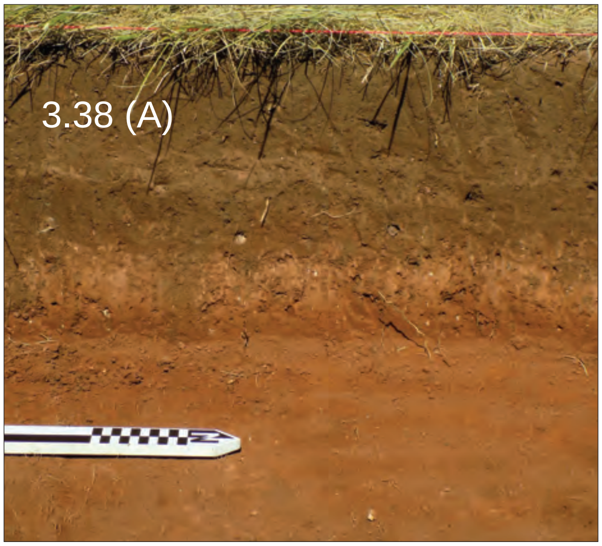


Figure 3.36. Illustration of soil horizons and cultural features exposed in Units 24 and 25, Area 7.

Figure 3.37. Photograph of Feature 11 prior to excavation.

or post-depositional disturbance. By contrast, the contents of the burned rock concentration can be regarded as uncontained and subject to tramping, mixing, and displacement. Burned rocks are primary constituents of the basin hearths and the burned rock concentration but are only incidentally present in the fill of the storage pit.

At least two feature subtypes occur within the rock-filled pit type. One subtype—an earth oven—is distinguished by the presence of a continuous layer of tightly interlocking burned rocks, which served as the oven's primary heating element. Features 3, 10, and 13 exhibited burned rock layers of this type lining the floor of the basin, indicating that they originally were constructed as earth ovens. Features 1 and 5 also exhibited tightly interlocking layers of burned rock, but in those features the rock layer was underlain by



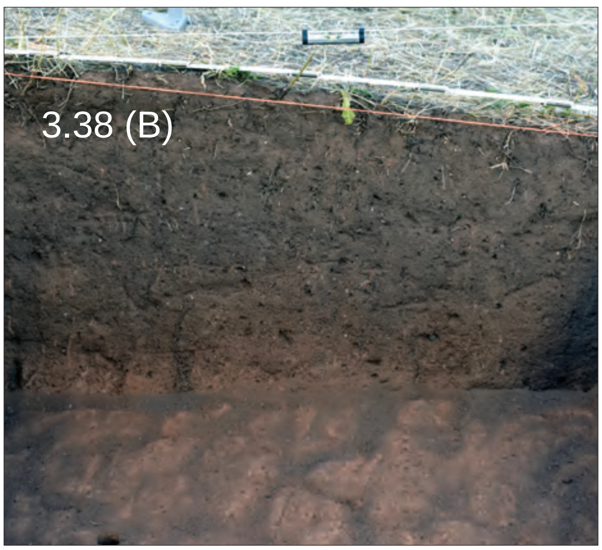


Figure 3.38. Three photographs of soil horizons exposed during the 2017-2018 fieldwork. A: West profile of Unit 19 in Area 4; B: North profile of Unit 36 in Area 4; C: North profile of Unit 24 in Area 7. Among the three excavation squares, Unit 19 was highest on the colluvial apron, while Unit 24 was the lowest.

Figure 3.39. Two photographs of soil horizons exposed during the 2017-2018 fieldwork. Top: West profile of Unit 6 in Area 4; Bottom: West profile of Unit 19 in Area 4. These two profiles were 1 m apart (E354 and E354), but a truncation of the upper B horizon occurred between them. In Unit 6, a disconformity occurred at the base of the A2 (Early Ceramic) horizon.

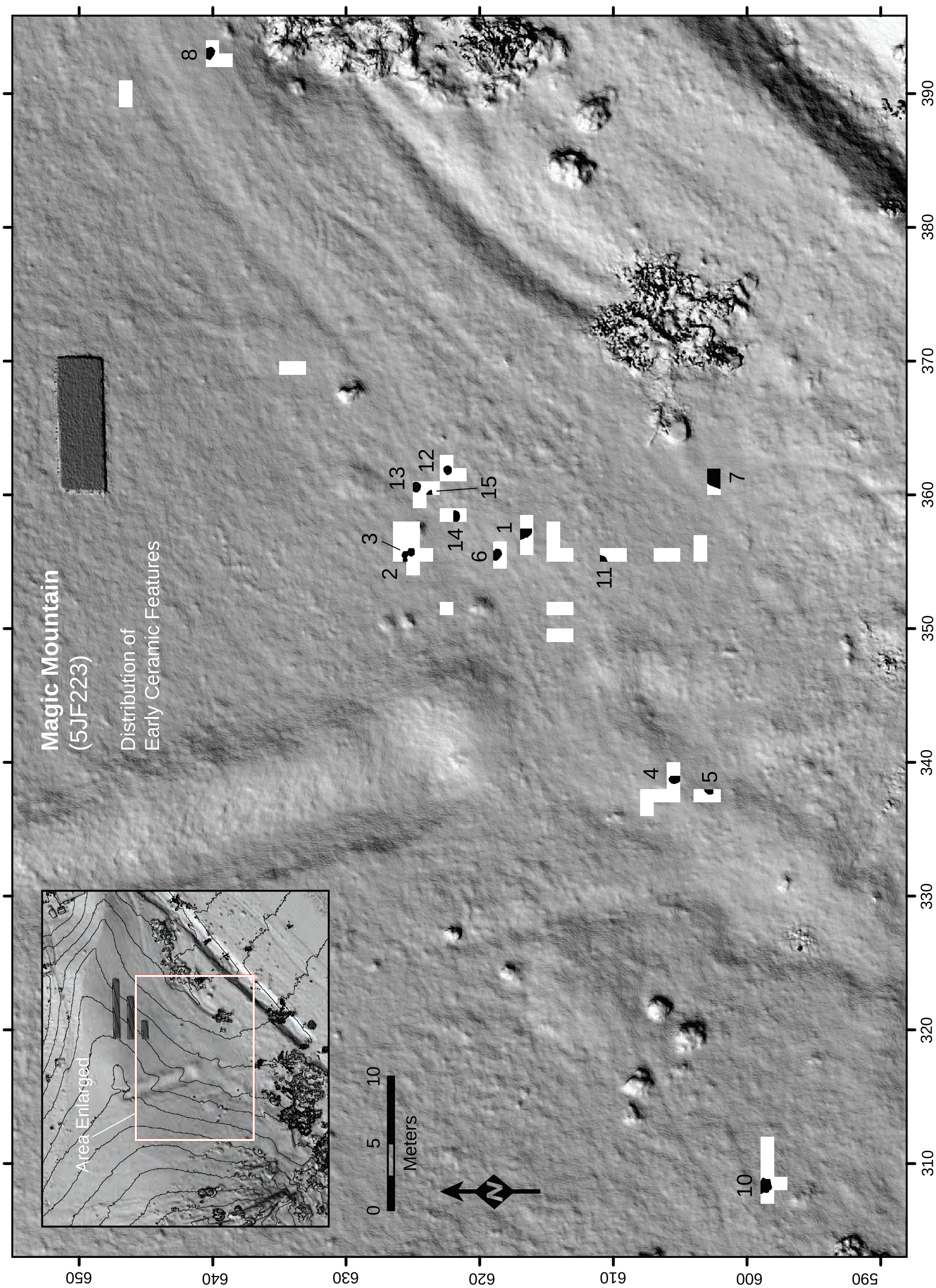


Figure 3.40. Terrain map showing the locations of Early Ceramic features sampled during the 2017-2018 fieldwork.

Table 3.7. Morphology, estimated original size, and other data on 14 Indigenous American features.

Year	Area	Feature	Subtype	Estimated Dimensions (cm)			Solid Geometry	Estimated Volume (liters)	Disturbed Upper?	Reused?
				Major Axis	Minor Axis	Depth				
2017	4	1	Earth Oven (Secondary)	120	90	22	Ellipsoid	124.4	Y	Y
2017	4	2	Storage pit	50	50	15	Spherical Segment	31.2	N	N
2017	4	3	Earth Oven (Primary)	115	70	50	Ellipsoid	210.0	Y	Y
2017	3	4	Basin hearth	100	75	35	Ellipsoid	137.4	Y?	Y?
2017	3	5	Earth Oven (Secondary)	90	65	17	Ellipsoid	52.1	N	Y
2017	4	6	Basin hearth	75	70	22	Ellipsoid	60.5	Y	nd
2017	7	7	FCR concentration	nd	nd	23	Not determined	nd	na	na
2017	6	8	Basin hearth	nd	nd	11	Not determined	nd	Y	N?
2018	2	10	Earth Oven (Primary)	115	115	18	Spherical Segment	142.0	Y	N
2018	7	11	Basin hearth	120	100	20	Ellipsoid	125.7	N	Y?
2018	4	12	Basin hearth	72	65	20	Ellipsoid	49.0	N	Y?
2018	4	13	Earth Oven (Primary)	40	40	22	Spherical Segment	103.2	Y?	N?
2018	4	14	Basin hearth	50	50	25	Ellipsoid	130.9	N	N
2018	4	15	Basin hearth	nd	nd	8	Not determined	nd	Y?	N?

charcoal-stained sediment suggesting that they were converted to an earth oven later in their history of use.

The second subtype also contained numerous burned rocks. However, the rocks were not tightly interlocking but instead surrounded by a matrix of charcoal-stained sediment containing artifacts and animal bones. In several cases, notably Feature 12, the rocks were unevenly distributed within the fill. Scattered rocks in these features may represent boiling stones; however, many were improbably large to serve that purpose. Features 4, 6, 8, 11, 12, 14, and 15 can be assigned to the second subtype, termed "basin hearths."

Table 3.7 also provides estimates of each feature's original size. The estimates are extrapolated from the size and shape of the portion of each feature exposed during excavation, assuming approximate bilateral symmetry. Volumes were calculated using formulas for geometric solids. The volumes of features exhibiting roughly flat floors were calculated using the formula for a spherical segment. Volumes of features exhibiting continuously sloping sides were calculated using the formula for a triaxial ellipsoid. Estimated volumes should be regarded as ordinal approximations rather than precise interval values.

The mean volume of the ten rock-filled pits for which estimated original volume could be calculated is 113.5 liters. The mean volume of the three features originally constructed as earth ovens is roughly 50 percent greater than that of the five that do not exhibit the characteristics of earth ovens (151.7 liters compared to 100.7 liters). However, this difference is due in part to the fact that the largest rock-filled pit (Feature 3) originally was constructed as two separate earth ovens that merged into a single feature later in its use-life. Nevertheless, the estimated mean volume of all five features used as earth ovens (126.3 liters) is slightly larger than the mean for all rock-filled pits combined (113.5 liters).

Six basin hearths, including Features 1, 3, 4, 5, 11, and 12, exhibited possible or definite evidence of reconstruction and reuse. Two types of evidence suggest reuse. One is notable vertical or horizontal differences in the content of the fill, including the distribution of burned rocks. The second is irregular or asymmetrical plan outline, especially differences in basin morphology or perimeter between the base and the top of the feature. The six other basin hearths lack evidence for reuse.

Possible or definite evidence for post-use disturbance of a feature's upper surface was observed for seven of the 12 rock-filled pits. Documented disturbance prior to burial primarily consisted of the removal of the upper feature fill or the displacement of feature rocks by surface erosion. The upper surface of Feature 3 likely was disturbed by ongoing activities of site's American Indian occupants after the feature was no longer used as an earth oven.

Feature Content

Artifact densities can be used to gauge differences or similarities among the sampled features. Table 3.8 provides data on the volume of sediment excavated from ten of the features, including five earth ovens (three of which originally were built as earth ovens and two of which were later converted to earth ovens) and five basin hearths. Excluded are Feature 2 (a small storage pit) and Feature 7 (a burned rock concentration). Two basin hearths also are excluded: Feature 6, the fill of which had been removed by erosion prior to burial, and Feature 15, which only was minimally sampled. Data on Feature 3 are limited to FL3 and FL4, which together represent the early uses of the feature as an earth oven; the two upper levels of Feature 3 likely were disturbed by post-use activities. Note that a dryscreen sample was not collected from Feature 14. The Feature 14 sample represents only a small portion of the fill; only the south half of the pit was excavated, and the upper portion of the feature fill was included with the overlying general level samples.

Table 3.9 provides data on burned rock density, bone density by count and weight, flaking debris density, and stone tool counts. On average, the features shown in table 3.9 contained about three-fourths of a kilogram of burned rock per liter of excavated sediment. Rock density is slightly lower among earth ovens (primary and secondary) than among basin hearths (733 g/liters compared to 814 g/liter). However, this difference does not seem especially meaningful.

In contrast to the relatively homogeneous distribution of burned rocks, the density of vertebrate faunal remains varies among features. Feature 10, a well-sampled earth oven, contained the lowest density by count or weight. Another well-sampled earth oven, Feature 3 (FL3 and FL4), contained the highest density. Systematic differences in bone density do not appear to exist between the two subtypes of rock-filled pits.

Compared to bone density values, flaking debris is relatively evenly distributed among the sampled features. The highest flake density (7.8 flakes/liter in the Feature 4 bulk sediment sample) is about eight times the lowest density (1.0 flakes/liter in the Feature 8 bulk sample), whereas the highest bone density (by count) is almost 70 times the lowest. However, as is true of other materials, flake density values do not appear to be a function of feature subtype.

Note that flake densities observed in bulk sediment samples are generally twice as great as flake densities observed in ⅛-in dryscreen samples from the same contexts. Bulk samples were floated in the lab, while dryscreen samples were picked in the field. The lower values for dryscreen samples strongly suggest that many specimens were missed in the field. Additional data on the effects of recovery method on sample size are presented in chapter 4.

Stone tools are uncommon in all feature contexts. Ground stone tool fragments are roughly three times more abundant that chipped stone tools; however, all

Table 3.8. Excavated volume of ten rock-filled pit features.

		Excavated Volume (Liters)		
Feature Number	Subtype	⅛-in Dryscreen	Bulk Sediment	Total
1	Earth Oven (Secondary)	118.3	31.8	150.1
3 (FL3-4)	Earth Oven (Primary)	79.6	39.5	119.1
4	Basin Hearth	51.1	25.0	76.1
5	Earth Oven (Secondary)	23.3	5.3	28.6
8	Basin Hearth	36.5	21.0	57.5
10	Earth Oven (Primary)	90.6	10.0	100.6
11	Basin Hearth	18.3	10.0	28.3
12	Basin Hearth	28.6	15.0	43.6
13	Earth Oven (Primary)	43.9	25.0	68.9
14	Basin Hearth	-	35.0	35.0

Table 3.9. Densities of artifacts and other materials within 10 sampled features.

Feature	Subtype	FCR	Vertebrate Fauna		Flakes		Stone Tools	
		(g/liter)	(count/liter)	(g/liter)	Dryscreen (count/liter)	Bulk (count/liter)	Chipped (count)	Ground (count)
1	Earth Oven (Secondary)	706	1.1	0.17	0.4	3.2	0	7
3 (FL3-4)	Earth Oven (Primary)	625	6.8	1.12	2.3	3.9	9	5
4	Basin Hearth	885	1.7	0.15	3.1	7.8	5	3
5	Earth Oven (Secondary)	910	2.1	0.25	2.3	5.1	1	22
8	Basin Hearth	884	1.6	0.10	0.0	1.0	0	2
10	Earth Oven (Primary)	706	0.1	0.01	2.5	4.9	0	8
11	Basin Hearth	613	0.5	0.01	0.8	2.0	0	0
12	Basin Hearth	721	1.7	0.11	1.2	2.5	0	5
13	Earth Oven (Primary)	720	0.6	0.04	0.8	2.8	1	1
14	Basin Hearth	967	0.3	0.18	na	1.5	0	0
Means		746	2.0	0.28	1.5	3.3	-	-

of these fragments represent specimens repurposed as heating element stones or boiling stones. Ground stone tool fragments were more commonly incorporated in earth ovens than basin hearths. Chipped stone tools only occur in four of the ten features, and more than half of the feature assemblage occurs in just one feature (Feature 3).

These comparisons indicate that the two morphological subtypes—earth ovens and basin hearths—are not distinguished by distinctive artifact assemblages. Put another way, feature content does not appear to directly reflect feature function. Instead, the characteristics of the fills may reflect the types of activities—or their intensity—that occurred adjacent to the feature, especially those that occurred close to or at the end of the features' period of use.

Feature 3 (FL3-FL4) stands out among the rock-filled pits sampled during the 2017-2018 DMNS/PCRG/KU-Odyssey project. Feature 3 contains more chipped stone tool fragments than any other feature. It also is the only feature that produced projectile points. It also contains more vertebrate faunal remains than any other feature, including 21 of the 51 identifiable specimens recovered from feature contexts. (Ten additional identifiable specimens were recovered from FL1 and FL2.) The meaning of the distinctiveness of Feature 3 is not clear; however, it was located within the possible basin house or workspace that appears to have been a center of activity.

Feature Age and Use History

The following interpretations of the age and use history of each feature combine radiocarbon data with data on feature morphology, integrity, and soil stratigraphic context. Data on the occurrence and distribution of temporally sensitive artifacts—pottery and projectile points—are discussed but explicitly excluded from the analysis of feature age and use history. This was done so that the chronology of artifact types and styles could be evaluated independently.

Radiocarbon dates are the backbone of the feature chronology. A total of 32 dates were obtained from feature contexts (table 3.10). Four sets of samples were submitted for dating. The first round or group of samples was submitted to evaluate the overall chronological structure of the deposits exposed during 2017. Just one feature sample was submitted during the first round; one additional date obtained during the first round is discussed in chapter 2. The second round of samples was submitted to date

Table 3.10. Radiocarbon sample provenience and other data.

Dating Round	Catalog Number	Unit Number	Feature Number	Level	Plot Location (cm) N	E	Z	Charred Material Type[a]	Weight (g)
4	4098	7	1	FL2	60	83	63	*Pinus ponderosa*	0.080
2	4105	7	1	FL2	72	64	72	*Pinus ponderosa*	0.270
2	4125	7	1	FL1				*Prunus* sp.	0.054
2	4100	6	2	FL1	17	17	56	*Pinus ponderosa*	0.220
2	4102	6	2	FL1	20	24	55	*Pinus ponderosa*	0.200
2	4165	5-6	3	FL4-North				*Chenopodium* spp. seeds	0.033
4	4165	5/6	3	FL4-North				Cheno-am perisperm	0.014
2	4188	5-6	3	FL4-South				*Chenopodium* spp. seeds and perisperm	0.011
4	4188	5/6	3	FL4-South				Cactaceae spines	0.010
2	3093	18	4	FL1				Asteraceae	0.035
4	3093	18	4	FL1				Rosaceae	0.036
2	3095	18	4	FL1	82	70	72	*Pinus ponderosa*	0.110
4	3127	1/2	5	FL1				*Prunus* sp. seeds	0.006
2	3127-1	1-2	5	FL1				*Prunus* sp.	0.016
2	3127-2	1-2	5	FL1				*Arctostaphylos uva-ursi* seed	0.008
1	7046	25	7	FL1	43	28	62	Not identified	0.530
2	6037	13-14	8	FL3				*Cercocarpus montanus*	0.035
4	2038-3	48-56	10	FL1				*Pinus* sp.	0.030
4	2042	48	10	FL1	65	21	45	*Pinus ponderosa*	0.080
3	2038-1	48-56	10	FL1				*Cercocarpus montanus*	0.012
3	2038-2	48-56	10	FL1				Rosaceae (vitrified)	0.015
3	7115	32	11	FL1				*Pinus* sp. (small branch)	0.030
4	7125	32	11	FL1	60	6	56	*Pinus ponderosa*	0.050
3	7126	32	11	FL1	87	20	58	*Pinus ponderosa* (small branch)	0.140
4	4342	42-55	12	FL1	36	99	63	*Pinus ponderosa*	0.120
3	4345-1	42-55	12	FL1				*Vitis riparia* seed	0.015
3	4345-2	42-55	12	FL1				Rosaceae (twig)	0.030
3	4387	44	13	FL1	94	40	53	Salicaceae (small branch)	0.090
4	4388	44	13	FL1	56	74	50	*Pinus ponderosa*	0.040
3	4393	44	13	FL1	95	59	56	*Pinus ponderosa* (small branch)	0.100
3	4405-1	52	14	FL1-South				Rosaceae (twig)	0.020
3	4405-2	52	14	FL1-South				*Cercocarpus montanus* (twig)	0.023

[a] All samples consisted of wood charcoal unless otherwise indicated.

features exposed during 2017, while the third round was submitted to date features exposed during 2018. The fourth and final round was submitted to answer specific questions raised by the dates obtained during the second and third rounds.

At least two radiocarbon samples were submitted for most of the identified features (table 3.11). No samples were submitted for Features 6 or 15. The fill of Feature 6 had been entirely removed by erosion, while the fill of Feature 15 had mostly been removed. Just one date each was obtained for Features 7 and 8. Feature 7 was a large, uncontained dump of burned rock and charcoal, the margins of which were incompletely defined. Feature 8 had been partially deflated. Two to four dates were obtained for each of the remaining 10 features.

Species identification was performed on all dated samples, apart from the single Feature 7 sample. Roughly 60 percent of the dated specimens were picked from floated feature fill samples. The balance consists of piece-plotted charcoal fragments. Specimens representing short-lived species were preferred for dating, including seeds of annual plants or herbaceous perennial plants. If specimens representing short-lived species were not available, then seeds, twigs, or branches of woody shrubs were

Table 3.11. Distribution of 32 radiocarbon dates among 14 American Indian cultural features.

Area Number	Feature Number	Number of Dates
4	1	3
4	2	2
4	3	4
3	4	3
3	5	3
4	6	-
7	7	1
6	8	1
2	10	4
4	11	3
4	12	3
4	13	3
4	14	2
4	15	-
Total	14	32

selected. However, specimens meeting these criteria were not present in all dated contexts. In those cases, twigs or small branches of tree species were selected. Shorter-lived hardwoods, such as willow, cottonwood, or aspen (Salicaceae), were preferred among tree species. However, 13 of the 31 identified samples consist of *Pinus* sp. wood charcoal.

Because dates were obtained on specimens representing species with different life spans and subject to different rates of decomposition, the so-called "old wood problem" is a potentially confounding factor in the analysis of feature ages. Serviceable fuelwood can persist in semi-arid environments for decades or centuries after a tree has died. Many trees, including ponderosa pines, shed branches as they mature (Allred 2015). Live branches cut from long-lived species also can contain wood that is significantly older than the cutting date. Thus, it is possible that cultural features could contain wood charcoal that is much older than the feature's age of construction and use.

However, an *a priori* assumption that wood charcoal of long-lived species must necessarily be older than the age of the feature with which is are associated is not warranted (Mitchell 2017). On the contrary, one could more easily assume that old wood was not commonly used for fuel at frequently occupied camps where repeated scavenging of downed limbs or removal of accessible branches would have consumed all or most of the easily acquired fuelwood early in the period of occupation. A determination of whether old wood is present in a particular context is an empirical problem that can only be solved by comparing pairs or groups of dates, in combination with analyses of feature stratigraphy and integrity.

Feature 1

Feature 1 was a large, oblong, rock-filled basin located in Area 4 (Unit 7). Three feature fill samples, together totaling 31.8 liters, were collected for flotation (CN4125, CN4126, and CN4206). Roughly half of the fill (16.8 liters) was analyzed for botanical remains. Three radiocarbon dates were obtained on charcoal associated with Feature 1, including one *Prunus* sp. specimen taken from flotation sample CN4125 and two *Pinus ponderosa* specimens that were piece-plotted in the field (table 3.12). Two of the three were dated during Round 2 and one was dated during Round 4. The measured ages of the three samples are not statistically equivalent (T=33.3). Pairwise comparisons also fail tests of contemporaneity.

The slightly bi-lobed plan of Feature 1 suggests that it may have been reconstructed and reused at least once. The non-contemporaneity of the measured radiocarbon ages supports the field observation that the feature may have been reused. The most recent date, roughly 1700 B.P., is on a specimen from the upper portion of the fill, while the two older dates are on specimens from the lower portion of the feature. Use of dead-and-down fuelwood may therefore be a minor factor. The two oldest specimens both consisted

Table 3.12. Feature 1 AMS dating results.

				Fraction of Modern			
Round	CN	Lab Number	Dated Material	pMC	1σ Error	δ ^{13}C	Age (^{14}C yr B.P.)
2	4105	D-AMS 031955	*Pinus ponderosa*	78.72	0.27	-[a]	1922±28
2	4125	D-AMS 031956	*Prunus* sp.	80.87	0.25	-[a]	1706±25
4	4098	D-AMS 039754	*Pinus ponderosa*	79.96	0.22	-24.82‰	1797±22

[a] Unreported δ ^{13}C value.

of *Pinus ponderosa* charcoal, while the youngest consisted of *Prunus* sp. (possibly chokecherry or American plum) charcoal. The overall span of the sample ages is just over two radiocarbon centuries.

Although a single radiocarbon age cannot be assigned to Feature 1, both stratigraphic and radiocarbon data indicate that it was used early in Magic Mountain's Early Ceramic occupation, prior to 1700 B.P.

No diagnostic artifacts occur within Feature 1. However, a re-worked corner-notched arrow point, an arrow point fragment, an arrow point preform, and a possible distal fragment of a dart point occurred within the A2 horizon in Unit 17. A single pottery sherd was recovered from the A2 horizon in Unit 8.

Feature 2

Feature 2 was a small, straight sided to slightly undercut storage pit in Area 4 (Units 5 and 6) that was capped or sealed by an overturned millingstone. Two fill samples totaling roughly 15.4 liters were collected for flotation in the lab, one from the western half (CN4110) and one from the eastern half (CN4101). A 3.4-liter portion of CN4101 was analyzed for botanical remains. Two specimens were submitted for radiocarbon dating, both of which consisted of piece-plotted *Pinus ponderosa* charcoal (table 3.13). The measured ages of the two specimens are statistically equivalent and yield a weighted mean age of 1260±20 ^{14}C yr B.P. (T=0.0).

Taken at face value, the contemporaneity of the two dates samples suggests that Feature 2 was filled about 1250 B.P. However, definitive stratigraphic data show that Feature 2 must postdate the final use of Feature 3, or at least 1034±24 ^{14}C yr B.P. (the age of Feature 3 is discussed in the next section). The dates obtained on the contents of Feature 2 therefore could indicate that the pit was filled with material deposited on the surface earlier in the site's Early Ceramic occupation. Alternatively, the Feature 2 dates could reflect the use of old fuelwood; however, because Feature 2 was not a hearth, it is more likely that the dated charcoal is simply not associated with the construction and use of the feature. The near equivalence of the dates suggests that the two piece-plotted specimens may represent a single branch.

Temporally diagnostic artifacts were not recovered from the fill of Feature 2. However, arrow point fragments and preforms occur within the A2 horizon above Feature 2 in Units 5 and 19.

Feature 3

Feature 3 consisted of two intersecting earth ovens in Area 4 (Units 5 and 6) that exhibited abundant stratigraphic evidence for repeated use. Three bulk samples totaling 39.5 liters were collected for flotation, all of which were analyzed for botanical specimens (CN4139, CN4165, and CN4188). Four samples consisting of charred short-lived botanical species were submitted for radiocarbon dating (table 3.14). All four were taken from the bottom of the feature (FL4), immediately above the beds of interlocking stones comprising the feature's original heating elements. Two of the samples were associated with the feature's northern lobe (CN4165), while two were associated with the southern lobe (CN4188).

The measured ages of the two Round 2 samples are not statistically equivalent, suggesting that the feature's two lobes are not contemporaneous (T=6.1). Two additional samples, one from each lobe, were submitted to evaluate that possibility. The Round 4 dates confirm the non-contemporaneity of the lobes. The two north lobe dates are equivalent (T=0.2), yielding a weighted mean age of 1113±18 ^{14}C yr B.P. The two south lobe dates are not equivalent (T=18.6).

Because all of the dated specimens represent short-lived plants, the old wood problem cannot be responsible for the non-contemporaneity of the two lobes of the feature or of the two south lobe dates. The oldest date was obtained from cactus spines, which could persist in the environment for years or perhaps decades. Although intrusion of more recent charred

Table 3.13. Feature 2 AMS radiocarbon dating results.

Round	CN	Lab Number	Dated Material	Fraction of Modern pMC	Fraction of Modern 1σ Error	δ ^{13}C	Age (^{14}C yr B.P.)
2	4100	D-AMS 031953	*Pinus ponderosa*	85.45	0.33	-[a]	1263±31
2	4102	D-AMS 031954	*Pinus ponderosa*	85.50	0.28	-[a]	1258±26

[a] Unreported δ ^{13}C value.

Table 3.14. Feature 3 AMS dating results. The CN4165 samples were taken from the north lobe of Feature 3, while the CN4188 samples were taken from the south lobe.

				Fraction of Modern			
Round	CN	Lab Number	Dated Material	pMC	1σ Error	δ ^{13}C	Age (^{14}C yr B.P.)
2	4165-1	D-AMS 031957	*Chenopodium* spp. seeds	86.95	0.29	-[a]	1123±27
4	4165-2	D-AMS 039755	Cheno-am perisperm	87.14	0.24	-16.26‰	1106±22
2	4188-1	D-AMS 031958	*Chenopodium* spp. seeds and Cheno-am perisperm	87.92	0.26	-[a]	1034±24
4	4188-2	D-AMS 039756	Cactaceae spines	86.46	0.22	-9.47‰	1169±20

[a] Unreported δ ^{13}C value.

seeds cannot be ruled out entirely, the fact that all four samples were taken from the deepest portion of the feature makes that unlikely. In sum, the radiocarbon data suggest that use of Feature 3 began about 1170 B.P. The final use of the feature was no earlier than 1035 B.P. The number of reuse episodes cannot be determined with precision, but it must have been at least three. Stratigraphic data suggests that it was likely rebuilt and reused multiple times.

The stratigraphic position of Feature 2, which was superimposed on the north lobe of Feature 3, indicates that the Early Ceramic occupation continued after Feature 3 was no longer in use. Feature 2 could have been built no earlier than the weighted mean age of the north lobe of Feature 3 or 1113±18 ^{14}C yr B.P. However, the stratigraphy of Feature 3 suggests that Feature 2 in fact postdates the youngest date associated with Feature 3, 1034±24 ^{14}C yr B.P.

Complete corner-notched arrow points, along with arrow point fragments and preforms, were recovered from the fill of Feature 3. Arrow point fragments and preforms also occur in the A2 horizon overlying Feature 3.

Feature 4

Feature 4 was a basin hearth located in Area 3 (Unit 18). A single feature fill sample, totaling 25 liters, was collected for flotation (CN3093). Five liters of the sample were analyzed for macrofloral remains. Three specimens were submitted for radiocarbon dating (table 3.15). Two consisted of charcoal taken from the macrofloral subsample, both of which represented woody shrub species. The third sample consisted of piece-plotted *Pinus ponderosa* charcoal. The two Round 2 dates are not statistically equivalent (T=12.3). A third date, submitted during Round 4, falls between the two Round 2 dates. The two most recent dates are statistically equivalent (T=2.4) and yield a weighted mean age of 1459±18 ^{14}C yr B.P. That mean age is not equivalent to the oldest date from the feature (T=9.8).

The modest dispersion of the radiocarbon dates suggests that Feature 4 may have been reused on one or more occasions between about 1560 B.P. and 1460 B.P. The ponderosa pine specimen yielded the youngest of the three dates while the Asteraceae specimen yielded the oldest, indicating that the use of dead-and-down fuelwood was not a factor in the non-contemporaneity of the dates. However, the oldest date coincides with a century-long plateau in the calibration curve. As a result, the total span of feature use is uncertain and may have been well less than 100 radiocarbon years.

A single dart point preform occurred in the fill of Feature 4. Complete and fragmentary arrow points occurred in the A horizon overlying Feature 4 in Unit 3. Pottery also was recovered from excavation squares

Table 3.15. Feature 4 AMS radiocarbon dating results.

				Fraction of Modern			
Round	CN	Lab Number	Dated Material	pMC	1σ Error	δ ^{13}C	Age (^{14}C yr B.P.)
2	3093-1	D-AMS 031949	Asteraceae	82.32	0.29	-[a]	1563±28
2	3095	D-AMS 031950	*Pinus ponderosa*	83.70	0.27	-[a]	1429±26
4	3093-2	D-AMS 039757	Rosaceae	83.13	0.25	-[a]	1484±24

[a] Unreported δ ^{13}C value.

adjacent to Feature 4 (Units 2 and 4); however, they occurred in spoil deposits overlying intact Early Ceramic deposits.

Feature 5

Feature 5 was a shallow, rock-filled pit located in Area 3 (Units 1 and 2), roughly 2.5 m southwest of Feature 4. The distribution of burned rocks within the feature suggest that it was repurposed as an earth oven during its period of use. One 5.3-liter sample of feature fill was collected for flotation, all of which was analyzed for botanical specimens (CN3127). Three specimens drawn from the feature fill sample were submitted for radiocarbon dating (table 3.16). Two consisted of seeds from woody shrubs, while one consisted of charcoal from a woody shrub. The ages of the two specimens submitted during dating Round 2 are not statistically equivalent (T=22.0). The two oldest dates—both on charred seeds—are equivalent (T=0.0) and yield a weighted mean age of 1561±17 ^{14}C yr B.P.

The evidence for feature reuse suggests that the youngest date as well as the weighted mean age of the two oldest dates accurately reflect the feature's period of use, or approximately 1560 to 1410 B.P. However, as was the case for Feature 4, the older dates coincide with a significant plateau in the radiocarbon calibration curve and so the total span of feature use is uncertain and may have been shorter than the measured ages indicate.

Temporally diagnostic artifacts are not directly associated with Feature 5. Five diagnostic projectile points and two ceramic sherds were recovered from Unit 2. Both sherds were recovered from displaced spoil. Two of the projectile points are darts. A McKean point was recovered from B horizon sediment well below Feature 5. A second dart, a possible McKean point, was recovered from Early Ceramic deposits overlying Feature 5. Arrow point preforms were A2 horizon sediment into which Feature 5 was cut as well as A2 horizon sediment overlying Feature 5. A complete arrow point also was recovered from the surface of Unit 2.

Feature 6

Feature 6 was a rock-filled pit located in Units 22 and 23 in Area 4. The feature's fill had been removed by surface erosion prior to burial and no radiocarbon samples were recovered. A single diagnostic projectile point—a probable McKean point—was recovered from B horizon sediment underlying Feature 6. No pottery sherds were recovered from Units 22 and 23.

Although a numerical date is not available for Feature 6, its stratigraphic position suggests that it was built and used relatively late in the site's Early Ceramic sequence.

Feature 7

Feature 7 was a large concentration of burned rock located in Area 7 (Units 24 and 25). A bulk fill sample was not collected. However, several piece-plotted charcoal samples were collected from the base of the burned rock pile and one was submitted for dating during Round 1 (table 3.17). The species represented was not determined; however, it likely was pine.

Table 3.16. Feature 5 AMS radiocarbon dating results.

				Fraction of Modern			
Round	CN	Lab Number	Dated Material	pMC	1σ Error	δ ^{13}C	Age (^{14}C yr B.P.)
2	3127-1	D-AMS 031951	*Prunus* sp.	83.88	0.28	-[a]	1412±27
2	3127-2	D-AMS 031952	*Arctostaphylos uva-ursi* seed	82.32	0.27	-[a]	1563±26
4	3127-3	D-AMS 039758	*Prunus* seeds	82.36	0.22	-[a]	1559±21

[a] Unreported δ ^{13}C value.

Table 3.17. Feature 7 AMS radiocarbon dating results.

				Fraction of Modern			
Round	CN	Lab Number	Dated Material	pMC	1σ Error	δ ^{13}C	Age (^{14}C yr B.P.)
1	7042	D-AMS 025173	Not identified	83.94	0.41	-[a]	1406±39

[a] Unreported δ ^{13}C value.

The age span of Feature 7 cannot be determined from the single date. However, the location from which the sample was taken suggests that the burned rock pile mostly accumulated after about 1410 B.P. Four diagnostic projectile points were recovered from Units 24 and 25. All consist of arrow points, arrow point fragments, or arrow point preforms and all were recovered from stratigraphic contexts that postdate Feature 7. No pottery sherds were recovered from Area 7.

Feature 8

Feature 8 was a basin hearth located in Units 13 and 14 in Area 6. Three bulk sediment samples were obtained, one from each of three feature levels. The FL3 sample (CN6037), which comprised 8 liters of sediment, was analyzed for botanical remains and a single charred mountain mahogany twig was selected for radiocarbon dating (table 3.18).

The age span of Feature 8 cannot be determined from the single date. The upper portion of the feature likely was disturbed by surface erosion prior to burial. However, no evidence for reuse was noted. Feature 8 originated at the base of the AB horizon and was excavated into underlying B horizon. This stratigraphic position aligns with the 1965 B.P. date for the feature.

A single diagnostic projectile point was identified in Area 6. A corner-notched arrow point was recovered from GL1 in Unit 14, at least 27 cm above Feature 8. Two pottery sherds were recovered from Area 6. One came from GL4 in Unit 13. Feature 8 originated within GL4 and so the pottery specimen from Unit 13 could have been deposited either before Feature 8 was constructed or after it was no longer in use. A second pottery sherd was recovered from GL2 in Unit 12, several meters north of Feature 8.

Feature 10

Feature 10 was an earth oven located in Area 2 (Units 48 and 56). Approximately 15.25 liters of feature fill were collected for flotation (CN2038) and four radiocarbon dates were obtained (table 3.19). The first two samples, which were dated during Round 3, consisted of charcoal from woody shrubs, which were taken from the flotation sample (CN2038-1 and CN2038-2). Two additional radiocarbon samples consisting of a charred *Pinus* sp. twig and a small *Pinus ponderosa* branch were submitted for dating during Round 4. One was taken from the flotation sample (CN2038-3), while the other was a plotted specimen taken from the middle of the feature. The two Round 3 dates are not statistically equivalent (T=167.0). The two Round 4 dates are equivalent, yielding a weighted mean age of 1899±17 ^{14}C yr B.P. (T=1.8).

Several factors could explain the wide dispersion of the Feature 10 dates. It is possible that the feature was used on multiple occasions that were widely separated in time. Alternatively, the oldest dates—both of which were obtained from *Pinus* samples—may reflect the use of old fuelwood. Finally, one or both of the younger samples may reflect post-use disturbance of the feature. Some combination of these factors could also be responsible.

Table 3.18. Feature 8 AMS radiocarbon dating results.

				Fraction of Modern			
Round	CN	Lab Number	Dated Material	pMC	1σ Error	δ ^{13}C	Age (^{14}C yr B.P.)
2	6037	D-AMS 031959	*Cercocarpus montanus*	78.31	0.26	-[a]	1964±27

[a] Unreported δ ^{13}C value.

Table 3.19. Feature 10 AMS radiocarbon dating results.

				Fraction of Modern			
Round	CN	Lab Number	Dated Material	pMC	1σ Error	δ ^{13}C	Age (^{14}C yr B.P.)
3	2038-1	D-AMS 036148	*Cercocarpus montanus*	86.22	0.24	-[a]	1191±22
3	2038-2	D-AMS 036149	Rosaceae	81.92	0.23	-[a]	1602±23
4	2038-3	D-AMS 039759	*Pinus* sp. (twig)	78.73	0.23	-22.94‰	1921±23
4	2042	D-AMS 039760	*Pinus ponderosa* (sm. branch)	79.16	0.23	-23.22‰	1877±23

[a] Unreported δ ^{13}C value.

Data on the morphology and integrity of Feature 10 suggest that the first option—reconstruction and reuse—is not the best explanation. The feature is somewhat irregular but roughly symmetrical in plan. No evidence for internal stratigraphy was observed. Feature 10 is classified as an earth oven and the feature's primary heating element, which consisted of tightly interlocking burned stones, is intact. These observations suggest that the feature was built, used, and abandoned over a relatively short period. The "old wood problem" is probably not a factor. The fact that the two ponderosa pine dates are statistically equivalent provides some evidence that the age of the fuel and the age of the feature are roughly equivalent.

Stratigraphic data further suggest that Feature 10 was constructed and used during the earlier portion of Magic Mountain's Early Ceramic occupation. The feature originates at the base a soil that began forming during the Early Ceramic. Stratigraphic data also indicate that disturbance processes may have introduced the two younger samples. On the feature's western side, a portion of the feature's upper surface had been stripped away by surface erosion prior to burial. That process could have introduced younger charcoal from other nearby features or from the adjacent surface.

Six diagnostic projectile points were recovered from Area 2. Three, all of which are arrow point fragments, came from Unit 56. One was recovered from GL2, well above the origin of Feature 10. Two others were recovered from GL4. Because the modern ground surface, as well as subsurface horizons, dip to the east, GL4 incorporates horizons that predate Feature 10 as well as horizons that postdate Feature 10. The arrow point fragments could have been discarded prior to the construction or immediately after the use of Feature 10. No pottery sherds were recovered from Area 2.

Although the wide dispersion of dates introduces uncertainty into the interpretation of the age of Feature 10, the most parsimonious explanation is that it was built and used about 1900 B.P., the approximate weighted mean age of the two oldest dates.

Feature 11

Feature 11 was a basin hearth located in Unit 32 in Area 7. A single 10-liter fill sample (CN7115) was collected for flotation, all of which was analyzed for macrofloral remains. Three specimens were submitted for radiocarbon dating, including one *Pinus* sp. branch fragment from the bulk sample and two plotted *Pinus ponderosa* branch fragments (table 3.20). Both plotted specimens were recovered from charcoal-stained sediment in the middle of the feature. The two samples submitted during Round 3 fail a test of contemporaneity (T=8.0). The third sample, submitted during Round 4, is statistically equivalent to the younger of the Round 3 dates, yielding a weighted mean age of 1318±16 ^{14}C yr B.P. (T=1.3). All three dates from Feature 11 fail a test of contemporaneity (T=16.5).

Internal stratigraphic evidence suggests that Feature 11 may have been rebuilt and reused on one or more occasions. Its upper surface does not appear to have been disturbed. The modest dispersion of radiocarbon dates suggests that Feature 11 was used between about 1430 and 1320 B.P.

No temporally diagnostic projectile points were recovered from Unit 32. However, two corner-notched arrow points, one arrow point fragment, and one arrow point preform were recovered from Units 29 and 30, 3 to 5 m south of Feature 11. Both corner-notched arrow points came from the horizon overlying Feature 11 (GL3). No pottery sherds were recovered from Area 7.

Feature 12

Feature 12 was a basin hearth located in Area 4 (Units 42 and 55). A single fill sample, which consisted of approximately 15 liters of sediment, was collected

Table 3.20. Feature 11 AMS radiocarbon dating results.

Round	CN	Lab Number	Dated Material	Fraction of Modern pMC	Fraction of Modern 1σ Error	δ ^{13}C	Age (^{14}C yr B.P.)
3	7115	D-AMS 036153	*Pinus* sp. (small branch)	84.67	0.24	-[a]	1337±23
4	7125	D-AMS 039761	*Pinus ponderosa*	85.04	0.22	-23.62‰	1302±21
3	7126	D-AMS 036152	*Pinus ponderosa* (small branch)	83.66	0.26	-[a]	1433±25

[a] Unreported δ ^{13}C value.

from the lower half of the feature (CN4345). The sample was analyzed in its entirety for botanical remains. Two charred specimens, including a Rosaceae twig and a *Vitis riparia* (grape) seed, were selected for radiocarbon dating during Round 3 (table 3.21). A third sample consisting of a piece-plotted fragment of ponderosa pine charcoal was submitted during Round 4. The Round 3 dates fail a test of contemporaneity (T=15.2), as do all three dates from the feature (T=97.1).

The asymmetrical distribution of burned rocks in Feature 12 suggest that it may have been rebuilt and reused at least once. No evidence was observed for disturbance of the feature's upper surface prior to burial. The oldest of the three Feature 12 dates was obtained on a sample representing a comparatively long-lived species, suggesting that the old wood problem might partially be responsible for the dispersion of the measured ages. However, on balance, the radiocarbon and stratigraphic evidence suggests that the Feature 12 was used repeatedly between about 1320 and 1020 B.P.

