



INDEX OF TEXAS ARCHAEOLOGY

Open Access Gray Literature from the Lone Star State

Volume 2017

Article 101

2017

Survey Of Bouldering Problems And Enhanced Documentation Of Native American Rock Imagery, Hueco Tanks State Park And Historic Site, El Paso County, Texas

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Survey Of Bouldering Problems And Enhanced Documentation Of Native American Rock Imagery, Hueco Tanks State Park And Historic Site, El Paso County, Texas

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SURVEY OF BOULDERING PROBLEMS AND ENHANCED
DOCUMENTATION OF NATIVE AMERICAN ROCK IMAGERY,
HUECO TANKS STATE PARK AND HISTORIC SITE,
EL PASO COUNTY, TEXAS

Christopher V. Goodmaster, Lawrence L. Loendorf, and Myles Miller



Prepared for:
Texas Parks and Wildlife Department

Texas Antiquities Permit 7586

Versar Miscellaneous Reports of Investigations Number 616



August 2017

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Texas Antiquities Permit 7586

Versar Miscellaneous Reports of Investigations
Number 616

August 2017

ABSTRACT

This report presents the results of an extensive photographic survey of recreational boulder climbing routes (i.e., bouldering problems) and enhanced documentation of Native American rock imagery at Hueco Tanks State Park and Historic Site in El Paso County, Texas, by Versar, Inc., for Texas Parks and Wildlife Department. Fieldwork for this project was conducted between March and June 2016. Based on the two most comprehensive bouldering guidebooks available for Hueco Tanks, approximately 1,901 published bouldering problems exist within the park. Of these, 172 bouldering problems are within areas indicated as closed as of June 2015 by the Public Use Plan and park administration for erosion control, rock art protection, or other resource conflicts and therefore were not part of the survey scope; however, 18 of these closed bouldering problems were documented during training exercises for this survey. An additional 122 previously unpublished bouldering problems were identified and documented during this survey. In total, 1,869 bouldering problems were documented by this project. During this survey, the rock surface along each boulder problem was systematically photographed. A digital image enhancement algorithm (DStretch) was applied to each survey photograph, which were then reviewed for the presence of Native American rock art imagery or pigment remnants. Native American imagery or pigment remnants were identified and documented at 31 locations within or near currently open bouldering problems and at three locations adjacent to currently closed problems. Native American rock imagery identified and documented during this effort range from sparse pigment remnants to identifiable stylistic elements and patterns characteristic of the Jornada Mogollon prehistoric cultural region.

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ACKNOWLEDGEMENTS

Much appreciation is extended to the Texas Parks and Wildlife Department for providing the Versar team with this opportunity. Thanks are extended to TPWD Director of Cultural Resources Michael Strutt, Regional Cultural Resources Coordinator Tim Roberts, and Archeology Laboratory Collections Manager Aina Dodge for their coordination efforts at the state and regional levels. The staff of Hueco Tanks State Park and Historic Site patiently facilitated survey efforts and graciously allowed the survey team daily access to various areas of the site. Ian Cappelle and Sid Roberts diligently assisted in all aspects of field survey and contributed immensely to the efficiency of this project. Dr. Jon Harman provided the team with comprehensive training for use of the DStretch software during survey and analysis, and Virginia Hatfield diligently processed over 25,000 images using the software. Mark Willis contributed to the survey design and training of the field team and collected UAV aerial imagery of the site for use in mapping and documentation efforts. Selected rock art locations were assessed and documented by Larry Loendorf and illustrated by Laurie White. The prehistoric rock art imagery of Hueco Tanks was assessed within local and regional archaeological contexts by Larry Loendorf and Myles Miller.

Several additional Versar personnel were involved in this project, and their participation and insights are appreciated. Technical Services Lead Duane Peter maintained oversight and quality control throughout the process of this investigation, and Michelle Wurtz Penton provided support with numerous aspects of project management. Andrew Parkyn assisted in processing GPS survey data and created TPWD forms for each documented rock art location. Bridget McGregor edited the technical report and was responsible for its formatting and production.

Chapter One

Introduction

Hueco Tanks is a cluster of low volcanic mountains located at the eastern margin of the Hueco Bolson, a high-altitude desert basin near the Texas-New Mexico border in eastern El Paso County, Texas (Figure 1.1). The location derives its name from the Spanish word “*hueco*” meaning “hole” or “hollows” in reference to the numerous shallow depressions across the surface of the rock outcrops that form the hills. The area preserves a vast corpus of prehistoric Native American rock art imagery representing millennia of spiritual beliefs and social interaction within this distinctive desert environment. The location was later important in the early exploration and settlement of the region. Hueco Tanks is also widely regarded as one of the best areas in the world for bouldering, a form of rock climbing that does not rely on the use of ropes for protection against falls, and has become an internationally acclaimed destination for climbing enthusiasts seeking a wide variety of boulder climbing routes (referred to as “problems” by rock climbers). Due to the unique concentration of archaeological and historical resources, vegetation, wildlife, and recreational opportunities, the property was acquired by the State of Texas in the late 1960s and was opened to the public as Hueco Tanks State Historical Park in May 1970 under the stewardship of the Texas Parks and Wildlife Department (TPWD).

Hueco Tanks State Park and Historic Site is located approximately 32 miles northeast of the city of El Paso. The park encompasses an area of 860 acres and includes four prominent porphyritic syenite outcrops, often referred to as North Mountain, West Mountain, East Mountain, and the East Spur (Figure 1.2). The park was listed in the National Register of Historic Places on July 14, 1971, and was officially designated as a State Archeological Landmark on June 28, 1983. The mission of the park is to protect, restore, and interpret the unique natural and cultural features of the park. Due to increasing recreational use and resource conflicts within this fragile desert environment, a multi-staged conservation effort was made in the late 1990s to improve stewardship of cultural and natural resources and to maintain balance with recreational use at the site.

In response to increasing pressures on the natural and cultural resources of the park, TPWD initiated the development of a resource management plan (Bryan et al. 1999) and established a public use plan “to balance preservation of the natural and cultural resources and the accommodation of recreational use” (TPWD 2000:3). Inventory surveys were conducted during the public use plan review period in 1999 to provide additional information regarding the park’s cultural resources, including documentation of archeological sites (Howard et al. 2010) and rock art panels (Harry et al. 2001) within the park. The 1999 rock art survey provided an initial inventory of the pictograph panels known to exist within the park prior to the survey and