No temporally diagnostic projectile points were recovered from Feature 12. However, five diagnostic specimens were recovered from Units 42 and 55. Four are corner-notched arrow points, arrow point fragments, or arrow point preforms. Those specimens occur both above and below the origin of Feature 12. A single dart side-notched dart point was recovered from the general level in which Feature 12 originated. Pottery sherds were not recovered from Units 42 or 55. Two sherds were recovered from the Early Ceramic period horizon in Units 51 and 52 located 3 m northwest and 3 m west, respectively.

Feature 13

Feature 13 was an earth oven located in Area 4 (Unit 44). One bulk sediment sample (CN4386) was collected from the feature's fill and analyzed for botanical remains; however, no specimens suitable for radiocarbon dating were present in that sample. Instead, three piece-plotted specimens from the upper and middle portions of the feature were submitted for dating (table 3.22). Two consisted of ponderosa pine branch fragments and one consisted of a Salicaceae branch fragment. The two oldest dates, both of which were obtained on ponderosa pine charcoal, are statistically equivalent and yield a weighted mean date of 1208±16 ^{14}C yr B.P. (T=0.4). All three dates fail a test of contemporaneity (T=12.5).

The upper surface of Feature 13 likely was disturbed by surface erosion prior to burial. However, internal stratigraphic evidence for reconstruction and reuse was not observed in the field. The use of dead-and-down fuelwood may have affected the dispersion of radiocarbon ages: the two oldest dates were obtained on specimens of comparatively long-lived ponderosa pine specimens. However, there is no empirical reason to prefer the younger date over the older dates. Accordingly, Feature 13 likely was used on several occasions between about 1210 and 1110 B.P.

Diagnostic projectile points were not present in the fill of Feature 13. However, nine arrow points, arrow point fragments, or arrow point preforms were recovered from the Early Ceramic period horizon in Units 43, 44, and 51 overlying Feature 13. No dart points were present in these units. A pottery body sherd also was recovered from the Early Ceramic horizon in Unit 51.

Feature 14

Feature 14 was a shallow basin hearth located in Units 52 and 53 in Area 4. Only the lower portion of the south half of the feature was excavated separately. A single 35-liter bulk fill sample was collected and analyzed for botanical remains (CN4405). Specimens selected from that bulk sample for radiocarbon dating during Round 3 include twigs of two different woody shrub species (table 3.23). The dates obtained on

Table 3.21. Feature 12 AMS radiocarbon dating results.

Round	CN	Lab Number	Dated Material	Fraction of Modern pMC	Fraction of Modern 1σ Error	δ ^{13}C	Age (^{14}C yr B.P.)
4	4342	D-AMS 039762	*Pinus ponderosa*	84.83	0.22	-24.36‰	1322±21
3	4345-1	D-AMS 036146	*Vitis riparia* seed	86.74	0.24	-[a]	1143±22
3	4345-2	D-AMS 036147	Rosaceae (twig)	88.09	0.25	-[a]	1019±23

[a] Unreported δ ^{13}C value.

Table 3.22. Feature 13 AMS radiocarbon dating results.

Round	CN	Lab Number	Dated Material	Fraction of Modern pMC	1σ Error	δ ^{13}C	Age (^{14}C yr B.P.)
3	4387	D-AMS 036151	Salicaceae (small branch)	87.07	0.25	-[a]	1112±23
4	4388	D-AMS 039763	*Pinus ponderosa*	85.94	0.23	-22.82‰	1217±21
3	4393	D-AMS 036150	*Pinus ponderosa* (small branch)	86.13	0.24	-[a]	1199±22

[a] Unreported δ ^{13}C value.

those samples are statistically equivalent and yield a weighted mean age of 1826±19 ^{14}C yr B.P. (T=3.8).

No evidence either for disturbance or reuse of Feature 14 were observed during the fieldwork. The fact that the measured ages are equivalent suggests that use of the feature occurred over a relatively short period of time about 1825 B.P.

Nine arrow points, arrow point fragments, or arrow point preforms were recovered from Units 52 and 53. Two of these, both of which were corner-notched arrow points, occurred at the base of the Early Ceramic period horizon in Unit 52, at depths roughly equivalent to the upper surface of Feature 14. Two other corner-notched arrow points occurred at depths at or slightly below the upper surface of Feature 14 in Unit 53. A pottery body sherd also was recovered from the Early Ceramic horizon overlying Feature 14 in Unit 52.

Feature 15

Feature 15 was a basin hearth located in Unit 43 in Area 4. Feature 13 was located roughly 40 cm northeast of Feature 15. A bulk sediment sample was not collected from Feature 15 and only a small portion was excavated separately from the surrounding general levels. The feature's origin was difficult to determine, owing primarily to post-use disturbance; however, it likely originated within A2 (Early Ceramic) horizon sediment. Two piece-plotted charcoal fragments were recovered from the feature, but neither was submitted for radiocarbon dating due to uncertainty about the feature's integrity.

Although a numerical date is not available for Feature 15, its stratigraphic position suggests that it was built and used relatively late in the site's Early Ceramic sequence. Stratigraphic data suggests that was no older than, and likely younger than, Feature 13.

Summary

Table 3.24 summarizes the radiocarbon and stratigraphic data presented in this section. Also provided are calibrated date ranges for each radiocarbon-dated feature. Two-sigma calibrations are presented for individual measured ages and for weighted mean ages of multiple contemporaneous dates. One-sigma calibrations are presented for radiocarbon age ranges. An ordinal age group also is assigned to each feature.

The oldest dated feature (Feature 8) may have been constructed and used during the late first century B.C. or the first century A.D. The youngest feature was used sometime after the late tenth or early eleventh century.

Early features include those that predate 1700 B.P. (~ A.D. 255-415); middle period features include those that postdate 1560 B.P. (~ A.D. 436-561) but predate 1320 B.P (~ A.D. 660-772); and late period features postdate 1320 B.P. Four features are assigned to the early period, four are assigned to the middle period, and six are assigned to the late period.

Age spans are assigned to six features. Because radiocarbon ages are distributions, the numerical difference between the earliest and latest radiocarbon

Table 3.23. Feature 14 AMS radiocarbon dating results.

Round	CN	Lab Number	Dated Material	Fraction of Modern pMC	1σ Error	δ ^{13}C	Age (^{14}C yr B.P.)
3	4405-1	D-AMS 036154	Rosaceae (twig)	79.40	0.23	-[a]	1853±23
3	4405-2	D-AMS 036155	*Cercocarpus montanus* (twig)	80.13	0.30	-[a]	1779±30

[a] Unreported δ ^{13}C value.

Table 3.24. Summary of interpreted feature ages and radiocarbon calibration data.

		Calibrated Date(s)[A]		
Feature	Radiocarbon Age(s)	cal B.P.	cal B.C./A.D.	Sequence
1	<1706±25	<1695-1665 (*20.7*); 1625-1536 (*74.7*)	<A.D. 255-286 (*20.7*); 326-415 (*74.7*)	Early
2	>1034±24	>973-914 (*95.4*)	>A.D. 978-1037 (*95.4*)	Late
3	1170-1035	1175-1010 to 955 to 928	A.D. 776-941 to A.D. 995-1022	Late
4	1560-1460	1514-1390 to 1357-1310	A.D. 436-561 to A.D. 593-671	Middle
5	1560-1410	1514-1390 to 1344-1295	A.D. 436-561 to A.D. 607-655	Middle
6	-	-	-	Late?
7	1406±39 [1 date]	1374-1278 (*95.4*)	A.D. 576-673 (*95.4*)	Middle
8	1964±27 [1 date]	1986-1962 (*7.1*); 1947-1826 (*88.4*)	37-13 B.C. (*7.1*); A.D. 3-124 (*88.4*)	Early
10	1899±17 [2 dates]	1869-1852 (*8.7*); 1840-1739 (*86.7*)	A.D. 81-99 (*8.7*); A.D. 111-211 (*86.7*)	Early
11	1430-1320	1345-1304 to 1290-1179	A.D. 606-647 to A.D. 660-772	Middle
12	1320-1020	1290-1179 to 956-920	A.D. 660-772 to A.D. 995-1030	Late
13	1210-1110	1165-1075 to 1055-963	A.D. 785-876 to A.D. 895-988	Late
14	1826±19 [2 dates]	1819-1807 (*2.0*); 1794-1698 (*86.9*); 1658-1635 (*6.6*)	A.D. 131-143 (*2.0*); A.D. 156-252 (*86.9*); A.D. 292-316 (*6.6*)	Early
15	-	-	-	Late?

[A] 2-σ calibrations are presented for individual radiocarbon dates, weighted mean ages of multiple contemporaneous dates, and *terminus post quem* or *terminus ante quem* dates. 1-σ calibrations are presented for radiocarbon age ranges, assuming the mean error for all dates (25 years). Gaps in the 1-σ calibrated date ranges are eliminated for clarity. Calibrations performed by OxCal 4.4.4 (Bronk Ramsey 2021) using the IntCal20 curve (Reimer *et al*. 2020).

ages for each feature may not reflect the actual period of use. The corresponding calibrated date ranges suggest that the period of use could have been as brief as half of the difference of the numerical ages or as long as twice the difference.

Table 3.25 cross-tabulates feature subtype and age group. The temporal distribution of feature subtypes is even, with basin hearths and earth ovens (both primary and secondary) occurring in each of the three age groups.

Summary of Major Findings and Feature Analysis

During 2017 and 2018, DMNS/PCRG/KU-Odyssey archaeological field crews opened a total of 59 1 x 1-m excavation squares distributed among six excavation areas spread across roughly 3 ha (7.4 acres). A total of about 31 m^3 of sediment was excavated and screened. Fifteen cultural features were identified and sampled. Fourteen of the 15 features were associated with Indigenous American occupancy of the site.

The 2017-2018 fieldwork focused on a portion of the site that had not previously been investigated. That area—a gentle south- to southeast-facing slope located north of Apex Gulch and east of a prominent Lyon Sandstone outcrop—previously was thought to contain extensive cultural deposits and features dating to the Early Ceramic period (Irwin-Williams and Irwin 1966). That interpretation proved to be correct: all of the American Indian features exposed during the project date between about 2000 and 1000 B.P. Unexpectedly, post-occupation disturbance of those features proved to be minimal, in contrast to previously investigated areas where widespread

Table 3.25. Temporal distribution of feature subtypes.

	Age Group			
Feature Subtype	Early	Middle	Late	Total
Storage Pit			1	1
FCR Concentration		1		1
Basin Hearth	2	2	3	7
Earth Oven (Primary or Secondary)	2	1	2	5
Total	4	4	6	14

looting had occurred during the late nineteenth and early twentieth centuries.

Magnetic gradiometry and ground-penetrating radar data were used to select excavation unit locations opened during 2017. During 2018, magnetic data were again used to select unit locations, along with the preliminary results of the 2017 investigation and initial analysis of sediment cores obtained during fall 2017.

The magnetic gradiometry surveys were highly productive. Magnetic data helped to precisely target archaeological features of interest, thereby minimizing the project's impact on intact cultural deposits and maximizing the data obtained relative to the number of units opened. However, the reliance on magnetic data also strongly influenced the types of features that were selected for investigation. The ground-penetrating radar survey proved to be less effective in identifying subsurface cultural features. However, the resulting dataset remains important for understanding local geomorphological and depositional processes.

A single near-surface soil stratigraphic sequence was exposed across most of the excavation areas. That sequence comprises the modern soil that has formed primarily in colluvium. However, the number, thickness, and character of observed horizons varies depending on landscape position. Beneath a thin surficial Ap horizon, an A horizon containing Early Ceramic period artifacts varies in thickness from as little as 15 cm to as much as 40 cm. The A horizon is thickest close to the abandoned channel of Apex Gulch and thins upslope toward the northern side of Area 4. Slopewash is responsible for the incremental accumulation of sediment on the lower portion of the colluvial apron and the cumulic character of A horizon in that portion of the site. One or two Bt horizons also were observed in most excavation units. Artifacts occur in B horizon sediment, but all of the documented American Indian cultural features originated at the base of or within the A horizon.

Radiocarbon data, along with the distribution of temporally diagnostic artifacts, demonstrate that the development of the modern soil was approximately concurrent with the Early Ceramic period. The oldest features exposed during the 2017-2018 project date to the beginning of the Early Ceramic period and occur at the base of the A horizon. Later Early Ceramic features occur higher in the profile and Early Ceramic artifacts occur throughout the A horizon. Sediment consistently accumulated on the lower portion of the colluvial apron throughout the Early Ceramic, promoting preservation of features through burial as well as the formation of an anthropogenic horizon or zone in Areas 3 and 4. However, sediment accumulation was not continuous; the fact that the upper surfaces of several features appear to have been eroded prior to burial indicates that some sediment periodically was stripped away by wind or water. Deposition appears to have nearly ceased at the end of the Early Ceramic occupation; only two recovered diagnostic artifacts postdate the Early Ceramic and both were recovered from the uppermost portion of the A horizon or the surficial Ap horizon.

Most features appear to have been built on the ground surface: their upper surfaces dip parallel to the soil horizons and the modern surface. However, Features 2 and 3 originated from a truncated surface that may represent a shallow basin house or leveled outdoor workspace in Area 4. Edges of the truncated surface were observed in Units 19 and 51 and numerous artifacts occurred on that surface adjacent to Features 2 and 3. The inferred width of the basin or surface is roughly 5 m. However, no postmolds or other indications of the basin's perimeter were observed. If a basin house was at one time present in Area 4, evidence of it likely was obliterated by the ongoing occupation.

Four types of features were identified and sampled during the 2017-2018 project, including a storage pit, a burned rock discard pile, and twelve rock-filled pits. The rock-filled pits can further be partitioned into two subtypes. Basin hearths contained a mixture of burned rocks and charcoal-stained sediment. Earth ovens contained a tightly interlocking layer of burned rocks. The layer of interlocking rocks occurred on the floor of the basin among the features originally constructed as earth ovens. Similar rock layers occurred in the middle or upper portion of features converted to earth ovens during their period of use.

Apart from burned rocks—which are ubiquitous and indicative of food preparation—the types and densities of artifacts varied significantly among the features. For example, both the highest and the lowest bone density values occurred in two different earth ovens. Except for ground stone tool fragments repurposed as boiling stones or heating element stones, tools were uncommon in virtually all of the features. In fact, Feature 3 was the only rock-filled pit that contained a significant assemblage of artifacts and faunal remains. Overall, feature content does not appear to directly reflect feature function. Instead, the characteristics of the fills likely reflect the types of activities that took place adjacent to the features, especially those occurring close to or at the end of the features' period of use.

The oldest sampled feature was built about 1965 B.P. (~35 B.C-A.D. 125), while the most recent was built after 1035 B.P. (~A.D. 980-1035). In terms of nominal age groups, four of the dated features are assigned to an early group (predating about 1700 B.P.), four are assigned to a middle group (postdating 1560 B.P. but predating 1320 B.P.), and six are assigned to a late group (postdating 1320 B.P.). Feature function does not appear to have varied over time: earth ovens were built in each of the three nominal periods, as were basin hearths. All parts of the site investigated during 2017 and 2018 appear to have been used during the earliest portion of the Early Ceramic occupation (figure 3.41). Site use during the middle and late portions may have been concentrated to a somewhat greater degree, with notably intense use occurring in Area 4 during the late period.

Use-spans are assigned to half of the dated features. Radiocarbon and stratigraphic data indicate that these features were rebuilt and reused on at least one occasion. The amount of time that elapsed between uses cannot be confidently determined. However, reuse intervals as short as 20 to 50 years are possible. Lengthy intervals between successive uses are possible but seem unlikely given the probable rate of sediment deposition during the period of occupation.

Multiple radiocarbon dates were needed to determine feature ages. A variety of factors were responsible for this, including variations in the life cycles of the dated plants, shrubs, and trees; patterns of feature reuse; and mixing of archaeological materials, both during and after the occupation. The analysis shows that single dates from an individual feature may not accurately reflect its age.

All 14 features occurred within a single soil stratigraphic sequence. The summed probability distribution of all calibrated feature dates is roughly rectangular and spans the entire Early Ceramic period, which nominally dates to between 1800 and 800 B.P. (figure 3.42) (Gilmore 1999). Many of the variations in the probability distribution appear to correlate with concurrent variations in the calibration curve. Overall, the radiocarbon date distribution suggests intermittent but regular use of the site throughout the Early Ceramic.

The 2017-2018 artifact collection includes 92 temporally diagnostic projectile points, of which 75 are arrow points. Among the 26 arrow points that can be assigned to a specific period, just two postdate the Early Ceramic. Stratigraphic data further suggest that a large majority, and perhaps all, of the remaining arrow point fragments also date to the Early Ceramic.

Early Ceramic corner-notched arrow points occur within general level samples that were deposited after the most recently used features were abandoned. Thus, corner-notched arrow points definitely were manufactured and used after about 1035 B.P. (~975-915 cal B.P. or A.D. 980-1035).

The age of the oldest corner-notched projectile point is more difficult to determine. Multiple specimens were recovered from general level samples immediately overlying Feature 14, which is dated to 1826±19 ^{14}C yr B.P. (~1820-1635 cal B.P. or A.D. 130-316). Corner-notched arrow points also were recovered from general level samples that may predate Feature 14. Corner-notched arrow points also occur in a general level sample that was deposited in part before and in part after the construction and use of Feature 10. Feature 10 is dated to 1899±17 ^{14}C yr B.P. (~1870-1740 cal B.P. or A.D. 80-210).

Analytic Units

Radiocarbon and stratigraphic data together demonstrate that the 2017-2018 DMNS/PCRG/KU-Odyssey project primarily sampled Early Ceramic period contexts. The analytic units defined in this section were developed to isolate artifacts and other materials that date to the Early Ceramic from those that predate (or potentially postdate) Magic Mountain's Early Ceramic occupation. Each catalog number (plotted specimen or artifact lot) initially was assigned to one of seven analytic units based on stratigraphic position as determined from excavation unit profiles. A small number of catalog lots subsequently were re-assigned to a another analytic unit based on an analysis of the distribution of temporally diagnostic artifacts. Table 3.26 lists the seven analytic units.

Analytic Unit Descriptions

AU0 (Disturbed) includes spoil strata overlying intact archaeological deposits in Area 3. The spoil likely derives from the 1959 excavation of a water pipeline trench, which exposed at least one Early Ceramic feature (Irwin-Williams and Irwin 1966:26). The excavation of a rectangular cut into

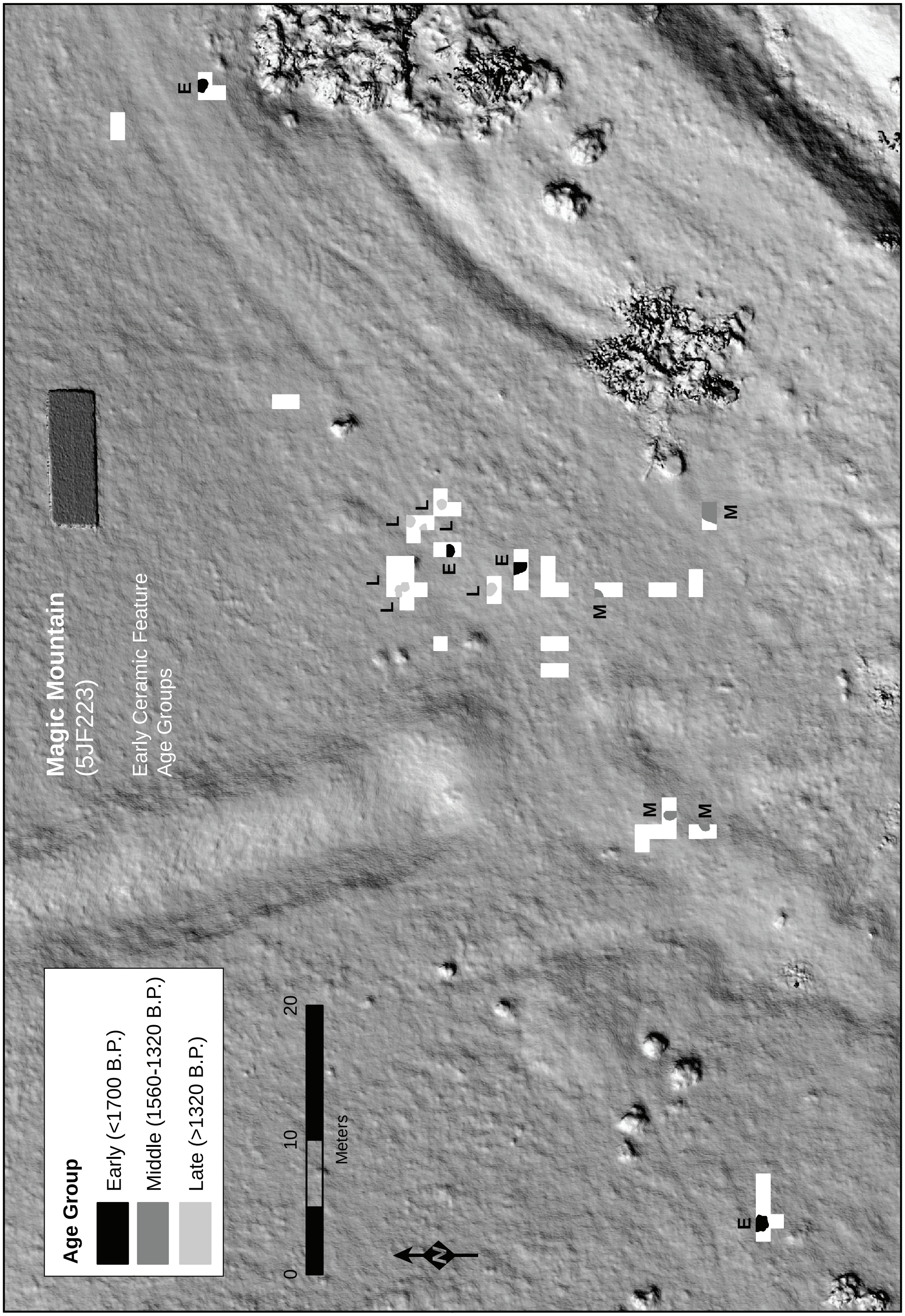


Figure 3.41. Terrain map showing the temporal distribution of Early Ceramic features sampled during the 2017-2018 fieldwork.

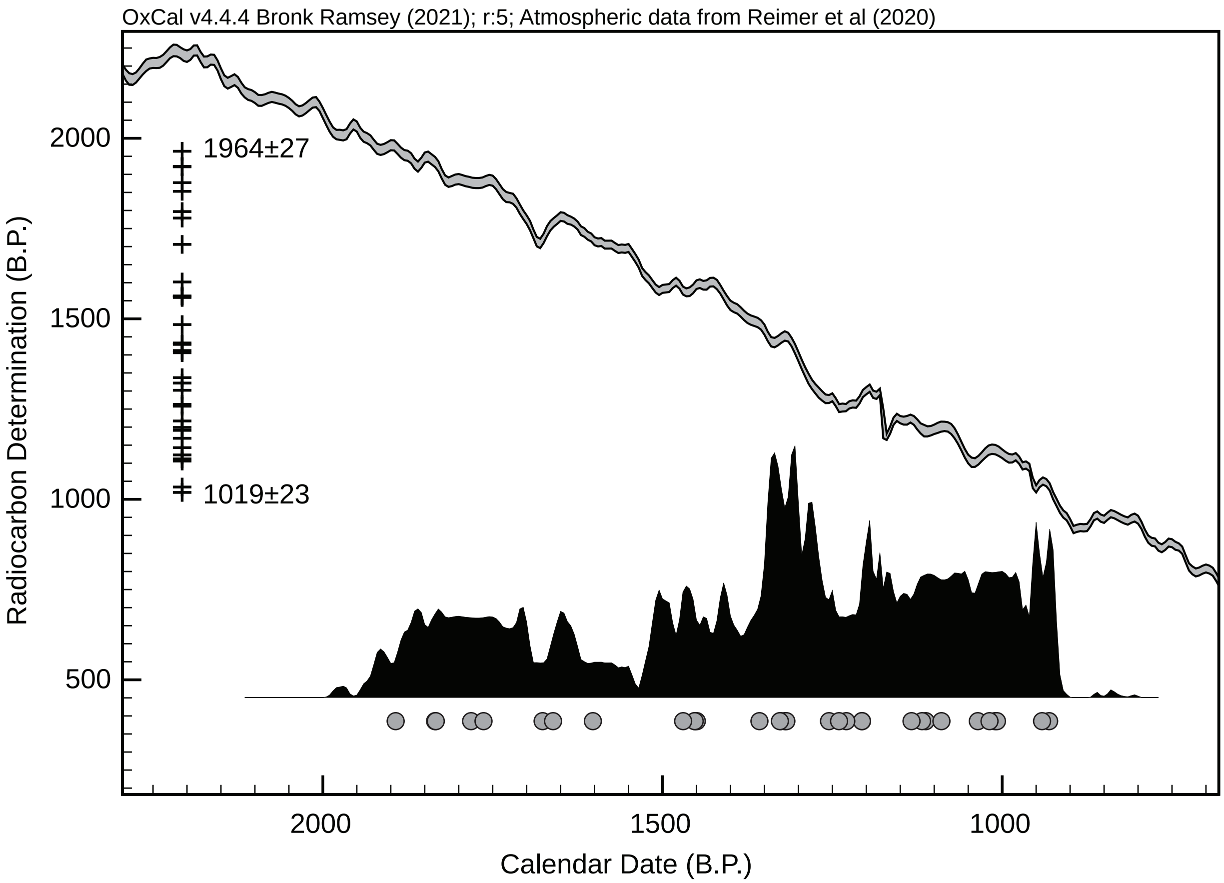


Figure 3.42. Summed probability distribution of all calibrated Early Ceramic period radiocarbon dates.

Table 3.26. Analytic unit descriptions.

Code	Unit Name	Description
AU0	Disturbed	Area 3 spoil units; may include minor amount of intact Early Ceramic (EC) deposits
AU1	Surface	Ap and A1 horizons; may include upper portion of EC horizon (GL1 and GL2)
AU2	EC General Levels	EC cultural deposits/anthropogenic A2 horizon; may include AB horizon
AU3	EC Features	Fill of defined cultural features assigned to EC based on ^{14}C dates or stratigraphic context
AU4	Mixed EC and pre-EC	Lower EC cultural deposits and upper portions of soil horizons below EC deposit
AU5	pre-EC	Deposits predating EC cultural features or horizons
AU9	Unassigned	Miscellaneous: fill of recent postmold (F9); GLs in Area 5; one specimen lacking provenience

the slope southwest of the Area 3 units may also have contributed sediment to the spoil layer.

General level samples were assigned to AU0 if they included any amount of spoil sediment. As a result, roughly 40 percent of the catalog numbers assigned to AU0 also sampled minor amounts of intact Early Ceramic period sediment; Early Ceramic materials assigned to AU0 lots therefore could derive either from intact archaeological deposits or from displaced spoil. Note that no diagnostic artifacts that certainly or probably predate the Early Ceramic period occur in AU0 lots. Rather, diagnostics associated with AU0 include a probable distal tip of an arrow point and three Early Ceramic period pottery body sherds.

AU1 (Surface) includes of the upper 10 to 12 cm of sediment that is identified as Ap and A1 horizons. Magic Mountain was not plowed, but the area investigated during 2017 and 2018 was used as a pasture for many years. The Ap and upper A1 horizons contain relatively few artifacts and may partially have formed through slopewash or aeolian deposition. All GL1 samples are assigned to AU1. In addition, 30 percent of AU1 lots consist of GL2 samples (or plots from GL2 contexts) that combine surface sediment with underlying A1 or A2 horizons due to the slope of the surface across the excavation unit or block. A single specimen recovered from the surface—an Early Ceramic arrowpoint— also is assigned to AU1. Two dart points occur in AU1 lots. One of the two (CN7052) may have been a found object repurposed by the site's Early Ceramic occupants. The other dart point (CN3211) is a small-to-medium sized corner-notched point. Points similar to the CN3211 specimen occur in Early Ceramic as well as Late Archaic contexts in Colorado (Mitchell 2018).

AU2 (Early Ceramic General Levels) comprises sediment deposited during the Early Ceramic period occupation. Just under half of the 954 catalog numbers allocated during the 2017-2018 fieldwork are assigned to AU2. Early Ceramic deposits are identified as A horizons (locally A1 or A2), AB horizons, and the upper portions of B horizons (locally BA, Bw, or Bt). The thicknesses of these horizons vary across the site. A horizons containing Early Ceramic artifacts are especially thick in Areas 3 and 4. Particularly in Area 4, the A2 and upper AB horizons appear to be partially anthropogenic and are identified as the "Early Ceramic horizon."

Forty-nine Early Ceramic projectile points occur in AU2 lots, along with nine dart points. One dart point (CN7061) appears to have been a recycled found object. One occurs in a lot that includes a small amount of pre-Early Ceramic sediment. Another occurs in a lot containing a small amount of water pipe trench spoil. Three occur within mottled Early Ceramic horizon sediment that may partly derive from the excavation of hearths and other features during the Early Ceramic occupation, which penetrated deeper, earlier archaeological deposits. The remaining three dart points appear to be out of stratigraphic context.

AU3 (Early Ceramic Features) includes samples obtained from cultural features assigned to the Early Ceramic based on radiocarbon dates, content, or stratigraphic context. A single dart point occurs in one radiocarbon-dated Early Ceramic feature (Feature 4). The boundaries of Feature 4 were challenging to define in the field; however, this specimen appears to be out of context.

AU4 (Mixed General Levels) consists of samples that combine sediment from the lower portions of the Early Ceramic horizon with underlying horizons that may contain older artifacts. Soil horizons commonly assigned to AU4 include the lower portions of B horizons (locally Bw or Bt). Three corner-notched arrow points and no dart points occur in AU4 lots.

AU5 (Pre-Early Ceramic General Levels) consists of sediment deposited prior to the Early Ceramic occupation. Soil horizons assigned to AU5 generally consist of Bt horizons of the modern soil, along with deeper horizons. One corner-notched arrow point fragment (CN3250) is assigned to AU5. A second possible arrow point, which is smaller than but exhibits some features of Late Archaic Yonkee points, also is assigned to AU5. Five dart points, including two possible McKean point fragments, occur in AU5 lots.

AU9 (Unassigned) consists of a small number of catalog lots from miscellaneous contexts, including general level samples from Area 5 units, a single feature level from a recent postmold (Feature 9), and one charcoal sample for which depth data are not available.

Analytic Unit Distribution

Table 3.27 cross-tabulates excavated sediment volume by report area and analytic unit. About 44 percent of the total excavated and screened volume is confidently assigned to the Early Ceramic period, including both general level ("Early Ceramic horizon") and feature contexts. The distribution of diagnostic artifacts suggests that contexts assigned to the "Surface" analytic unit also mostly reflect the site's Early Ceramic period occupation. In addition, artifacts dating to the Early Ceramic occur in the "Mixed" analytic unit, although the proportional representation of various time periods is unknown. Contexts that certainly predate the Early Ceramic period account for roughly 25 percent of the excavated volume. Miscellaneous disturbed and unassigned contexts account for about 8 percent.

Table 3.28 provides data on excavated sediment volume by recovery method and analytic unit. Eighty-six percent of the excavated volume was processed by dryscreening in the field over ¼-in mesh hardware cloth. About 11 percent of the total excavated volume was processed by fine-mesh waterscreening. Bulk sediment flotation and ⅛-in mesh dryscreening together account for just 3 percent.

A comparison of artifact and material densities among the seven analytic units is presented in table 3.29. Density values are highest in Early Ceramic

Table 3.27. Crosstabulation of excavation volumes (reported in liters of sediment), organized by report area and analytic unit.

	Report Area						
Analytic Unit	2	3	4	5	6	7	Total
Disturbed		2,219					2,219
Surface	778		2,754		353	1,066	4,951
Early Ceramic General Levels	778	1,417	7,406		875	2,272	12,748
Early Ceramic Features	101	105	469		58	143	875
Mixed	200		1,227		112	652	2,191
Pre-Early Ceramic General Levels		2,866	3,262		100	1,349	7,577
Unassigned			9	390			399
Total	1,857	6,606	15,127	390	1,497	5,482	30,959

Table 3.28. Crosstabulation of excavation volumes (reported in liters of excavated sediment), organized by recovery method and analytic unit.

	Recovery Method				
Analytic Unit	¼-in Dryscreen	⅛-in Dryscreen	Bulk Sediment	1/16-in Waterscreen	Total
Disturbed	1,986			233	2,219
Surface	4,656			295	4,951
Early Ceramic General Levels	11,217			1,531	12,748
Early Ceramic Features		627	233	15	875
Mixed	1,874			318	2,191
Pre-Early Ceramic General Levels	6,509			1,068	7,576
Unassigned	325	9		65	399
Total	26,567	636	233	3,523	30,959

Table 3.29. Artifact and material densities organized by analytic unit. Values for Early Ceramic period features are shaded.

			Vertebrate Fauna		
Analytic Unit	Flakes (flakes/m^3)	Tools (tools/m^3)	(g/liter)	(count/liter)	FCR (g/liter)
Disturbed	910	19	0.01	0.08	2
Surface	486	10	0.01	0.04	<1
Early Ceramic General Levels	1,054	23	0.08	0.32	2
Early Ceramic Features	2,250	83	0.34	2.43	696
Mixed	858	9	0.05	0.21	3
Pre-Early Ceramic General Levels	447	3	0.05	0.12	<1
Unassigned	220	5	<0.01	0.01	<1
Means	813	16	0.06	0.25	21

period contexts, especially in features dated to the Early Ceramic. Burned rock is virtually absent from non-feature contexts. Among intact contexts, densities are lowest in the “Pre-Early Ceramic” analytic unit. Densities also are low in the “Surface” analytic unit. The very low densities for the “Unassigned” analytic unit primarily reflect the dearth of material culture in Area 5.

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4

Modified Stone

Christopher M. Johnston

Modified stone is the best represented artifact class at Early Ceramic components in Colorado and Magic Mountain is no exception. Over 25,000 pieces of modified stone are present in the Magic Mountain assemblage and nearly two-thirds of the assemblage comes from contexts directly associated with the Early Ceramic occupations. This chapter begins by outlining laboratory procedures for all artifact classes followed by modified stone analysis methods. The overall collection is then summarized, along with a brief discussion of non-Early Ceramic components. The bulk of the chapter focuses on the Early Ceramic assemblage, concluding with a discussion of the site within a larger context of the Front Range Early Ceramic period.

Laboratory Methods

Modified stone in the Magic Mountain assemblage is present in all sample types. Field collection included piece-plotting individual items, ¼-in dryscreening of all general level lots, 1/16-in constant volume waterscreen samples from most general levels after GL1, ⅛-in dryscreening of feature samples, and bulk feature sample collection (see chapter 3 for a more descriptive summary of excavation and collection methods). Dryscreened samples were picked in the field and any specimen thought to be an artifact was bagged by catalog number and taken to the Denver Museum of Nature & Science (DMNS). Piece-plotted artifacts were also taken to DMNS for processing. Constant volume waterscreen samples were collected in their entirety—including natural rocks and other non-

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artifactual debris—and taken to the Paleocultural Research Group (PCRG) lab in Broomfield, Colorado for processing. Bulk feature samples were also taken to PCRG's lab for further analysis.

All samples—except selected bulk feature samples—were subjected to three basic processing steps: size-grading over nested screens, washing (as necessary), and sorting into artifact and material classes. Both DMNS and PCRG followed the same basic lab processes with their respective samples.

During size-grading, samples were manipulated or shaken over nested screens with four graduated square mesh opening sizes (U.S. Standard Sieve Cloth): grade 1 (G1) =1.000 in; G2=0.500 in; G3=0.223 in; and grade 4=0.100. Items smaller than G4 are classified as G5. To minimize damage, artifacts were manipulated by hand through size grades 1 and 2 screens. Samples were shaken for 15 to 20 seconds over size G3 and G4 screens.

Size-grading assists in the efficiency of the sorting process that follows, allowing the sorter to examine batches of specimens that are all approximately the same size. Size-grading also allows use of objective, size-determined cut-off points for the sorting of different types of artifacts. In addition, size distribution data for certain artifact classes are in themselves useful for study of site formation processes as well as the technological history of artifacts. Artifacts with different depositional histories can exhibit differing size distributions (Behm 1983; Sherwood et al. 1995). Distinct processing histories, such as distinct stone knapping technologies (Ahler 1989a, 1989b), can be isolated through careful attention to data controlled by size grade.

After size-grading, all samples were sorted into artifact and material classes, including modified stone. Coarse fraction materials (G1-3 size grades) were sorted in their entirety. Selective sorting was completed for G4 samples. Size grade 5 samples were quantified and discarded, except for botanical remains from feature fill samples.

Sorting and analysis at DMNS was conducted by student interns Cameron Benton, Erica Bradley, Brianna Dalessandro, Amy Gillaspie, Amy Maes, and Yessica Villagrana. They were overseen by Michele Koons, Curator of Archaeology at DMNS, and Erin Baxter, a DMNS Research Assistant. PCRG Lab Manager Britni Rockwell provided instruction and oversight during the entire process. Rockwell also oversaw the sorting process at PCRG and conducted the analysis of modified stone samples in the waterscreen and feature samples at the PCRG lab. She was assisted by University of Colorado at Boulder work-study students Jophen Chhetri, Frank Delaney, Connor Fisher, Arianna Jones, Matthew Menden, Jenna Scott, and Sebastian Wetherbee. PCRG work-study students Reagan Herdt and Sarah Montoya, from the University of Colorado – Denver, also assisted in the sorting process. PCRG Research Director Mark Mitchell and Project Archaeologist Chris Johnston collected additional data on selected stone tool classes. Mitchell oversaw the entire modified stone analysis and provided direction on the methodological framework.

Flaking Debris and Stone Tool Analysis Methods

The analysis of the Magic Mountain modified stone assemblage largely drew on methods developed by Stanley A. Ahler. The roots of Ahler's system lie in his study of the Rogers Shelter collection (Ahler 1971) and was subsequently expanded and refined in later years (Ahler 1989a, 1989b, 1992, 2002; Root *et al.* 1999). Variables and codes used for the modified stone analysis are listed in appendix B.

In Ahler's system, modified stone is first partitioned into two classes: chipped stone flaking debris and stone tools. A tool is defined as any intentionally shaped object, an item exhibiting use-wear, or a remnant nodule of raw material from which flakes were removed (Ahler and Swenson 1985:79-85). Intentionally shaped objects range in complexity from simple flakes exhibiting one or more retouched edges to items produced by flaking, pecking, grinding, or some combination techniques. Flakes, by contrast, are detached pieces discarded during lithic reduction, which therefore lack evidence of use or modification other than that produced by transport, trampling, or other post-depositional factors (Shott 2004).

The Magic Mountain analysis emphasizes the assemblage's technological, rather than functional, properties. Technological analysis of stone tools focuses mainly on how they were manufactured. The most important production variable is technological class—described in table 4.1—which is defined primarily by the dominant method used to manufacture it and secondarily by the form of the raw material blank (Ahler *et al.* 1994). Each method encompasses a sequence of production techniques, ranging from simple and expedient to complex and sequential. For example, patterned large thin bifaces are produced by the staged application of soft-

Table 4.1. Stone tool technological class definitions.

Technological Class	Sub Technological Class	Description
Small Patterned Biface		Produced by controlled and sequenced pressure flaking on small, thin flake blanks. When finished, artifacts in this class exhibit continuous bifacial retouch and are symmetrical in plan view and cross section. Includes arrow points, drills, and small cutting tools.
Large Patterned Biface		Produced by controlled and sequenced percussion flaking on various blank types. Symmetrical in plan view and cross section. Pressure flaking also is used, which sometimes obliterates evidence of earlier manufacturing stages. Includes dart points and hafted and unhafted bifacial cutting tools.
Unpatterned Biface		Produced by hard hammer percussion on tabular, pebble, or flake blanks; pressure flaking is used only rarely. Tools in this class are not symmetrical and often exhibit discontinuous bifacial edging.
Patterned Flake Tool		Produced by pressure flaking on flake or tabular blanks. Patterned flake tools exhibit plano-convex cross sections, but are bilaterally symmetrical in plan view. Includes hides scrapers; a few hafted beak tools designed for wood or bone working also are included in this class.
Unpatterned Flake Tool		Produced by use-flaking or pressure-flaking on a flake blank. Edge modification is highly variable and may be discontinuous. Unpatterned flake tools lack symmetry. Includes a wide variety of tools used for many different tasks.
	Use-modified	Unpatterned flake tools with only limited use and no marginal flaking.
	Retouch	Unpatterned flake tools with retouch along one or more margins.
Coarse Cutting Tool		Produced by free-hand percussion on large cobble blanks of coarse material. Tools are only minimally shaped and the cutting edge outline often is sinuous. Includes choppers, planes, and other unhafted tools.
Non-Bipolar Core		Produced by free-hand, nonbifacial percussion on various blank types. May be irregular or symmetrical. Includes cores and tested cobbles.
	Core	Includes unpatterned pieces modified by freehand percussion flaking in which removal of substantial flakes was the apparent purpose and result. At least one flake scar indicates removal of a large flake relative to the size of the nodule.
	Tested Cobble	Artifacts exhibit up to three percussion blows or insubstantial flake removals such that neither was a useful edge created on the artifact nor was an apparently useful flake blank produced.
	Random Flaking	Includes pieces of raw material that were repeatedly struck by freehand percussion blows, but without substantial flake removal or any apparent likelihood that useable flakes could be produced.
	Unoriented Fragment	Includes core fragments that exhibit flake removals but otherwise do not align with the other sub technological definitions for cores.
Bipolar Core/Wedge		Produced only or mainly by bipolar percussion. Irregular in plan view and cross section. Includes cores used for flake production, punches or wedges fractured during use, and tested cobbles.
Unpatterned Ground Stone		Produced by pecking or grinding or formed by use on various blank types. Irregular in plan view and cross section. Includes abrading tools, hammerstones, and bipolar anvils.
Patterned Ground Stone		Produced by pecking or grinding on various blank types. Blank form is substantially modified during the shaping process. Includes abrading tools, celts, mauls, pipes, beads and other decorative items.
Retouched Plate Tool		Produced by free-hand percussion flaking and pressure flaking on tabular or platy blanks. Tools in this class may exhibit unifacial or bifacial edging, but generally are asymmetrical in plan view. Includes a wide variety of tools used for many different tasks.
Ground Core		Produced by a combination of free-hand percussion flaking, battering, and grinding on irregular nodules. Used for multiple tasks, including flake production, heavy chopping, and abrading.

hammer percussion flaking and, to a lesser degree, pressure flaking on flake blanks or tabular pieces of stone. Unpatterned flake tools, by contrast, exhibit only simple edge modification, either through use or by marginal retouch.

Assessing tool technological class requires data on the methods used to manufacture a tool as well as inferences about the intended outcome of the manufacturing process. Determining manufacturing stage and technological trajectory in turn depend on the concept of *patternedness*. Patterned tools exhibit bilateral symmetry, whereas unpatterned tools are asymmetrical, with their form dictated mainly by the shape of the original input blank. Use-wear traces, though not rigorously quantified in this analysis, provide additional information about whether the production process was complete when an artifact was lost or discarded (use phase). Four use phase categories are used in the Magic Mountain analysis: tools that are unfinished but usable (thus, unbroken); tools that are unfinished and unusable (broken or rejected); tools that are finished and useable (unbroken, complete); and tools that are finished but unusable (broken, burnt, or exhausted).

Data were also collected on general raw material type (*e.g.*, chert, chalcedony, quartzite), a descriptive raw material type for specific sources or outcrops, raw material form (original input blank), completeness, rejection (reason for discard or failure), the presence of cortex, and for tools made from cryptocrystalline materials, intentional heat treatment and burning. Tools that exhibited multiple technological production modes were assigned case numbers to capture each different production mode of the tool.

Selected technological classes were further subdivided into sub-technological classes because two of the primary technological classes—flake tools and cores—are relatively broad and the sub-tech class designation offers a more refined approach to the analysis. Sub-technological classes are defined in table 4.1. Length, width, and thickness measurements were taken for tools when that measurement was complete. For instance, a biface missing a lateral edge would not have a width measurement but would have a length and thickness measurement taken.

Additional variables were also coded for projectile points, including a more descriptive completeness category and a typological designation for each point, when possible. Measurements were taken on projectile points only when the measurement was complete, including proximal and distal haft widths, distal haft length, blade base width, notch width and depth, and blade length.

Technological analysis of the flaking debris assemblage focuses on flake size and weight distributions. The suite of variables coded for all size grades includes general raw material type, a descriptive raw material type for specific sources or outcrops, and the presence of cortex. Additional variables coded for coarse fraction (sizes G1-3) flaking debris included intentional heat treatment and burning for flakes made from cryptocrystalline materials. Flakes from each catalog number with the same variable codes were counted and weighed to the nearest 0.1 g.

Size Grade 4 Bias

Different collection methods in the field resulted in variable distributions of modified stone, particularly flaking debris. Collections from general levels that were screened through ¼-in mesh mostly lack G4 artifacts because the size cutoff for this grade is 0.223 in. Although keen eyes by excavators resulted in some G4 artifacts being bagged before screening, G4 samples from general levels are not representative of actual raw material or flake type frequencies. The constant volume samples of general levels (waterscreened through 1/16-in mesh, and collected after GL1), however, are representative. Feature samples—both those screened through ⅛-in wire mesh and those collected in bulk—also captured all G4-sized artifacts. Data presented in the following chapter largely do not make the distinction between collection method and thus G4 samples should be treated with these caveats in mind. Where appropriate, extrapolations of G4 flaking debris are included and are based on excavation volume and density calculations from the constant volume samples.

Analytic Units

Data and analyses presented in this chapter are structured according to the analytic units described in chapter 3 (table 3.26). Seven analytic units (AU) were defined primarily using stratigraphic data. Because most of the collection comes from features and deposits dated to the Early Ceramic period, the AU structure was designed to isolate artifacts and other materials that date to that period from those that either predate or potentially postdate that period. Two AUs comprise Early Ceramic contexts: AU2 (Early Ceramic general levels) and AU3 (Early

Ceramic features). AU5 comprises pre-Early Ceramic contexts, while AU4 comprises potentially mixed Early Ceramic and pre-Early Ceramic contexts. Three AUs isolate materials from miscellaneous contexts, including disturbed sediment (AU0), potentially disturbed surface and near-surface deposits (AU1), and unassigned contexts (AU9). Summary data on the overall content and distribution of each AU are presented in tables 3.27 through 3.29.

Lithic Raw Materials

Raw materials suitable for stone tool production are abundant along the Front Range and the adjacent Rocky Mountains to the west, occurring as both primary and secondary sources (Black 2000). Within approximately 10 km of the Magic Mountain site, Black (2000:145) reports at least nine raw material sources. These include sources of quartzite, jasper, chert, chalcedony, and petrified wood. Many of these source locations have multiple material types noted, and Black (2000:134) notes many of the cryptocrystalline silicates from Jefferson County may instead be petrified wood from the Paleocene age Green Mountain conglomerate. Many of the quartzites present at Magic Mountain—which are of variable quality—are likely from sources along the Front Range and are primarily from the Dakota group (Black 2000:136).

Parker, or Black Forest, petrified (silicified) wood is a common chipped stone raw material from known sources found at sites along the Front Range (Black 2000; Gilmore 2005; Voynick 1994). This abundant material derives from the Dawson arkose, where it occurs as logs and large chunks. It also is available in secondary contexts across the Palmer Divide including in the Castle Rock Conglomerate and in Quaternary alluvium. Parker petrified wood is commonly medium- to fine-grained, although coarse-grained, partially silicified pieces also occur. Sources of Parker petrified wood are located roughly 40 km from Magic Mountain, making it the most locally available material from a known source location.

Parker petrified wood is quite variable and differentiating between it and other cryptocrystalline silicate rocks can be difficult. While predominantly brown to yellow in color, Parker petrified wood can also be translucent yellow, opaque white, and other colors; individual petrified logs can exhibit multiple colors and qualities (Gilmore 1989). Later sections of this chapter explore the difficulty in identifying Parker compared to other cherts and chalcedonies and the ramifications that problem can have on assemblage diversity data. Petrified wood also occurs in other formations in the Denver Basin (Black 2000).

In addition to local and near-local sources like Parker petrified wood, the Colorado mountains contain a number of extensive well-known tool stone sources. Among these is the Trout Creek jasper source (5CF84) in Chaffee County, near Buena Vista, Colorado (Black and Theis 2015). The Trout Creek quarry area, which covers over 400 ha and includes numerous outcrops, quarry pits, and workshop areas, produced a mostly yellow to red jasper and frequently contains dark inclusions that are often described as dendritic (Black and Theis 2015:339). While massive in size and scale, a number of other sources of a similar material occur in south-central Colorado, including south of Trout Creek and north into South Park (Black and Theis 2015:341). Thus, materials identified as Trout Creek may not come from that exact spot but are still at a distance from Magic Mountain.

Another well-known mountain source is Kremmling chert, which comes from the Miocene age Troublesome Formation in central and western Grand County (Black 2000:134). This high-quality opaque white to clear chert has been used since at least the Folsom period (Surovell 2022). Gleichman (2012:48) notes that Kremmling chert is the most common mountain source found along the Front Range. Northwest of the Kremmling chert quarries is another well-known source, Windy Ridge quartzite (Bamforth 2005; Black 2000). This Dakota Formation quartzite is fine grained, highly silicious, and was extensively mined by Indigenous Americans seeking toolstone, evidenced by the nearly 200 quarry pits with massive debris piles and adits connecting pits (Bamforth 2005). The primary color of the stone is gray, but it also grades to a golden brown, darker brown, and even light red to pink. Recent work by PCRG in the workshop area north of the site also indicates extensive biface manufacturing of Windy Ridge materials, ideal for transport away from the site.

Flattop Chalcedony (5LO34) occurs in Logan County, roughly 250 km from the site (Greiser 1983). This high-quality stone ranges from opaque white to a semi-transparent purple. This Oligocene-age rock also grades to hues of blue and pink, and often has white globular inclusions. Greiser (1983:8) reports over 200 depressions representing quarry pits atop the butte from which the material derives.

Archaeologists refer to as cherts and chalcedonies but this is geologically incorrect in most instances. Cherts are defined as opaque, silicate rocks and chalcedony as transparent to translucent silicate rocks. Flaked stone raw materials in this chapter are often described as cryptocrystalline silicates and coarse-grained stones, primarily because of the difficulty in distinguishing between some silicate rocks. Cryptocrystalline silicates include all cherts, chalcedonies, and petrified wood. Coarse-grained rocks—while inclusive of many different types in other contexts—in this chapter refer exclusively to quartzite unless otherwise noted.

The difficulty of visual raw material source identification often limits confidence in identifying one source over another. Further, as in the case of Trout Creek jasper, one well-documented primary or secondary source locale often is not the only one and similar materials can come from many different areas. Thus, drawing major conclusions about transport and mobility based solely on visual source identification can be tenuous. Considering this, during the raw material identification of the Magic Mountain assemblage, care was taken to not over-interpret source materials. All of the distant (non-local) sources identified in this section were coded when observed; however, each one also had a "possible" source code to account for the limits of visual source identification.

Collection Summary

The Magic Mountain modified stone assemblage consists of 25,183 flakes that together weigh 9,957 g (table 4.2) and 501 stone tool specimens that weigh 33,296 g (table 4.3). Four tools exhibit two different production modes, yielding a total of 505 technological cases; unless otherwise noted, tool data presented in this chapter represent case counts rather than specimen counts. Aside from selected extrapolations of G4 flaking debris, sampling procedures were not applied to the assemblage and so the reported values represent actual counts of flakes and tools rather than estimates.

The Early Ceramic period assemblage comprising over 60 percent of the flaking debris. The pre-Early Ceramic assemblage is the next best represented by count, but the surface assemblage has a slightly greater mass. Flakes from disturbed, mixed, and unassigned contexts comprise about 15 percent of the assemblage.

Tool counts follow a similar pattern, with about 73 percent of the tools coming from Early Ceramic contexts. Tools from the surface account for about 10 percent of the assemblage, while tools from disturbed contexts comprise about 8 percent. Early Ceramic tools account for over 98 percent of the assemblage when considered by mass. As table 4.4 shows, this weight distribution is due almost entirely to the abundance of ground stone tools—95 percent of which come from Early Ceramic contexts. Ground stone tools also account for about 95 percent of the mass of the entire stone tool assemblage.

The Early Ceramic has the greatest number of tools from every technological class across all analytic units. Unpatterned flake tools are the best represented technological class in the whole assemblage, followed by unpatterned ground stone tools and small patterned bifaces; most of the small patterned bifaces are arrow points. Bipolar cores or tools are the least represented, with only one case. Patterned ground stone is also poorly represented with only four cases.

Sub-technological class data for non-bipolar cores and unpatterned flake tools are summarized in table 4.5. The sub-tech class helps to refine these technological classes—which can be broad and inclusive of several different technological trajectories—to better assess the tool assemblage. Use-modified flake tools comprise nearly 65 percent of the unpatterned flake tool class, with retouched flakes only accounting for about 35 percent. Nearly 40 percent of the non-bipolar cores—accounting for about 14 percent of the total tool assemblage—are either tested cobbles, nodules with random and haphazard flaking, or unoriented fragments or shatter. Thus, only about 59 percent of these are true, non-bifacial cores, which is an important distinction when looking at on-site tool manufacture.

The remainder of this chapter uses the data presented in this section to examine the different analytic units. Data on disturbed, surface, and unassigned analytic contexts are only briefly summarized. Early Ceramic projectile points from those miscellaneous AUs are part of discussions in a later section. Data from pre-Early Ceramic contexts, while limited, are also discussed. The Early Ceramic period is the primary occupation at the Magic Mountain site and is the main focus of the remainder of this chapter.

Non-Early Ceramic Assemblage

The non-Early Ceramic assemblage includes deposits older than the Early Ceramic (AU5) and materials from mixed contexts (AU4), which includes

Table 4.2. Flake count and weight data organized by analytic unit and size grade.

	Counts						Specimen Weight (g)					
	Size Grade						Size Grade					
Analytic Unit	G1	G2	G3	G4	Total	Percent	G1	G2	G3	G4	Total	Percent
Disturbed	-	67	1,020	932	2,019	*8.0*	-	243.60	555.53	95.31	894.44	*9.0*
Surface	4	86	1,051	1,264	2,405	*9.6*	181.40	316.70	614.96	127.34	1,240.40	*12.5*
Early Ceramic	13	438	5,599	9,356	15,406	*61.2*	586.10	1,729.80	3,049.31	812.06	6,177.27	*62.0*
Mixed	1	42	611	1,227	1,881	*7.5*	45.00	156.80	337.76	91.26	630.82	*6.3*
Pre-Early Ceramic	1	75	1,031	2,277	3,384	*13.4*	39.90	296.80	503.45	155.57	995.72	*10.0*
Unassigned	-	-	30	58	88	0.3	-	-	14.93	3.77	18.70	*0.2*
Total	19	708	9,342	15,114	25,183	*100.0*	852.40	2,743.70	5,075.94	1,285.31	9,957.35	*100.0*

Table 4.3. Tool technological case count and specimen weight data organized by analytic unit.

	Case Counts						Specimen Weight (g)					
	Size Grade						Size Grade					
Analytic Unit	G1	G2	G3	G4	Total	Percent	G1	G2	G3	G4	Total	Percent
Disturbed	2	17	22	1	42	*8.3*	74.97	128.53	24.06	0.03	227.59	*0.68*
Surface	1	18	28	4	51	*10.1*	17.90	101.52	29.15	1.19	149.76	*0.45*
Early Ceramic	100	99	148	22	369	*73.1*	31,872.69	708.97	149.70	3.31	32,728.00	*98.30*
Mixed	2	10	8	-	20	*4.0*	44.60	48.08	6.78	-	99.46	*0.30*
Pre-Early Ceramic	-	13	7	1	21	*4.2*	-	81.89	6.33	0.13	88.35	*0.27*
Unassigned	-	-	2	-	2	0.4	-	-	2.43	-	2.43	*0.01*
Total	105	157	215	28	505	*100.0*	32,010.16	1,068.99	218.45	4.66	33,295.59	*100.00*

Table 4.4. Tool technological class count and weight summary organized by analytic unit.

	Analytic Unit								
Technological Class	Disturbed	Surface	Early Ceramic	Mixed	Pre-Early Ceramic	Unassigned	Total	Percent	Weight (g)
Small Patterned Biface	3	13	59	3	2		80	*15.8*	58.20
Large Patterned Biface	2	4	13	2	5		26	*5.1*	66.78
Unpatterned Biface	8	5	27	3	7		50	*9.9*	301.79
Patterned Flake Tool		1	23	3			27	*5.3*	84.34
Unpatterned Flake Tool	15	17	104	6	7	2	151	*29.9*	432.89
Non-bipolar Core	10	9	46	3			68	*13.5*	822.68
Bipolar Core/Tool			1				1	*0.2*	3.30
Unpatterned Ground Stone	4	2	92				98	*19.4*	30,679.18
Patterned Ground Stone			4				4	*0.8*	846.43
Total	42	51	369	20	21	2	505	*100.0*	33,295.59

some Early Ceramic deposits as well as pre-Early Ceramic (likely Archaic) deposits. This section also summarizes materials from disturbed (AU0), surface (AU1), and unknown (AU9) contexts, many of which are likely associated with the Early Ceramic occupations but could not be confidently assigned to those contexts based on stratigraphy. Diagnostic artifacts from different periods occur in all of these contexts and these are mostly discussed by period of manufacture rather than in-ground provenience (*e.g.*, corner-notched arrow points from disturbed contexts are discussed later in the Early Ceramic section).

Mixed Assemblage

AU4 contains samples that combine lower portions of Early Ceramic deposits with underlying sediment that may contain older artifacts. Deposits in this unit

Table 4.5. Sub technological class counts organized by analytic unit.

	Analytic Unit						
Sub Technological Class	Disturbed	Surface	Early Ceramic	Mixed	Pre-Early Ceramic	Unassigned	Total
Flake Tools							
Use-modified	11	13	65	2	5	1	97
Retouch	4	4	39	4	2	1	54
Sub Total	15	17	104	6	7	2	151
Non-bipolar Cores							
Core	2	3	34	1			40
Tested Cobble			1				1
Random Flaking	4	1	6				11
Unoriented Fragment	4	5	5	2			16
Sub Total	10	9	46	3	0	0	68

Table 4.6. Distribution of mixed assemblage (upper panel) and pre-Early Ceramic (lower panel) flaking debris raw material types by size grade.

	Counts					Weight (g)				
	Size Grade					Size Grade				
Raw Material	G1	G2	G3	G4	Total	G1	G2	G3	G4	Total
Chert		1	1	8	10		8.2	0.2	0.9	9.3
Chalcedony			21	14	35			8.3	2.4	10.7
Quartzite		22	280	507	809		75.6	165.0	37.7	278.3
Petrified Wood		17	307	686	1,010		45.7	163.1	48.9	257.7
Obsidian				1	1				0.3	0.3
Quartz	1	2	2	11	16	45.0	27.3	1.2	1.1	74.6
Total	1	42	611	1,227	1,881	45.0	156.8	337.8	91.3	630.8

	Counts					Weight (g)				
	Size Grade					Size Grade				
Raw Material	G1	G2	G3	G4	Total	G1	G2	G3	G4	Total
Chert		1	27	33	61		3.2	11.4	4.0	18.6
Chalcedony		1	28	31	60		4.2	13.7	4.9	22.8
Quartzite		41	519	989	1,549		171.3	254.5	69.9	495.7
Petrified Wood	1	30	439	1,193	1,663	39.9	108.3	212.5	73.6	434.2
Schist			2	1	3			1.0	0.1	1.1
Quartz		2	13	28	43		9.8	8.5	2.7	21.0
Metaquartzite			2	2	4			1.1	0.4	1.5
Unknown			1		1			0.8		0.8
Total	1	75	1,031	2,277	3,384	39.9	296.8	503.5	155.6	995.7

include 1,881 flakes (table 4.6, upper panel). The general distribution of raw materials is like that of the Early Ceramic component, although slightly more quartzite is represented in the mixed assemblage. It is more similar to the pre-Early Ceramic assemblage (lower panel in table 4.6) but given that there are just a few main material types overall—many of which are local or near-local—parsing the assemblage beyond being mixed based on raw material is not possible.

While few in number, cryptocrystalline tools account for 90 percent of the tool assemblage—and 97 percent by weight—in the mixed assemblage (table 4.7, upper panel). This closely resembles the Early Ceramic distribution (88 percent cryptocrystalline) but is quite different from the pre-Early Ceramic deposits. Unpatterned flake tools are the most represented tool in the mixed assemblage (table 4.8). The three patterned flake tools, as discussed in the Early Ceramic section, are likely best classified also as unpatterned flake tools but have a steep bevel.

Three small patterned bifaces in the assemblage include one mostly complete but small arrow point (CN4367), one arrow point preform (CN4396), and one arrow broken during manufacture (CN7094). These are all summarized in the Early Ceramic arrow point discussion later in this chapter. The two large patterned bifaces (CN7034 and 7094) are not dart points and their function is unknown. The raw material distributions, the presence of arrow points, and the lack of dart points, suggests that most of these deposits are associated with the Early Ceramic.

Pre-Early Ceramic Assemblage

AU5 contains most of the pre-Early Ceramic deposits at Magic Mountain. The modified stone assemblage from this context includes 3,384 flakes (table 4.6) and 21 tools (table 4.7). Petrified wood flaking debris is the best represented material type by count, but quartzite is greater by mass. Chert and chalcedony account for a small portion of the assemblage. Raw material coding issues, which are discussed in more detail later in the Early Ceramic section, indicate that both chalcedony and chert are best included with petrified wood as cryptocrystalline silicates. When the materials are combined, however, the overall distribution remains about the same for by both count and weight.

Table 4.7. Distribution of mixed assemblage (upper panel) and pre-Early Ceramic (lower panel) stone tool raw material types by size grade.

	Count				Weight (g)			
	Size Grade				Size Grade			
Raw Material	G1	G2	G3	Total	G1	G2	G3	Total
Chert		3	1	4		9.4	0.3	9.7
Chalcedony			1	1			1.5	1.5
Quartzite		1	1	2		1.5	1.4	2.9
Petrified Wood	2	6	5	13	44.6	37.2	3.6	85.4
Total	2	10	8	20	44.6	48.1	6.8	99.5

	Count				Weight (g)			
	Size Grade				Size Grade			
Raw Material	G2	G3	G4	Total	G2	G3	G4	Total
Chert	1	1		2	1.8	0.3		2.1
Chalcedony		1		1		0.4		0.4
Quartzite	7	2	1	10	50.6	3.2	0.1	53.9
Petrified Wood	5	3		8	29.5	2.4		39.1
Total	13	7	1	21	81.9	6.3	0.1	88.3

Table 4.8. Cross tabulation of stone tool technological class and raw material for the mixed assemblage.

	Raw Material				
Technological Class	Chert	Chalcedony	Quartzite	Petrified Wood	Total
Small Patterned Biface	2			1	3
Large Patterned Biface	1			1	2
Unpatterned Biface				3	3
Patterned Flake Tool		1	1	1	3
Unpatterned Flake Tool			1	5	6
Non-bipolar Core	1			2	3
Total	4	1	2	13	20

Raw material source data for the pre-Early Ceramic assemblage indicate 394 flakes are Parker petrified wood. Three flakes are possibly Kremmling (Troublesome Formation) chert, one is possibly Flattop Butte chalcedony, and one is possibly from the Trout Creek jasper source. Aside from two unpatterned flake tools that are made from Parker petrified wood, no tools are made from known distant sources. Like the Early Ceramic assemblage, nearly all of the flakes are likely from local or near-local sources.

Raw material for coarse fraction (size classes G1-3) flaking debris is nearly equal between the two high level material classes—cryptocrystalline silicates and quartzite—although quartzite is slightly better represented. Only 79 flakes show evidence of burning and only 59 are likely or definitely heat-treated. Just under 9 percent have cortex. Nearly 73 percent (n=1,656) of the G4 assemblage comes from waterscreen samples. No features predating the Early Ceramic were identified and therefore none of the pre-Early Ceramic assemblage comes from features.

Table 4.9 summarizes the technological classes recognized in the pre-Early Ceramic assemblage. Two-thirds of the assemblage is unpatterned bifaces and unpatterned flake tools. Two small patterned bifaces are in the assemblage. One (CN3250) is the tang of what may be an arrow point but also could be from a corner-notched dart point. The other (CN3168) is a slightly concave base, side-notched to stemmed dart point. It has a slightly serrated blade and resembles, in some ways, Middle to Late Archaic-aged Yonkee points (Kornfeld *et al*. 2010). It is also similar to Armijo side-notched points of the Oshara tradition in norther New Mexico that date roughly to the same period (Chapin 2017).

The five large patterned bifaces include two likely dart point preforms, and one distal (tip) fragment that is too large to be from an arrow. One (figure 4.1, CN3183) is a Middle Archaic McKean dart point. Only the proximal portion is represented. The base is concave, with slight grinding on the basal margins. The distal portion was broken by a bending fracture, possibly from impact. Another (CN4157) is a proximal fragment of what is likely a McKean base. It has a slight concavity in the base but is highly fragmented.

The entire Magic Mountain assemblage contains 12 additional dart point fragments or preforms. Ten of these come from Early Ceramic AUs (chapter 3 provides data on the contexts of these specimens). Three are distal segments that are too large to be arrow points and are likely dart point tips. Another two are likely dart point preforms. Seven are dart point fragments. These include CN3075, discussed in the Early Ceramic stone tool section, which is likely a James Allen fragment but could be a McKean basal fragment, and CN7061, a stemmed dart point that was likely re-purposed during an Early Ceramic occupation as a cutting tool.

Two are shallow, broad side-notched dart points, including CN2005 shown in figure 4.1. The base morphology is quite similar to Irwin-Williams and Irwin's (1966:82-84) MM20 type, which come from the pre-ceramic levels (Zone C) and what they term the Apex Complex, which is roughly equivalent to the Middle Archaic period. Two more (CN3211 and CN3219, figure 4.1) are stemmed to side-notched dart points with convex bases. They somewhat resemble Irwin-Williams and Irwin's (1966:80-82) MM18 type, which also comes from the Apex Complex in Zones C, D, and E, or roughly Middle to Late Archaic.

Although pre-Early Ceramic deposits comprise about 25 percent of the total volume excavated during the DMNS/PCRG/KU-Odyssey project, they contain just 13 percent of the flake assemblage and 4 percent of the tool assemblage. Prior work at the site (Irwin-Williams and Irwin 1966) indicates that pre-Early Ceramic deposits comprise much of the record at the site. However, the 2017-2018 pre-Early Ceramic assemblage is too small to provide significant data on

Table 4.9. Summary of Pre-Early Ceramic technological classes by raw material.

	Technological Class				
Raw Material	Small Patterned Biface	Large Patterned Biface	Unpatterned Biface	Unpatterned Flake Tool	Total
Chert		2			2
Chalcedony		1			1
Quartzite	2	2	4	2	10
Petrified Wood			3	5	8
Total	2	5	7	7	21

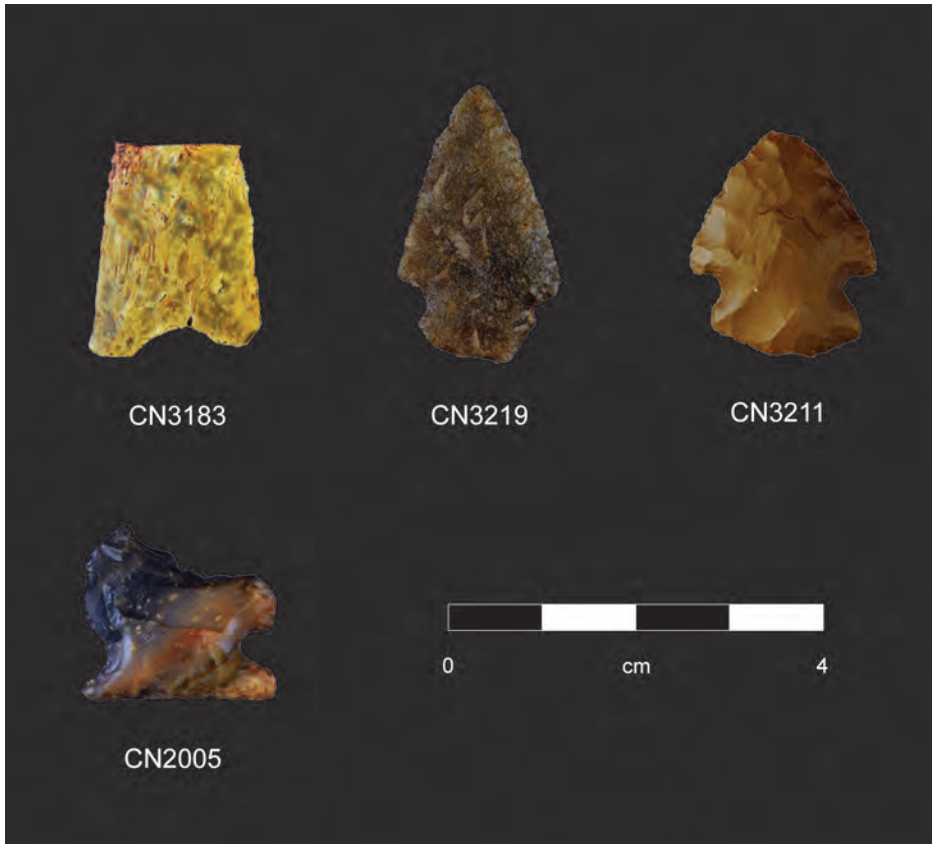

Figure 4.1. Selected Archaic dart points from the 2017-2018 assemblages. Types for each are described in the text.

the site's earlier occupations. Aside from the possible James Allen point fragment, the oldest known artifacts in this area date to the Middle Archaic period with the few McKean point fragments.

Surface, Disturbed, and Unassigned Contexts

Excluding the Early Ceramic deposits, the remaining analytic units contain 4,512 flakes (table 4.10). About 45 percent of these come from disturbed contexts, 53 percent from surface contexts, and only 2 percent (n=88) are from unassigned contexts. These contexts also contain 95 tools (table 4.11). About 44 percent (n=42) of these come from surface contexts and 54 percent (n=51) are from disturbed contexts. Only two tools, both unpatterned flake tools, come from unassigned contexts.

Unpatterned flake tools are the most common from these contexts, followed by cores and small patterned bifaces. Fifteen of the small patterned bifaces are arrow points, arrow point fragments, or arrow point preforms. Four of these are corner-notched arrow points and discussed in a later section. Seven are arrow point preforms, most likely representing corner-notched arrows based on their morphology, and three are fragments.

The entire Magic Mountain modified stone assemblage contains only two side-notched arrow points. CN7084 comes from the surface AU and the other, CN7104, comes from a context assigned to the Early Ceramic. CN7084 is the proximal end of a heat-treated Parker petrified wood point with a slightly concave base. The tip is missing from a bending fracture. CN7104 (figure 4.2) is also a Parker petrified wood point with a straight base. The point is complete and is not heat treated.

Modified stone from disturbed contexts—and many of the surface artifacts—are most likely associated with the Early Ceramic occupations at the site. Intact post-Early Ceramic deposits were not documented in the 2017-2018 excavations, and just two diagnostic artifacts were recovered. Post-Early Ceramic occupation of the site was limited and less extensive than the Early Ceramic occupations.

Early Ceramic Assemblage

The Early Ceramic period assemblage (AU2 and

Table 4.10. Distribution of flaking debris raw materials by size grade from surface, disturbed, and unknown contexts.

	Counts					Weight (g)				
	Size Grade					Size Grade				
Raw Material	G1	G2	G3	G4	Total	G1	G2	G3	G4	Total
Chert		4	104	62	170		14.4	53.0	10.5	77.9
Chalcedony		1	92	63	156		3.2	52.6	9.4	65.2
Quartzite	2	76	914	840	1,832	156.4	276.7	517.9	80.7	1031.7
Rhyolite			1	1	2			0.3	0.1	0.4
Basalt			1		1			0.7		0.7
Petrified Wood	2	65	959	1,255	2,281	25.0	224.4	539.0	119.6	908.0
Unknown			2		2			1.3		1.3
Schist			1		1			0.6		0.6
Quartz		7	27	33	67		41.6	20.1	6.11	67.8
Total	4	153	2,101	2,254	4,512	181.4	560.3	1185.4	226.4	2153.5

Table 4.11. Cross tabulation of stone tool technological class and raw material type from disturbed, surface, and unknown contexts.

	Raw Material							
Technological Class	Chert	Chalcedony	Quartzite	Petrified Wood	Sandstone	Quartz	Other	Total
Small Patterned Biface	6	1	4	4		1		16
Large Patterned Biface	1		3	2				6
Unpatterned Biface		2	3	8				13
Patterned Flake Tool				1				1
Unpatterned Flake Tool	4	1	3	26				34
Non-bipolar Core	3			16				19
Ground Stone					5		1	6
Total	14	4	13	57	5	1	1	95

Figure 4.2. One of the two side-notched arrows from the 2017-2018 assemblage.

AU3 combined) is the largest at the site, consisting of 15,406 flakes and 369 stone tool technological cases.

Raw Material Usage

Table 4.12 presents the distribution of raw materials by size grade for the Early Ceramic flake assemblage. Twelve different raw material types are represented, with petrified wood being the most common across all size grades. Quartzite is the second most common, at over 35 percent of the assemblage. Chalcedony and chert are the third and fourth most common materials, respectively; however, these materials together only account for about five percent of the entire assemblage. G1 and G2 flakes make up less than 3 percent of the Early Ceramic flake assemblage, indicating little reduction of larger nodules or bifaces occurred at the site or those flakes were being made into tools and either discarded on-site or removed.

Flaking debris from imported materials is

Table 4.12. Distribution of Early Ceramic flaking debris raw material types by size grade.

	Size Grade					
Raw Material Type	G1	G2	G3	G4	Total	Percent
Chert		9	145	192	346	*2.2*
Chalcedony		16	207	271	494	*3.2*
Quartzite	6	195	2,134	3,156	5,491	*35.6*
Rhyolite		2	7	5	14	*0.1*
Basalt			2	1	3	*<0.1*
Petrified Wood	4	202	3,018	5,578	8,802	*57.1*
Obsidian				3	3	*<0.1*
Argillite			1		1	*<0.1*
Schist			8	1	9	*0.1*
Quartz	3	11	65	142	221	*1.4*
Metaquartzite		1	9	5	15	*0.1*
Unknown		2	3	2	7	*<0.1*
Total	13	438	5,599	9,356	15,406	*100.0*

Table 4.13. Distribution of Early Ceramic flaking debris from identified raw material sources, organized by size grade.

	Size Grade				
Raw Material Type	G1	G2	G3	G4	Total
Flattop Chalcedony		1	3		4
Possible Flattop Chalcedony			2		2
Parker Petrified Wood	1	99	1,740	974	2,814
Troublesome (Kremmling) Chert			5	1	6
Possible Troublesome (Kremmling) Chert			1		1
Trout Creek Jasper			2		2
Possible Trout Creek Jasper			1	10	11
Possible Windy Ridge Quartzite			1		1
Obsidian-Malad, ID				1	1
Obsidian-Obsidian Ridge (Jemez, NM)				1	1
Obsidian-Polvadera Peak (Jemez, NM)				1	1
Total	1	100	1,755	988	2,844

minimally represented in the Early Ceramic assemblage (table 4.13). Identified sources include those located in the mountains to the south and west and from the Plains to the east. Sourced, or potentially sourced, flaking debris accounts for about 18 percent of the entire assemblage. The most common source is Parker petrified wood. All other sources represented in the flaking debris assemblage—including those identified as potentially identifiable—account for about one percent of the sourced assemblage. Troublesome Formation (Kremmling) chert, which comes from the Middle Park area, is the best represented with six specimens. Two specimens are Trout Creek jasper and eleven more are tentatively identified as Trout Creek jasper. However, ten of those are in the G4 size sample and identifying the source can be difficult in smaller size grades.

Three G4 obsidian flakes also occur in the assemblage. These were sent to the University of Missouri Research Reactor (MURR) Archaeometry Laboratory for X-ray fluorescence analysis. Two of the samples are sourced to New Mexico (Obsidian Ridge and Polvadera Peak), which are roughly 400 km southwest of Magic Mountain (Jeffrey Fergusson, personal communication 2022). MURR sourced the other piece to the Malad, Idaho, source located about 700 km northwest of the site. The Bayou Gulch site (5DA265)—a multi-component site in Douglas County with Early Ceramic deposits—produced 16 obsidian samples, most of which came from the New

Mexico sources but two came from Malad (Gilmore *et al.* 2021:63-66). Obsidian hydration measurements on the Bayou Gulch samples led Gilmore and others to suspect that they date to sometime after A.D. 1100 and may be associated with the Middle Ceramic or later components at the site. The Magic Mountain samples are all firmly within Early Ceramic contexts.

Burning and heat treatment was coded only for the coarse fraction (G1-3) flake assemblage and was not coded on coarse-grained materials like quartzite. Just over 5 percent of the assemblage for which heat treatment was coded is either definitely or likely heat-treated, and over 17 percent of the Parker petrified wood flakes are heat treated. About 37 percent of all tools—and 43 percent of the Parker petrified wood tools—are heat treated. About 16 percent of the flakes are burned, and 17 percent of the tools are burned.

Chipped stone tool raw material data are presented in table 4.14. The only identified source for chipped stone tools is the near-local Parker petrified wood, suggesting that flaking debris from imported sources represents tool maintenance rather than manufacture. Petrified wood tools account for two-thirds of the entire chipped stone tool assemblage, with Parker and other petrified wood sources equally represented. Tools made from chert account for over 14 percent of the assemblage, a contrast with the much lower frequency of chert flaking debris. Chalcedony tools follow a similar pattern.

Table 4.14. Summary of raw materials used to produce chipped stone tools in the Early Ceramic assemblage.

	Size Grade					
Raw Material Type	G1	G2	G3	G4	Total	Percent
Chert	-	11	25	3	39	*14.3*
Chalcedony	2	3	13	3	21	*7.7*
Quartzite	4	9	18	2	33	*12.1*
Petrified Wood	5	34	41	10	90	*33.0*
Parker Petrified Wood	4	33	50	3	90	*33.0*
Total	15	90	147	21	273	*100.0*

Raw Material Distribution

Different lithic raw materials are unevenly distributed between the two primary recovery methods—¼-in dryscreening and 1/16-in waterscreening—to a degree that warrants further discussion. Waterscreen materials captured a representative sample from all general levels after GL1. These values can be extrapolated using volume data to examine the quantity of artifacts—primarily flaking debris—that were missed due to ¼-in dry screening. This is particularly relevant for the G4 sample since flakes of that size would pass through the ¼-in screen. For example, in the Early Ceramic assemblage, 3,068 G4 flakes were recovered from dryscreened samples compared to 4,871 from waterscreened samples. This equates to a density of 0.27 and 3.18 G4 flakes per liter, respectively, highlighting the disparity between the two collection methods. When extrapolated to the entire Early Ceramic assemblage, the assemblage would include over 40,000 flakes, rather than the 9,356 that were actually collected.

Despite this recovery bias, the expectation is that the proportions of different raw material types should be comparable between the two collection methods because both sampled the same deposits; however, in the Early Ceramic assemblage this is not the case. Table 4.15 illustrates this difference, particularly in the fine-grained cryptocrystalline materials like chert, chalcedony, and petrified wood. Coarse-grained materials, like quartzite, are evenly distributed between the two sampling methods. Multiple evaluations of the dataset are presented here to help explain the difference between raw material types by recovery method. Given the uneven collection of G4 flaking debris between the two methods, only the coarse fraction (G1-3) flakes are used to compare samples.

Figure 4.3 shows the percent of G1-3 flakes in the assemblage compared to the percent of dryscreen and waterscreen samples by area. This almost identical distribution shows that the recovery method itself does not bias the flake sample. Further, the nearly even flake densities by recovery method within areas also indicate that the raw material discrepancy is not

Table 4.15. Percent of coarse fraction (G1-3) raw materials organized by recovery method. Raw materials accounting for 1 percent or less are excluded.

Raw Material	¼-in Dryscreen	1/16-in Waterscreen
Chert	*2.4*	*0.3*
Chalcedony	*4.4*	-
Quartzite	*40.3*	*39.3*
Petrified Wood	*52.9*	*60.4*
Total	*100.0*	*100.0*

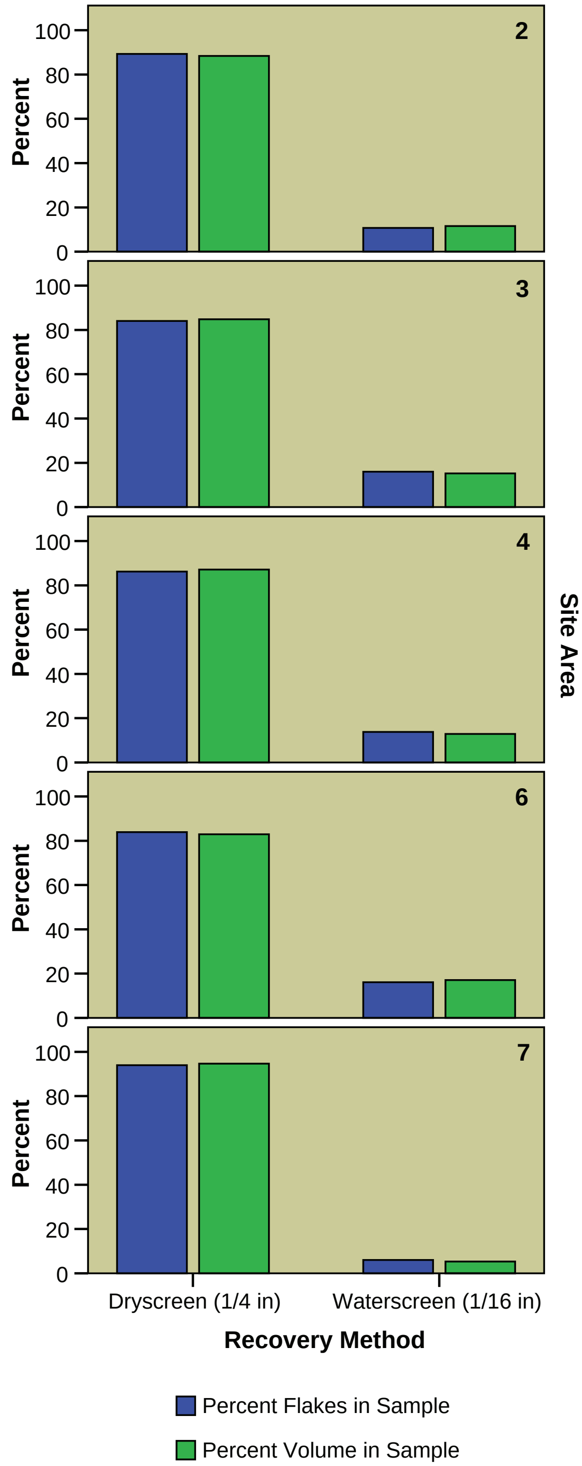

Figure 4.3. Bar chart displaying the percent of Early Ceramic coarse fraction (G1-3) flaking debris by recovery method compared to the percent of samples retrieved by each recovery method for each area of the site.

a sampling bias caused either by the sampling method or the excavators.

The most likely explanation for the difference in raw material types between sampling methods is that was a product of differing analysis methods applies to the dryscreened and waterscreened samples. As noted in the methods section, PCRG lab staff analyzed all waterscreened samples while DMNS staff and interns analyzed all dryscreened samples. Extensive efforts were made to keep the data coding as consistent as possible—including training and data checks by PCRG staff with DMNS staff and interns. However, the inherent problem of identifying petrified wood versus other cryptocrystalline materials like chert and chalcedony—particularly from the Parker petrified wood source—present the potential for error. Likely over-coding of petrified wood in the waterscreen samples and under-coding of petrified wood in the dryscreen samples is responsible. Therefore, comparisons between raw material types throughout this section are only made between specimens recovered and analyzed in the same way. Additionally, in some instances, rather than differentiating between chert, chalcedony, and petrified wood, these are all collapsed into the category of cryptocrystalline silicate rocks to facilitate discussions of the different uses of rock types.

Stone Tool Technology

Table 4.16 presents a cross-tabulation of stone tool raw materials and technological classes for the 369 cases comprising the Early Ceramic stone tool assemblage. This case count only reflects stone tools from the Early Ceramic analytic units; additional Early Ceramic projectile points were recovered from other analytic units—primarily from surface contexts—and are discussed later in this chapter. Unpatterned flake tools and ground stone tools account for over 50 percent of the entire Early Ceramic tool assemblage. Small patterned bifaces—most of which are arrow points or arrow point preforms—are the next most common technological class in the assemblage. There is only one bipolar tool in the entire assemblage, and only four patterned ground stone specimens.

Four multi-case tools are present in the assemblage. These include a large patterned biface that was then flaked by bipolar percussion and two patterned flake tools that were subsequently recycled into unpatterned flake tools. One other specimen (CN7061) is a large patterned biface—which is a stemmed dart point

Table 4.16. Cross-tabulation of stone tool raw materials and technological classes from Early Ceramic analytic units. Case counts include specimens from all recovery methods.

	Technological Class										
Raw Material	Small Patterned Biface	Large Patterned Biface	Unpatterned Biface	Patterned Flake Tool	Unpatterned Flake Tool	Non-bipolar Core	Bipolar Core/Tool	Unpatterned Ground Stone	Patterned Ground Stone	Total	Percent
Chert	19	3	1	1	10	5				39	*10.6*
Chalcedony	4	3		1	9	4				21	*5.7*
Quartzite	7	5	6		12	3				33	*8.9*
Rhyolite									1	1	*0.3*
Petrified Wood	12	1	12	15	34	16				90	*24.4*
Parker Petrified Wood	17	1	8	6	39	18	1			90	*24.4*
Sandstone								75	1	76	*20.6*
Schist								8	1	9	*2.4*
Other Igneous								6		6	*1.6*
Other Unknown								3	1	4	*1.1*
Total	59	13	27	23	104	46	1	92	4	369	*100.0*
Percent	16.0	3.5	7.3	6.2	28.2	12.5	0.3	24.9	1.1	100.0	

fragment—that was then subsequently recycled into an unpatterned flake tool. All are made from petrified wood, three of which are made from Parker petrified wood.

Small Patterned Bifaces

Fifty-nine small patterned bifaces are present in the Early Ceramic assemblage. Fifty-five (93 percent) of these are classified as arrow points or fragments, and arrow point preforms. These do not include the additional arrow points from surface, mixed, and disturbed contexts. Over 50 percent of these are finished points but are broken. Just under a third are preforms that were broken during manufacture or were otherwise unfinished. Nine are complete corner-notched arrow points but were discarded at the site. These use phase data indicate a relatively high degree of projectile point manufacture occurring at the site, which will be discussed more in the arrow point section later in this chapter.

One of the small patterned bifaces is a nearly complete small cutting tool made from petrified wood that is burned. The other three small patterned bifaces are functionally indeterminate. One is a margin fragment made from heat treated petrified wood. Another is a small distal end fragment, and another is a small proximal fragment.

Large Patterned Bifaces

Early Ceramic analytic units contain 13 large patterned bifaces. One, CN3140, is a fragment of an unfinished quartzite bifacial knife (figure 4.4). Two are of indeterminate function. The other 10 are dart point or dart point fragments. The discussion of Early Ceramic analytic units in chapter 3 provides some context for the presence of dart point fragments in the Early Ceramic assemblage. Four of these are distal (tip) fragments on specimens that are likely too large to be arrow points andare likely dart point tips. One (CN7061, figure 4.4), is a two-case tool and is a recycled found object. It is a stemmed dart point, with an unground base that has an impact fracture. This specimen was recycled, likely during the Early Ceramic, as an unpatterned flake tool.

Two of the dart point fragments appear to come from Early Ceramic lots that contained a small amount of pre-Early Ceramic sediment or disturbed sediment (water pipe trench spoil). Three come from mottled Early Ceramic sediment that may partly

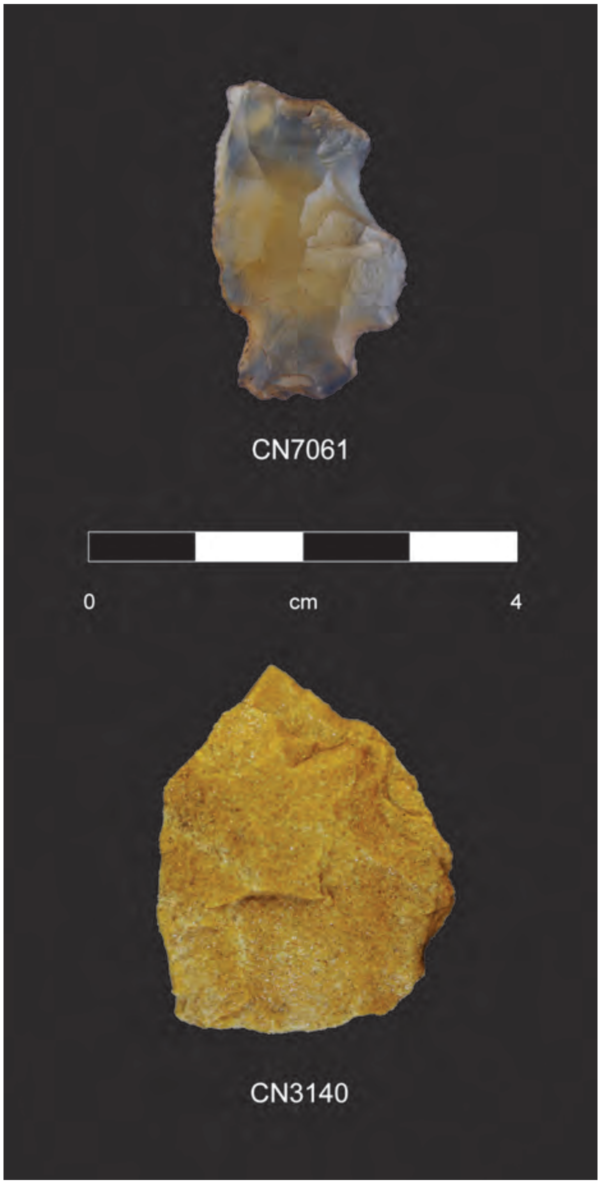

Figure 4.4. Selected large patterned bifaces. CN7061 is a dart point repurposed as an Early Ceramic cutting tool. CN3140 is a portion of a bifacial knife.

derive from the excavation of features during the Early Ceramic occupations which encountered deeper, earlier deposits. One of these (CN3075) is a heavily ground stemmed base that is slightly concave and broken by an impact fracture. The fracture prevents confident typing but it is likely a James Allen partial base. It could also be a McKean lanceolate point, but the heavy basal grinding argues for the former. Three appear to be out of context and one (CN3129), a likely dart point preform, was found in Feature 4—an Early Ceramic rock-filled pit. As discussed in chapter 3, the boundaries of Feature 4 were challenging to define in the field, but this point is also likely out of context.

Unpatterned Bifaces

Twenty-seven small to medium unpatterned bifaces are present in the assemblage. CN2014 in figure 4.5 shows an example of this technological class. Nearly 80 percent of these were finished and unusable when discarded; three were unfinished and unusable (broken) and three were finished and useable when discarded. Six are made from quartzite while the remaining 21 are made from cryptocrystalline silicate rocks, including eight coded as Parker petrified wood. Five are burned, and eight are likely or definitely heat treated. One (CN7029) comes from Feature 7—a fire-cracked rock concentration—while the other 26 come from Early Ceramic general level lots. Thirty-eight percent are margin fragments and about 27 percent are complete or nearly complete.

Patterned, Steeply Beveled Flake Tools

Twenty-three patterned flakes tools were coded in the Early Ceramic assemblage. Often, although not exclusively, this technological class consists of hafted scraping tools, with a patterned form and steep edge angle. During a more in-depth analysis of selected tool classes after the coding had been completed it was noted that most tools assigned to this technological class are, in fact, unpatterned flake tools. This resulted from a miscommunication between the analysts at DMNS and PCRG staff. DMNS analysts recognized the steeply beveled (high edge angle) edge morphology but did not consider the patternedness of the tool when making technological class assignments. Qualitatively, a limited number of patterned flake tools are present in the assemblage, and morphologically they are hafted endscrapers (CN4103 in figure 4.5); however, these are rare and indicate hide processing was a limited activity at the site during the Early Ceramic occupations.

While many of the tools assigned to this class should have been classified as unpatterned flake tools, they all have working edges with high angles. Functionally, these are most likely scraping tools but usewear analysis was not conducted to confirm this nor provide insight on materials they may have worked. All are cryptocrystalline silicate rocks and five show evidence of burning; only four are likely or definitely heat treated. All of the specimens came from

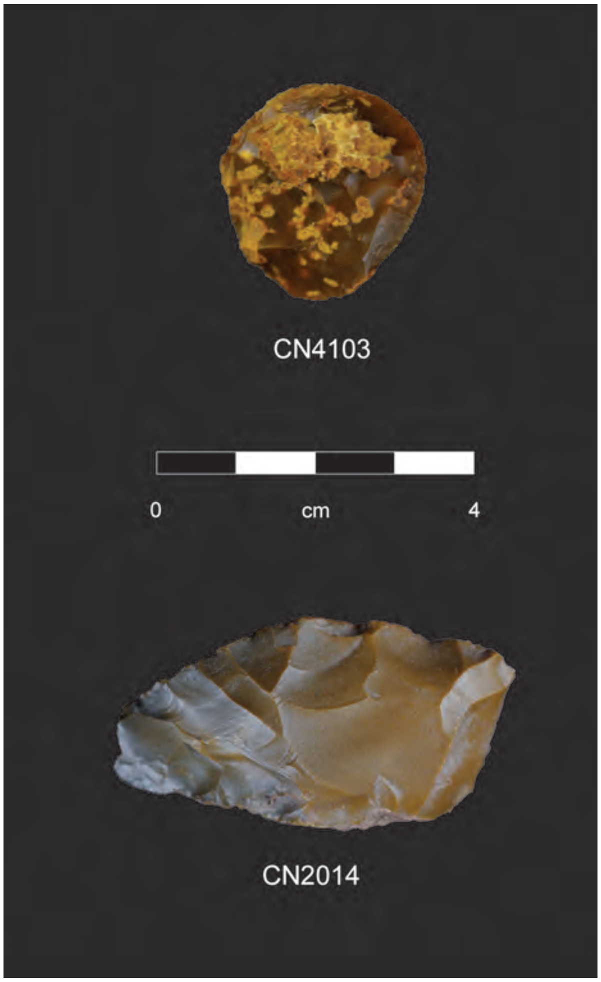

Figure 4.5. An unpatterned biface (CN2014), and hafted endscraper (patterned flake tool, CN4103) from the 2017-2018 assemblage.

Early Ceramic general level lots. Sixteen are finished and unusable and four are finished and useable; three were broken during manufacture.

Unpatterned Flake Tools

Unpatterned flake tools are the most common technological class in the Early Ceramic assemblage. Nearly 90 percent are made from cryptocrystalline silicates—including 39 sourced as Parker petrified wood—while just 12 are made from quartzite. Sub-technological class data indicate that about 62 percent are use-modified—or expedient flake tools—while the remainder (n=39) are retouched flake tools. Nine of the 12 quartzite flake tools are use-modified. Only 11 are burned, but 24 are either definitely or likely heat treated.

Flakes exhibiting low-angle edge damage, even if relatively slight, were generally coded as flake tools. In retrospect a higher threshold for A relatively low threshold was implemented when coding use-modified flake tools and some of these are likely edge damage from trampling rather than use. Many, however, do show evidence of use along just one margin, indicating limited, expedient use. Very few of the retouched flake tools have substantial retouch on multiple working edges, and few of these have extensive wear from use, indicating limited investment of time in flake tool production, maintenance, and use.

Non-bipolar Cores

Forty-six non-bipolar core tools are present in the Early Ceramic assemblage. Three of these are made from quartzite while the other 43 are cryptocrystalline silicates, including 18 classified as Parker petrified wood. Thirteen are burned and eight are likely or definitely heat-treated. Nearly 57 percent have some cortex. Forty-two are exhausted cores or core fragments and are considered finished and unusable.

The Magic Mountain analysis recognizes four core subclasses: multi-directional freehand cores exhibiting at least three productive flake removals; tested cobbles exhibiting one or two flake removals; randomly battered pieces lacking effective flake removals; and unorientable fragments. Table 4.17 shows a cross-tabulation of core subclass and size grade. Nearly 75 percent of the specimens—including all of the quartzite cores—are multi-directional freehand cores (figure 4.6). Six specimens are randomly battered pieces, and five—four of which account for half of the G3 cores—are unoriented fragments. These are mainly small pieces of cores that likely detached during flake removal, and some could be considered shatter. Only one tested cobble is present in the Early Ceramic assemblage.

One of the cores is an exhausted chalcedony microblade core (figure 4.6). Microblade cores, and the resultant microblades or microliths are, in general, presumed to be "an efficient way to produce large quantities of usable cutting edge from a given piece of stone (Lee *et al.* 2016:141). Lee and others (2016) show that microblade cores occur at sites across the northwestern Plains from the Paleoindian period to the Late Prehistoric period but that the technology is relatively rare, or at least has not been explicitly identified in many Plains assemblages. The conical-shaped microblade core from Magic Mountain displays many flake initiations from a single proximal platform, however few of the flake scars extend all the way to the keel like many classic microblade cores. Two possible microlith flakes were identified in the flaking debris analysis; however one is coded as chert and the other as petrified wood. If these are correctly identified then at least two other microblade cores were used at the site but not recovered in the 2017-2018 excavations. Additional microblith flakes could be in the assemblage but may have easily been overlooked. The resultant microblades likely were manufactured to complete highly specialized functions (Lee *et al.* 2016:152).

Table 4.17. Sub technological class data on for non-bipolar cores organized by size grade.

	Size Grade			
Sub Technological Class	G1	G2	G3	Total
Core	8	24	2	34
Tested Cobble		1		1
Random Flaking		4	2	6
Unoriented Fragment		1	4	5
Total	8	30	8	46

Ground Stone

Ninety-six ground stone tools are in the assemblage, second only to unpatterned flake tools in terms of count. This includes four patterned ground stone tools and 92 unpatterned. A total of 10 items refit to make four separate tools. Each refit item comes from the same catalog number. For example, CN4306 includes two items from different size grades that refit to make one tool. No major effort was made to refit between different catalog numbers. Therefore, a maximum of 86 ground stone tools are present in the Early Ceramic assemblage and includes both hand stones and grinding slabs or basin stones, along with hammer stones.

Fifty-three ground stone artifacts (of the 96 individual pieces) come from features, indicating likely recycling of ground implements as boiling stones or hearth rocks. Feature 5—a repurposed earth oven that is described in more detail in chapter 3—contains 22 pieces of ground stone. Eight ground stone pieces come from Feature 10, an earth oven that dates to the earlier portion of the Early Ceramic occupation. The other 23 ground stone artifacts come from six different features.

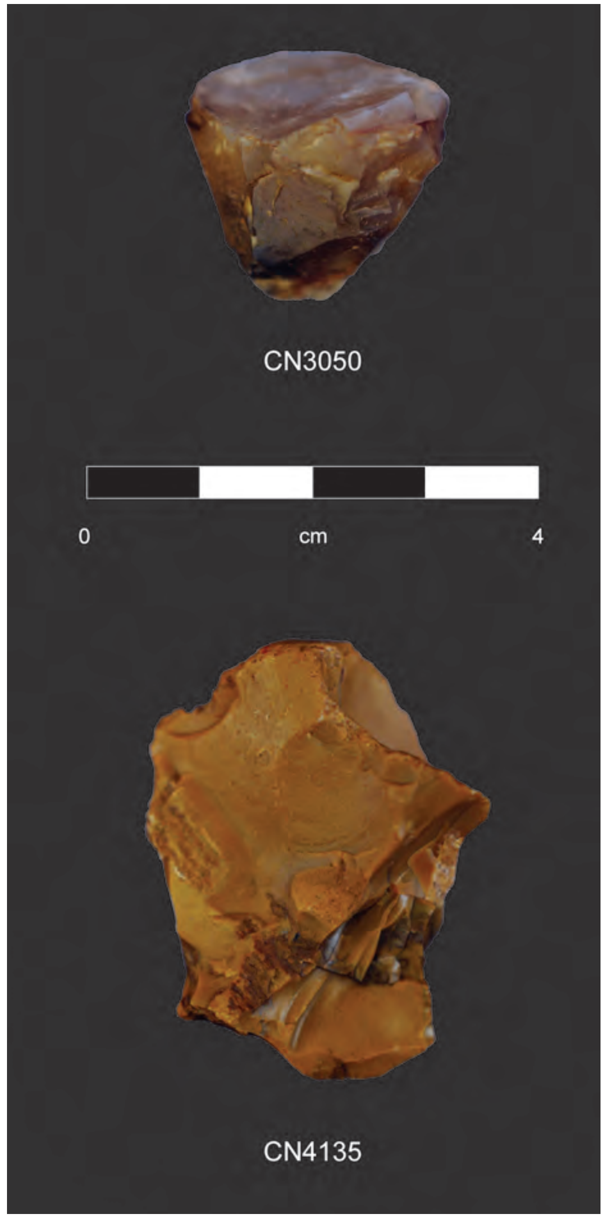

Figure 4.6. The microcore (CN3050), showing the flat top where most flake initiations are from and the conical shape with the keel on the bottom. The bottom image (CN4135) displays an example of a freehand core from the 2018-2018 assemblage.

Nearly 80 percent of the ground stone artifacts are made from sandstone, which is readily available near and around the site. Schist and igneous rocks—likely granites—comprise the remaining 20 percent. One rhyolite, or volcanic tuff, ground stone tool was also recorded; however, the analyst made a note that the material type was uncertain.

Only three are complete and one is nearly complete and could be used again. The remaining 93 are considered finished but unusable and include mostly indeterminate ends and margin portions. The average weight of each piece is 327 g, with a median weight of 214 g.

Early Ceramic Arrow Points

The Magic Mountain assemblage contains 72 corner-notched arrow points, arrow preforms or manufacturing failures, or arrow point fragments (table 4.18). Nearly 85 percent of these come from Early Ceramic analytic units (AU2 and AU3), but a small sample come from disturbed, surface, mixed, and pre-Early Ceramic contexts. Preforms and arrow fragments are included in this discussion as most of the site assemblage comes from Early Ceramic occupations, and thus are most likely to be related to that; however, it is possible some of the fragments could be from later side-notched arrows as two are present in the assemblage.

Over 83 percent of the arrow assemblage are made from cryptocrystalline silicates. Twenty-nine are identified as petrified wood, 22 of which are Parker petrified wood. No other identifiable sources are represented in the point assemblage. Table 4.19 summarizes thermal alteration of the point assemblage. Heat treatment and burning was not coded for coarse-grained materials like quartzite and quartz. Nearly 92 percent of the codable assemblage shows either burning or heat treatment. Over 83 percent are heat-treated, including 23 of the 25 cryptocrystalline silicate corner-notched points for which heat treatment was coded; the other two are burned, one of which comes from Feature 3. Only three others—all point fragments—are burned.

Arrow Preforms and Fragments

Twelve of the 19 fragments are distal ends (tips), four are medial segments, and three are margin fragments. Proximal fragments, or portions that retain enough attributes to be typed as corner-notched (such as CN3222 in figure 4.7) are included in the corner-notch arrow count. Table 4.20 lists the fracture type (reason for rejection) for preforms and fragments. All but two preforms—which are both complete—were discarded due to manufacturing failures, including 18 with perverse fractures, such as CN4279 in figure 4.7. Arrow fragments appear mostly to have been discarded due to fractures from use, including four with impact fractures and nine with bending or end-shock fractures, which commonly result from impact.

Complete Arrow Points

Twenty-seven points and fragments are complete enough to type as corner-notch arrow points. Nine are broken points with various portions represented (table 4.21). Eighteen are nearly complete—missing only a portion of the tip—or complete (figure 4.8). Eleven are broken from bending fractures or end shock and four are broken from impact fractures, including CN4218 shown in figure 4.7. One has a radial break fracture.

Table 4.22 summarizes the descriptive statistics on the metric data that could be collected for arrow point specimens. The corner-notched arrow point assemblage is highly variable. No meaningful correlations could be found in these data, indicating that input blank likely has as much to do with determining final point design and size than stylistic

Table 4.19. Summary of thermal alteration of arrow points, preforms, and fragments from all contexts in the Magic Mountain assemblage.

Class	Heat Treated	Burned	Total
Corner-notched	23	2	25
Arrow preform	15		15
Arrow fragment	12	3	15
Total	50	5	55

Table 4.18. Cross tabulation of Early Ceramic arrow points, preforms, and fragments by raw material type.

	Raw Material					
Class	Chert	Chalcedony	Quartzite	Petrified Wood	Quartz	Total
Corner-notched arrow	12	3	2	10		27
Arrow preform	11		4	10	1	26
Arrow fragment	4	1	5	9		19
Total	27	4	11	29	1	72

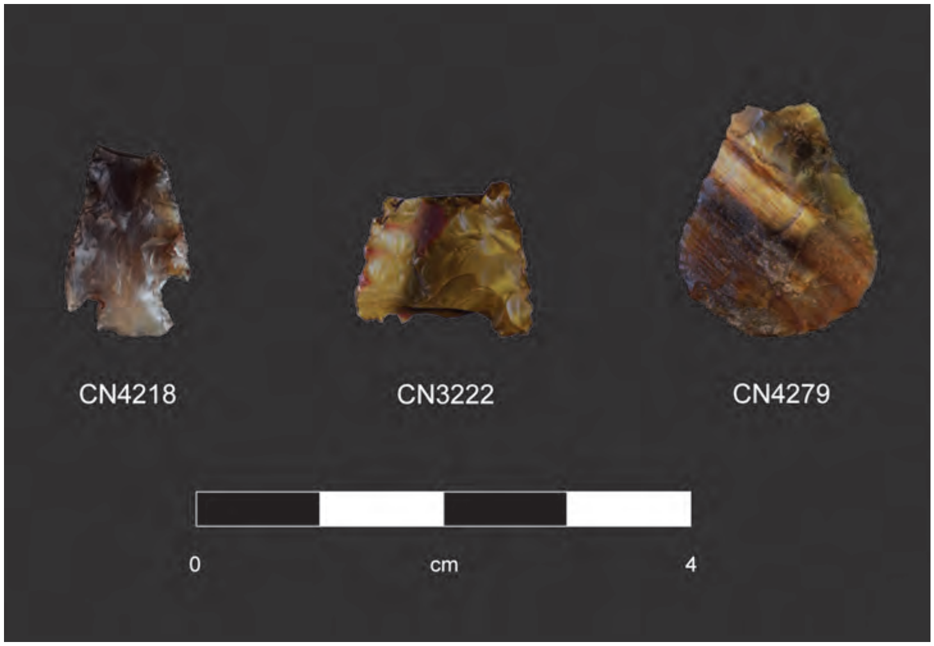

Figure 4.7. Selected fragmented arrows (CN4218 and CN3222) and a corner-notched arrow preform broken during manufacture (CN4279).

Table 4.20. Fracture type for arrow point preforms and fragments.

	Fracture Type								
Class	None	Bending	Perverse	Material Flaw	Hinge/Step	Impact	Thermal	Lateral	Total
Arrow preform	2	1	18	2	1			2	26
Arrow fragment		9	1	1		4	2	2	19
Total	2	10	19	3	1	4	2	4	45

Table 4.21. Completeness and portion represented for Early Ceramic corner-notched arrow points.

Portion Present	Count
Complete	11
Nearly Complete	7
Distal End	1
Proximal End	5
Medial Fragment	1
Margin Fragment	2
Total	27

preference. Only one of the points has evidence of slight reworking, possibly into a small cutting tool, but this is tentative. Blade serration was not specifically coded but is a common attribute of Early Ceramic arrow points in this region and several Magic Mountain points (although likely less than 50 percent) show moderate to heavy blade serration.

Projectile Point Summary

Early Ceramic arrow points, fragments, and preforms are the fourth most common tool in the assemblage. Metric data indicate that the points are quite variable and visual inspection confirms this interpretation. Many points exhibit the classic Hog Back corner-notched form (Nelson 1971), with broad blade base widths, serrated blades, deep corner-notching, and a slightly convex base. Others, however, are smaller in overall size, and have narrower blade base widths, shallower notching, and no blade serration.

Three Early Ceramic arrow points and two preforms are directly associated with features. All are from Feature 3, an irregular pit filled with burned rock and earth that contained the remains of at least two earth ovens. Stratigraphic data indicate Feature 3 was used on at least three different occasions, spanning the period between about 1170 to 1035 B.P. and was one of the youngest features sampled during the 2017-2018 excavations. Feature 3 also happens to

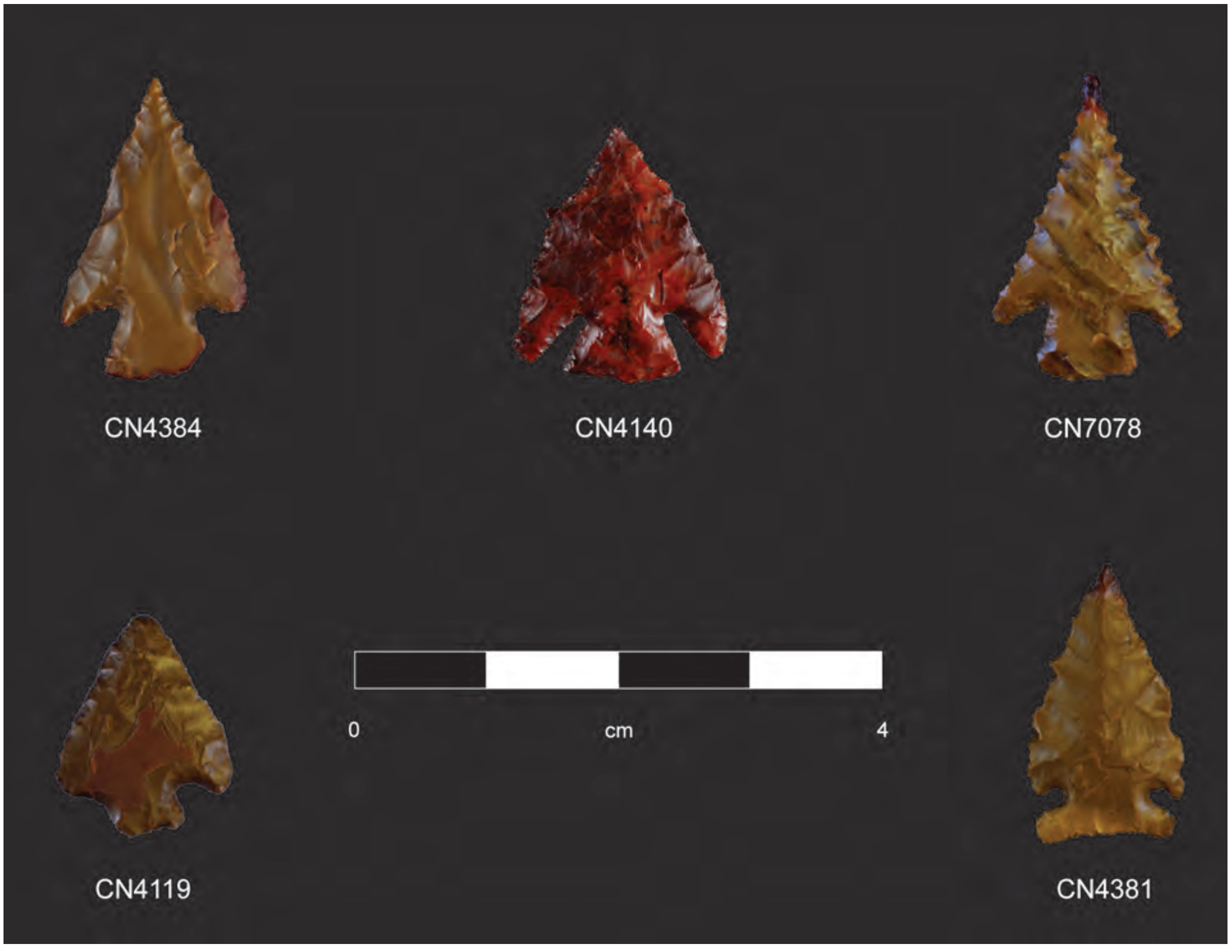

Figure 4.8. Selected complete and nearly complete corner-notched arrow point in the 2017-2018 assemblage.

Table 4.22. Descriptive statistics of metric data (mm) for the corner-notched arrow point assemblage.

Measurement	Measurable Points	Minimum	Maximum	Mean	Std. Deviation
Length	16	15.6	29.3	21.8	3.5
Width	17	10.5	17.4	13.5	2.1
Thickness	23	2.1	4.0	2.9	0.5
Proximal Haft Width	23	4.2	11.3	8.1	1.5
Distal Haft Width	21	3.9	7.2	6.2	0.8
Distal Haft Length	22	2.6	5.7	4.4	0.8
Blade Base Width	16	10.5	17.4	13.6	2.2
Blade length	15	12.8	26.4	19.0	3.5
Notch Depth	23	1.5	4.4	3.0	1.0
Notch Width	24	1.3	3.7	2.3	0.6

be located within a possible basin house or outside workspace and contained more chipped stone tools and vertebrate fauna remains than any other feature. Two of the three points from Feature 3, CN4119 and CN4140, are shown in figure 4.8.

Heat treatment was a very common occurrence, in both finished points and on preforms. Nearly every finished cryptocrystalline point is heat-treated; among the four unheated points, two are burned and two are quartzite for which heating was not coded. Over 70 percent of the cryptocrystalline silicate preforms are also heat-treated. Many of these were made on heat-treated flakes, meaning input blanks were being created, then heat-treated, and then flaked.

Arrow point production was clearly taking place at the site. Over a quarter of the Early Ceramic point assemblage consists of preforms in various stages of production. Most were discarded due to breakage although two are unbroken. Only five of the preforms are identified as Parker petrified wood, meaning the other eighty percent are most likely derived from local sources. About a third of the completed points are made from Parker petrified wood. Eleven of the finished points—or roughly 40 percent of the assemblage—are complete. The reason they were discarded is unknown but likely indicates a fundamental lack of investment in arrow point technology. In other words, the arrow points themselves were the least valuable piece of the bow-and-arrow technological system.

Intrasite Variation

Chapter 3 describes the spatial distribution of excavation units that is used in this discussion of variability around the site. Feature data presented in chapter 3 also make clear that there are multiple Early Ceramic occupations but assigning most of the modified stone assemblage to a specific occupation is difficult and was not attempted. For example, there are 73 modified stone tools directly associated with six different features but 53 of those are repurposed ground stone tools. Features 5, 7, 13, and 15 each contain only one chipped stone tool. Feature 4 contains five chipped stone tools, and Feature 3 contains 11—two from the first two feature levels and 9 from levels 3 and 4. Feature 3 is the only feature associated with corner-notched arrow points or fragments. Therefore, this section briefly examines spatial patterns among the different excavation areas across the entirety of the Early Ceramic occupations.

Area 4 contains more tools than the other four areas combined by count. Area 4, however, was the focus of most of the excavation so when normalized by volume a different picture emerges. (Volume and tool density data only include materials from the Early Ceramic analytic units.) Table 4.23 displays stone tool density per cubic meter for each technological class and area and indicates that Area 2 is the most tool-dense portion of the site. These values exclude ground stone tools from features within each area because most—if not all—of these tools were likely repurposed as boiling stones or hearth rocks and thus not reflective of tool use in each area. Area 2 also has a non-bipolar core and unpatterned biface density that is nearly three times that of any other area. Area 3 has the highest density of unpatterned flake tools and non-feature ground stone tools, although this is about equal to values for Area 4.

Area 4 has a high frequency of unpatterned flake tools as well as small patterned bifaces. This area is the location of a possible basin house or outside work area, and the tool diversity here helps illuminate this. For example, there is a low density of large patterned bifaces, which are typically larger cutting tools and could reasonably be considered part of a butchery toolkit. There is also a moderate density of non-bipolar cores—suggesting tool production—and a relatively high density of ground stone tools. Unlike Areas 2 and 3— where all or most of the ground stone came from features—nearly two-thirds of the ground stone in Area 4 was not directly associated with a feature and thus could be considered to have been

Table 4.23. Early Ceramic stone tool density per cubic meter by area. Ground stone tools from features are excluded from density values.

	Technological Class								
Area	Small Patterned Biface	Large Patterned Biface	Unpatterned Biface	Patterned Flake Tool	Unpatterned Flake Tool	Non-bipolar Core	Bipolar Core/Tool	Ground Stone	Total
2	4.6	3.4	9.1	1.1	4.6	10.2	1.1	-	34.1
3	4.2	2.0	3.3	3.9	12.5	2.6	-	4.6	32.2
4	6.8	0.9	1.1	1.7	8.1	3.8	-	4.1	25.3
6	-	-	-	-	-	1.1	-	1.1	2.1
7	2.8	-	2.1	1.2	7.0	0.8	-	1.2	14.9
Total	5.3	1.0	2.0	1.7	7.6	3.4	0.1	3.2	23.2

Table 4.24. Density per cubic meter of Early Ceramic arrow points, fragments, and preforms by area.

	Class			
Area	Corner-notched Arrow	Arrow Preform	Arrow Fragment	Total
2	1.1	1.1	2.3	4.6
3	0.7	2.0	0.7	3.3
4	2.3	1.5	1.3	5.1
7	0.8	0.4	0.8	2.1
Total	1.6	1.2	1.1	4.0

deposited there after use rather than having been repurposed as feature rock.

Additionally, Area 4 has the highest overall density of arrow points and fragments, and over two times as many corner-notched arrow points as the next highest area (table 4.24). There is also a relatively high density of point production (preforms) in Area 4, second only to Area 3. Area 2 contains the highest density of arrow point fragments.

Comparing tool data to flaking debris data reveals some additional patterns. In general, coarse fraction flakes (size classes G1-3) generally result from earlier stage tool production and the smaller G4 flakes result from later stage tool production and maintenance. Coarse fraction flake density, discussed earlier in this chapter and shown in table 4.25, shows a similar pattern to that discussed previously, with Area 2 being the densest, followed by Areas 3 and 4. Fine fraction flakes (size class G4) exhibit an inverse pattern (table 4.26). These data only include waterscreened samples since dryscreened samples do not accurately reflect the actual size of the G4 sample. Area 7, with a relatively low tool density, has the highest density of G4 flaking debris. Conversely, Area 2 has the second lowest G4 flake density which sharply contrasts to the coarse fraction flake distribution. Area 2 also has the highest density of cores, unpatterned bifaces, and large patterned bifaces, all tools that are likely to produce larger flakes from manufacturing. Areas 3 and 4, with higher densities of flake tools and projectile point preforms, are arguably locations where more tool production and maintenance were occurring.

Table 4.25. Early Ceramic coarse fraction (G1-3) flake density by area between the two primary sampling methods.

	Flakes per L	
Area	¼-in Dryscreen	1/16-in Waterscreen
2	1.07	0.98
3	0.64	0.68
4	0.40	0.44
6	0.07	0.07
7	0.33	0.38

Table 4.26. Size class G4 flake density per cubic meter by area.

Area	G4 Flake Density
2	1,877.8
3	3,842.2
4	3,424.7
6	346.7
7	4,166.7
Total	3,151.7

Context and Summary

There are several ways to approach intersite variation in modified stone assemblages to situate Magic Mountain into the larger Early Ceramic period context, including tool diversity, normalized assemblage density, and raw material diversity. Data recording and reporting issues make the two former approaches difficult. However, chipped stone raw material diversity data from assemblages at several Early Ceramic sites in the South Platte basin and adjacent Front Range Mountains are accessible and allow for some discussion about mobility during the Early Ceramic period.

James Benedict (1992) proposed multiple mobility models for the Early Ceramic period. Benedict's models are primarily focused on how people living along the Front Range during this period also utilized the mountains— particularly high-elevation game drive sites—which were most frequently used during the Early Ceramic period (Benedict 1975, 1985, 1996; Cassells 2000; LaBelle and Pelton 2013; Meyer 2021; Whittenburg 2017). One model, a circular route, posits that groups living along the Front Range during the cold season would travel north and west as the weather warmed and spend time in North and Middle

Parks. As the season began to change, groups would cross back to the Continental Divide and utilize the high-elevation game drive systems.

An alternate model suggests a more direct use of game drives, in an up-down fashion that would not include visiting the primary interior mountain toolstone source areas like the circular route would. One way to test these models is with raw material distributions—particularly those of materials from mountain sources like Kremmling chert and Windy Ridge quartzite—in Front Range assemblages. A sample of sites with Early Ceramic components are used in this analysis, combined with the Magic Mountain data, to test these models. These include the Rock Creek site (5BL2712, Gleichman *et al.* 1995), the Van Ness site (5AH416, Kalasz *et al.* 1996), the Oeškeso site (5DA1957, Gantt *et al.* 2007), the Ridgegate site (5DA1000, Kalasz *et al.* 2008), the Valley View site (5LR1085, Brunswig 2016), and the Cass site (5WL1483, Kalasz *et al.* 1992).

The distribution of basic raw material type for these sites is displayed in figure 4.9. Sites to the south clearly show a reliance on petrified wood sources, primarily Parker petrified wood as these sites are relatively close to the main source areas. Many of the other materials also indicate a likely reliance on local or near-local bedrock sources along the mountain front or alluvial cobbles, similar to the pattern at Magic Mountain. Petrified wood is less common in the north and farther away from Parker and other petrified wood source areas and is almost non-existent on the Plains in Weld County at the Cass site.

Table 4.27 displays the percentage of local and imported stone at each of these sites. Imported stone is defined as material from sources at a distance greater than about 80 km, or a several days walk between the primary source area and the site where it was ultimately deposited. Half of the sites in this dataset—including Magic Mountain—are comprised almost entirely of local (or presumably local to near-local) materials. The Cass site has a higher proportion of imported stone, almost all of which is Flattop Butte chalcedony. Cass, in central Weld County, is about 80 km west of the Flattop source area in Logan County, a distance close to the imported versus near-local class but is defined here as imported.

Two sites, Valley View and Rock Creek, stand apart from the rest. Imported materials at Rock Creek are all mountain sources, including Windy Ridge and Kremmling chert—two sources that would conceivably be on the route proposed in Benedict's circuit model. Trout Creek could be a part of a similar model, except one centered more around South Park than North and Middle parks, similar to a model proposed by Johnson and others (1997). Valley View imported materials include 6.3 percent Kremmling chert and 2.5 percent Hartville chert from southeastern Wyoming.

One major caveat to the dataset is that raw material data for smaller flake sizes are largely excluded. This is primarily due to use of non-comparable size classes and the difficulty of visually sourcing smaller specimens. Additionally, many smaller size classes would not be systematically recovered using traditional recovery methods (¼-in mesh screens), thus resulting in an incomplete sample of the smaller size grades. Flakes of imported stone are more likely to occur in the smaller size classes because they are more likely to be produced during tool sharpened and maintenance, rather than primary production. Tools made from imported materials, however, would also be expected to be discarded to some degree and these are very limited to nonexistent at all sites in the dataset.

The data presented here do not support Benedict's circular seasonal mobility model. Instead, it indicates a primary reliance on local or near local materials across the Front Range. They do support the up-

Table 4.27. Percent of local and imported stone from a selection of Early Ceramic sites.

Site	Local	Imported	Comments
Magic Mountain (2017-2018)	*99.9*	*<0.1*	Kremmling chert, Windy Ridge, Flattop, Trout Creek, Obsidian
Ridgegate	*99.5*	*0.5*	Source(s) unspecified
Oeškeso	*99.0*	*1.0*	Alibates (TX), Kremmling chert, Trout Creek
Van Ness	*100.0*	*0.0*	No imported materials identified
Rock Creek	*90.0*	*10.0*	Kremmling chert, Windy Ridge, Trout Creek
Valley View	*91.0*	*9.0*	Kremmling chert, Hartville chert (WY)
Cass	*95.0*	*5.0*	Flattop Butte chalcedony, petrified wood

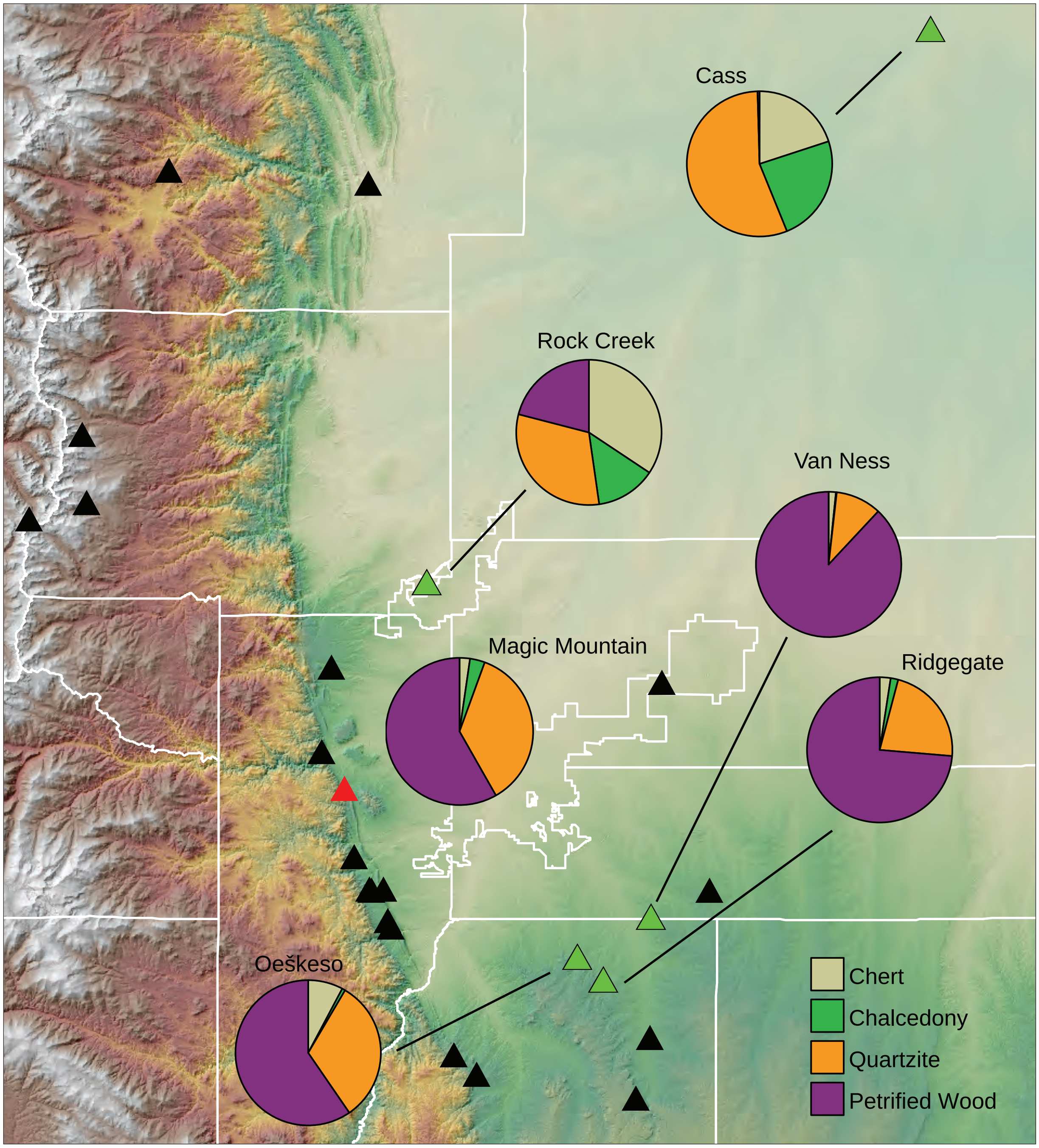

Figure 4.9. Map of the Front Range showing Early Ceramic sites (black triangles) and the distribution of raw material types from selected sites (green triangles) and Magic Mountain (red triangle).

down system Benedict proposes, where the raw material expectations would not be the same because the destination (high-elevation game drives) would be reached prior to encountering the primary raw material source areas in the mountains. People were clearly using primary interior mountain source areas—at least intermittently—and people during the Early Ceramic period were using mountain game drive systems more intensely than during any other period, but clear evidence of intensive use based only on flaked stone raw materials is largely lacking. Obsidian data—particularly from Magic Mountain but also from the Bayou Gulch site noted earlier in this chapter—indicate mobility or interactions far beyond the Front Range and interior mountains. Clearly the Early Ceramic period is one of stability—indicated by low inter-occupation functional variability at sites like Magic Mountain—but also complexity with groups utilizing many different resources and at least limited evidence of long-distance interactions.

Raw material data suggest that the occupants at Magic Mountain and many other Front Range Early Ceramic sites relied almost entirely on Front Range stone sources. Figure 4.10 displays the proportion of tools and flaking debris by primary raw material type that further supports this. Cryptocrystalline silicates account for 87 percent of the Early Ceramic tool assemblage but only 61 percent of the flake assemblage. Over a third of these are Parker petrified wood. Quartzite—which likely was more readily available in the immediate vicinity of the site than petrified wood—accounts for only about 8 percent of the tool assemblage but over 35 percent of the flake assemblage. This indicates groups arriving to the site with some curated toolkit, probably from south of the site, depositing some of those tools and then manufacturing additional tools from local materials and removing them from the site.

The intrasite spatial differences among tool class representation and flake densities are relatively minor, with a few exceptions. Portions of the site clearly were used differently during the various Early Ceramic occupations. However, many aspects of the site, like features, reflect homogeneity in how the site was used over a long period (chapter 3). Area 4 may be an exception, with the possible basin house or outdoor task area. Further, the spatial differences reflected in the modified stone data more likely indicate the production and use status of the toolkit at the time of occupation rather than any significant differences in activities occurring at the site.

The Magic Mountain Early Ceramic modified stone assemblage suggests limited large animal carcass processing. There are very few larger knives, few hafted end scrapers, and no large pounding tools. This is also reflected in the faunal assemblage, discussed in chapter 5. Instead, there is an abundance of small cutting tools, ground stone tools, cores, and arrow points—including many instances of failed arrow point production. Additionally, while not coded explicitly, trampling damage was evident on multiple tool and flake margins, indicating many chipped stone artifacts were deposited on the surface rather than in pits or in rapidly accumulating middens. All of this, combined with the lack of visible architectural features (with one possible exception), indicate that the Early Ceramic occupations at Magic Mountain were primarily task-focused rather than seasonally residential.

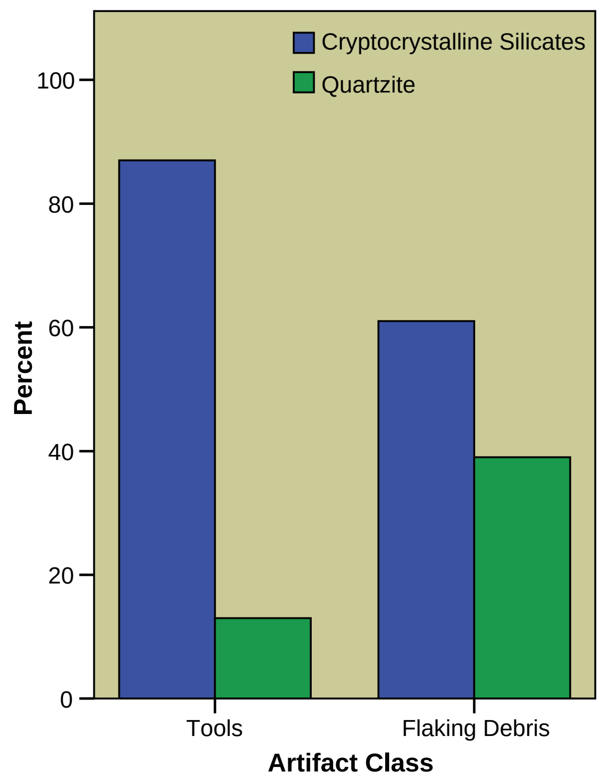

Figure 4.10. Bar chart showing the distribution of chipped stone tools and coarse fraction (G1-3) flaking debris by general raw material type. Data displayed are only from non-waterscreen and feature contexts for raw material comparative purposes.

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5

Vertebrate Faunal Remains

Carl R. Falk

This chapter provides basic description and analysis of nearly two kilograms of animal bone recovered during archaeological investigation of the Magic Mountain site (5JF223) in 2017 and 2018 by the Denver Museum of Nature and Science and Paleocultural Research Group. The sample, consisting almost exclusively of fragmented mammal bone, is from 59 1x1-m excavation units distributed across six areas of the site (table 3.3). Fifteen cultural features were identified during the investigation. Fourteen features, primarily earthen ovens and basin hearths, reflect American Indian use of the site during the Early Ceramic period. Vertebrate remains were recovered from 12 features, as well as from associated general level deposits. In addition, animal bone was recovered from sediments predating the Early Ceramic occupation, perhaps reflecting use of the site area during Middle and Late Archaic periods. Although not systematically studied for this project, bone preservation is reasonably good with only a few larger specimens showing cracking, splintering, flaking, or exfoliation associated with heavy weathering.

Following review of field and laboratory procedures, succeeding sections report specimen count and weight information, and taxonomic and specimen identifications, along with consideration of temporal and spatial distributions within the areas sampled. Identified vertebrate remains reported by previous investigators (Irwin-Williams and Irwin 1966; Kalasz *et al.* 1995; Kalasz and Shields 1997) working to the south and west of the 2017-2018 project area (figure 1.7) are examined, as well as Early Ceramic period materials reported from a number of locations within Colorado's South Platte River basin.

2022 *Archaeological Investigations at the Magic Mountain Site, Jefferson County, Colorado*, edited by Mark D. Mitchell, pp. 145-163. Research Contribution 122. Paleocultural Research Group, Broomfield, Colorado.

Modified bone—tools and ornamental pieces—from the 2017-2018 project are treated in a similar manner in final sections of this chapter. General locations for archaeological sites referenced in chapter 5 are noted elsewhere in figure 1.9.

Field and Laboratory Preparation

Excavation methods and sampling strategies are detailed in chapter 3 and briefly reviewed here. Recovery techniques and sampling within excavation units varied by archaeological context, resulting in five sample types. General level sediments were dryscreened over 1/4-inch mesh hardware cloth and all cultural remains, including bone, were hand-picked from the screen in the field. Constant volume samples (approximately 15 percent of excavated fill from each level) were taken from all general levels, excepting the first level for each unit which generally was not sampled. Constant volume samples were waterscreened over 1/16-inch mesh with screen remains returned to the lab for final processing. Feature level deposits were dry screened over 1/8-inch mesh hardware cloth and hand-picked in the field. Where possible, bulk samples were taken from feature levels and returned to the lab for flotation and additional processing. Finally, whenever possible, the precise physical location of potentially significant stone, ceramic, botanical, and bone artifacts was plotted within each test unit as the excavations proceeded. Piece-plotted specimens comprise a sample type.

Following standardized procedures, samples were size graded over nested screens by catalog lot – either by the author (dryscreened general level and feature samples), or by lab personnel in Broomfield (constant volume and bulk samples). Graduated square-mesh opening sizes (U.S. Standard Sieve Cloth) include: grade 1=1.000 inch, grade 2=0.500 inch, grade 3=0.223 inch, and grade 4=0.100 inch. Items smaller than grade 4 are classified as grade 5. Size grade fractions were divided into burned and unburned portions and quantified by count and weight. Bone tools, ornaments, and other modified pieces, along with unmodified specimens potentially identifiable with respect to taxon and skeletal element were separated and set aside for further study.

Analytic Units

Data and analyses presented in this chapter are structured according to the analytic units described in chapter 3 (table 3.26). Seven analytic units (AU) were defined primarily using stratigraphic data. Because most of the collection comes from features and deposits dated to the Early Ceramic period, the AU structure was designed to isolate artifacts and other materials that date to that period from those that either predate or potentially postdate that period. Two AUs comprise Early Ceramic contexts: AU2 (Early Ceramic general levels) and AU3 (Early Ceramic features). AU5 comprises pre-Early Ceramic contexts, while AU4 comprises potentially mixed Early Ceramic and pre-Early Ceramic contexts. Three AUs isolate materials from miscellaneous contexts, including disturbed sediment (AU0), potentially disturbed surface and near-surface deposits (AU1), and unassigned contexts (AU9). Summary data on the overall content and distribution of each AU are presented in tables 3.27 through 3.29.

Specimen Counts and Weights for Unmodified Bone

The unmodified bone assemblage totals 7,852 specimens weighing 1.845 kg (table 5.1). The recovered sample is highly fragmented with the combined grade 4 and grade 5 samples totaling 68.4 percent by count, and 12.1 percent by weight. The grade 3 fraction adds 28.8 percent by count and 35.2 percent by weight, and grade 2 remains contribute a further 2.5 percent by count and 26.4 percent by weight. Finally, 25 grade 1 specimens, 0.3 percent by count and 26.3 percent by weight, complete the sample. Burned materials comprise 43.0 percent of the total by count and 21.1 percent by weight. Count and weight data presented in table 5.1 generally show an inverse relationship between size grade and percent burned: as specimen size decreases the proportion of burned bone increases for both counts and weights. In contrast, the percent burned values decrease slightly for the grade 5 fraction, perhaps reflecting practical difficulties in distinguishing evidence of burning for very small pieces of bone, even with the use of low power (10x) magnification.

Table 3.5 cross tabulates nearly a thousand catalog lots by reporting area and sample type. Building on this information, table C.1 (appendix C) presents specimen counts and weights by size grade and sample type, allowing quantification of variations in animal bone recovery for each sample type and associated process of recovery. These data should be useful in

Table 5.1. Specimen counts and weights organized by size grade. Italicized values represent percentages.

	Count					Weight (g)				
Size Grade	Unburned	Burned	Total	Total	Burned	Unburned	Burned	Total	Total	Burned
G1	23	2	25	0.3	*8.7*	479.2	5.7	484.9	26.3	*1.2*
G2	167	31	198	2.5	*15.7*	441.4	45.4	486.8	26.4	*9.3*
G3	1,436	829	2,265	28.8	*36.6*	414.8	234.9	649.7	35.2	*36.2*
G4	2,650	2,387	5,037	64.2	*47.4*	116.9	101.1	218.0	11.8	*46.4*
G5	198	129	327	4.2	*39.4*	3.6	2	5.6	0.3	*35.7*
Total	4,474	3,378	7,852	100.0	*43.0*	1,455.9	389.1	1845.0	100.0	*21.1*
Percent Total	*57.0*	*43.0*	*100.0*			*78.9*	*21.1*	*100.0*		

planning future field and laboratory investigations. General level deposits, dry screened over 1/4-inch mesh screen with bone hand-picked in the field, represent nearly 86 percent of total excavated deposits (table 3.29, chapter 3) and provide 24.4 percent of the bone sample by count and 34.2 percent by weight. General level samples are dominated by grade 3 specimens but sizable numbers of grade 4 and grade 5 specimens are also recorded. Ideally, general level samples should be limited to grade 1-3 specimens. But, taken together, the grade 4 and grade 5 fractions make-up 16.0 percent by count, and 3.8 percent by weight, of the general level sample. Grade 4, and some grade 5, specimens expected to pass through 1/4-inch mesh instead were hand-picked, reflecting difficulties encountered in dry screening deposits encountered through 1/4-inch mesh.

Feature level deposits, dry screened over 1/8-inch mesh, accounted for just over 2 percent of the total excavated volume (table 3.29) and returned 11.6 percent of the total sample by count and 8.9 percent by weight. Constant volume samples, waterscreened over 1/16th mesh, represented an additional 11.4 percent of the excavated volume (table 3.29) and returned grade 2-5 specimens with grade 4 remains contributing the highest counts and weights. Constant volume samples provided nearly half (48.3 percent) of the total sample by count but only 10.7 percent by weight. Bulk sediment samples only contributed 0.7 percent of all excavated deposits, yet provided 12.5 percent of the total specimen count and 3.4 percent of the total weight. The bulk samples are dominated by grade 4 and grade 5 remains.

Table 5.2 collapses size grade distinctions and organizes specimen counts and weights by report area (figure 3.3) and illustrates the distribution of recovered bone within and between areas of the site investigated during the two-year program. Measured by specimen counts or weights, nearly 70 percent of the vertebrate sample is from 30 test units (table 3.3) located within Area 4; nearly half of all excavated deposits are within Area 4.

Fourteen features associated with Indigenous American site occupation were identified, including five earth ovens, seven basin hearths, one storage pit, and a concentration of fire-cracked rock (table 3.7). Twelve of the features yielded 288.6 g of bone (2,127 specimens); burned specimens comprised 52.4 percent by count and 52.4 percent by weight of this total. Table C.2 organizes specimen counts and weights for these features. Bone was not recovered from two features. Features are fully described in chapter 3 with function, morphology, and other characteristics summarized in tables 3.7 and 3.8. Table 3.9 provides density data (counts and weights per liter) for unmodified bone for ten of the sampled features, underlining comparatively high density values for Feature 3, feature levels 3 and 4.

Table 5.3 summarizes specimen count and weight data by analytic unit and reveals heavy concentrations of bone remains within Early Ceramic period general level and feature level deposits—78.6 percent of the site sample by count and 68.9 percent by weight. Density values presented in table 3.29 underscore bone distribution patterns in table 5.3, with feature level deposits showing the greatest density value. Bone remains were also recovered in substantial quantities from sediments predating the Early Ceramic period, though density values are comparatively low for this analytic unit.

Identified Remains, Taxonomic Representation, and Abundance

Element and taxon were recorded for all identified specimens. A specimen was considered 'identifiable' when the skeletal element or element group (*e.g.*, rib, thoracic vertebra, proximal phalange), side (left,

Table 5.2. Specimen counts and weights organized by report area.

	Counts				Weights (g)			
Report Area	Unburned	Burned	Total	Percent	Unburned	Burned	Total	Percent
2	40	44	84	*1.1*	3.6	4.9	8.5	*0.5*
3	797	443	1,240	*15.8*	118.7	39.6	158.3	*8.6*
4	2,935	2,508	5,443	*69.3*	936.8	302.7	1,239.5	*67.2*
5	3	2	5	*0.1*	0.3	0.2	0.5	*< 0.1*
6	95	68	163	*2.1*	10.1	5.4	15.5	*0.8*
7	604	313	917	*11.7*	386.1	36.2	422.3	*22.9*
Total	4,474	3,378	7,852	*100.1*	1,455.6	389.0	1,844.6	*100.0*

Table 5.3. Specimen counts and weights organized by analytic unit.

	Counts				Weights (g)			
Analytic Unit	Unburned	Burned	Total	Percent	Unburned	Burned	Total	Percent
Disturbed	110	60	170	*2.2*	16.0	8.1	24.1	*1.3*
Surface	102	69	171	*2.2*	36.4	7.5	43.9	*2.4*
Early Ceramic General Levels	2,349	1,693	4,042	*51.5*	770.3	206.4	976.7	*52.9*
Early Ceramic Features Levels	1,015	1,114	2,129	*27.1*	178.4	116.0	294.4	*16.0*
Mixed (EC/Pre-EC)	271	178	449	*5.7*	90.8	22.0	112.8	*6.1*
Pre-Early Ceramic Levels	624	262	886	*11.3*	363.6	28.8	392.4	*21.3*
Unassigned Deposits	3	2	5	*0.1*	0.3	0.2	0.5	*< 0.01*
Total	4,474	3,378	7,852	*100.1*	1,455.8	389	1,844.8	*100.0*

right), and portion (*e.g.*, proximal, distal, cranial, caudal) could be determined with reasonable certainty. Phalanges, sesamoids, and distal metapodial fragments were not sided. An estimated percentage of completeness was recorded for each identified specimen. Information was recorded for evidence of burning, tool marks, gnawing by carnivores and/or rodents, and surface characteristics (acid-etched, corroded, or rounded and polished edges) indicating partial digestion and a likely scatological origin. Specimen data, along with catalog number, size grade, and basic provenience information, were recorded on work sheets in the lab and later transferred to a permanent database to accompany site records. Element identifications and taxonomic assessments were completed with the use of a collection of modern reference skeletons maintained by the author. Scientific and vernacular names for mammals follow Armstrong and others (2011) and Baker and others (2003). All vertebrate remains, organized by year and catalog lot, were packaged for return to the Denver Museum of Nature and Science for permanent storage.

The vertebrate faunal sample recovered during the 2017-2018 investigation does not contain recognizable human remains in contrast to the results of early work at the site. Irwin-Williams and Irwin (1966:51-54) describe three burials, linked to both ceramic and preceramic levels, exposed during field efforts completed in 1959 and 1960. Kalasz and others (1995:179) report "trace amounts of human remains from the grid block excavation" carried out in 1994, the remains attributed to "post-interment disturbance by rodents". Additional human remains were encountered during the 1996 investigation and a detailed account of these materials is provided by Kalasz and Shields (1997:186).

The 2017-2018 sample includes 262 identified specimens. Mammals (NISP=259) contribute 98.9 percent of the identified total with snake (NISP=2) and bird (NISP=1) making-up the balance. Artiodactyls (NISP=178) comprise 67.9 percent of the identified sample. Table 5.4 summarizes numbers of identified specimens by size grade. The remains of artiodactyls dominate the size grade G1-3 samples, contributing 100 percent, 94.6 percent, and 72.9 percent, respectively. The grade 4 sample is mixed, with snake, bird, and medium to small-sized mammals recorded. Rodents and lagomorphs make-up 85.2 percent of the grade 4 fraction. G4 specimens account for 23.3 percent of the combined sample. Forty-five burned specimens comprise 17.2 percent of the identified remains.

Table 5.4. Specimen counts (NISP) by taxonomic group and size grade

	Size Grade					Burned	
Taxonomic Group	G1	G2	G3	G4	Total	NISP	Percent
Serpentes (snakes)				2	2		
Aves (birds)				1	1		
Sciuridae (squirrels)				5	5		
Cynomys ludovicianus (black-tailed prairie dog)			7	11	18	2	*11.1*
Castor canadensis (beaver)		1			1		
Thomomys talpoides (northern pocket gopher)		1	7	15	23	1	*4.3*
Cricetidae (cricetid rats and mice)				6	6	2	*33.3*
Microtus sp. (voles)			1	6	7	1	*14.3*
Microtus ochrogaster (prairie vole)			2		2		
Neotoma sp. (woodrat)				2	2		
Lepus sp. (jackrabbit)				1	1	1	*100.0*
Sylvilagus sp. (cottontail)		1	2	6	9	3	*33.3*
Canis sp. (domestic dog, coyote, gray wolf)		2	4		6	1	*16.7*
Procyon lotor (raccoon)				1	1		
Artiodactyla (small-medium bodied artiodactyls)	6	51	42	4	103	28	*27.2*
Odocoileus sp. (deer)	11	35	20	1	67	6	*9.0*
Odocoileus hemionus (mule deer)	3	1			4		
Bison bison (bison)	3	1			4		
Total	23	93	85	61	262	45	*17.2*
Percent	*8.8*	*35.5*	*32.4*	*23.3*	*100.0*		

Size grade distributions are partially mirrored in table 5.5 which organizes the identified specimens by sample type. Artiodactyls dominate the general level and feature level samples and comprise 100 percent of piece-plotted remains. Small animals—snakes, birds, rodents, and lagomorphs— are more heavily represented in the constant volume and bulk sediment samples where fine-mesh screen and flotation techniques were employed. The low frequencies of small animals in feature level samples may indicate the practical difficulties inherent in dry screening compact sediments over 1/8-inch mesh and hand-picking small, potentially fragile specimens.

The following sections provide a descriptive summary of taxonomic and specimen identifications followed by discussion of spatial and temporal distribution of identified remains within excavated deposits. Comparisons with the results of major work at the site in 1959-1960 (Irwin-Williams and Irwin 1966), 1994 (Kalasz *et al.* 1995), and 1996 (Kalasz and Shields 1997) are noted as appropriate and summarized in appendix C (table C.3). Unfortunately, unmodified vertebrate remains from the 1959-1960 investigation have not been systematically studied or reported, with available information limited to brief summary comments (*e.g.*, Irwin-Williams and Irwin 1966:182, 195, 209; Kalasz and Shields 1997:17-18). Faunal remains from the 1994 and 1996 investigations have been partially studied (Kalasz 1995; Kalasz *et al.* 1997) and a sizeable body of data is reported. However, full analyses have not been completed and, for most practical purposes, information contained in the available reports is not easily accessed nor consistently linked to clearly defined analytic units. Further, the 1994 study provides specimen counts (NISP) by taxon while the 1996 report relies on minimum number of individual (MNI) estimates but does not include NISP data. Working between the two datasets is challenging, a fact noted by Kalasz and Shields (1997:170). It is possible to extract information from tabular data provided in an appendix to the combined 1994/1996 report (Kalasz *et al.* 1997) but comparable data are not readily available for the combined two-year sample.

Reptiles

The suborder Serpentes (snakes) is represented by two vertebrae, both small G4 fragments, each retaining the condyle and a portion of the opposing cotyle. The ventral surfaces of the unburned vertebrae are degraded, and specimens are not identified to a

Table 5.5. Counts (NISP) for identified specimens by taxonomic group and sample type.

	Sample Type					
Taxonomic Group	General Level	Feature Level	Constant Volume	Piece Plotted	Bulk Sediment	Total
Serpentes (snakes)			1		1	2
Aves (birds)			1			1
Sciuridae (squirrel)					5	5
Cynomys ludovicianus (black-tailed prairie dog)	8	1	6		3	18
Castor canadensis (beaver)		1				1
Thomomys talpoides (northern pocket gopher)	9	1	12		1	23
Cricetidae (cricetid mice and rats)			5		1	6
Microtus sp. (voles)	2		5			7
Microtus ochrogaster (prairie vole)	2					2
Neotoma sp. (woodrat)			1		1	2
Lepus sp. (jackrabbit)			1			1
Sylvilagus sp. (cottontail)	3		4		2	9
Canis sp. (domestic dog, coyote, gray wolf)	2	2	1		1	6
Procyon lotor (raccoon)	1					1
Artiodactyla (small-medium bodied artiodactyls)	51	13	9	27	3	103
Odocoileus sp. (deer)	25	5	2	32	3	67
Odocoileus hemionus (mule deer)	1			3		4
Bison bison (bison)	1			3		4
Total	105	23	48	65	21	262
Percent	*40.1*	*8.8*	*18.3*	*24.8*	*8.0*	*100.0*

lower taxonomic rank. Thirty-nine snake bones are reported by Kalasz and others (1995) from the 1994 investigation of the site; an additional three snake bones are recorded from the 1996 investigation, one identified as rattlesnake (Kalasz and Shields 1997:173-174). There is no clear evidence of a direct association between recovered snake bones and past human use of the site.

Birds

Bird bone is nearly absent in the sample. One size grade 4 specimen, the distal fragment of a left ulna, was recovered. The piece is highly eroded with thin, polished edges and appears partially digested. The specimen is likely from a small to medium-sized passerine, but this identification is problematic. Several small diaphysis fragments sorted from G3 debris may be bird remains but even this class-level identification is uncertain. Several pieces of bird bone are present in the 1994 Magic Mountain samples. Kalasz and Shields (1997:173) report single specimens for mourning dove (*Zenaida macroura*), wild turkey (*Meleagris gallopavo*), and unidentified shore bird and raptor in the 1994 collection, as well as 16 pieces of unidentified bird. One unidentified bird is also recorded for the 1996 investigation (Kalasz and Shields 1997:179).

Mammals

Sciuridae. The squirrel family is represented by 23 specimens. Five specimens (humerus diaphysis, thoracic vertebra, and three caudal vertebrae) are not identified below the family Sciuridae and likely represent the remains of one or more of the variety of chipmunks, ground squirrels, and tree squirrels found in Jefferson County (Armstrong *et al.* 2011). The remaining 18 sciurid specimens are referred to the genus *Cynomys*, the prairie dogs; two specimens, an ulna and a scapula, are burned. Three prairie dogs species are recognized in Colorado: Gunnison's prairie dog (*C. gunnisoni*), black-tailed prairie dog (*C. ludovicianus*), and white-tailed prairie dog (*C. leucurus*). The range for Gunnison's prairie dog includes much of central, south-central, and southwestern Colorado and extends into the southern third of Jefferson County (Armstrong *et al.* 2011:138-139). The black-tailed prairie dog is found throughout the eastern half of the state. Armstrong and others (2011:144) illustrates a range that includes the northern and central portions of Jefferson County, including the Magic Mountain locale. The white-tailed prairie dog is found in the northwestern and west central portions of the state (Armstrong *et al.* 2011:140-141), well west and north of Jefferson County. Initially, prairie dog remains were referred to the genus, *Cynomys*, but it was not possible to define species on strictly morphological grounds given the fragmented character of available specimens. However, based on range distributions noted above, it is likely that black-tailed prairie dogs are represented in the identified sample and are so listed in chapter 5 tables.

Black-tailed prairie dogs are reported in earlier Magic Mountain studies (Kalasz 1995; Kalasz and Shields 1997:172, 179). The 1994 sample records 43 specimens and an MNI of two is tabulated for the 1996 materials. The basis for species identifications are not discussed for these remains but are presumably based on modern range distributions and, perhaps, morphological traits. Inventories for the 1994 investigation (Kalasz *et al.* 1995:180-181) tally unidentified ground squirrel (NISP of 6) and thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*), as well as the much larger heavy-bodied yellow-bellied marmot (*Marmota flaviventris*). The 1996 inventory (Kalasz and Shields 1997:172) also includes 13-lined ground squirrel.

Castoridae. The American beaver (*Castor canadensis*) is represented by the diaphysis of a right tibia. The specimen, from Feature 3 (feature level 3), is unburned. Beaver are represented in the 1994 Magic Mountain assemblage by a distal humerus (Kalasz *et al.* 1997:B38) and Kalasz and Shields (1997:179) report an MNI of one for the 1996 sample.

Geomyidae. Twenty-three specimens are referred to the family Geomyidae, the pocket gophers. One specimen, a small edentulous mandible fragment, appears to be burned. Armstrong and others (2011) report two gopher species in Jefferson County, the plains pocket gopher (*Geomys bursarius*) and the somewhat smaller-bodied northern pocket gopher (*Thomomys talpoides*). The northern pocket gopher is found throughout the county while the plains pocket gopher is restricted to the northern and northeastern portions; both include the Magic Mountain locality. Based on dental evidence (recovered upper incisors lacking longitudinal grooves) and size comparisons with modern skeletons, the Magic Mountain specimens are identified as northern pocket gopher. A second member of the genus *Thomomys* is found in Colorado, Botta's pocket gopher (*T. bottae*). Botta's pocket gopher is found in southern, southcentral, and southwestern areas of the state but is not reported from Jefferson County (Armstrong *et al.* 2011:178).

Based on left mandibles, a minimum of three gophers is represented in the 2017-2018 assemblage. However, the identified specimens are from 15 excavation units distributed within the three-hectare area sampled. Twenty-one of the 23 specimens are from general level deposits ranging in depth from level 2 through level 9. The implied temporal variability, combined with spatial distribution, of identified specimens, strongly suggests that more than three animals are represented. Armstrong and others (2011:183) suggest a density range from 15 to 74 individuals per hectare (2.471 ac) for northern pocket gophers. Given wide range of density values for modern gopher populations, and considering the potential time depth represented in tested deposits, the recovery of 23 fragmented bones argues that the widely scattered remains of this strongly fossorial rodent reflect natural taphonomic processes and not present in the deposits as a result of human predation.

Cricetidae. Seventeen specimens represent the family Cricetidae, the cricetid rats and mice. Six specimens (mandible fragment, humerus, proximal femur, proximal tibia, thoracic vertebra, and caudal vertebrae) are not identified beyond the family rank; the tibia and caudal vertebra are burned.

Within the cricetid group, nine specimens are from microtines (subfamily Arvicolinae). Seven of the specimens (maxilla fragment, mandible fragment, distal humerus, 2 complete femora, proximal femur, and lumbar vertebra) are referred to the genus *Microtus*. Two specimens, both mandibles, are identified as prairie vole (*Microtus ochrogaster*) on the basis of dental characters for M_1 (Semken and Wallace 2002:26-30, fig. 4j) that also allow exclusion of meadow vole (*M. pennsylvanicus*), montane vole (*M. montanus*), and long-tailed vole (*M. longicaudus*), all found, along with the prairie vole, in Jefferson County (Armstrong *et al.* 2011).

Two specimens (metacarpal, and m3) are referred to the genus *Neotoma* (woodrats) and complete the cricetid sample. Six species of wood rat are currently found in Colorado but only two, the bushy-tailed woodrat (*N. cinerea*) and the Mexican woodrat (*N. mexicana*) are known from Jefferson County. The specimens are unburned.

Inventories provided for the 1994 investigation

(Kalasz *et al.* 1995:294) identify small rodents, vole (*Microtus* sp.), and woodrat (*Neotoma* sp.). MNI estimates provided for the 1996 sample (Kalasz and Shields 1997:179) also include mountain vole (*Microtus montanus*), western harvest mouse (*Reithrodontomys megalotis*), and deer mouse (*Peromyscus maniculatus*).

Erethizontidae. The remains of porcupine (*Erethizon dorsatum*) were not identified during the present study. Kalasz and others (1995:180-181) report three specimens in the 1994 sample.

Leporidae. Ten specimens are assignable to the Family Leporidae, the rabbits and hares. Based on morphology and size comparison to larger-bodied leporids, nine pieces are identified as cottontail (*Sylvilagus* sp.). Two incisor fragments and an astragalus are burned. One specimen, an innominate from Unit 8 (general level 1), may be of comparatively recent origin based on the presence of adhered sinew.

Three species of cottontail are recorded for Jefferson County: desert cottontail (*S. audubonii*), eastern cottontail (*S. floridanus*), and the mountain, or Nuttall's cottontail (*S. nuttallii*). Generalized range maps presented by Armstrong and others (2011: 265-270), reflecting both modern and historic distributions, suggest each of the three species might be expected in the montane shrubland, riparian, and wetland systems found in the general site area. A lack of adequate modern comparative materials for desert cottontail and mountain cottontail—combined with incomplete archaeological specimens and the near absence of cranial bones—prevented identification beyond the generic level.

A tenth specimen, a burned cuneiform, is identified as jackrabbit (*Lepus* sp.) based on size comparisons to modern specimens. Either black-tailed jackrabbit (*L. californicus*) or white-tailed jackrabbit (*L. townsendii*) may be represented given historic and modern distributions (Armstrong *et al.* 2011:274, 277). The Snowshoe hare (*Lepus americanus*), recorded in the extreme northwestern corner of Jefferson County was not considered, based on relative body size and the animal's association with subalpine and alpine habitats at higher elevation (Armstrong 2011:271-272).

Leporids are relatively common in the 1994 and 1996 Magic Mountain assemblages (Kalasz and Shields 1997: 172, 179). Two specimens from 1994, a complete right mandible and a fragment of an unsided distal femur, are identified as desert cottontail but the morphological basis for the identifications is unstated. Seventy-seven specimens are referred to the genus, *Sylvilagus* and an additional 51 specimens are classified simply as leporid. At least 11 specimens recovered during the 1996 investigation were identified as desert cottontail (Kalasz *et al.* 1997:B34-B39); again the bases for specific identifications are not discussed. Jackrabbit is reported for the 1994 assemblage (Kalasz *et al.* 1995:180) for but none are listed in the 1996 sample.

Felidae. Members of the cat family, Felidae, are not represented in the 2017-2018 sample. However, Kalasz and Shields (1997:179) record a felid, possibly a mountain lion (*Puma concolor*), in the 1996 inventory with a single individual.

Canidae. Canids are represented by six specimens (lumbar vertebra arch fragment, proximal femur, distal femur, distal fragment of proximal phalange, two medial phalanges) in the identified sample. These remains are referred to the genus *Canis*. The proximal phalange is burned; none of the specimens show tool marks. The remains may be those of domestic dog (*C. familiaris*), coyote (*C. latrans*), or gray wolf (*C. lupus*). Although the canid species is undetermined, the specimens size and morphology are similar to the remains of modern coyotes collected in central Nebraska, though domestic dog also must be considered. The presence of gray wolf is considered unlikely. Kalasz and Shields (1997:172-179) report 10 large canid specimens for the 1994 sample, with five specimens identified as wild or domestic dog, four as domestic dog, and one as coyote. The basis for the identifications are not discussed. The 1996 inventory lists gray wolf, an identification based on the apparent large size of the element recovered, an axis, or second cervical vertebra (Kalasz and Shields 1997:174; Kalasz *et al.* 1997:B39).

Procyonidae. A complete upper incisor from a medium sized carnivore was recovered from disturbed deposits in Area 7. The size and morphology are similar to raccoon (*Procyon lotor*) incisors but the identification is provisional, particularly in the absence of additional specimens for this taxon. Information provided by Cary (1911:193-194), Armstrong (1972:268), and Armstrong and others (2011:434) show raccoons reliably documented throughout much of the state, including the eastern plains and foothill streams, since the early years of the twentieth century. The possibility that the specimen reflects a comparatively recent addition to site deposits cannot be ignored. Raccoons are not listed in faunal inventories for the 1994 and 1996 Magic

Mountain investigations. While the occurrence and distribution of raccoons during the prehistoric period is uncertain, the remains of raccoons are listed for the Senac (5AH380) and Bradford House II (5JF5l) sites by Gilmore (1999:193, 212).

Cervidae, Antilocapridae, and Bovidae. The 2017-2018 faunal assemblage includes 174 specimens that are the remains of small to medium-sized artiodactyls (<63.5 kg or 140 lbs.) represented in three distinct mammalian families: Cervidae (deer), Antilocapridae (pronghorn and kin), and Bovidae (cattle, goats, sheep, and kin). Based on historic and modern range information reviewed by Cary (1911), Fitzgerald and others (1994), and Armstrong and others (2011), four native species are expected in the Magic Mountain locality within the Platte River basin: mule deer (*Odocoileus hemionus*), white-tailed deer (*O. virginianus*), pronghorn (*Antilocapra americana*), and mountain, or bighorn, sheep (*Ovis canadensis*). Mule deer are found in nearly all ecosystems throughout Colorado, including those in Jefferson County. At present, white-tailed deer are found primarily in riparian and wetland areas in the eastern plains within the South Platte, Arkansas, and Republican River drainages, including the northeastern and east central portions of Jefferson County. Pronghorn are most closely linked to grasslands and semi-desert shrub lands of eastern Colorado but also are found in appropriate habitat in northwestern, west central, and central parts of the state. Current distributional plots for pronghorn include a thin strip in northeastern Jefferson County. Finally, bighorn sheep are found in mountain woodland and forest, subalpine forest, and alpine tundra within a broad band that runs north to south through the state and includes the western edge of Jefferson County.

Taxonomic identifications, nearly always difficult with highly fragmented specimens, were accomplished through direct comparisons to a series of modern pronghorn, mule deer, and white-tailed deer skeletons, supplemented by published reference materials (Jacobson 2003, 2004; Lawrence 1968). Bighorn sheep skeletal materials were not available for this study. Just over 88 percent of the pieces representing small to medium-sized artiodactyls are small (G2-4) specimens (table 5.4). Of 174 examples considered, four specimens are identified as mule deer and 67 specimens are referred to the genus *Odocoileus*, and may be either mule deer or white-tailed deer. Six identified specimens are burned. The remaining 103 specimens represent small to medium-sized artiodactyls; mule deer, white-tailed deer, pronghorn, and bighorn sheep are all possibilities. However, the skeletal remains of pronghorn and bighorn sheep are not recognized in this study and it is likely that unassigned artiodactyl specimens are mostly deer. Fetal and neonatal animals are not present in the identified sample. Stone tool marks were noted for three specimens (hyoid, rib shaft, and distal tibia) and 28 specimens are burned. Table C.4 (appendix C) summarizes identified small to medium sized artiodactyl remains organized by taxon and skeletal element.

Deer (*Odocoileus* sp.) are the most common taxon, measured by NISP or MNI values, in collections resulting from earlier work at the site in 1994 and 1996 (table C.3). The 1994 sample includes 195 specimens (Kalasz *et al.* 1995:180-181) with a minimum of 28 animals estimated by Kalasz and others (1997:179) for the 1996 sample. Identification below the genus rank may not have been attempted.

Four identified specimens represent large bodied artiodactyls, potentially either elk (*Cervus canadensis*) or bison (*Bison bison*). Elk, nearly extirpated in Colorado during the early years of the last century, were once widespread through the western mountains but also in suitable habitat in the eastern part of the state (Armstrong 1972:302-303; Armstrong *et al.* 2011:447-448; Cary 1911:53-54). Bison appear to have ranged over much of Colorado, with the exception of the southwest corner of the state, during the prehistoric and early historic periods (Cary 1911:60-62, Armstrong 1972:308).

A complete phalanx 1 and the proximal portion of phalanx 3 are easily identified as bison; phalanx 3 shows signs of carnivore gnawing. The proximal epiphysis of phalanx 1 is fully fused, suggesting an animal at least four years of age (Duffield 1973). Both specimens are lightly stained and show minor surface erosion and leaching. A third specimen consists of the fragmented diaphysis of a left tibia. This piece is identified as bison based on comparisons to a range of bison and elk tibiae, with particular attention to muscle scar patterning on the caudal surface. An additional fragment of this element was plotted separately in an adjacent excavation unit. Identified fragments are lightly stained, cracked, and exfoliated. A final specimen, a sacrum, represented by the left cranial articular process of the first segment is identified as bison, based on general morphology and comparisons to modern bison and elk sacra. Elk are not represented in the 2018-2019 sample.

Bison are well represented from work at the site in 1994 (Kalasz *et al.* 1995:180-181) with 86 specimens reported. An MNI of one is estimated for the 1996 assemblage (Kalasz and Shields 1997:179). The remains of elk also are recorded at Magic Mountain, with 18 specimens reported for the 1994 investigation (Kalasz *et al.* 1995:180) and an MNI of five animals estimated for the 1996 investigation (Kalasz and Shields 1997:179).

Distribution of Identified Specimens

Table 5.6 summarizes counts for identified remains organized by reporting areas (table 3.3) and offers a simple measure of the distribution of identified specimens within and between areas of the site investigated. The majority (64.1 percent) of the identified sample is from 30 test units in Area 4. Nearly half of the total excavated volume during the 2017-2018 investigation is from Area 4. Areas 3 and 7 are also well represented, contributing 16.7 percent and 18.3 percent, respectively, of the identified total.

Fifty-one specimens were identified from ten features, contributing 19.5 percent of the 2017-2018 sample. Table C.5 summarizes identified specimen counts by taxonomic group and feature. Features are organized by age group (early, middle, and late) based on analysis of stratigraphic and radiocarbon data (table 3.24). Forty-two specimens from five features in the late group contribute 82.4 percent of the feature total. Feature 3—an earth oven assigned to the late group—contributed 60.8 percent of the combined feature total. Deer and unassigned small to medium-sized artiodactyl remains dominate the Feature 3 sample which also includes snake, prairie dog, beaver, pocket gopher, cottontail, and large canid remains. Burned bone makes-up 38.7 percent of the Feature 3 sample. Burned bone was also found in two basin hearths, Feature 4 (middle group) and Feature 12 (late group).

Table 5.7 organizes the 262 identified specimens by taxonomic group and analytic unit. Analytic units 2 (Early Ceramic general levels) and unit 3 (Early Ceramic feature levels) comprise 72.9 percent of the identified sample. Analytic unit 5 (pre-Early Ceramic) adds an additional 13.0 percent to the total. Surface, disturbed, and mixed deposits contribute 4 to 5 percent each. Deer and unassigned small to medium-

Table 5.6. Specimen counts (NISP) for identified vertebrate remains organized by taxonomic group and reporting area.

	Report Area						
Taxonomic Group	2	3	4	5	6	7	Total
Serpentes (snakes)			1			1	2
Aves (birds)			1				1
Sciuridae (squirrel)			4			1	5
Cynomys ludovicianus (black-tailed prairie dog)		7	7			4	18
Castor canadensis (beaver)			1				1
Thomomys talpoides (northern pocket gopher)	3	7	8			5	23
Cricetidae (cricetid rats and mice)		3	1			2	6
Microtus sp. (voles)		2	5				7
Microtus ochrogaster (prairie vole)		1	1				2
Neotoma sp. (woodrat)			2				2
Lepus sp. (jackrabbit)		1					1
Sylvilagus sp. (cottontail)			9				9
Canis sp. (domestic dog, coyote, gray wolf)		2	4				6
Procyon lotor (raccoon)?						1	1
Artiodactyla (small-medium bodied)		16	71		1	15	103
Odocoileus sp. (deer)		2	47			18	67
Odocoileus hemionus (mule deer)		1	3				4
Bison bison (bison)			3			1	4
Totals	3	42	168	0	1	48	262
Percent Total	*1.1*	*16.0*	*64.1*	*0.0*	*0.4*	*18.3*	*99.9*
Percent Burned	*0.0*	*16.7*	*19.6*	*0.0*	*0.0*	*10.4*	*17.2*

Table 5.7. Specimen counts (NISP) for identified specimens by taxonomic group and analytic unit.

	Analytic Unit								
Taxonomic Group	0	1	2	3	4	5	9	NISP	Percent
Serpentes (snakes)				1	1			2	*0.8*
Aves (birds)			1					1	*0.4*
Sciuridae (squirrels)				5				5	*1.9*
Cynomys ludovicianus (black-tailed prairie dog)			9	4		5		18	*6.9*
Castor canadensis (beaver)				1				1	*0.4*
Thomomys talpoides (northern pocket gopher)	2		11	2	2	6		23	*8.8*
Cricetidae (New World rats, mice, voles)	3			1		2		6	*2.3*
Microtus sp. (voles)	2	4				1		7	*2.7*
Microtus ochrogaster (prairie vole)	1	1						2	*0.8*
Neotoma sp. (woodrat)				1		1		2	*0.8*
Lepus sp. (jackrabbit)	1							1	*0.4*
Sylvilagus sp. (cottontail)		2	4	3				9	*3.4*
Canis sp. (domestic dog, coyote, gray wolf)			3	3				6	*2.3*
Procyon lotor (raccoon)		1						1	*0.4*
Artiodactyla (small-medium bodied)	3	3	61	21	5	10		103	*39.3*
Odocoileus sp. (deer)		1	48	9	4	5		67	*25.6*
Odocoileus hemionus (mule deer)			2			2		4	*1.5*
Bison bison (bison)			1		1	2		4	*1.5*
Total	12	12	140	51	13	34	0	262	*100.2*
Percent Total	*4.6*	*4.6*	*53.4*	*19.5*	*5.0*	*13.0*	*0.0*	*100.1*	
Percent Burned	*16.7*	*0.0*	*14.3*	*27.5*	*30.8*	*14.7*	*0.0*		

sized artiodactyls dominate the Early Ceramic sample. Prairie dog, unassigned squirrel, northern pocket gopher, and leporids also are present, though in lower numbers. Bison are represented by a single specimen in the Early Ceramic sample. The pre-Early Ceramic (Archaic) deposits yielded two bison specimens, and mixed deposits contained one bison specimen.

Early Ceramic Period Subsistence

Of the 262 identified faunal specimens recovered during the 2019-2018 field investigations, 191 are from Early Ceramic deposits. Table 5.8 presents specimen counts and MNI estimates for animals that are likely to have played a role in the subsistence economy of American Indian groups who occupied the site during the Early Ceramic period. Snake, bird, indeterminate squirrel, and cricetid remains found in Early Ceramic deposits are not included in the table.

Table 5.8 also includes information drawn from table C.3 summarizing NISP values and MNI estimates for vertebrate remains recovered from the site during the 1994 and 1996 investigations. For present purposes, the 1994 and 1996 samples reported by Kalasz and others (1995) and Kalasz and Shields (1997) are assumed to reflect occupation of the Magic Mountain site during the Early Ceramic period;, however there is a likelihood that samples may include a small, but unknown, amount of material from earlier Archaic period deposits. Table 5.8 is limited to mammals. Fish are absent from the 2017-2018 sample, and snake and bird are represented by single indeterminate specimens. One fish bone, along with amphibian, lizard, and snake remains, is reported from the 1994 and 1996 excavations at the site (table C.3). Currently there is no evidence to indicate that fish, amphibians, or reptiles played a role in local subsistence pursuits and it is reasonable to surmise that the identified remains entered site deposits primarily due to natural processes.

The origin of bird specimens reported for 1994 and 1996 samples is less clear. Eighteen pieces of unidentified bird bone are recorded for 1994, with single specimens identified as mourning dove and turkey. The 1996 sample is limited to an MNI of one, identified simply as bird. Birds, including turkey, are represented in the modified samples discussed below and there seems little doubt that birds were hunted, with their bones, skins, feathers, and, perhaps, flesh sought for a variety of purposes—including the

Table 5.8. Number of individual specimens (NISP) and minimum number of individuals (MNI) for select faunal remains from Early Ceramic contexts for the 2017-2018 field investigations and the 1994 and 1996 excavations at Magic Mountain.

	2017-2018		1994	1996
Taxonomic Group	NISP	MNI	NISP	MNI
Marmota flaviventris (yellow-bellied marmot)			1	
Cynomys ludovicianus (black-tailed prairie dog)	13	2	43	2
Castor canadensis (beaver)	1	1	1	1
Thomomys talpoides (northern pocket gopher)	13	2	108	25
Leporidae (leporids)			51	
Lepus sp. (jackrabbit)			6	
Sylvilagus sp. (cottontail)	7	1	79	7
Canis sp. (domestic dog, coyote, gray wolf)	6	1	10	1
Artiodactyla (small-medium bodied)	82	3		
Cervus canadensis (elk)			18	5
Odocoileus sp. (deer)	57	2	195	28
Odocoileus hemionus (mule deer)	2	1		
Antilocapra americana (pronghorn)			8	1
Bison bison (bison)	1	1	86	1
Total	182	14	606	71

manufacture of utilitarian and ornamental pieces. The overall importance of birds in the subsistence base of Early Ceramic period groups is not certain. Based on available evidence, the near absence of bird in the 2017-2018 sample and the minimal presence of mourning dove and turkey in the 1994 collection, birds do not appear to have been a major part of the subsistence economy at Magic Mountain. Review of faunal lists for Early Ceramic components, including those summarized by Gilmore (1999), generally supports this conclusion.

The remains of large to mid-sized rodents and lagomorphs are present in varying frequencies in archaeological collections from Magic Mountain. Beaver, associated with riparian and wetland zones, are represented in each of the samples considered, though in low frequency. A single specimen identified as yellow-bellied marmot (*Marmota flaviventris*) is recorded for the 1994 sample. Though both species are relatively rare in Early Ceramic assemblages reviewed for this study, it is probable that these comparatively large rodents may have been taken when encountered, likely for meat and skins, and perhaps for skeletal parts.

Black-tailed prairie dogs are represented in each of the samples considered (table 5.8). One specimen, from 2017-2018 Early Ceramic period deposits, is burned. The dietary importance, if any, of prairie dogs at the Magic Mountain site is uncertain. The sample from work in 2017-2018 is a small one with identified remains fragmented and widely scattered. Few details are available regarding prairie dog materials included in 1994 and 1996 project reports. Prairie dogs also are recorded in several Early Ceramic period assemblages including Bayou Gulch, 5DA265 (Gilmore *et al.* 2021) and Rock Creek, 5BL712 (Gleichman *et al.* 1995). Gilmore (1999) lists the presence of prairie dog at several Early Ceramic period sites including Uhl (5WL32), Box Elder-Tate Hamlet (5DV3017), and Senac (5AH380). Citing O'Neil and others. (1988), he notes that "…the presence of burned prairie dog bone at the Senac site…suggests that these animals were cooked and eaten there, and by extension at other sites as well" (Gilmore 1999:268). Gilmore goes on to say "Objectively, prairie dogs as a food source would seem to be a desirable resource, offering several advantages. They are social rodents that live in large colonies at a location that is predictable from year to year, and are relatively easy to trap, snare, or hunt."

Gopher bones are commonly recovered from sites in the Platte River basin. Twenty-three northern pocket gopher specimens were recorded for the 2017-2018 project and 13 specimens, representing a minimum of two animals, were recovered from Early Ceramic levels. None of these specimens are burned. Earlier in the chapter it was reasoned that gopher remains entered site deposits through natural taphonomic processes, not because of human predation. This conclusion differs with one put forward by Kalasz and Shields (1997:181) who state "Given the MNI, it becomes obvious that they [pocket gophers] were actively pursued." NISP and MNI values for the 1994 and 1996 sample are given in table 5.8; the basis for the MNI estimate of 25 is not known. Distributional data for identified remains is not discussed, nor is direct evidence for procurement or processing of pocket gophers provided. Gophers, like prairie dogs, may have played a minor, perhaps seasonally important, role in Indigenous American subsistence. Studies from adjacent regions unquestionably document use of gophers and other small rodents as a source of food (Falk 2013:147-148; Falk and Semken 1990, 1998; Shaffer 1992), but evidence for this dietary practice at Magic Mountain is wanting at present.

The leporid group includes jackrabbits and cottontails; both animals are represented in the combined 2017-2018 sample but only cottontails are present in the Early Ceramic period sample. Three of the seven specimens are burned. Leporids are well represented in samples collected in 1994 and 1996. The 1994 sample includes 136 specimens representing jackrabbit, cottontail, and unassigned leporids. An MNI of 7 is estimated for unassigned leporids recovered in 1996. Both jackrabbits, and especially cottontails, are relatively common in Early Ceramic assemblages throughout the basin including Bayou Gulch (Kihm 2021), Cass (5WL1483, Kalasz *et al.* 1992), Rock Creek (Gleichman *et al.* 1995), and Ridgegate (5DA1000, Kalasz *et al.* 2008) sites. Cottontails and jackrabbits would offer a likely source of sustenance and their bones clearly provided raw materials for the manufacture of bone tools and decorative pieces.

The 2017-2018 investigation recovered six specimens identified as the remains of large canids (domestic dog, coyote, and gray wolf), all from Early Ceramic period deposits; one specimen is burned. Additional canid remains were recovered during the 1994 and 1996 projects. The 1996 inventory lists a single gray wolf. The 1994 sample (Kalasz *et al.* 1995:180) lists five specimens as wild or domestic dog, four specimens as domestic dog, and one specimens as coyote; the basis for species identifications for domestic dog and coyote is not provided. Large canids are reported from a few Early Ceramic period sites, including the Cass (Kalasz *et al.* 1992) and Uhl (Gilmore 1999:89) sites, but in comparatively low frequency. Given available evidence, large canids do not seem to be animals maintained or hunted for food, although they may have provided an occasional meal. If domestic dog were present at Magic Mountain, they may have been important in hunting pursuits.

The remains of deer and unassigned small to medium-sized artiodactyls—potentially deer and pronghorn—dominate the Early Ceramic period sample from the 2017-2018 project, and clearly provided a major focus, if not the major focus for prehistoric hunters occupying the site. MNI estimates are of questionable value given the small sample and spatial scatter of the recovered remains, but a minimum of six animals are represented in the combined group. Comparisons with the 1994 and 1996 samples underline the relative importance of deer at Magic Mountain with an NISP of 195, and an MNI of 28, tallied for each sample, respectively. Though not treated here, Kalasz and others (1995:179-180) also classify 12,282 pieces of bone simply as Artiodactyla, a group that specifically encompasses deer, pronghorn, elk, and bison, further suggesting that bison, and "… to a lesser extent, deer, are predominant."

Bison are present in the 2017-2018 sample, represented by four specimens, a very low frequency given the extent of the area sampled. Only one specimen is from Early Ceramic period deposits. In comparison, 86 pieces of bison bone are identified from the sample reported for 1994 and a single individual is noted for the 1996 investigation. Apparently, bison are present at the site, but evaluation of data shown for the earlier sample is difficult without additional, more detailed analysis and data presentation.

The apparent absence of pronghorn in the 2017-2018 sample is curious, particularly since the animal is represented in archaeological samples from the 1994 and 1996 field investigations. Kalasz and colleagues (1995:180) include eight pronghorn specimens in the 1994 sample and Kalasz and Shields (1997:172, 179) estimate a minimum of one animal present in the 1996 sample. Based on an examination of coded information presented by Kalasz and others (1997), pronghorn identifications include a complete tooth, three tooth enamel fragments, two distal metacarpals, a distal first row phalange, and a distal metapodial. Specimen counts and element identifications are not provided for 1996. Depending on specimen completeness and state of preservation, the pronghorn identifications may well be correct but the absence of other, more diagnostic remains, is noteworthy. Of interest, the results of protein residue analysis failed to show evidence of pronghorn while deer, elk, and bison were the dominant taxa represented in analysis results

(Kalasz and Shields 1997:210-211). Though of no real analytic value, Irwin-Williams and Irwin (1966:195, 209) point toward the importance of deer, but not pronghorn, in summary comments on subsistence and identify only deer metapodials and antler when describing modified bone pieces (Irwin-Williams and Irwin 1966:167, 169). In any case, it appears that pronghorn remains are absent or poorly represented in the Magic Mountain samples, indicating perhaps that Indigenous peoples occupying the site during the Early Ceramic period made only limited use of this semidesert shrub and grassland species. Elk are also absent in the identified 2017-2018 sample but are represented in the 1994 and 1996 investigations (table 5.8). Again, without detailed analysis of identified materials, the meaning of specimen counts and MNI estimates is uncertain.

Archaeological investigation of the Magic Mountain site in 2017-2018 yielded nearly two kilograms of bone. Two hundred sixty-two specimens are assigned to 18 taxonomically based groups representing a variety of mammals, as well a reptile and bird. Based on the results of the 2017-2018 investigations, small to medium-sized artiodactyls, primarily deer, were the principal focus of Early Ceramic period hunters. Pronghorn and elk were not identified in the 2017-2018 sample but are represented in the earlier work at the site. The remains of smaller game animals, including black-tailed prairie dog, cottontail, and beaver, also were recovered from the site. Comparison of the 2017-2018 faunal materials with those recovered from the site in 1994 and 1996 projects underline the importance of deer. Bison, though present, is represented by a single element from Early Ceramic contexts. Like many Early Ceramic sites on the Front Range, bison is poorly represented at Magic Mountain. This pattern likely reflects an increasing diet breadth which, unlike earlier periods, was not centered around bison hunting.

Modified Bone

Eight pieces of modified bone were recovered from the site during the two-year investigation; two specimens from excavation unit 19 refit and are part of the same tool. Table 5.9 summarizes the modified specimens grouped by generalized function, presenting basic specimen measurements, provenience, and sample information.

Three distal tool fragments are classified as awls or punches. The first specimen, comprised of two refit pieces (CN4069 and CN4073), is manufactured from a split long bone taken from a deer-sized animal. The general form of the portion remaining suggests the tool was manufactured from a metatarsal or metacarpal but specific element identification is uncertain. The converging lateral margins are rounded, worn smooth, and tapered to a thick conical point (figure 5.1, right). The distal tip of the tool is slightly chipped. Incomplete specimen length of the conjoined pieces is 42.4 mm. This tool is burned. A second awl or punch, manufactured from an indeterminate mammal bone, is represented by a burned distal fragment (CN3251). The tip of this awl is also conical and slightly chipped. A third specimen (CN3233), is an unburned distal tool fragment. The tip is relatively sharp in comparison to the two previous specimens. This tool is also manufactured from indeterminate mammal bone.

Two specimens are classified as ornamental or non-utilitarian items. The first (CN4165) is a complete bead that appears to have been cut from the metacarpal or metatarsal of a small to medium-sized mammal, though the long bone of small to medium-

Table 5.9. Modified bone organized by functional group. Shaded specimens are conjoined pieces of the same tool. Measurements are in millimeters and weight is in grams.

Function	Analytic Unit	CN	Size Grade	Provenience	Sample Type	Weight	Length	Width	Thickness
Awl or Punch	2	4069	3	Unit 19	Constant Volume	1.3	28.2	10	5.7
Awl or Punch	2	4073	3	Unit 19	Piece Plot	1	14.9	12.2	6.2
Awl or Punch	0	3251	4	Unit 45	Constant Volume	0.2	13.5	4.6	3.9
Awl or Punch	0	3233	4	Unit 35	Constant Volume	0.03	6	2.6	1.6
Ornamental	3	4165	4	Unit 5/6	Bulk Sediment	0.1	6.8	3.5	3.3
Ornamental	2	4370	3	Unit 41	General Level	0.1	15.3	5.5	3.7
Unknown	2	4319	2	Unit 51	General Level	1.6	31.3	11.9	7.5
Unknown	2	4343	3	Unit 51	General Level	0.9	24.4	9.1	5.7

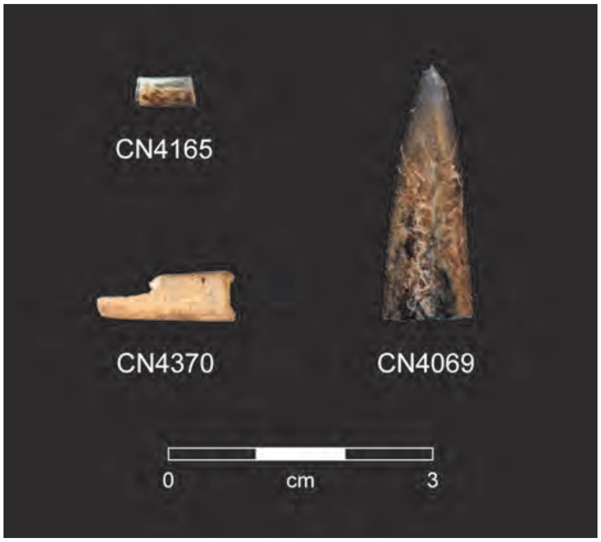

Figure 5.1. Selected modified bones from the 2017-2018 excavations.

sized bird cannot be discounted (figure 5.1, top left). One end and the body of the bead are worn and polished. The opposite end shows the traces of shallow transverse cuts that ring the diaphysis and indicate manufacture using a 'groove and snap' procedure. This specimen is burned. A second piece (CN 4370) is a fragment of what appears to be a tubular bead, also manufactured from the long bone of a small to medium-sized mammal (figure 5.1, bottom left). The general morphology and cross-section of this piece suggest manufacture using the tibia of a small lagomorph, likely a cottontail (*Sylvilagus* sp.). One end of the specimen shows the worn and polished remnants of a transverse cut. The opposite end is broken and unpolished.

The final two pieces are classified as utilitarian items of unknown function; both specimens are burned. The first, a small fragment of deer antler tine (CN4319) shows possible tool marks and evidence of smoothing, and slight polish. This specimen may be a fragment of an expedient punch or flaking tool and is the only example of antler identified in the 2017-2018 assemblage. The possibility that observed striations and smoothing are a result of natural processes (such as the scraping or rubbing of antler against trees or shrubs to remove velvet) during the life of the animal cannot be dismissed. The final piece of modified bone (CN4343) is a burned fragment of compact tissue showing clear striations over a small section of original cortex; the function of this piece is unknown.

Intrasite Comparisons

Bone tools and ornaments are reported from prior work at the Magic Mountain site in 1959-1960, and in 1994 and 1996. Irwin-Williams and Irwin (1966:165-172) report a minimum of 30 modified specimens from excavations completed in the period 1959-1960, noting that "For the size of the area excavated, worked bone was extremely scarce" (1966:165). Twenty specimens are from Early Ceramic period deposits (Zone A). Six pieces of modified bone from deposits representing the Early, Middle, and Late Archaic occupations of the site, and three pieces from unassigned or unknown contexts, are not considered here. Finally, 14 modified pieces were recovered in 1994 (Kalasz *et al.* 1995:186-189) and three additional specimens were collected in 1996 (Kalasz and Shields 1997:181-186). Echoing the earlier comments, Kalasz and Shields (1997:181) suggest that while modified

Table 5.10. Counts of modified bone recovered from the Magic Mountain site organized by general function and year of investigation.

	Year of Investigation			
Functional Group	1959-1960 [a]	1994, 1996 [b]	2017-2018	Total
Patterned awl or punch	3	5	3	11
Flaking tool, gouge/chisel	3			3
Unknown, utilitarian			2	2
Ornamental—tubular bead	11	1	1	13
Ornamental—bead	2	3	1	6
Ornamental—incised piece	2			2
Unknown		8		8
Total	21	17	7	45

[a] Irwin-Williams and Irwin 1966

[b] Kalasz *et al.* 1995; Kalasz and Sheilds 1997

bone is present in the assemblage "…there is a general paucity of bone tools/ornaments and a lack of diversity of form." Kalasz and Shields (1997:186) also note that the "Distribution of bone tools and ornaments do [*sic*] not pattern or correlate with other materials." The precise meaning of this assertion is ambiguous but the modified pieces reported here are assumed to be from contexts reflecting Early Ceramic period occupations of the site.

Table 5.10 summarizes modified specimens from Early Ceramic period deposits at Magic Mountain. Two specimens (awl or punch) recovered from disturbed deposits processed in 2018 are omitted from the table. Two bone beads are listed in association with an inhumation (Burial 1) exposed in Zone A (Irwin-Williams and Irwin 1966:51). In a following section a single bead is linked to the burial (Irwin-Williams and Irwin 1966:170); two beads are included below in table 5.10.

Descriptive analysis of modified bone resulting from earlier work as the site is incomplete and a detailed study of the combined assemblages would likely result in improved description and classification for some specimens. Nonetheless, information on hand is sufficient to recognize broad similarities within and between the multi-year samples. Awls or punches are a consistent presence in each sample. Generally manufactured from split deer long bones (commonly metacarpals or metatarsals), awls provide nearly 25 percent of the combined assemblage of modified bone. Small ornamental pieces, in particular beads and tubular beads (specimens with a length to diameter ration greater than 3:1), are an even more common feature, making-up 46.7 percent of the total. Beads were manufactured using the common groove and snap technique making use of the long bones of small to medium-sized mammals, especially cottontail and jackrabbit, as well as those of small to medium-sized birds. Kalasz and Shields (1997:Table 36, Figure 34C) describe a use of a turkey femur for bead manufacture; the specimen illustrated appears to represent manufacture discard. Irwin-Williams and Irwin (1966:168-169) report possible flaking tools (one using deer antler, the other an indeterminate fragment) and two gouge or chisel-like tools (fashioned from the corneal process of a bison and an unidentified bison long bone) from Early Ceramic and Middle to Late Archaic levels. Antler tine found during the 2017-2018 project may be a fragment of a flaking tool (or punch) but this interpretation is only conjecture at present. In sum, modified tools and ornamental pieces recovered during the 2017-2018 investigation are consistent with modified materials reported from earlier work within adjacent areas of the Magic Mountain site complex.

Regional Comparisons

Moving beyond Magic Mountain, investigation of two Early Ceramic period occupations yielded modified bone remains that can be compared in general terms with the Magic Mountain materials: Rock Creek and Bayou Gulch. At Rock Creek, located about 24 km north of Magic Mountain in Boulder County, two bone tools are reported (Gleichman *et al.* 1995: 80, 101-102). Both specimens, manufactured from small or medium-sized mammal long bone splinters, appear to have functioned as awls or punches, possibly to work leather.

Bayou Gulch is located about 50 km southeast of Magic Mountain in Douglas County. An analysis of fauna, including modified bone, was prepared by Allen Kihm in 1979 and his original report is included as an appendix (Kihm 2021) in Gilmore and others (2021). As part of a reanalysis of materials from the site, a number of modified specimens were reexamined leading to a conclusion that "…brief survey of selected bone from Bayou Gulch indicates potential for research to correct classification errors that occurred during the original faunal analysis" (Gilmore *et al.* 2021:99). Use of available information on the modified remains from the site must proceed cautiously until the results of a reevaluation are complete.

In his original report, Kihm described 14 modified specimens including two distal awl fragments, and a third awl represented by a metapodial fragment—a piece that in all likelihood is discard from the manufacture of an awl or similar tool. Other described materials are a complete bone bead manufactured from the metapodial of a large canid (*Canis* sp.), a possibly modified tooth root (taxon unidentified), six polished bone fragment, a bison scapular spine showing slight wear on the acromion, and a bison metapodial with a drilled hole into "…the articular surface slightly dorsal to the midline" (Kihm 2021). A final specimen from the site is a portion of the right scapula of a bison. Evidence of modification include fine parallel lineations, wide shallow grooves, and fine striations, all leading Kihm to suggest that the specimen may have been part of a digging tool, and that at least some of the observed modifications may be the result of tool hafting (see Gilmore 1999:99-100). In the absence of more detailed description and improved photographs, evaluation of the specimen is difficult without examining the piece. As might be expected, a degree of interest has been shown in this specimen since scapula digging tools are not known from Early Ceramic period assemblages in the area.

Although original reports were not readily available to the author at the time of this writing, summaries of modified bone recovered from four additional Early Ceramic period components are presented by Gilmore (1999). Situated roughly 50 km west of Magic Mountain, in Arapahoe County, excavations at the Senac site yielded "…six awls, three beads, one shaft straightener, one grooved deer tooth, one fiber processor, two perforators, and three scrapers" (Gilmore 1999:193). Three Jefferson County sites, located about 12 km south of Magic Mountain include Bradford House II (5JF51), Bradford House III (5JF52), and the Swallow site (5JF321). The sample of modified bone at Bradford House II includes "… awls (n=9), one tubular bird bone bead, one reamer, bone scrapers (n=14), bone drills (n=2), and three fragments of antler flakers" (Gilmore 1999:212). A comparatively large and diverse assemblage was recovered from Bradford House III. Specimens listed by Gilmore (1999:213) include:

> …one flaker, awls (n=5), one pointed tool, one worked deer scapula, one bipointed tool, one canid tooth with an annuler [*sic*] groove around the root and thought to be a pendant, tubular mammal bone beads (n=9), one bone disk, one piece of incised bone (possibly a gaming piece), miscellaneous pieces of broken, polished or incised bone that may represent pieces of broken tools or early manufacturing stages of bone beads, and four fragments of antler tools, possibly flakers and/or perforators [Gilmore 1999: 213].

Lastly, bone beads and bone awls are noted for the Woodland component at the Swallow site (Gilmore 1999:211).

Review of modified bone from deposits at Magic Mountain—together with quantitative and qualitative data for six broadly contemporaneous Early Ceramic components—permits some general conclusions despite apparent differences in sampling strategies, field recovery practices, and reporting. During the Early Ceramic period indigenous groups living in the Platte River basin appear to have made common use of a relatively basic kit that included a variety of piercing tools (awls and punches), as well as tools for flaking stone, and scraping hides. Other forms, reamers, tools for processing fiber, shaft straighteners, and gouges also have been reported, though less frequently. Ornamental and other nonutilitarian pieces are reported, with undecorated beads and tubular beads common, occasionally found in large numbers. Tooth pendants, small incised pieces, and discs (perhaps gaming pieces) also are reported, but again, in generally low frequency. The majority of bone tools and ornaments are manufactured from the bones of artiodactyls, especially those of deer, pronghorn, and—to a lesser degree—bison and elk. Small to medium-sized mammals, including jackrabbits, cottontails, and large canids, as well as birds, provided raw material for both utilitarian and ornamental pieces.

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6

Macrofloral Remains

Kathryn Puseman

Macrofloral analysis was conducted on 14 samples representing 11 rock-filled features excavated at the Magic Mountain site during 2017 and 2018. These features consist of five earth ovens, five basin hearths, and a storage pit found in five designated site areas. With the exception of the storage pit, these features were filled with burned granitic rock. Radiocarbon dates note use of the site multiple times during the Early Ceramic period, from the late first century B.C. or first century A.D. to sometime after the late tenth or early eleventh centuries A.D. (chapter 3). Many of the features sampled for macrofloral remains exhibited evidence of reconstruction and reuse. Macrofloral analysis was used to provide charred seeds and charcoal for radiocarbon analysis, subsistence information concerning plant resources utilized by the site's occupants, and to determine if the different feature types or time periods yield differing results.

Macrofloral Methods

Sediment samples were floated to recover macrofloral remains using a bucket system. Samples were measured and added one liter at a time to a bucket filled with water. After swirling, the floating material (light fraction) was poured through a 150-micron-mesh sieve. This process was repeated with additional water until all floating material was recovered. After pouring the heavy fraction remaining in the bottom of the bucket through a 0.5-mm-mesh screen, the floated light and heavy fractions were dried.

Light fractions were weighed, then screened using a series of graduated

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screens (U. S. Standard Sieves with 4-mm, 2-mm, 1-mm, 0.5-mm, and 0.25-mm openings). The contents of each screen were then examined. The total charcoal fragments recovered in the 2-mm and/or 4-mm screens were isolated and weighed. Charcoal fragments from a representative sample (n=40) were broken to expose fresh, cross, tangential, and radial sections, then examined under a Bausch and Lomb Stereozoom microscope at a magnification of 70x. Some specimens were also examined using a Nikon Optiphot 66 microscope at magnifications of 100-600x. Within the representative sample, both counts and weights were noted. A top-loading Tree® high-resolution electronic balance with a precision of 0.001 g was used to record the charcoal weights.

Light fraction material remaining in the 4-mm, 2-mm, 1-mm, 0.5-mm, and 0.25-mm screens was examined under a Bausch and Lomb Stereozoom microscope at magnifications of 10-70x. The light fraction material smaller than 0.25 mm in size was not examined. The heavy fraction was scanned under a 2x magnifying light for the presence of botanical remains. Macrofloral remains were recorded as charred or uncharred and whole or fragmentary using counts, weights, or frequencies. Macrofloral remains and charcoal fragments were identified to the lowest taxonomic level using standard identification manuals (Carlquist 1988; Core *et al.* 1976; Davis 1993; Delorit 1970; Hoadley 1990; Martin and Barkley 2000; Panshin and deZeeuw 1980), internet web sites (InsideWood 2004; Schweingruber and Landolt 2005), and a modern comparative collection. Taxonomic nomenclature follows the *North American Plant Atlas* (Kartesz 2015), *Flora of North America* (Flora of North America Editorial Committee 1993), and the PLANTS Database (NRCS 2022). Clean laboratory methods were used so that charcoal or other charred botanical remains could be submitted for AMS radiocarbon dating. Samples were protected from contact with modern carbon, and all instruments were washed with distilled water prior to analysis and between samples.

Because both modern and prehistoric seeds can be recovered from archaeological samples, criteria for distinguishing modern from prehistoric seeds must be employed. One criterion used by many ethnobotanists is to consider charred remains to be prehistoric and uncharred remains to be modern. Most uncharred seeds will not survive intact in the soil for prolonged periods of time. Some exceptions to this rule do apply. It is possible for uncharred remains to survive in protected locations, such as caves, vessels, and structures, as well as in water-logged sites and very arid areas. As a result, interpretation of uncharred material in archaeological sites as prehistoric is made on a sample-by-sample basis (J. Harrington 1972; Justice and Bass 1987; Minnis 1981; Quick 1961).

Results

This section presents a feature-by-feature discussion of the charred macrofloral remains recovered in the 11 features sampled for such (table 6.1). Additional sample data, including the entire sample contents, are presented in appendix D. Complete feature descriptions and radiocarbon ages are in chapter 3.

Feature 1

Feature 1 was a large, oblong, rock-filled pit, slightly bi-lobed in shape, located in Area 4. This feature appears to have been reconstructed and reused at least once, with secondary use as an earth oven. The base of the feature revealed two basins. Radiocarbon dates indicate that the feature was used prior to 1700 B.P. Macrofloral sample CN4125 represents fill from the upper portion of the earth oven. This sample yielded a charred Cactaceae spine fragment and a charred *Chenopodium* sp. seed fragment, suggesting use of cactus and goosefoot seeds (tables 6.2 and 6.3). A few charred *Pinus* spp. bark scale fragments and a dominance of *Pinus* spp. charcoal note burning pine logs or branches with adhering bark as fuel. Species of *Pinus* currently found in Jefferson County include *Pinus contorta* (lodgepole pine), *Pinus flexilis* (limber pine), and *Pinus ponderosa* (ponderosa pine) (Kartesz 2015). The sample also contained two fragments of charred, vitrified tissue. Vitrified tissue exhibits a shiny, glassy appearance due to fusion by heat and might represent charcoal or other charred plant tissue too vitrified for identification. In addition to fragments of *Pinus* spp. charcoal, the representative charcoal record yielded a few fragments of *Prunus* spp. charcoal. *Prunus americana* (American plum), *Prunus pennsylvanica* (pincherry), *Prunus pumilla* (sandcherry), and *Prunus virginiana* (chokecherry) currently grow in Jefferson County (Kartesz 2015).

Fill from the middle of the feature, in the area of the northwest basin, was collected as sample CN4126. Recovery of numerous charred *Pinus* spp. bark scale fragments and large chunks of *Pinus* spp. charcoal

Table 6.1. Provenience data for macrofloral samples.

Catalog Number	Feature Number	Unit(s)	Area	Depth (cm DD)	Unit SW Corner	Description
4125	1	7	4	55-67	616NE356	Upper fill from large, oblong rock-filled earth oven
4126	1	7	4	58-87	616NE356	Middle fill from large, rock-filled earth oven
4101	2	5/6	4	53-65	624NE355	Domestic refuse from fill of small storage pit covered with slab millingstone; superimposed on north lobe of Feature 3
4139	3	5/6	4	60-80	624NE355	Domestic refuse above rock layer in two intersecting earth ovens
4165	3-North	5/6	4	80-100	624NE355	Fill from base in northern lobe of two intersecting earth ovens
4188	3-South	5/6	4	80-100	624NE355	Fill from base in southern lobe of two intersecting earth ovens
3093	4	18	3	66-86	605NE338	Fill from N1/2 of steep-sided basin hearth with large, burned cobbles
3127	5	1/2	3	68-85	602NE337	Fill from small earth oven tightly packed with burned rock
6037	8	13/14	6	65-72	640NE392	Fill from east half of shallow, rock-filled basin hearth
2038	10	48/56	2	36-58	598NE308	Fill from earth oven filled with burned rock
7115	11	32	7	53-70	610NE355	Fill from bottom of rock-filled basin hearth
4345	12	42/55	4	50-70	622NE361	Fill from basin hearth with burned rocks and charcoal-stained sediment
4386	13	44	4	49-71	624NE360	Fill from tightly packed, rock-filled earth oven
4405	14	52	4	60-80	621NE358	Lower fill from S1/2 of rock-filled basin hearth with charcoal lens

Table 6.2. Index of charred macrofloral remains and charcoal.

Scientific Name or Taxon	Common Name
Charred Floral Remains:	
Arctostaphylos uva-ursi	Kinnikinnick, Bearberry
Cactaceae	Cactus family
Echinocereus viridiflorus	Nylon hedgehog cactus
Cheno-am	Includes Goosefoot and Amaranth families
Amaranthus	Pigweed, Amaranth
Chenopodium	Goosefoot
Chenopodium berlandieri	Pitseed goosefoot
Helianthus	Sunflower
Iva axillaris	Povertyweed
Pinus	Pine
Poaceae	Grass family
Poaceae C	Members of the grass family with small caryopses, such as *Agrostis* (bentgrass), *Muhlenbergia* (muhly grass), *Phragmites australis* (common reed), *Poa* (bluegrass), etc.
Polygonum	Smartweed; Knotweed
Prunus - cherry	Cherry
Vitis riparia	Riverbank grape
PET starchy tissue	Starchy parenchymoid tissues; contain starchy storage cells
Vitrified tissue	Charred material with a shiny, glassy appearance due to fusion by heat
Charcoal/Wood:	
Acer	Maple, Box elder
Asteraceae	Sunflower family

Table 6.2. Index of charred macrofloral remains and charcoal (*continued*).

Scientific Name or Taxon	Common Name
Juniperus	Juniper
Pinus	Pine
Rosaceae	Rose family
Cercocarpus montanus	Alderleaf mountain mahogany, Birchleaf mountain mahogany
Prunus	Cherry, Plum
Salicaceae	Willow family
Unidentified hardwood - vitrified	Wood from a broad-leaved flowering tree or shrub, exhibiting a shiny, glassy appearance due to fusion by heat
Unidentifiable - vitrified	Charcoal exhibiting a shiny, glassy appearance due to fusion by heat

Table 6.3. Macrofloral remains in samples from Feature 1, Area 4.

CN and Provenience	Identification	Part	Charred		Weights/Comments[1]
			Whole	Fragment	
CN4125	**Volume Floated**				**6.6 L**
Feature 1	**Light Fraction Weight**				**28.778 g**
55-67 cm	Charred Floral Remains:				
	Cactaceae	Spine		1	<0.001 g
	Chenopodium spp.	Seed		1	<0.001 g
	Pinus spp.	Bark scale		3	0.002 g
	Vitrified tissue			2	0.023 g
	Charcoal:				
	Total charcoal≥2 mm				1.503 g
	Pinus spp.	Charcoal		36	0.730 g
	Prunus spp.	Charcoal		4	0.054 g
CN4126	**Volume Floated**				**10.2 L**
Feature 1	**Light Fraction Weight**				**101.416 g**
80-100 cm	Charred Floral Remains:				
	Pinus spp.	Bark scale		118	0.064 g
	Vitrified tissue			16	0.075 g
	Charcoal:				
	Total charcoal≥4 mm				11.289 g
	Pinus	Charcoal		36	2.804 g

[1] L=liters; g=grams

suggests that the area sampled reflects a fuel layer where pine wood was burned to heat the oven. The only other charred botanical remains in the sample consist of several charred, vitrified tissue fragments.

Feature 2

Feature 2 was a small storage pit intrusive into an earth oven (Feature 3). The storage pit was capped by a millingstone. Although charcoal from the feature fill returned a weighted mean age of 1260±20 ^{14}C yr B.P., the storage pit feature should postdate the final use of the Feature 3 earth oven. Therefore, its use must be after 1034±24 ^{14}C yr B.P. Sample CN4101 consists of domestic refuse from the pit fill. Several charred remains were present in this sample, possibly reflecting spilled remains in the area around Feature 3, into which the Feature 2 pit was excavated. These remains could have been incorporated into the sediment surrounding Feature 3, which then filled the Feature 2 pit after its use as a storage pit. Charred *Amaranthus* spp. and *Chenopodium* spp. seeds and seed fragments reflect use of amaranth and goosefoot (table 6.4). Seeds might have spilled while being parched in preparation for being ground into a flour, or seeds might have been burned through use of green plants in a buffering vegetation layer when cooking meat and other foods. Four charred Cheno-am perisperms also note use of amaranth or goosefoot. Cheno-am seed perisperm is similar to endosperm and consists only of the nutritive tissue of the seed, surrounding and absorbed by the embryo. The outer seed coat (testa) is missing. Without the diagnostic outer seed coat, a specific genus cannot be assigned to the Cheno-am perisperm. A charred Poaceae caryopsis (seed) fragment and two charred unidentified seeds might also represent seed processing activities or seeds burned through use of green plants in a buffering vegetation layer. Two charred Cactaceae spine fragments suggest use of cactus fruits or pads. A moderate amount of charred *Pinus* spp. bark scale fragments and *Pinus* spp. charcoal fragments again note use of pine wood as fuel.

Feature 3

Feature 3 was a bi-lobed, rock-filled pit in Area 4 that represents two intersecting earth ovens used repeatedly over time. The southern lobe yielded both the oldest date of 1169±20 ^{14}C yr B.P. and the youngest date of 1034±24 ^{14}C yr B.P. Two radiocarbon dates from the northern lobe yielded a weighted mean age of 1113±18 ^{14}C yr B.P. This feature represents occupation of the site late in the Early Ceramic period. The feature fill contained a significant amount of lithic artifacts and bone, and samples from this feature yielded the greatest quantities of charred remains of all the features examined. Macrofloral sample CN4139 was collected from domestic refuse above the rock layer. Recovery of a few charred Cheno-am perisperms, a few charred *Amaranthus* spp. seeds and seed fragments, and several charred *Chenopodium* spp. seeds and seed fragments note use of amaranth and goosefoot (table 6.5). Two charred *Echinocereus viridiflorus* seeds and seed fragments reflect use of nylon hedgehog cactus fruits. A charred Cactaceae spine fragment might also indicate use of nylon hedgehog or possibly another type of cactus. In addition, the sample contained a charred unidentified seed and five seed fragments and a few pieces of charred, vitrified tissue. Numerous charred *Pinus* spp. bark scale fragments and an abundance of *Pinus* spp. charcoal indicate use of pine wood as fuel.

Sample CN4165 was taken from fill in the base of the northern lobe of Feature 3. Charred remains in this sample include numerous Cheno-am perisperms and perisperm fragments, *Amaranthus* spp. seeds and seed fragments, and *Chenopodium* spp. seeds and seed fragments, as well as two *Chenopodium berlandieri* (pitseed goosefoot) seed fragments. Four charred *Echinocereus viridiflorus* seeds and several charred Cactaceae spine fragments reflect use of cacti including nylon hedgehog cactus. Three charred *Helianthus* spp. seed fragments and a charred *Iva axillaris* seed suggest processing wild sunflower and povertyweed seeds. One unidentified seed endosperm might also reflect seed processing activities.

Two pieces of charred PET starchy tissue were

Table 6.4. Macrofloral remains in the sample from Feature 2, Area 4.

			Charred		
CN and Provenience	Identification	Part	Whole	Fragment	Weights/Comments[1]
CN4101	**Volume Floated**				**3.4 L**
Feature 2	**Light Fraction Weight**				**20.751 g**
53-65 cm	Charred Floral Remains:				
	Cactaceae	Spine		2	<0.001 g
	Cheno-am	Perisperm	4		<0.001 g
	Amaranthus spp.	Seed	5	3	<0.001 g
	Chenopodium spp.	Seed	7	45	0.001 g
	Pinus spp.	Bark scale		65	0.052 g
	Unidentified	Seed	2		<0.001 g
	Vitrified tissue			2	0.023 g
	Charcoal:				
	Total charcoal≥2 mm				0.974 g
	Pinus spp.	Charcoal		40	0.426 g

[1] L=liters; g=grams

Table 6.5. Macrofloral remains in samples from Feature 3, Area 4.

CN and Provenience	Identification	Part	Charred Whole	Charred Fragment[1]	Weights/Comments[2]
CN4139	**Volume Floated**				**8.8 L**
Feature 3	**Light Fraction Weight**				**31.292 g**
60-80 cm	Charred Floral Remains:				
	Cactaceae	Spine		1	<0.001 g
	Echinocereus viridiflorus	Seed	2	2	<0.001 g
	Cheno-am	Perisperm	5	2	<0.001 g
	Amaranthus spp.	Seed	4	4	<0.001 g
	Chenopodium spp.	Seed	8	20	0.001 g
	Pinus spp.≥2 mm	Bark scale		187	0.108 g
	Pinus spp.<2 mm	Bark scale		X	Numerous
	Unidentified	Seed	1	5	<0.001 g
	Vitrified tissue			9	0.052 g
	Charcoal:				
	Total charcoal≥2 mm				1.008 g
	Pinus spp.	Charcoal		40	0.459 g
CN4165	**Volume Floated**				**14.7 L**
Feature 3-North	**Light Fraction Weight**				**102.366 g**
80-100 cm	Charred Floral Remains:				
	Cactaceae	Spine		33	0.001 g
	Echinocereus viridiflorus	Seed		4	0.002 g
	Cheno-am	Perisperm	73	24	0.014 g
	Amaranthus spp.	Seed	31	53	0.005 g
	Chenopodium spp.	Seed	19	132	0.033 g
	Chenopodium berlandieri	Seed		2	<0.001 g
	Helianthus spp.	Seed		3	0.003 g
	Iva axillaris	Seed		1	<0.001 g
	PET Starchy	Tissue		2	0.006 g
	Pinus spp.≥2 mm	Bark scale		44	0.174 g
	Pinus spp.<2 mm	Bark scale		X	Numerous
	Unidentified	Endosperm	1		<0.001 g
	Vitrified tissue			6	0.044 g
	Charcoal:				
	Total charcoal≥4 mm				10.976 g
	Acer spp.	Charcoal		3	0.183 g
	Pinus spp.	Charcoal		31	2.342 g
	Salicaceae	Charcoal		6	0.194 g
CN4188	**Volume Floated**				**16.0 L**
Feature 3-South	**Light Fraction Weight**				**109.407 g**
80-100 cm	Charred Floral Remains:				
	Cactaceae	Spine		82	
	Echinocereus viridiflorus	Seed	8	6	0.002 g
	Cheno-am	Perisperm	34	7	0.004 g
	Amaranthus spp.	Seed	15	9	0.001 g
	Chenopodium spp.	Seed	10	92	0.007 g
	Iva axillaris	Seed	4		<0.001 g
	Pinus spp.≥2 mm	Bark scale		50	0.150 g
	Pinus spp.<2 mm	Bark scale		X	Moderate
	Polygonum sp.	Seed		1	<0.001 g

Table 6.5. Macrofloral remains in samples from Feature 3, Area 4 (*continued*).

CN and Provenience	Identification	Part	Charred		Weights/Comments[2]
			Whole	Fragment[1]	
	Prunus sp. - cherry	Seed		1	0.002 g
	Unidentified	Seed	2		<0.001 g
	Vitrified tissue			12	0.069 g
	Charcoal:				
	Total charcoal≥4 mm				8.991 g
	Pinus spp.	Charcoal		40	2.813 g

[1] X=present in sample
[2] L=liters; g=grams

noted. The term PET (Processed Edible Tissue) originated with Nancy Stenholm (1994) and refers to softer tissue types, such as starchy parenchymoid or fruity epithelioid tissues. PET starchy tissues contain starchy storage cells, common in seeds and edible roots. The earth oven might have been used to cook root resources such as *Cymopterus* (springparsley), *Lomatium* (biscuitroot), *Typha* (cattail), or others. Numerous *Pinus* spp. bark scale fragments and large fragments of *Pinus* spp. charcoal reflect pine wood burned as fuel. A few pieces of *Acer* spp. and Salicaceae charcoal also indicate burning of maple or boxelder and willow or cottonwood. These trees would have been found growing in the riparian habitat along Apex Creek or one of the other creeks in the area.

Sample CN4188 was removed from fill in the base of the southern lobe of Feature 3. Several charred Cheno-am perisperms and perisperm fragments, charred *Amaranthus* spp. seeds and seed fragments, and *Chenopodium* spp. seeds and seed fragments once again reflect use of amaranth and goosefoot. Four charred *Iva axillaris* seeds, a charred *Polygonum* sp. seed fragment, and two charred unidentified seeds suggest seed processing activities involving povertyweed, knotweed, and other seeds. Alternatively, seeds might have been charred through use of green plants in a buffering vegetation layer. Eight charred *Echinocereus viridiflorus* seeds and six seed fragments, as well as a charred *Prunus* sp. (cherry) seed fragment, note use of hedgehog cactus fruits and wild cherries. The sample also yielded a moderate amount of charred *Pinus* spp. bark scale fragments and large chunks of *Pinus* spp. charcoal from burning pine wood as fuel.

Feature 4

Feature 4 was a steep-sided basin hearth containing large, burned cobbles located in Area 3. Radiocarbon dates from charcoal in the feature fill reflect a radiocarbon age of 1560-1460 B.P. This feature might have been reused one or more times during this middle time frame of the Early Ceramic period. Macrofloral sample CN3093 was collected from fill in the north half of Feature 4. This sample contained nine charred Cactaceae spine fragments, reflecting use of cactus (table 6.6). A charred Poaceae awn fragment notes use of grasses. Seeds might have been processed or grasses used as tinder, in a buffering vegetation layer, or for other purposes. Three charred *Prunus* spp. seed fragments again reflect use of wild cherry fruits. In addition, the sample contained one charred unidentified seed, nine fragments of charred, vitrified tissue, and numerous charred *Pinus* spp. bark scale fragments. *Pinus* spp. dominated the representative charcoal record, with a few fragments of *Acer* spp., Asteraceae, and Rosaceae charcoal present. Pine, maple or boxelder, and a woody member of the rose family were burned as fuel.

Feature 5

Feature 5 was a small earth oven tightly packed with burned rock found in Area 3. The earth oven function appears to have been a secondary use of the feature. Radiocarbon dates are contemporaneous with those from Feature 4 and note an age of 1560-1410 B.P. for Feature 5, again reflecting a middle Early Ceramic period occupation. Fill from Feature 5 was collected as sample CN3127. This sample yielded a charred *Amaranthus* sp. seed fragment, suggesting use of amaranth seeds (table 6.7). Two charred *Arctostaphylos uva-ursi* seeds might reflect use of kinnikinnick fruits,

Table 6.6. Macrofloral remains in the sample from Feature 4, Area 3.

CN and Provenience	Identification	Part	Charred Whole	Charred Fragment	Weights/Comments[1]
CN3093	**Volume Floated**				**5.0 L**
Feature 4	**Light Fraction Weight**				**33.960 g**
66-86 cm	Charred Floral Remains:				
	Cactaceae	Spine		9	<0.001 g
	Poaceae	Awn		1	<0.001 g
	Pinus spp.	Bark scale		102	0.042 g
	Prunus spp. - cherry	Seed		3	0.002 g
	Unidentified	Seed	1		<0.001 g
	Vitrified tissue			9	0.045 g
	Charcoal:				
	Total charcoal≥2 mm				
	Acer spp.	Charcoal		4	0.510 g
	Asteraceae	Charcoal		1	0.035 g
	Pinus spp.	Charcoal		33	0.025 g
	Salicaceae	Charcoal		2	0.364 g

[1] L=liters; g=grams

Table 6.7. Macrofloral remains in the sample from Feature 5, Area 3.

CN and Provenience	Identification	Part	Charred Whole	Charred Fragment	Weights/Comments[1]
CN3127	**Volume Floated**				**5.3 L**
Feature 5	**Light Fraction Weight**				**39.395 g**
68-85 cm	Charred Floral Remains:				
	Amaranthus sp.	Seed		1	<0.001 g
	Arctostaphylos uva-ursi	Seed	2	2	0.008 g
	Cactaceae	Spine		18	<0.001 g
	Pinus spp.	Bark scale		42	0.019 g
	Prunus spp. - cherry	Seed		5	0.006 g
	Vitrified tissue			2	0.009 g
	Charcoal:				
	Total charcoal≥2 mm				0.585 g
	Cercocarpus montanus	Charcoal		2	0.010 g
	Pinus spp.	Charcoal		32	0.316 g
	Pinus sp. twig	Charcoal		1	0.009 g
	Prunus spp.	Charcoal		3	0.016 g
	Unidentifiable - vitrified	Charcoal		2	0.005 g

[1] L=liters; g=grams

while five charred *Prunus* spp. seed fragments suggest use of wild cherries. Several charred Cactaceae spine fragments indicate use of cacti. In addition, the sample contained a moderate amount of charred *Pinus* spp. bark scale fragments and two fragments of vitrified tissue. The representative charcoal record was dominated by *Pinus* spp., including a *Pinus* sp. twig fragment, with a few pieces of *Cercocarpus montanus* (alderleaf mountain mahogany) and *Prunus* spp. charcoal present. Two pieces of charcoal were too vitrified for identification. Vitrified charcoal has a shiny, glassy appearance that can range from still recognizable in structure "to a dense mass, completely 'molten' and non-determinable" (Marguerie and Hunot 2007; McParland *et al.* 2010:2679). Experiments by McParland and others (2010) have demonstrated that it is currently not clear exactly what conditions produce vitrified charcoal. It is likely that a combination of factors such as burning at high temperature or burning green wood are responsible.

Feature 8

Feature 8 was a shallow, rock-filled basin hearth located in Area 6. Macrofloral sample CN6037 consists of FL3 fill from the east half of the hearth. Charred remains in the sample include several Cactaceae spine fragments, *Pinus* spp. bark scale fragments, and five pieces of vitrified tissue (table 6.8). Fragments of *Pinus* spp. dominated the representative charcoal record, with a few pieces of *Cercocarpus montanus*, *Prunus* spp., and Salicaceae charcoal present. The *Cercocarpus montanus* charcoal was submitted for radiocarbon analysis, resulting in an age of 1964±27 ^{14}C yr B.P. This date places use of Feature 8 early during the Early Ceramic period.

Feature 10

Feature 10 was an earth oven filled with burned rock located in Area 2. Four radiocarbon dates from this feature yielded dispersed dates; however, the feature is believed to have been used about 1900 B.P. This reflects occupation of the site early in the Early Ceramic period. Sample CN2038 was recovered from the feature fill and contained several charred *Pinus* spp. bark scale fragments and an abundance of *Pinus* spp. charcoal, reflecting use of pine wood as fuel (table 6.9). A few pieces of *Cercocarpus montanus* and vitrified Rosaceae charcoal were also present.

Feature 11

Feature 11 was a rock-filled basin hearth located in Area 7. This feature might have been rebuilt and reused one or more times between about 1430-1320 B.P., noting a middle Early Ceramic occupation. Sample CN7115 was taken from fill at the bottom of Feature 11 and yielded a few charred Cactaceae spine fragments, reflecting use of cactus fruits or pads (table 6.10). The sample also contained a charred *Pinus* sp. bark scale fragment and a few pieces of vitrified tissue. Fragments of *Pinus* spp. charcoal indicate use of pine wood as fuel.

Feature 12

Feature 12 was a basin hearth containing burned rocks and charcoal-stained sediment located in Area 4. Radiocarbon dates and feature stratigraphy suggest that the feature was used repeatedly during the late Early Ceramic between about 1320-1020 B.P. Sample CN4345 was collected from fill in the lower half of Feature 12. This sample yielded six charred *Echinocereus viridiflorus* seed fragments and several charred Cactaceae spine fragments, suggesting that nylon hedgehog fruits and possibly other cacti were processed (table 6.11). A charred *Vitis riparia* seed notes use of riverbank grapes. One charred Poaceae awn fragment and a charred Poaceae C caryopsis

Table 6.8. Macrofloral remains in the sample from Feature 8, Area 6.

			Charred		
CN and Provenience	Identification	Part	Whole	Fragment	Weights/Comments[1]
CN6037	**Volume Floated**				**8.0 L**
Feature 8	**Light Fraction Weight**				**46.522 g**
65-72 cm	Charred Floral Remains:				
	Cactaceae	Spine		14	<0.001 g
	Pinus spp.	Bark scale		32	0.012 g
	Vitrified tissue			5	0.037 g
	Charcoal:				
	Total charcoal≥2 mm				1.497 g
	Cercocarpus montanus	Charcoal		4	0.035 g
	Pinus spp.	Charcoal		31	0.804 g
	Prunus spp.	Charcoal		3	0.012 g
	Salicaceae	Charcoal		2	0.008 g

[1] L=liters; g=grams

Table 6.9. Macrofloral remains in the sample from Feature 10, Area 2.

CN and Provenience	Identification	Part	Charred Whole	Charred Fragment	Weights/Comments[1]
CN2038	**Volume Floated**				**15.25 L**
Feature 10	**Light Fraction Weight**				**73.426 g**
Unit 48/56	Charred Floral Remains:				
	Periderm			29	0.033 g
	Vitrified tissue			12	0.088 g
	Charcoal:				
	Total charcoal≥2 mm				1.038 g
	Cercocarpus montanus	Charcoal		3	0.012 g
	Pinus spp.	Charcoal		35	0.507 g
	Rosaceae - vitrified	Charcoal		2	0.015 g

[1] L=liters; g=grams

Table 6.10. Macrofloral remains in the sample from Feature 11, Area 7.

CN and Provenience	Identification	Part	Charred Whole	Charred Fragment[1]	Weight/Comments[2]
CN7115	**Volume Floated**				**8.0 L**
Feature 11	**Light Fraction Weight**				**56.352 g**
Unit 32	Charred Floral Remains:				
	Cactaceae	Spine		3	<0.001 g
	Pinus sp.	Bark scale		1	0.003 g
	Vitrified tissue≥2 mm			6	0.057 g
	Vitrified tissue<2 mm			X	Few
	Charcoal:				
	Total charcoal≥2 mm				2.252 g
	Pinus spp.	Charcoal		40	0.880 g

[1] X=present
[2] L=liters; g=grams

Table 6.11. Macrofloral remains in the sample from Feature 12, Area 4.

CN and Provenience	Identification	Part	Charred Whole	Charred Fragment[1]	Weights/Comments[2]
CN4345	**Volume Floated**				**15.0 L**
Feature 12	**Light Fraction Weight**				**107.444 g**
Unit 42	Floral Remains:				
	Cactaceae	Spine		45	0.002 g
	Echinocereus viridiflorus	Seed		6	0.002 g
	Pinus spp.	Bark scale		31	0.013 g
	Poaceae	Awn		1	<0.001 g
	Poaceae C	Caryopsis	1	1	<0.001 g
	Vitis riparia	Seed	1		0.015 g
	Vitrified tissue≥2 mm			32	0.183 g
	Vitrified tissue<2 mm			X	Few
	Charcoal:				
	Total charcoal≥4 mm				10.447 g
	Pinus spp.	Charcoal		40	2.616 g

[1] X=present
[2] L=liters; g=grams

and caryopsis fragment might reflect processing of grasses with small seeds, such as *Agrostis* (bentgrass), *Muhlenbergia* (muhly grass), *Phragmites australis* (common reed), *Poa* (bluegrass), and so forth. Alternatively, grasses might have been used as tinder or in a buffering vegetation layer. In addition, the sample contained several charred *Pinus* spp. bark scale fragments and vitrified tissue fragments. The representative charcoal record consisted of *Pinus* spp., noting use of pine wood as fuel.

Feature 13

Feature 13 was an earth oven filled with tightly packed and interlocking rocks located in Area 4. This feature likely was used several times in the late Early Ceramic period between 1210-1110 B.P. Macrofloral sample CN4386 was recovered from the feature fill and contained a few charred Cactaceae spine fragments, reflecting use of cactus (table 6.12). Two charred Poaceae C caryopses and four caryopsis fragments again suggest processing of small grass seeds or use of grasses as tinder, in a buffering vegetation layer, or for other purposes. Several charred *Pinus* spp. bark scale fragments and fragments of *Pinus* spp. charcoal indicate that pine wood was burned.

Feature 14

Feature 14 was a shallow, rock-filled basin hearth in Area 4. The middle of the feature exhibited a concentrated charcoal lens. Lower fill from the feature was collected as sample CN4405. This sample yielded a charred Cactaceae spine fragment, again noting use of cactus (table 6.13). A single charred *Pinus* sp. bark scale fragment and two pieces of charred, vitrified tissue were also noted. The representative charcoal record contained several larger chunks of *Prunus* spp. charcoal, reflecting cherry or plum wood burned as fuel. Several pieces of hardwood charcoal were too vitrified for identification. Fewer pieces of Salicaceae, vitrified Rosaceae, *Cercocarpus montanus*, vitrified *Cercocarpus montanus*, *Juniperus* spp., and *Pinus* spp. charcoal reflect burning of a woody member of the willow family, alderleaf mountain mahogany, possibly another woody member of the rose family, juniper, and pine wood. The *Cercocarpus montanus* and Rosaceae charcoal were submitted for radiocarbon analysis. The dates from these two charcoal types were statistically equivalent and yield a weighted mean age of 1826±19 ^{14}C yr B.P., noting use of the feature early in the Early Ceramic period.

Discussion

Macrofloral analysis of 14 samples from 10 rock-filled features and a storage pit at the Magic Mountain site yielded several types of charred remains that indicate use of a variety of native plants. Charred Cactaceae spine fragments were the most ubiquitous remain, noted in 12 of the 14 macrofloral samples examined and present in all but Feature 2, the storage pit. Charred *Echinocereus viridiflorus* seeds and seed fragments occurred in all three samples from Feature 3 and in Feature 12, suggesting use of nylon hedgehog cactus fruits.

Table 6.12. Macrofloral remains in the sample from Feature 13, Area 4.

			Charred		
CN and Provenience	Identification	Part	Whole	Fragment[1]	Weight/Comments[2]
CN4386	**Volume Floated**				**24.0 L**
Feature 13	**Light Fraction Weight**				**146.763 g**
Unit 44	Charred Floral Remains:				
	Cactaceae	Spine		7	<0.001 g
	Pinus spp.≥2 mm	Bark scale		43	0.082 g
	Pinus spp.<2 mm	Bark scale		X	Few
	Poaceae C	Caryopsis	2	4	<0.001 g
	Vitrified tissue			5	0.036 g
	Charcoal:				
	Total charcoal≥2 mm				1.344 g
	Pinus spp.	Charcoal		40	0.353 g

[1] X=present
[2] L=liters; g=grams

Table 6.13. Macrofloral remains in samples from Feature 14, Area 4.

CN and Provenience	Identification	Part	Charred Whole	Charred Fragment	Weights/Comments[1]
CN4405	**Volume Floated**				**18.5 L**
Feature 14	**Light Fraction Weight**				**87.045 g**
Unit 52	Charred Floral Remains:				
	Cactaceae	Spine		1	<0.001 g
	Pinus sp.	Bark scale		1	0.003 g
	Vitrified tissue			2	0.028 g
	Charcoal:				
	Total charcoal≥4 mm				4.201 g
	Juniperus spp.	Charcoal		2	0.062 g
	Pinus spp.	Charcoal		2	0.065 g
	Rosaceae – vitrified	Charcoal		3	0.059 g
	Cercocarpus montanus	Charcoal		1	0.019 g
	C. montanus – vitrified	Charcoal		1	0.023 g
	Prunus spp.	Charcoal		13	0.371 g
	Salicaceae	Charcoal		8	0.153 g
	Unidentified hardwood – vitrified	Charcoal		10	0.402 g

[1] L=liters; g=grams

Many members of the cactus (Cactaceae) family were important food resources for Native groups. Cacti are found on dry, rocky, or sandy soils throughout the western U. S. Gasser (1981:224) notes that cactus fruits, buds, and stems or pads provided essential nutrients not available in most native foods. Cacti such as *Opuntia* (prickly pear), *Echinocereus* (hedgehog cactus, strawberry cactus), *Mammillaria* (pincushion cactus), *Echinocactus* (ball cactus), and others were utilized for their fruits, seeds, and stems or pads. Cactus fruits were eaten fresh, cooked, or dried for future use. Seeds were parched and ground into a meal. Prior to use, spines were rubbed, peeled, picked, or burned off the fruits and stems (Fischer 1989; H. Harrington 1972:123-127; Kershaw 2000:142-143; Kirk 1975:50-52; Moerman 1998).

Echinocereus viridiflorus (nylon hedgehog cactus) is widely distributed in grasslands and woodlands from Wyoming to Texas. It is common in dry, open places. The short, ribbed stems can be spheric to short cylindric, solid or clumping. The small, juicy fruits are yellowish-green to dark purple or reddish with white pulp. The fruits are covered with spines that loosen at maturity and can be brushed off. Fruits were eaten raw after the spines were removed (Ackerfield 2015:258; Bailey and Bailey 1976:413; Fischer 1989:39; Moerman 1998:206; Quinn 2001:38).

Members of the Cheno-am group appear to have been used during several of the Magic Mountain occupations. Charred *Amaranthus* spp. seeds were found in five samples from Features 2, 3, and 5, while charred *Chenopodium* spp. seeds occurred in five samples from Features 1, 2, and 3. Charred *Chenopodium berlandieri* seed fragments in the sample from Feature 3-North note use of pitseed goosefoot. Charred Cheno-am perisperms in all three samples from Feature 3 also reflect use of these plants. Seeds might have been processed or green plants might have been used in a buffering vegetation layer.

The Cheno-am group includes members of the Chenopodiaceae (goosefoot family), as well as the genus *Amaranthus* (amaranth). These plants are weedy annuals or perennials that can produce large quantities of seeds, often growing on waste ground, disturbed areas, in fields, and along roadsides. They are widely distributed in North America, especially in the western U. S. Members of the Cheno-am group were extensively used by Native groups. Young leaves, shoots, and stems were eaten fresh or cooked as greens. These plants contain calcium oxalates; however, cooking reduces oxalate levels. The small seeds can be eaten raw, but most often they were parched and eaten whole or ground into a flour used in making bread, cakes, mush, or gruel. Many members of this group are rich in calcium, protein, and vitamins A, B1, B2, B6, and C (Elmore 1976:37; H. Harrington 1972:69-71, 82-84; Kershaw 2000:202-203; Kirk 1975:56-63; Sweet 1976:48; Tilford 1997:14-15, 88-89).

Amaranthus (amaranth, pigweed) is an annual herb growing up to six feet high. Species of *Amaranthus* are common and widespread in fields, waste areas, recently abandoned land, and along roadsides. They were favored by Native groups as a food source, and plants were often encouraged to grow. Fresh greens were eaten raw or cooked, and dried greens were added to soups and stews. Leaves are high in vitamin C, calcium, iron, and zinc. Seeds were eaten raw or parched, both whole and ground into a meal used for making bread, cakes, mush, or gruel (Elias and Dykeman 1982:72; H. Harrington 1972:69-71; Kallas 2010:358-359, Kirk 1975:63).

Chenopodium (goosefoot) are annual or perennial herbaceous plants found in a variety of habitats. The seeds were commonly used as food by Native groups throughout the U. S. Seeds were eaten whole or parched and ground into a black flour meal that was used to make cakes and porridge. The seed flour is noted to be bitter and often was mixed with other seed flour. Seeds provide protein, calcium, phosphorus, potassium, and niacin. Like many other members of the Cheno-am group, *Chenopodium* leaves are a good source of beta carotene, calcium, potassium, and iron and provide trace minerals, B-complex vitamins, vitamin C, and fiber. Young plants and leaves were eaten raw, steamed, or boiled. The leaves contain oxalates, although boiling reduces the oxalate levels. Cooked leaves also are mildly laxative. A leaf tea was used to treat mouth sores, stomach pains, rheumatism, arthritis, and to prevent scurvy. Leaves were chewed to treat toothaches. Leaf poultices were applied to burns, swellings, wounds, and inflamed eyes. The red, fleshy fruit clusters of *Chenopodium capitatum* (blite goosefoot/strawberry blite) were eaten raw or cooked. Some Native groups used the red flower clusters to make a dye that is bright red at first but eventually darkens to purple or maroon. Over 20 species of *Chenopodium* are found in the western U. S., with about 10 species occurring in Jefferson County, Colorado (Brill and Dean 1994:47; H. Harrington 1972:82-84; Kartesz 2015; Kershaw 2000:202-203; Kirk 1975:56-57; Sweet 1976:48; NRCS 2022).

Charred evidence for use of grasses in the Magic Mountain features includes Poaceae awn and caryopsis fragments, as well as Poaceae C caryopses, noted in Features 2, 4, 12, and 13. Grass seeds might have been processed or the grasses might have been used for other purposes such as tinder or in a buffering vegetation layer. Members of the Poaceae (grass family) are a large and diverse group of plants. They are important food plants, and grasses were extensively utilized by Native groups. Grasses such as *Achnatherum* (ricegrass), *Hordeum* (little barley grass), *Elymus* (ryegrass), *Eragrostis* (lovegrass), *Muhlenbergia* (muhly), *Panicum* (panicgrass, witchgrass), *Phragmites australis* (common reed), *Poa* (bluegrass), *Sporobolus* (dropseed), and many others all produce edible, starchy seeds or grains (caryopses) that ripen from spring to fall, depending on the species. Grasses with larger grains or those that separate more readily from the surrounding bracts (florets) were utilized more often. Grass grains could be eaten raw but usually were cooked as gruel, added to soups or stews, or parched and ground into a meal to make various mushes and cakes. A light burning helped to remove the florets and awns (hairs) and parch the seeds. Young shoots and leaves were eaten raw or cooked as greens. Roots were eaten raw, boiled, roasted, or dried and ground into flour. Grass stems were important utilitarian items, used to make baskets, mats, cordage, nets, hatching, and other items (Kershaw 2000:216-217; Kirk 1975:177-190; Moerman 1998).

Charred *Prunus* spp. (cherry) seed fragments occurred in samples from Features 3-South, 4, and 5, suggesting use of wild cherries. Fragments of *Prunus* spp. charcoal were found in samples from Features 1, 5, 8, and 14. The *Prunus* group includes cherries and plums, as well as apricots, peaches, nectarines, and almonds. These fruits are called stone fruits or drupes, and most contain large, hard pits encasing the single seed. Cherry, plum, peach, nectarine, and apricot pits all contain glycosides which break down into cyanide or prussic acid, although the acids are destroyed by cooking (Kirk 1975:95; McGee 2004:358; Small 2014:217). Many species of native plums and cherries are found in the U. S. In Jefferson County, Colorado, *Prunus* species are small trees or shrubs, often thicket-forming, and are found in canyons and gulches, forests, on rocky slopes, along creeks and streams, in cool ravines, and on sandstone cliffs and bluffs (Ackerfield 2015:732-734). *Prunus americana* (American plum) is often found in canyons mixed with grapevines (*Vitis* spp.) and chokecherries (*Prunus virginiana*) (Morgan 2013:210). The fruits of all species are edible and available from late summer to early fall. Native groups ate the fruits fresh. Fruits were also dried and stored for winter use, pounded into a pulp that was formed into cakes and dried in the sun, or mixed with meat to make pemmican. *Prunus* species were used extensively as medicines.

A tea made from root, bark, and leaf decoctions was used to treat colds, coughs, asthma, fevers, diarrhea, and stomachaches. Leaf poultices and powdered root or bark treated cuts, sores, burns, and bruises. *Prunus* stems provided arrow shafts. The bark of *Prunus virginiana* (chokecherry) was used to make baskets and cordage. Fruits, roots, and bark yielded red, brown, and reddish-brown dyes (Angell 1981:44-48; Brill and Dean 1994; 110-112, 119-123; Derig and Fuller 2001:140-143; Kershaw 2000:66-67; Morgan 2013:209-212).

Other charred remains were present less frequently. Charred *Helianthus*, *Iva axillaris*, and *Polygonum* seeds and seed fragments were noted only in samples from Feature 3, suggesting processing of wild sunflower, povertyweed, and knotweed seeds by the late Early Ceramic occupants using this earth oven. Alternatively, seeds might have been burned when green plants were used in a buffering vegetation layer. Species of *Helianthus* (sunflower) are annual or perennial plants found on plains, prairies, and valleys, often on disturbed or dry sites, throughout the western U. S. Stems are branched or unbranched, and the leaves vary from narrow to heart-shaped. The flowers consist of bright yellow ray flowers surrounding a large, reddish-brown or purple button of disc flowers. The seeds of all species are edible, and sunflowers were extensively utilized by Native groups. Seeds were gathered in the late summer and early fall, cracked, and the inner nuts eaten raw. Seeds were also parched and ground into flour that was used to make soup, mush, gruel, or cakes. One pound of sunflower seeds contains 540 calories, along with protein, linoleic acid, calcium, phosphorus, iron, sodium, riboflavin, iron, and vitamin C. Black and purple seeds were used to make dyes. *Helianthus annuus* (common sunflower) is the most common and widespread sunflower. It is an annual that can grow up to eight feet tall with large flowerheads. In the Rocky Mountain region, it is found on open, often disturbed sites in plains and foothills zones, up to 9000 ft (2745 m) in elevation. Flowers, seeds, and oil are edible. Seeds were eaten raw, although they were most commonly dried, parched, and ground lightly to break the shells. The inner kernels were eaten whole or ground into a meal, while the shells were roasted and used to make a coffee-like beverage. Seed meal was often boiled in water to make gruel or mixed with bone marrow or grease to make cakes that provided a lightweight, high-energy food on journeys. Oil was extracted from crushed seeds boiled in water. Sunflower was used medicinally to treat a variety of ailments, including rheumatism, headaches, fatigue, malaria, worms, sores, swellings, and blisters. Coughs and laryngitis were sometimes treated with sunflower seed oil, while a medicinal tea made from the flowers was used to treat lung problems and high fever. Leaves were applied as poultices or brewed into medicinal teas. The flowers yielded a yellow dye, and the seeds yielded a black or purple dye. *Helianthus annuus* was cultivated by several Native groups, who selected plants for larger and larger seed size (Brill and Dean 1994:93-94, 195-196; Elias and Dykeman 1982:156; H. Harrington 1972:127-130; Kershaw 2000:180; Moerman 1998:257-259; Morgan 2013:42-44). Species of *Helianthus* currently found in Jefferson County include *H. annuus*, *H. ciliaris* (Texas blueweed), *H. maximilliani* (Maximilian sunflower), *H. nuttallii* (Nuttall's sunflower), *H. pauciflorus* (stiff sunflower), *H. petiolaris* (prairie sunflower), and *H. pumilis* (little sunflower) (Kartesz 2015; NRCS 2022).

Iva axillaris (povertyweed) is a perennial herb. It is common in dry, open areas in the plains and in valleys, often occurring with pinyon-juniper at elevations between 3500 and 7500 ft (1065 and 2285 m) (Ackerfield 2015:164). *Iva* seeds were roasted or boiled to split the tough outer shell and to remove the unpleasant odor and taste. The seeds are similar in calorie content to sunflower seeds and contain about 2,500 calories per pound, as well as 40 percent fat and 32 percent protein. Seeds also are good sources of thiamine, niacin, calcium, iron, and phosphorous (Asch and Asch 1978:302). *I. axillaris* provided a medicinal resource for Shoshoni and Ute groups (Moerman 1998:279).

Species of *Polygonum* are annual or perennial, terrestrial or aquatic herbs with angular, jointed stems. They are found in many habitats including moist, wet, dry, saline, rocky, sunny, or shady. Native groups utilized the various species for food and medicine. All species are edible but with varying degrees of palatability. The leaves and shoots were eaten raw or cooked as potherbs. Some species have peppery leaves that can be used as a seasoning. Seeds were roasted whole or ground into flour. Some species produce thick, starchy rootstalks, and Native groups ate the starchy roots raw, boiled, roasted, or dried and ground into flour. The dried, powdered roots and leaves are astringent and were used as washes, gargles, to relieve minor skin irritations and to reduce inflammation, as well as a styptic agent to stop bleeding. The plant was also used to treat arthritis and stomach troubles. It is rich in vitamin C and was eaten to prevent and treat scurvy (Angier 2008:100-101; Elias and Dykeman 1982:155; Harrington 1954:195; H. Harrington 1972:37-40; Kershaw 2000:206-207; Kirk 1975:56; Moerman 1998:424; Tilford 1997:18-19). Currently, *P. douglasii* (Douglas' knotweed) and *P. ramosissimum* (bushy knotweed) grow in Jefferson County (Kartesz 2015; NRCS 2022).

Two charred *Arctostaphylos uva-ursi* seeds and seed fragments in Feature 5 suggest use of kinnikinnick berries. *Arctostaphylos uva-ursi* is a prostrate shrub with evergreen leaves that forms mats 1 to 2 m in size. It is a common ground cover in forests from 6100 to 13,000 ft (1860 to 3960 m) (Ackerfield 2015:342). The red berries are edible, although they are starchy, puckery-sweet, and full of seeds. Native groups boiled the berries or added them to soups and stews. A medicinal tea was made from leaves to treat kidney and bladder problems, urinary tract infections, back pain, diarrhea, menstrual cramps, and bleeding. Dried leaves and bark were smoked alone, added to tobacco, or mixed with other leaves and bark. Leaves are rich in tannin and were used to tan hides (Kershaw 2000:90; March and March 1983:82-83; Morgan 2013:202-203).

A single charred *Vitis riparia* seed in Feature 12 reflects use of riverbank grape. *Vitis riparia* is a woody vine with forked tendrils, large toothed or lobed leaves, and edible, purplish black fruits. It is found along streams, in cool canyons, and on open hillsides at elevations of 3500 to 7000 ft (1065 to 2135 m) (Ackerfield 2015:774). Native groups ate wild grapes fresh or dried. These fruits provide potassium, betas carotene, fructose, tartaric acid, quercitrin, tannin, malic acid, gum, and potassium bitartrate (Brill and Dean 1994:167; Moerman 1998:599). The large leaves were used to line earth ovens, wrap foods, and as poultices. Stems provided rope, string, and basketry material (Derig and Fuller 2001:52; Kirk 1975:263-265).

Several charcoal taxa were noted in the samples from Magic Mountain; however, the charcoal record was dominated by fragments of *Pinus*, which was noted in all 14 samples examined. *Pinus* was the dominant charcoal type in all but Feature 14, and it was the only taxa present in the representative charcoal record for half of the samples examined. Recovery of charred *Pinus* spp. bark scale fragments in all 14 macrofloral samples also reflects burning pine wood.

Species of *Pinus* are resinous, coniferous trees with evergreen needles in bundles of one to five and woody female cones containing winged or unwinged seeds borne in pairs at the base of the cone scales. In the western U. S., they are widespread in foothills and montane zones from low elevations up to timberline and are well-adapted to a variety of soils and environmental conditions. All species of *Pinus* produce edible nuts, and the oily seeds are high in protein and fat. Cones were roasted to open the scales and release the seeds. Seeds were eaten raw, roasted, or ground into a meal. Pine trees will produce a good seed crop every few years. The inner bark (cambium) contains starches, sugars, vitamins, and minerals. It is most sweet and succulent when the sap is running in the spring. Native groups peeled the bark from one side of the tree and the inner bark was scraped off, boiled, and eaten. The inner bark was also mashed and formed into cakes or dried and pounded into flour. Young male cones can be boiled and eaten, or pollen can be used like flour. Pine pitch was chewed as a gum. Pine needles, inner bark, and resin were used medicinally. The needles are rich in vitamins A and C, and a medicinal tea was used to treat a variety of ills including fevers, colds, and coughs. The inner bark was used to make poultices and bandages. Pine pitch was used to draw out splinters and infections and was spread as a salve on sores, burns, and inflammations. The pitch also was heated and used to treat pneumonia, rheumatism, muscular aches, swellings, skin infections, and insect bites. Gallagher (1977:113) notes that pine was valued as firewood by Native American groups because the pitch would readily start the wood burning, even if wet. Pine wood was also used as a construction material. Pitch was used as an adhesive and for water-proofing woven containers and baskets (Brill and Dean 1994:217-219; Brockman 2001:5, 44; H. Harrington 1972:98-99; Kershaw 2000:36-38; Little 1980:248; Moore 2003:195-197; Morgan 2013:233-238; Preston 1940:2; Sweet 1976:14-15).

Woody members of the Rosaceae family also provided fuel for the cooking features at Magic Mountain. As noted previously, *Prunus* spp. charcoal was found in Features 1, 5, 8, and 14. *Cercocarpus montanus* charcoal occurred in Features 5, 8, 10, and 14, while Rosaceae charcoal not identified to genus was found in Features 4, 10, and 14. The Rosaceae (rose) family includes numerous shrubs and herbaceous plants that produce edible fruits or berries. Berries were eaten fresh or dried for winter storage. Many genera in this family were used medicinally. Wood was fashioned into arrows, bows, and a variety of tools and utensils (Kershaw 2000; Kirk 1975; Moerman 1998; Morgan 2013).

Cercocarpus montanus (alderleaf mountain mahogany) is a large shrub or small tree with thin, grayish-brown bark found on hills, dry slopes, and mesas, often associated with juniper and pinyon pine. In the fall and early winter, the small fruits exhibit a conspicuous, one- to three-inch-long, feathery, spirally twisted tail (style). Roots and bark were used to treat stomach problems and to make a red dye. The leaves, bark, and wood of all *Cercocarpus* species are strong astringents with antimicrobial effects and can be used to make a wash or dressing for burns, abrasions, and trauma, while sore gums, sore throat, gastritis, and diarrhea are treated internally with a tea. The wood is very hard and heavy, but it is brittle and breaks easily. Dead branches provide an excellent fuel and create a hot fire. Wood was also used to make bows and digging sticks (Elmore 1976:62; Harrington 1954:299; Moerman 1998:149-150; Moore 2003:169-170; Sweet 1976:25; Taylor 1978:45).

Features 3-North, 8, and 14 yielded fragments of Salicaceae charcoal. The Salicaceae family includes both *Populus* (aspen/cottonwood/poplar) and *Salix* (willow). Cottonwood and willow can be found growing along rivers and streams, with willows also found along lakes and other moist areas. Aspen trees grow along stream sides, on mountain slopes, and in mountain meadows. Members of the Salicaceae family were important resources for Native groups. The twigs were woven into baskets. Because the wood swells when it gets wet, water-tight baskets could be made from strips of willow. Willow bark was used to make string, nets, and baskets. Willow branches were used to make a variety of common articles, such as traps, meat racks, structure frames, arrows, cradleboards, hide scrapers, and as a fuel when tanning hides. Populus wood is soft but moderately heavy and strong. The root was valued for carving. Whistles were made from both *Populus* and *Salix* branches. Populus catkins are rich in vitamin C and can be eaten raw or boiled. In the spring, the inner bark (cambium) of aspen trees (*Populus tremuloides*) was scraped off and eaten raw. Young *Salix* shoots, leaves, buds, and inner bark are also rich in vitamin C and can be eaten raw or cooked as an emergency food. The inner bark can be dried and ground into flour.

Populus and *Salix* were used for a variety of medicinal purposes. The bark, especially that of willow, contains salicin, which is closely related to the pain-relieving ingredients in aspirin. The bark was chewed or boiled into a tea used to treat pain, fever, sore throats, arthritis, diarrhea, other digestive problems, and urethra or bladder problems, as well as to aid in recovery after childbirth and to facilitate nursing. Crushed leaves were used as an antiseptic and to treat headaches and earaches. A willow bark tea or a crushed leaf poultice was applied to minor burns, cuts, wounds, scrapes, insect bites, rashes, ulcers, and corns. The leaf buds were used to make an ointment for skin irritations, burns, and wounds. A bud ointment also was rubbed on the chest for coughs, colds, flu, and pneumonia. Flowers and seeds were made into a strong tea and applied to sore gums. Bleeding wounds and broken bones were treated with a poultice of crushed bark and sap (Berry 1966:173-183; Foster and Hobbs 2002:308; Hellson and Gadd 1974:119, 122; Kershaw 2000:41, 48-49; Kirk 1975:106, 261-263; Moerman 1998:427-433, 501-509; Tilford 1997:114, 164; Williamson 2002:45-46, 151-154). Members of the Salicaceae family found in Jefferson County include *Populus angustifolia* (narrowleaf cottonwood), *Populus balsamifera* (balsam poplar), *Populus deltoides* (eastern cottonwood), and over 10 species of *Salix* (willow) (Kartesz 2015; NRCS 2022).

A few fragments of *Acer* spp. charcoal were found in Features 3-North and 4. Species of *Acer* have a sweet spring sap that was tapped by Native groups to make syrup and sugar. The wood produces hot, long-lasting fires (Kershaw 2000:58). Both *Acer glabrum* (Rocky Mountain maple) and *Acer negundo* (box elder) grow in Jefferson County. *Acer glabrum* is a clumped shrub found in moist foothill and montane sites, on mesic slopes, and along stream banks. Branches were steeped in water to make teas taken as medicine and used as washes for treating swellings and snakebites. The wood is strong, and it was used by Native groups to make bows, arrows, snowshoes, spoons, handles, hoops, and cradle frames (Kershaw 2000:58-59; Moerman 1998:38). Box elder (*Acer negundo*) can range in size from shrubs to medium-sized trees and are found along rivers and streams, in valleys and canyons, and in other moist places. It can also grow in waste places, roadsides, and other poor sites. The pinnately compound leaves often resemble those of poison ivy or poison oak. The inner bark was collected by Native groups, dried, and stored for winter use. The inner bark also was boiled to obtain sugar or used to make an emetic tea. Box elder is fast-growing but short-lived, and the wood is weak and brittle. Large burls or knots on the lower tree trunk were used to make bowls, dishes, and drums. Small branches were made into pipe stems and bellows (Brockman 2001:216; Elmore 1976:46; Kershaw 2000:58-59; Little 1980:534; Moerman 1998:39-40).

Feature 4 yielded the only fragments of Asteraceae charcoal, reflecting a woody member of the sunflower family that was burned as fuel. The Asteraceae (sunflower or aster family) is the largest family of dicots worldwide. Members of the Asteraceae family were used by Native groups in a variety of ways, including as construction materials, tools, crafts, medicines, and as food (Kirk 1975; Moerman 1998; Tilford 1997).

Juniperus spp. charcoal occurred in Feature 14, indicating use of juniper wood as fuel. Junipers are aromatic, evergreen plants that range in size from shrubs to medium-sized trees and are common on dry, open sites, especially on foothill and montane slopes. Juniper trees provided many utilitarian resources. Wood was used as a fuel, for building, and to make bows and lance shafts. The pitch was used as an adhesive. Bark was used as tinder, to line babies' cradleboards, and to line pits where dried fruits were stored. Bark, berries, and leaves yield a brown dye. Seeds were strung as beads. Juniper also provided edible and medicinal resources. Juniper "berries" are actually fleshy female cone scales fused together. These were collected in the late summer and fall and eaten fresh or boiled, roasted, or dried and stored for winter use. Mush and cakes were made using a meal made from pounded, dried berries, and berries were also used to flavor meat. The inner bark was eaten raw or cooked as an emergency food. Juniper was used to treat a variety of ailments. Juniper leaves are high in vitamins E and C and were used to make an all-purpose medicinal tea, commonly used for coughs, colds, fever, and pneumonia. Arthritic and rheumatic joints were treated with a heated tea. Berries were chewed to relieve colds, treat upset stomach, and to stimulate the appetite. The smoke and fumes from burning twigs was also inhaled to treat colds. Juniper was used by many Native groups for purification, religious ceremonies, to bring good luck, and as protection (Derig and Fuller 2001:28-29; Kershaw 2000:42-45; Kirk 1975:19-20; Moerman 1998:282-292; Tilford 1997:226). Both *J. communis* (common juniper) and *J. scopulorum* (Rocky Mountain juniper) grow in Jefferson County (Kartesz 2015; USDA NRCS 2022).

Fragments of charred, calcined, and uncharred bone fragments were present in all features examined, suggesting use of the features for cooking meat resources. Lithic flakes were also noted in all features examined, reflecting tool maintenance or manufacture. In addition, most samples contained disturbance indicators consisting of uncharred seeds, insect chitin fragments, insect eggs, insect puparium, and worm castings.

Comparison by Feature Type and Time Period

Comparison of the charred remains present in the 11 features examined from Magic Mountain notes a greater quantity and variety of charred remains in features that functioned as earth ovens (table 6.14). Of the 14 charred plant taxa present in the Magic Mountain samples, 12 of these were found in the five earth oven features (Features 1, 3, 5, 10, and 13). The five basin hearth features (4, 8, 11, 12, and 14) yielded only five charred plant taxa. However, these basin hearth features contained all eight charcoal taxa, while the earth oven features yielded five of the eight types of charcoal.

When compared by time period, the four features believed to have been used during the latest Early Ceramic period occupations (Features 2, 3, 12, and 13) yielded the greatest varieties and quantities of charred plant taxa, with 13 of the 14 plant taxa present (table 6.15). Features 4, 5, and 11 from the middle Early Ceramic period yielded five charred plant taxa, while Features 1, 8, 10, and 14 from the earliest Early Ceramic period occupation yielded only two types of charred plant taxa. The charcoal record, however, was much more diverse in features from the early and middle Early Ceramic occupations. Features from each of these two earlier timer periods contained six types of charcoal. The representative charcoal record for samples from Feature 3, dated to the later Early Ceramic, were dominated by pine charcoal, but also contained a few pieces of maple or boxelder and willow or cottonwood. The other three features from the later Early Ceramic occupations yielded only pine charcoal. This might reflect the scarcity of other types of shrubs and trees in the site vicinity at the time of the later occupations or a preference for pine wood as fuel by the later Early Ceramic site occupants.

Summary and Conclusions

Ten rock-filled features and a storage pit sampled during excavations at the Magic Mountain site in 2017 and 2018 were examined for charred macrofloral

Table 6.14. Comparison of charred macrofloral remains and charcoal by feature type.

	Earth Oven (Primary)		Earth Oven (Secondary)		Basin Hearth		Storage Pit	
Taxon and Part	Whole	Fragment	Whole	Fragment	Whole	Fragment	Whole	Fragment
Charred Floral Remains:								
Arctostaphylos uva-ursi seed			2	2				
Cactaceae spine	1	122		19		72		2
Echinocereus viridiflorus seed	14	8				6		
Cheno-am perisperm	112	33					4	
Amaranthus seed	50	66		1			5	3
Chenopodium seed	37	244		1			7	45
Chenopodium berlandieri seed		2						
Helianthus seed		3						
Iva axillaris seed	5							
Poaceae awn						2		
Poaceae caryopsis								1
Poaceae C caryopsis	2	4			1	1		
Polygonum seed		1						
Prunus (cherry) seed		1		5		3		
Vitis riparia seed					1			
Unidentified seed/endosperm	4	5			1		2	
Pinus bark scale		396		163		167		65
PET starchy tissue		2						
Vitrified tissue		49		20		54		4
Charcoal/Wood:								
Acer		3				4		
Asteraceae						1		
Juniperus						2		
Pinus		186		109		146		40
Rosaceae		2				5		
Cercocarpus montanus		3		2		6		
Prunus				7		16		
Salicaceae		6				10		
Unidentified hardwood - vitrified						10		
Unidentifiable - vitrified				2				
Features Included	3, 10, 13		1, 5		4, 8, 11, 12, 14		2	
Total Sample Volume (liters)	78.8		22.1		54.5		3.4	

remains. A subsample of the charred seeds and charcoal fragments recovered in these samples was submitted for radiocarbon analysis. The macrofloral record yielded a somewhat diverse assemblage of remains from plants utilized by the occupants of the site during the Early Ceramic period. Plants that appear to have been exploited during the Early Ceramic period at Magic Mountain include nylon hedge cactus and possibly other types of cacti, Cheno-am plants including amaranth and goosefoot, grasses, wild cherries, povertyweed, sunflower, knotweed, kinnikinnick, riverbank grape, and possibly a starchy root or tuber resource. Seeds and fruits from these plants would have been available in the late summer or fall. Pine wood was commonly burned as fuel in these features. Other types of wood appear to have been burned less frequently such as members of the rose family including cherry or plum and mountain mahogany, willow or cottonwood, maple or box elder, a woody member of the sunflower family, and juniper. The presence of charcoal indicates the availability of the trees and shrubs represented to provide edible and medicinal resources, as well as wood for fuel. The earth oven features contained a greater quantity

Table 6.15. Comparison of charred macrofloral remains and charcoal by occupation period with the Early Ceramic.

	Early		Middle		Late	
Taxon and Part	Whole	Fragment	Whole	Fragment	Whole	Fragment
Charred Floral Remains:						
Arctostaphylos uva-ursi seed			2	2		
Cactaceae spine		16		30	1	169
Echinocereus viridiflorus seed					14	14
Cheno-am perisperm					112	33
Amaranthus seed				1	55	69
Chenopodium seed		1			44	289
Chenopodium berlandieri seed						2
Helianthus seed						3
Iva axillaris seed					5	
Poaceae awn				1		1
Poaceae caryopsis						1
Poaceae C caryopsis					3	5
Polygonum seed						1
Prunus (cherry) seed				8		1
Vitis riparia seed					1	
Unidentified seed/endosperm					6	5
Pinus bark scale		183		145		420
PET starchy tissue						2
Vitrified tissue		37		17		68
Charcoal/Wood:						
Acer				4		3
Asteraceae				1		
Juniperus		2				
Pinus		144		106		231
Rosaceae		5		2		
Cercocarpus montanus		9		2		
Prunus		20		3		
Salicaceae		10				6
Unidentified hardwood - vitrified		10				
Unidentifiable - vitrified				2		
Features Included	1, 8, 10, 14		4, 5, 11		2, 3, 12, 13	
Total Sample Volume (liters)	58.6		18.3		81.9	

and variety of potential food remains than did the basin hearth features, although the earth oven features yielded less variety of charcoal types. When compared by time period within the Early Ceramic, the features associated with the later Early Ceramic period occupations contained the greater variety of charred remains from potential food plants, although these later occupation features also yielded far fewer charcoal types.

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Appendix A:
Project Participants

Table A.1. List of participants from the 2017 and 2018 field seasons.

Year	Name	Position	Hours
2018	Donald Andrews	Volunteer Field Technician	160
2018	Amanda Avram	DMNS Staff	45
2017	Ryan Baker	Graduate Student Volunteer	112
2018	Malcolm Bamba	Teen Science Scholar	160
2018	Erin Baxter	DMNS Research Assistant	128
2018	Cory Bertelsen	Volunteer Field Technician	32
2018	Andy Bertelsen	Volunteer Field Technician	24
2017, 2018	Kevin Black	Volunteer Field Technician	184
2018	Will Bottoms	Volunteer Field Technician	24
2017	Treloar Bower	DMNS Staff	80
2018	Jill Buck	Volunteer Field Technician	40
2017	Houdini Cedrillo	DMNS Staff	45
2017, 2018	Jophen Chhetri	Volunteer Field Technician	72
2018	Josh Collins	KU Field Technician	128
2017, 2018	Chip Colwell	DMNS Staff	16
2018	Frank Conard	KU Field Technician	128
2017	Jamie Cottrell	Volunteer Field Technician	24
2018	Courtney Crawford	Volunteer Field Technician	32
2017, 2018	Brianna Dalessandro	Graduate Student Volunteer, Education Excavator	248
2018	Loretta Daniel	Volunteer Field Technician	24
2018	Warren Dave	Volunteer Field Technician	16
2018	Emma Davis	Volunteer Field Technician	32
2018	Greg Davis	Volunteer Field Technician	8
2018	Vickie Davis	Volunteer Field Technician	32
2017	Jen Deats	PCRG Crew Chief	128
2018	Frank Delaney	Volunteer Field Technician	152
2018	Andrew Drysdale	Volunteer Field Technician	24
2017	Meghan Dudley	Graduate Student Volunteer	104
2018	Paige Englert	KU Field Technician	128
2018	Sue Fraley	Volunteer Field Technician	24
2017, 2018	MaryAnn Gabriel	Volunteer Field Technician	104
2018	Brisa Garcia-Gonzalez	DMNS Staff	45
2017, 2018	Amy Gillaspie	Volunteer Field Technician, Education Excavator	88
2018	Guest Services	DMNS Staff	140
2018	Ayanah Gutierrez	Teen Science Scholar	160
2018	Bill Haddock	Volunteer Field Technician	48
2017	Kristen Hall	Graduate Student Volunteer	112
2018	Pengxiao Hao	Volunteer Field Technician	24

Table A.1. List of participants from the 2017 and 2018 field seasons. (*continued*)

Year	Name	Position	Hours
2018	Erika Heacock	Volunteer Field Technician	48
2018	Taylor Hitte	DMNS Staff	140
2018	Talle Hogrefe	PCRG Crew Chief	152
2017	Kris Holien	Volunteer Field Technician	24
2017	Bernie Holien	Volunteer Field Technician	24
2018	Ann Holloway	Volunteer Field Technician	64
2018	Bruce Holloway	Volunteer Field Technician	72
2017	Laura Holthus	Volunteer Field Technician	40
2017, 2018	Mark Howard	Volunteer Field Technician	48
2018	Victor Hurlburt	Volunteer Field Technician	16
2017	Dan Jepson	Volunteer Field Technician	24
2018	Brittany Johnson	Volunteer Field Technician	16
2017, 2018	Chris Johnston	History Colorado, PCRG Assistant Field Director	192
2018	Sue Kane	Volunteer Field Technician	24
2018	Isata Kanu	Teen Science Scholar	160
2018	David Kessel	Volunteer Field Technician	24
2018	Ira Kessel	Volunteer Field Technician	8
2018	Laura Kirsche	KU Field Technician	112
2017, 2018	Michele Koons	DMNS Co-PI	288
2018	Ann Kusic	Volunteer Field Technician	8
2018	Ken Kvamme	UA Remote Sensing Specialist	16
2018	Morgan Lark	Volunteer Field Technician	40
2017	Steve Latham	Volunteer Field Technician	96
2018	Andrew Leung	Volunteer Field Technician	24
2017	Megan MacGregor	DMNS Staff	45
2017, 2018	Rolfe Mandel	KU Geoarchaeologist	64
2018	Yesenia Martin	Native American Teen	160
2018	Katherine McComb	Education Excavator	16
2017	Matthew Menden	Volunteer Field Technician	40
2017, 2018	Mark Mitchell	PCRG Co-PI	288
2018	Renat Mohamed	Teen Science Scholar	160
2018	Hanan Mohammed	Teen Science Scholar	160
2018	Jennifer Moss Logan	DMNS Staff	160
2018	Katherine Moulton	Volunteer Field Technician	48
2017, 2018	Amy Nelson	PCRG Assistant Field Director, PCRG Crew Chief	216
2018	Dante Nicolais	Volunteer Field Technician	88
2018	Roger Oberdier	Volunteer Field Technician	56
2018	Katherine Onorato	Volunteer Field Technician	80
2018	Neamiah Pedraza	Teen Science Scholar	160
2018	Sean Perkins	Volunteer Field Technician	16
2017	John Peterson	Volunteer Field Technician	48
2017	Leslie Peterson	Volunteer Field Technician	56
2017	Dan Petschaver	Volunteer Field Technician	48
2017	Rin Porter	Volunteer Field Technician	32
2018	Donovan Roberts	Native American Teen	160
2018	Emily Robinson	Volunteer Field Technician	48
2018	Olivia Robinson	Teen Science Scholar	160
2017, 2018	Britni Rockwell	PCRG Crew Chief	288
2018	Bob Rushforth	Volunteer Field Technician	32

Table A.1. List of participants from the 2017 and 2018 field seasons. (*continued*)

Year	Name	Position	Hours
2017	Felicia Sanchez	Volunteer Field Technician	8
2017	Paul Sanders	Volunteer Field Technician	40
2018	Christopher Schmitt	Volunteer Field Technician	24
2018	Jennifer Sitompul	Teen Science Scholar	160
2017	Brittany Soderquist	Volunteer Field Technician	32
2018	Jeff Stephenson	Volunteer Field Technician	16
2018	Elizabeth Storey	Volunteer Field Technician	24
2017, 2018	Teens, Inc.	Field Technicians	768
2018	Alexis Thiel	Volunteer Field Technician	32
2018	Sophia Tribelhorn	Teen Science Scholar	160
2018	Jessica Valdez	DMNS Staff	45
2018	Kailee Vermillion	Native American Teen	160
2018	Yessica Villagrana	Teen Science Scholar	160
2017	Katy Waechter	Volunteer Field Technician	56
2018	Michael Ward	Volunteer Field Technician	24
2017	Ryan Weaver	Volunteer Field Technician	8
2017, 2018	Jess Wellington	DMNS Staff	16
2017, 2018	Rick Wicker	DMNS Photographer	24
2017	Jerricah Wilhoite	Volunteer Field Technician	56
2018	Claire Wineman	Volunteer Field Technician	56
2017	Greg Wolff	Volunteer Field Technician	16
2018	Morning Star Yazzie	Native American Teen	160
2018	Lisa Yeager	Education Excavator	56
2017	Brittany Zewe	Volunteer Field Technician	64
Total	134		9,529

Appendix B:
Modified Stone Coding Format

Table B.1. Chipped stone flaking debris coding format.

Code	Description
CN	**Catalog number**
SG	**Size grade**
1	G1
2	G2
3	G3
4	G4 and smaller (DS sample)
RAWM	**Raw material type**
1	chert
2	chalcedony
3	quartzite
4	rhyolite
5	basalt
6	petrified wood
7	obsidian
8	sandstone
9	unknown
10	argillite
11	schist
12	quartz
13	metaquartzite
14	unknown igneous
DESC	**Descriptive Category (G1-G3 only)**
15	Troublesome Formation/Kremmling chert
16	Possible Troublesome Formation chert
17	Flattop Chalcedony (White River group)
18	Windy Ridge quartzite
20	Possible Flattop chalcedony
22	Parker petrified wood
23	Trout Creek jasper
24	Possible Trout Creek jasper
25	Possible Windy Ridge quartzite
99	Unspecified

Table B.1. Chipped stone flaking debris coding format (*continued*).

CORT	**Cortex**
0	absent
1	present
BURN	**Burning (G1-G3 only)**
0	absent
1	present
9	not applicable
HEAT	**Heat Treatment (G1-G3 only)**
0	unheated
1	possibly present
2	definitely present
3	suspected but unknown due to burning
9	not applicable
COUNT	**Number of specimens in group**
WEIGH	**Group weight (if weight 0.0 coded as 0.03)**

Table B.2. Stone tool coding format.

Code	Description
CN	**Catalog number**
SG	**Size grade**
1	G1
2	G2
3	G3
4	G4
SEQ	**Sequence number within level lot**
CASE	**Multiple records on a single specimen**
WEIGH	**Group weight (if 0.0 coded as 0.03)**
RAWM	**Raw Material Type**
1	chert
2	Chalcedony
3	Quartzite
4	Rhyolite
5	basalt
6	petrified wood
7	obsidian
8	sandstone
9	unknown
10	argillite
11	schist
12	quartz
13	metaquartzite
14	unknown igneous
DESC	**Descriptive category (G1-G3 only)**
15	Troublesome Formation/Kremmling chert
16	Possible Troublesome Formation chert
17	Flattop Chalcedony (White River group)
18	Windy Ridge quartzite
20	Possible Flattop chalcedony
22	Parker petrified wood
23	Trout Creek jasper
99	Unspecified
TECH	**Technological class**
1	patterned small thin biface
2	patterned large thin biface
3	unpatterned small to medium biface
4	patterned steeply beveled flake took
5	unpatterned other flake tool, retouched or use-modified
6	large, thick bifacial core tool
7	nonbipolar core and core tool
8	bipolar core and core tool
9	unpatterned pecked or ground stone
10	patterned pecked or ground stone
11	radial break tool
12	retouched tabular piece or plate
13	ultrathin biface
14	ground core

Table B2. Stone tool coding format (*continued*).

SUB TECH	**Sub Technological Class**
Tech 5	*Flake tools*
5.1	use modified
5.2	retouch
Tech 7	*Core tools*
7.1	core
7.2	tested cobble
7.3	random flaking
7.4	unoriented fragment
BLANK	**Blank Type**
1	tabular cobble/pebble
2	thin plate
3	subrounded, rounded, cobble or pebble
4	blocky/angular cobble or pebble
5	split cobble
6	nonbipolar flake, unprepared platform
7	bifacial thinning flake
8	bipolar flake
9	blade
10	shatter
11	indeterminate
12	other nonbipolar flake, ground platform
13	finished patterned biface
14	unfinished patterned biface
15	unpatterned flake tool
16	patterned flake tool
COMP	**Completeness**
1	complete
2	nearly complete, primary part of core
3	distal end
4	proximal end
5	medial segment
6	indeterminate end
7	margin fragment
8	channel flake or channel flake fragment
9	unknown
USE	**Use Phase**
1	1 unfinished, usable
2	2 unfinished, unusable
3	3 finished, usable
4	4 finished, unusable
BURN	**Burning (G1-G3 only)**
0	absent
1	present
HEAT	**Heat Treatment (G1-G3 only)**
0	Unheated
1	Possibly present
2	Definitely present
3	Suspected but uncertain due to burning
9	Not applicable

Table B.2. Stone tool coding format (*continued*).

CORT	**Cortex**
0	Absent
1	Present
COMP2	**Projectile Point Completeness**
1	Complete
2	Resharpened tip, complete base
3	Missing tip
4	Basal fragment
5	Fragment with ground edge
6	Distal segment
7	Distal part lacking base
9	Not applicable or indeterminate
REJECT	**Reason for rejection, failure, discard**
1	Has potential for further work or use
2	Bending fracture or end shock
3	Perverse fracture
4	Material flaw or poor quality stone
5	Outré-passé fracture
6	Compound hinge/step occurrence
7	Impact fracture
8	Small size or exhaustion
9	Indeterminate
10	Heat or thermal fracture
11	Lateral break
12	Broken by radial fracture
13	Crescentic chunk from tool margin
14	Channel flake or fragment
15	Recycled into other use by bipolar process
16	Burination spall
17	Resharpening flake, no further use possible
18	Recycled into other use nonbipolar process
LENG	**Maximum length, to 0.1 mm**
WIDE	**Maximum width, to 0.1 mm**
THICK	**Maximum thickness, to 0.1 mm**
PHEW	**Proximal haft element width, to 0.1 mm**
DHEW	**Distal haft element width, to 0.1 mm**
DHEL	**Distal haft element length, to 0.1 mm**
BASEWID	**Blade base width, to 0.1 mm**
BLADE	**Blade element length, to 0.1 mm**
NOTDP	**Notch depth, to 0.1 mm**
NOTWID	**Notch width, to 0.1 mm**

Appendix C:
Vertebrate Remains

Table C.1. Specimen counts and weights (g) organized by sample type and size grade[1].

		Counts				Weight (g)			
Recovery Method	Size Grade	Unburned	Burned	Total	Percent	Unburned	Burned	Total	Percent
¼-in Dryscreen	G1	5	1	6		24.5	0.1	24.6	
	G2	75	18	93		139.3	22	161.3	
	G3	1004	507	1511		276.9	144	420.9	
	G4	211	79	290		16.2	6.8	23	
	G5	12	6	18		1.2	0.3	1.5	
Subtotal		1307	611	1918	*24.4*	458.1	173.2	631.3	*34.2*
⅛-in Dryscreen	G1								
	G2	13	9	22		20.7	18.9	39.6	
	G3	156	158	314		47.6	44.3	91.9	
	G4	280	294	574		17	15.3	32.3	
Subtotal		449	461	910	*11.6*	85.3	78.5	163.8	*8.9*
1/16-in Waterscreen	G1								
	G2	2	1	3		2.3	0.1	2.4	
	G3	136	117	253		35.1	30	65.1	
	G4	1792	1545	3337		67.5	61.1	128.6	
	G5	123	80	203		1.1	0.5	1.6	
Subtotal		2053	1743	3796	*48.3*	106	91.7	197.7	*10.7*
Plotted	G1	18	1	19		454.7	5.6	460.3	
	G2	75	2	77		272.7	3	275.7	
	G3	108	5	113		46.5	2.6	49.1	
	G4	33	1	34		3.5	0.1	3.6	
Subtotal		234	9	243	*3.1*	777.4	11.3	788.7	*42.8*
Float	G1								
	G2	2	1	3		6.1	1.4	7.5	
	G3	32	42	74		8.7	14	22.7	
	G4	334	468	802		12.8	17.7	30.5	
	G5	63	43	106		1.3	1.1	2.4	
Subtotal		431	554	985	*12.5*	28.9	34.2	63.1	*3.4*
Total		4474	3378	7852	*99.9*	1455.7	388.9	1844.6	*100*

[1] Minor variations between weight totals between table C.1 and table 5.1 reflect rounding errors.

Table C.2. Specimen counts and weights organized by feature.

		Count				Weight			
Feature Type	Feature	Unburned	Burned	Total	Percent Burned	Unburned	Burned	Total	Percent Burned
Earth oven	1	96	63	159	*39.6*	19.7	5.1	24.8	*20.6*
Storage pit	2	49	66	115	*57.4*	4	6.9	10.9	*63.3*
Earth oven	3 (FL 1-2)	277	320	599	*53.4*	45.9	25.5	71.4	*37.7*
Earth oven	3 (FL 3-4)	299	514	813	*63.2*	63	69.8	132.8	*52.6*
Basin hearth	4	92	41	133	*30.8*	8	3.4	11.4	*29.8*
Earth oven	5	42	18	60	*30.0*	6.8	0.4	7.2	*5.6*
Basin hearth	8	61	31	92	*33.7*	4.7	1.1	5.8	*19.0*
Earth oven	10	7	5	12	*41.7*	0.7	0.6	1.3	*46.2*
Basin hearth	11	4	9	13	*69.2*	0.1	0.2	0.3	*66.7*
Basin hearth	12	50	25	75	*33.3*	3.4	1.5	4.9	*30.6*
Earth oven	13	25	17	42	*40.5*	1.8	1.1	2.9	*37.9*
Basin hearth	14	2	3	5	*60.0*	0.2	0.2	0.4	*50.0*
Basin hearth	15	7	2	9	*22.2*	14.3	0.2	14.5	*1.4*
Total		1,011	1,114	2,127	*52.4*	172.6	116	288.6	*40.2*
Percent		*47.6*	*52.4*	*100.0*		*59.8*	*40.2*	*100.0*	

Table C.3. Comparison of taxonomic representation and abundance for vertebrate fauna reported for the Magic Mountain site by Irwin-Williams and Irwin 1966 (1959-1960), 1994 Kalasz *et al*. (1995:180-181), 1996 Kalasz and Sheilds (1997:179), and Falk present study (2017-2018).

	Year of Field Investigation - Quantification			
Taxonomic Group	1959-60	1994 (NISP)	1996 (MNI)	2017-18 (NISP)
Osteichthyes (bony fish)		1		
Amphibia (amphibians)		5	1	
Iguania (lizards)		3		
Serpentes (snakes)		39	3	2
Aves (birds)		18	1	1
Zenaida macroura (mourning dove)		1		
Meleagris gallopavo (wild turkey)		1		
Sciuridae (squirrels)		6		5
Marmota flaviventris (yellow-bellied marmot)		1		
Ictidomys tridecemlineatus (13-lined ground squirrel)		1	1	
Cynomys ludovicianus (black-tailed prairie dog)	present	43	2	18
Castor canadensis (beaver)		1	1	1
Thomomys talpoides (northern pocket gopher)	present	108	25	23
Cricetidae (Cricetid rats and mice)				6
Microtus sp. (voles)		14		7
Microtus montanus (montane vole)			1	
Microtus ochrogaster (prairie vole)				2
Reithrodontomys megalotis (w. harvest mouse)			6	
Peromyscus sp. (deer mouse)			1	
Small rodent		10		
Neotoma sp. (woodrats)		4		2
Erethizon dorsatum (porcupine)		3		
Leporidae (leporid)		51		
Lepus sp. (jackrabbit)		6		1
Sylvilagus sp. (cottontail)	present	77	7	9
(*S. audubonii*) desert cottontail		2		
Felidae (mountain lion, lynx, bobcat)			1	
Canis sp. (domestic dog, coyote, wolf)				6
C. familiaris (domestic/wild dog)		9		
C. latrans (coyote)		1		
C. lupus (gray wolf)			1	
Procyon lotor (raccoon)				1
Artiodactyla (small-medium bodied artiodactyl)				103
Cervus canadensis (elk)		18	5	
Odocoileus sp. (deer)	present	195	28	67
Odocoileus hemionus (mule deer)				4
Antilocapra americana (pronghorn)		8	1	
Bison bison (bison)	present	86	1	4
Totals		712	86	262

Table C.4. Specimen counts (NISP) organized by skeletal element for black-tailed deer (*Odocoileus hemionus*), deer (*Odocoileus* sp.) and unassigned small to medium-sided artiodactyl remains, Magic Mountain, 2017-2018.

	Taxonomic Group			
Element – portion	*Odocoileus hemionus*	*Odocoileus* sp.	Unassigned artiodactyl	Total
Temporal			3	3
Mandible		3	2	5
Hyoid			1	1
Unsocketed tooth		8	1	9
Cervical vertebra			9	9
Thoracic vertebra			5	5
Lumbar vertebra			7	7
Rib			8	8
Scapula	1	4	4	9
Humerus diaphysis			3	3
Distal	1			1
Radius proximal			1	1
Diaphysis			1	1
Distal			1	1
Ulna proximal		1		1
Diaphysis		1	1	2
Carpals	1	6		7
Metacarpal proximal	1	1		2
Diaphysis		1	3	4
Distal		1	2	3
Innominate		2	2	4
Femur proximal			2	2
Diaphysis			7	7
Tibia diaphysis		1	4	5
Distal			2	2
Lateral malleolus		1		1
Astragalus		4	2	6
Calcaneus		1	3	4
Metatarsal proximal		1		1
Diaphysis			6	6
Distal			1	1
Phalanx 1		15	9	24
Phalanx 2		8	8	16
Phalanx 3		6		6
Sesamoid		2	2	4
Metapodial			3	3
Total	4	67	103	174

Table C.5. Specimen counts (NISP) for identified specimens organized by taxonomic group, feature, and relative ages, Magic Mountain, 2017-2018.

	Features by Age Group											
	Early		Middle			Late						
Taxonomic Group	1	8	4	5	11	2	3	12	13	15	Non-Feature	Total
Serpentes (snakes)							1				1	2
Aves (birds)											1	1
Sciuridae (squirrels)					1			1	3			5
Cynomys ludovicianus (black-tailed prairie dog)	1		2				1				14	18
Castor canadensis (beaver)							1					1
Thomomys talpoides (northern pocket gopher)							1	1			21	23
Cricetidae (cricetid rats and mice)								1			5	6
Microtus sp. (voles)											7	7
Microtus ochrogaster (prairie vole)											2	2
Neotoma sp. (woodrat)								1			1	2
Lepus sp. (jackrabbit)											1	1
Sylvilagus sp. (cottontail)							3				6	9
Canis sp. (domestic dog, coyote, gray wolf)							2	1			3	6
Procyon lotor (raccoon)											1	1
Artiodactyla (small-medium bodied)		1	2	1		1	14	1		1	82	103
Odocoileus sp. (deer)	1						8				58	67
Odocoileus hemionus (mule deer)											4	4
Bison bison (bison)											4	4
Totals	2	1	4	1	1	1	31	6	3	1	211	262
Percent Burned	*0*	*0*	*25*	*0*	*0*	*0*	*38.7*	*16.7*	*0*	*0*	*14.7*	*17.2*

Appendix D:
Macrofloral Remains

Table D.1. Index of macrofloral remains in samples from Magic Mountain.

Scientific Name	Common Name
FLORAL REMAINS:	
Arctostaphylos uva- ursi	Kinnikinnick, Bearberry
Argemone	Prickly poppy
Asteraceae	Sunflower family
Ambrosia	Ragweed
Helianthus	Sunflower
Iva axillaris	Marsh elder
Lactuca	Wild lettuce
Taraxacum	Dandelion
Tragopogon	Salsify
Brassicaceae	Mustard family
Lesquerella montana	Mountain bladderpod
Cactaceae	Cactus family
Echinocereus viridiflorus	Hedgehog cactus, Strawberry cactus
Cheno-am	Includes Goosefoot and Amaranth families
Amaranthus	Pigweed, Amaranth
Atriplex	Saltbush, Shadscale
Chenopodium	Goosefoot
Chenopodium berlandieri	Pitseed goosefoot
Convolvulus	Bindweed
Convolvulus arvensis	Field bindweed
Erodium	Storksbill, Filaree
Fabaceae	Bean family
Astragalus	Milkvetch
Trifolium	Clover
Onagraceae	Evening primrose family, Willowherb family
Poaceae	Grass family
Poaceae A	Members of the grass family with larger-sized caryopses, such as *Agropyron* (wheatgrass), *Elymus* (ryegrass), *Bromus* (brome grass), etc.
Poaceae B	Members of the grass family with medium-sized caryopses, such as *Festuca* (fescue), *Hordeum* (wild barley), *Stipa* (needlegrass), etc.
Poaceae C	Members of the grass family with small caryopses, such as *Agrostis* (bentgrass), *Muhlenbergia* (muhly grass), *Phragmites australis* (common reed), *Poa* (bluegrass), etc.
Sporobolus	Dropseed
Polygonum	Smartweed; Knotweed
Populus	Cottonwood
Prunus - cherry	Cherry
Sambucus	Elderberry
Sphaeralcea	Globemallow

Table D.1. Index of macrofloral remains in samples from Magic Mountain (*continued*).

Scientific Name	Common Name
Verbascum thapsus	Common mullein
Vitis riparia	Riverbank grape
PET starchy tissue	Starchy parenchymoid tissues; contain starchy storage cells
Vitrified tissue	Charred material with a shiny, glassy appearance due to fusion by heat
CHARCOAL/WOOD:	
Acer	Maple, Box elder
Asteraceae	Sunflower family
Juniperus	Juniper
Pinus	Pine
Rosaceae	Rose family
Cercocarpus montanus	Alderleaf mountain mahogany
Prunus	Cherry, Plum
Salicaceae	Willow family
Unidentified hardwood - vitrified	Wood from a broad-leaved flowering tree or shrub, exhibiting a shiny, glassy appearance due to fusion by heat
Unidentifiable - vitrified	Charcoal exhibiting a shiny, glassy appearance due to fusion by heat
NON-FLORAL REMAINS:	
Insect puparium	A rigid outer shell made from tough material that includes chitin (a natural polymer found in insect exoskeleton and crab shells) and hardens from a larva's skin to protect the pupa as it develops into an adult insect
Worm castings	Worm manure - the end product of the breakdown of organic matter by earthworms

Table D.2. Macrofloral remains in samples from Magic Mountain.

			Charred		Uncharred		
CN and Provenience	Identification	Part	W[1]	F[2]	W	F	Weight/Comments
4125	**Volume Floated**						**6.6 Liters**
Feature 1	**Light Fraction Weight**						**28.778 g**
55-67 cm	Floral Remains:						
	Cactaceae	Spine		1			<0.001 g
	Chenopodium sp.	Seed		1			<0.001 g
	Pinus spp. > 0.5 mm	Bark scale		3			0.002 g
	Pinus spp. < 0.5 mm	Bark scale		X[3]			Few
	Vitrified tissue			2			0.023 g
	Argemone sp.	Seed				1	
	Asteraceae	Seed			2		
	Lactuca spp.	Seed			2		
	Chenopodium spp.	Seed			9	1	
	Poaceae	Stem				X	Few
	Poaceae	Inflores.[4]			3		
	Poaceae A	Floret			1		
	Poaceae A	Caryopsis			3		
	Rootlets					X	Moderate
	Charcoal:						
	Total charcoal > 2 mm						1.503 g
	Pinus spp.	Charcoal		36			0.730 g
	Prunus spp.	Charcoal		4			0.054 g
	Non-Floral Remains:						
	Bone					2	0.062 g
	Bone – calcined			6			0.403 g
	Insect	Chitin				8	
	Insect	Egg			X	X	Few
	Lithic flake					12	0.908 g
	Rock/Gravel					X	Moderate
	Snail shell				1		
4126	**Volume Floated**						**10.2 Liters**
Feature 1	**Light Fraction Weight**						**101.416 g**
80-100 cm	Floral Remains:						
	Pinus spp. > 0.5 mm	Bark scale		118			0.064 g
	Pinus spp. < 0.5 mm	Bark scale		X			Moderate
	Vitrified tissue			16			0.075 g
	Argemone sp.	Seed				1	
	Asteraceae	Seed			2		
	Taraxacum sp.	Seed			1		
	Chenopodium spp.	Seed			12	1	
	Convolvulus arvensis	Seed			1	1	
	Lesquerella montana	Silique				2	
	Lesquerella montana	Seed			1		
	Poaceae	Stem				X	Few
	Poaceae A	Floret			1		
	Poaceae A	Caryopsis			2		
	Sporobolus spp.	Caryopsis			2		
	Roots					X	Few
	Rootlets					X	Moderate

Table D.2. Macrofloral remains in samples from Magic Mountain (*continued*).

CN and Provenience	Identification	Part	Charred W[1]	Charred F[2]	Uncharred W	Uncharred F	Weight/Comments
	Charcoal:						
	Total charcoal > 4 mm						11.289 g
	Pinus	Charcoal		36			2.804 g
	Non-Floral Remains:						
	Bone > 2 mm					23	0.780 g
	Bone < 2 mm					X	Moderate
	Bone			3pc[5]			0.495 g
	Bone – calcined			1			0.014 g
	Insect	Chitin				16	
	Insect	Egg				X	Few
	Lithic flake					12	0.908 g
	Rock/Gravel					X	Moderate
	Fire-cracked rock					5	18.753 g
	Worm castings				X	X	Few
4101	**Volume Floated**						**3.4 Liters**
Feature 2	**Light Fraction Weight**						**20.751 g**
53-65 cm	Floral Remains:						
	Cactaceae	Spine		2			<0.001 g
	Cheno-am	Perisperm	4				<0.001 g
	Amaranthus > 0.5 mm	Seed	5	3			<0.001 g
	Amaranthus < 0.5 mm	Seed		X			Few
	Chenopodium > 0.5 mm	Seed	7	45			0.001 g
	Chenopodium < 0.5 mm	Seed		X			Few
	Pinus spp. > 0.5 mm	Bark scale		65			0.052 g
	Pinus spp. < 0.5 mm	Bark scale		X			Moderate
	Unidentified	Seed	2				<0.001 g
	Vitrified tissue			2			0.023 g
	Roots					X	Few
	Rootlets					X	Moderate
	Charcoal:						
	Total charcoal > 2 mm						0.974 g
	Pinus spp.	Charcoal		40			0.426 g
	Non-Floral Remains:						
	Bone > 2 mm					15	0.724 g
	Bone < 2 mm					X	Few
	Bone > 2 mm			9			0.193 g
	Bone < 2 mm			X			Few
	Bone – calcined > 2 mm			8			0.324 g
	Bone – calcined < 2 mm			X			Few
	Insect	Chitin				4	
	Insect	Egg				X	Few
	Lithic flake > 2 mm					21	1.596 g
	Lithic flake < 2 mm					X	Few
	Rock/Gravel					X	Few
	Snail shell				6	5	
	Worm castings				X	X	Few

Table D.2. Macrofloral remains in samples from Magic Mountain (*continued*).

CN and Provenience	Identification	Part	Charred W[1]	Charred F[2]	Uncharred W	Uncharred F	Weight/Comments
4139	**Volume Floated**						**8.8 Liters**
Feature 3	**Light Fraction Weight**						**31.292 g**
60-80 cm	Floral Remains:						
	Cactaceae	Spine		1			<0.001 g
	Echinocereus viridiflorus	Seed	2	2			<0.001 g
	Cheno-am	Perisperm	5	2			<0.001 g
	Amaranthus spp.	Seed	4	4			<0.001 g
	Chenopodium spp.	Seed	8	20			0.001 g
	Pinus spp. > 2 mm	Bark scale		187			0.108 g
	Pinus spp. < 2 mm	Bark scale		X			Numerous
	Unidentified	Seed	1	5			<0.001 g
	Vitrified tissue			9			0.052 g
	Ambrosia sp.	Seed				4	
	Lactuca sp.	Seed			1		
	Poaceae A	Caryopsis			2		
	Sporobolus sp.	Caryopsis			1		
	Roots					X	Few
	Rootlets					X	Moderate
	Charcoal:						
	Total charcoal > 2 mm						1.008 g
	Pinus	Charcoal		40			0.459 g
	Non-Floral Remains:						
	Bone > 2 mm					52	4.113 g
	Bone < 2 mm					X	Moderate
	Bone > 2 mm			12			0.484 g
	Bone < 2 mm			X			Few
	Bone – calcined > 2 mm			28			1.306 g
	Bone – calcined < 2 mm			X			Few
	Insect	Chitin			3	17	
	Insect	Egg			X	X	Few
	Lithic flake					28	1.306 g
	Rock/Gravel					X	Moderate
	Snail shell				9	2	
	Worm castings				X	X	Few
4165	**Volume Floated**						**14.7 Liters**
Feature 3	**Light Fraction Weight**						**102.366 g**
80-100 cm	Floral Remains:						
	Cactaceae	Spine		33			0.001 g
	Echinocereus viridiflorus	Seed		4			0.002 g
	Cheno-am	Perisperm	73	24			0.014 g
	Amaranthus > 0.5 mm	Seed	31	53			0.005 g
	Amaranthus < 0.5 mm	Seed		X			Few
	Chenopodium > 0.5 mm	Seed	19	132			0.033 g
	Chenopodium < 0.5 mm	Seed		X			Few
	Chenopodium berlandieri	Seed		2			<0.001 g
	Helianthus spp.	Seed		3			0.003 g
	Iva axillaris	Seed		1			<0.001 g
	PET Starchy	Tissue		2			0.006 g
	Pinus spp. > 2 mm	Bark scale		44			0.174 g

Table D.2. Macrofloral remains in samples from Magic Mountain (*continued*).

			Charred		Uncharred		
CN and Provenience	Identification	Part	W[1]	F[2]	W	F	Weight/Comments
	Pinus spp. < 2 mm	Bark scale		X			Numerous
	Unidentified	Endosperm	1				<0.001 g
	Vitrified tissue			6			0.044 g
	Asteraceae	Seed			1		
	Ambrosia spp.	Seed				5	
	Taraxacum sp.	Seed			1		
	Atriplex spp.	Seed			3		
	Erodium spp.	Seed			2		
	Poaceae A	Floret			1		
	Sporobolus sp.	Caryopsis			1		
	Prunus sp. - cherry	Seed				1	
	Roots					X	Few
	Rootlets					X	Numerous
	Charcoal:						
	Total charcoal > 4 mm						10.976 g
	Acer spp.	Charcoal		3			0.183 g
	Pinus spp.	Charcoal		31			2.342 g
	Salicaceae	Charcoal		6			0.194 g
	Non-Floral Remains:						
	Bone > 2 mm					55	6.932 g
	Bone < 2 mm					X	Moderate
	Bone > 2 mm			10			0.396 g
	Bone < 2 mm			X			Few
	Bone – calcined > 2 mm			34			1.961 g
	Bone – calcined < 2 mm			X			Moderate
	Insect	Chitin			2	14	
	Insect	Egg			X	X	Few
	Insect	Puparium			2		
	Lithic flake > 2 mm					53	4.813 g
	Lithic flake < 2 mm					X	Moderate
	Rock/Gravel					X	Moderate
	Snail shell				92	6	
	Tooth enamel					1	0.021 g
	Worm castings				X	X	Few
4188	**Volume Floated**						**16.0 Liters**
Feature 3	**Light Fraction Weight**						**109.407 g**
80-100 cm	Floral Remains:						
	Cactaceae	Spine		82			
	Echinocereus viridiflorus	Seed	8	6			0.002 g
	Cheno-am	Perisperm	34	7			0.004 g
	Amaranthus spp.	Seed	15	9			0.001 g
	Chenopodium spp.	Seed	10	92			0.007 g
	Iva axillaris	Seed	4				<0.001 g
	Pinus spp. > 2 mm	Bark scale		50			0.150 g
	Pinus spp. < 2 mm	Bark scale		X			Moderate
	Polygonum sp.	Seed		1			<0.001 g
	Prunus sp. - cherry	Seed		1			0.002 g
	Unidentified	Seed	2				<0.001 g
	Vitrified tissue			12			0.069 g

Table D.2. Macrofloral remains in samples from Magic Mountain (*continued*).

			Charred		Uncharred		
CN and Provenience	Identification	Part	W[1]	F[2]	W	F	Weight/Comments
	Asteraceae	Seed			2		
	Helianthus spp.	Seed				2	
	Lactuca sp.	Seed			1		
	Brassicaceae	Seed			1		
	Convolvulus arvensis	Seed			1		
	Poaceae	Floret			1		
	Poaceae	Caryopsis			2		
	Sporobolus spp.	Caryopsis			6		
	Sphaeralcea sp.	Seed			1		
	Unidentified	Seed				1	
	Roots					X	Few
	Rootlets					X	Numerous
	Charcoal:						
	Total charcoal > 4 mm						8.991 g
	Pinus spp.	Charcoal		40			2.813 g
	Non-Floral Remains:						
	Bone > 2 mm					62	2.893 g
	Bone < 2 mm					X	Moderate
	Bone > 2 mm			40			5.537 g
	Bone < 2 mm			X			Moderate
	Bone – calcined > 2 mm			58			3.997 g
	Bone – calcined < 2 mm			X			Moderate
	Insect	Chitin			2	28	
	Insect	Egg			X	X	Few
	Lithic flake > 2 mm					64	5.171 g
	Lithic flake < 2 mm					X	Moderate
	Rock/Gravel					X	Moderate
	Fire-cracked rock					X	Few
	Snail shell				189	5	
	Tooth					1	0.562 g
	Tooth enamel					1	0.010 g
	Worm castings				X	X	Numerous
3093	**Volume Floated**						**5.0 Liters**
Feature 4	**Light Fraction Weight**						**33.960 g**
66-86 cm	Floral Remains:						
	Cactaceae	Spine		9			<0.001 g
	Poaceae	Awn		1			<0.001 g
	Pinus spp.	Bark scale		102			0.042 g
	Prunus spp. - cherry	Seed		3			0.002 g
	Unidentified	Seed	1				<0.001 g
	Vitrified tissue			9			0.045 g
	Argemone spp.	Seed			1	1	
	Chenopodium spp.	Seed			2	7	
	Convolvulus arvensis	Seed			2		
	Poaceae A	Caryopsis			4	1	
	Sporobolus spp.	Caryopsis			6		
	Trifolium spp.	Seed			5		
	Verbascum thapsus	Seed			1		
	Leaf					2	

Table D.2. Macrofloral remains in samples from Magic Mountain (*continued*).

CN and Provenience	Identification	Part	Charred W[1]	Charred F[2]	Uncharred W	Uncharred F	Weight/Comments
	Roots					X	Few
	Rootlets					X	Moderate
	Charcoal:						
	Total charcoal > 2 mm						
	Acer spp.	Charcoal		4			0.510 g
	Asteraceae	Charcoal		1			0.035 g
	Pinus spp.	Charcoal		33			0.025 g
	Salicaceae	Charcoal		2			0.364 g
	Non-Floral Remains:						0.004 g
	Bone > 2 mm					26	1.004 g
	Bone < 2 mm					X	Few
	Bone > 2 mm			4			0.064 g
	Bone < 2 mm			X			Few
	Bone – calcined > 2 mm			1			0.024 g
	Bone – calcined < 2 mm			X			Few
	Insect	Chitin				51	
	Insect	Egg			X	X	Few
	Insect	Puparium					
	Lithic flake > 2 mm					39	9.308 g
	Lithic flake < 2 mm					X	Moderate
	Rock/Gravel					X	Moderate
	Worm castings				X	X	Few
3127	**Volume Floated**						**5.3 Liters**
Feature 5	**Light Fraction Weight**						**39.395 g**
68-85 cm	Floral Remains:						
	Amaranthus sp.	Seed		1			<0.001 g
	Arctostaphylos uva-ursi	Seed	2	2			0.008 g
	Cactaceae	Spine		18			<0.001 g
	Pinus spp.	Bark scale		42			0.019 g
	Prunus spp. - cherry	Seed		5			0.006 g
	Vitrified tissue			2			0.009 g
	Asteraceae	Seed			1		
	Ambrosia sp.	Seed				1	
	Argemone sp.	Seed				1	
	Chenopodium spp.	Seed			2	9	
	Convolvulus arvensis	Seed			1		
	Fabaceae	Seed			1		
	Astragalus sp.	Seed			1		
	Trifolium spp.	Seed			29		
	Onagraceae	Seed			1		
	Poaceae	Inflores.				1	
	Poaceae A	Floret			1		
	Poaceae A	Caryopsis			1		
	Sporobolus spp.	Caryopsis			8		
	Verbascum thapsus	Seed			8		
	Leaf				1		
	Roots					X	Few
	Rootlets					X	Moderate
	Charcoal:						

Table D.2. Macrofloral remains in samples from Magic Mountain (*continued*).

			Charred		Uncharred		
CN and Provenience	Identification	Part	W[1]	F[2]	W	F	Weight/Comments
	Total charcoal > 2 mm						0.585 g
	Cercocarpus montanus	Charcoal		2			0.010 g
	Pinus spp.	Charcoal		32			0.316 g
	Pinus sp. twig	Charcoal		1			0.009 g
	Prunus spp.	Charcoal		3			0.016 g
	Unidentifiable - vitrified	Charcoal		2			0.005 g
	Non-Floral Remains:						
	Bone > 2 mm					24	1.495 g
	Bone < 2 mm					X	Few
	Bone > 2 mm			4			0.186 g
	Bone < 2 mm			X			Few
	Bone – calcined > 2 mm			1			0.031 g
	Bone – calcined < 2 mm			X			Few
	Insect	Chitin				47	
	Insect	Egg			X	X	Few
	Lithic flake > 2 mm					34	2.511 g
	Lithic flake < 2 mm					X	Few
	Rock/Gravel					X	Moderate
	Snail shell				2		
	Tooth enamel					2	0.050 g
	Worm castings				X	X	Few
6037	**Volume Floated**						**8.0 Liters**
Feature 8	**Light Fraction Weight**						**46.522 g**
65-72 cm	Floral Remains:						
	Cactaceae	Spine		14			<0.001 g
	Pinus spp.	Bark scale		32			0.012 g
	Vitrified tissue			5			0.037 g
	Asteraceae	Seed			1		
	Helianthus spp.	Seed				11	
	Chenopodium spp.	Seed			5	2	
	Fabaceae	Seed			1		
	Lesquerella montana	Seed			1		
	Poaceae	Inflores.				1	
	Poaceae A	Floret			1	1	
	Poaceae A	Caryopsis			4	2	
	Poaceae C	Floret			1		
	Trifolium spp.	Seed			3		
	Rootlets					X	Moderate
	Charcoal:						
	Total charcoal > 2 mm						1.497 g
	Cercocarpus montanus	Charcoal		4			0.035 g
	Pinus spp.	Charcoal		31			0.804 g
	Prunus spp.	Charcoal		3			0.012 g
	Salicaceae	Charcoal		2			0.008 g
	Non-Floral Remains:						
	Bone > 2 mm					21	0.952 g
	Bone < 2 mm					X	Few
	Bone > 2 mm			5			0.134 g
	Bone < 2 mm			X			Few

Table D.2. Macrofloral remains in samples from Magic Mountain (*continued*).

CN and Provenience	Identification	Part	Charred W[1]	Charred F[2]	Uncharred W	Uncharred F	Weight/Comments
	Bone – calcined > 2 mm			6			0.273 g
	Bone – calcined < 2 mm			X			Few
	Insect	Chitin				X	Few
	Insect	Egg			X	X	Few
	Lithic flake > 2 mm					9	0.341 g
	Lithic flake < 2 mm					X	Few
	Rock/Gravel					X	Moderate
	Tooth enamel					3	0.144 g
2038	**Volume Floated**						**15.25 Liters**
Feature 10	**Light Fraction Weight**						**73.426 g**
Unit 48/56	Floral Remains:						
	Pinus spp.	Bark scale		29			0.033 g
	Vitrified tissue			12			0.088 g
	Amaranthus spp.	Seed			15	9	
	Argemone spp.	Seed			6	4	
	Asteraceae	Seed			2		
	Ambrosia spp.	Seed				13	
	Chenopodium spp.	Seed			35	8	
	Convolvulus spp.	Seed			5		
	Convolvulus arvensis	Seed			1	1	
	Lesquerella montana	Silique			5		
	Poaceae	Stem				X	Moderate
	Poaceae A	Floret			7	12	
	Poaceae A	Caryopsis			2		
	Sporobolus spp.	Caryopsis			3		
	Populus spp.	Fruit			2	1	
	Populus spp.	Seed			13		
	Verbascum thapsus	Seed			10		
	Leaf					X	Few
	Roots					X	Few
	Rootlets					X	Moderate
	Charcoal:						
	Total charcoal > 2 mm						1.038 g
	Cercocarpus montanus	Charcoal		3			0.012 g
	Pinus spp.	Charcoal		35			0.507 g
	Rosaceae - vitrified	Charcoal		2			0.015 g
	Non-Floral Remains:						
	Bone > 2 mm					6	0.024 g
	Bone < 2 mm					X	Few
	Bone – calcined > 2 mm			4			0.009 g
	Bone – calcined < 2 mm			X			Few
	Insect	Chitin				40	
	Insect	Egg			15		
	Insect	Puparium			2		
	Lithic flake > 2 mm					27	1.88 g
	Lithic flake < 2 mm					X	Moderate
	Rock/Gravel					X	Abundant

Table D.2. Macrofloral remains in samples from Magic Mountain (*continued*).

CN and Provenience	Identification	Part	Charred W[1]	Charred F[2]	Uncharred W	Uncharred F	Weight/Comments
7115	**Volume Floated**						**8.0 Liters**
Feature 11	**Light Fraction Weight**						**56.352 g**
Unit 32	Floral Remains:						
	Cactaceae	Spine		3			<0.001 g
	Pinus sp.	Bark scale		1			0.003 g
	Vitrified tissue > 2 mm			6			0.057 g
	Vitrified tissue < 2 mm			X			Few
	Amaranthus sp.	Seed				1	
	Asteraceae	Seed			1	3	
	Ambrosia spp.	Seed			2		
	Chenopodium spp.	Seed				5	
	Lesquerella montana	Silique			5		
	Poaceae	Stem				X	Moderate
	Poaceae A	Floret			3	24	
	Poaceae C	Floret			2	1	
	Sporobolus sp.	Caryopsis			1		
	Sphaeralcea sp.	Seed			1		
	Verbascum thapsus	Seed			6		
	Roots					X	Few
	Rootlets					X	Moderate
	Charcoal:						
	Total charcoal > 2 mm						2.252 g
	Pinus spp.	Charcoal		40			0.880 g
	Non-Floral Remains:						
	Bone > 2 mm					10	0.213 g
	Bone < 2 mm					X	Few
	Bone – calcined			1			0.010 g
	Insect	Chitin				21	
	Insect	Egg			17		
	Insect	Puparium			1		
	Lithic flake > 2 mm					27	1.832 g
	Lithic flake < 2 mm					X	Moderate
	Rock/Gravel					X	Moderate
	Sand					X	Abundant
	Rodent fecal pellet		2				
4345	**Volume Floated**						**15.0 Liters**
Feature 12	**Light Fraction Weight**						**107.444 g**
Unit 42	Floral Remains:						
	Cactaceae	Spine		45			0.002 g
	Echinocereus viridiflorus	Seed		6			0.002 g
	Pinus spp.	Bark scale		31			0.013 g
	Poaceae	Awn		1			<0.001 g
	Poaceae C	Caryopsis	1	1			<0.001 g
	Vitis riparia	Seed	1				0.015 g
	Vitrified tissue > 2 mm			32			0.183 g
	Vitrified tissue < 2 mm			X			Few
	Ambrosia sp.	Seed			1		
	Chenopodium spp.	Seed			16	21	
	Convolvulus arvensis	Seed			2		

Table D.2. Macrofloral remains in samples from Magic Mountain (*continued*).

CN and Provenience	Identification	Part	Charred W[1]	Charred F[2]	Uncharred W	Uncharred F	Weight/Comments
	Lesquerella montana	Silique			48	3	
	Poaceae	Stem				X	Moderate
	Poaceae A	Floret			1	46	
	Poaceae C	Floret			2		
	Poaceae C	Caryopsis			1		
	Sporobolus sp.	Caryopsis			1		
	Populus sp.	Seed			1		
	Tragopogon spp.	Seed				2	
	Verbascum thapsus	Seed			1		
	Roots					X	Few
	Rootlets					X	Numerous
	Charcoal:						
	Total charcoal > 4 mm						10.447 g
	Pinus spp.	Charcoal		40			2.616 g
	Non-Floral Remains:						
	Bone > 2 mm					45	1.08 g
	Bone < 2 mm					X	Few
	Bone > 2 mm			2			0.005 g
	Bone < 2 mm			X			Few
	Bone – calcined > 2 mm			5			0.067 g
	Bone – calcined < 2 mm			X			Few
	Insect	Chitin				89	
	Insect	Egg			2		
	Lithic flake > 2 mm					41	1.53 g
	Lithic flake < 2 mm					X	Moderate
	Rock/Gravel					X	Abundant
	Worm castings				19		
4386	**Volume Floated**						**24.0 Liters**
Feature 13	**Light Fraction Weight**						**146.763 g**
Unit 44	Floral Remains:						
	Cactaceae	Spine		7			<0.001 g
	Pinus spp. > 2 mm	Bark scale		43			0.082 g
	Pinus spp. < 2 mm	Bark scale		X			Few
	Poaceae C	Caryopsis	2	4			<0.001 g
	Vitrified tissue			5			0.036 g
	Ambrosia spp.	Seed			7	3	
	Chenopodium spp.	Seed			2	1	
	Convolvulus arvensis	Seed			4		
	Lesquerella montana	Silique			6		
	Poaceae	Stem				X	Moderate
	Poaceae A	Floret			4	8	
	Poaceae B	Floret			1		
	Sporobolus spp.	Caryopsis			3		
	Roots					X	Few
	Rootlets					X	Numerous
	Charcoal:						
	Total charcoal > 2 mm						1.344 g
	Pinus spp.	Charcoal		40			0.353 g
	Non-Floral Remains:						

Table D.2. Macrofloral remains in samples from Magic Mountain (*continued*).

			Charred		Uncharred		
CN and Provenience	Identification	Part	W[1]	F[2]	W	F	Weight/Comments
	Bone > 2 mm					27	1.07 g
	Bone < 2 mm					X	Few
	Bone > 2 mm			5			0.550 g
	Bone < 2 mm			X			Few
	Bone – calcined > 2 mm			1			0.025 g
	Insect	Chitin				124	
	Insect	Egg			4		
	Insect	Puparium				9	
	Lithic flake > 2 mm					63	10.20 g
	Lithic flake < 2 mm					X	Moderate
	Rock/Gravel					X	Abundant
	Snail shell					19	
	Worm castings				11		
4405	**Volume Floated**						**18.5 Liters**
Feature 14	**Light Fraction Weight**						**87.045 g**
Unit 52	Floral Remains:						
	Cactaceae	Spine		1			<0.001 g
	Pinus sp.	Bark scale		1			0.003 g
	Vitrified tissue			2			0.028 g
	Ambrosia spp.	Seed			2	1	
	Cactaceae	Spine				1	
	Chenopodium spp.	Seed			1	1	
	Convolvulus arvensis	Seed			8		
	Lesquerella montana	Silique			42	9	
	Poaceae	Stem				X	Moderate
	Poaceae A	Floret			2	29	
	Poaceae B	Floret				8	
	Poaceae C	Floret			2		
	Sporobolus spp.	Caryopsis			3		
	Sambucus spp.	Seed			2		
	Sphaeralcea sp.	Seed			1		
	Verbascum thapsus	Seed			1		
	Unidentified	Seed			1		
	Roots					X	Few
	Rootlets					X	Numerous
	Charcoal:						
	Total charcoal > 4 mm						4.201 g
	Juniperus spp.	Charcoal		2			0.062 g
	Pinus spp.	Charcoal		2			0.065 g
	Rosaceae – vitrified	Charcoal		3			0.059 g
	Cercocarpus montanus	Charcoal		1			0.019 g
	Cercocarpus montanus – vitrified						
	Charcoal		1			0.023 g	
	Prunus spp.	Charcoal		13			0.371 g
	Salicaceae	Charcoal		8			0.153 g
	Unidentified hardwood – vitrified	Charcoal		10			0.402 g
	Non-Floral Remains:						
	Bone – calcined > 2 mm			3			0.168 g
	Bone – calcined < 2 mm			X			Few

Table D.2. Macrofloral remains in samples from Magic Mountain (*continued*).

			Charred		Uncharred		
CN and Provenience	Identification	Part	W[1]	F[2]	W	F	Weight/Comments
	Insect	Chitin				32	
	Insect	Egg			10		
	Insect	Puparium				6	
	Lithic flake > 2 mm					38	2.41 g
	Lithic flake < 2 mm					X	Moderate
	Rock/Gravel					X	Abundant

[1] W=whole

[2] F = fragment

[3] X = presence noted in sample

[4] Inflores. = inflorescence

[5] pc = partially charred

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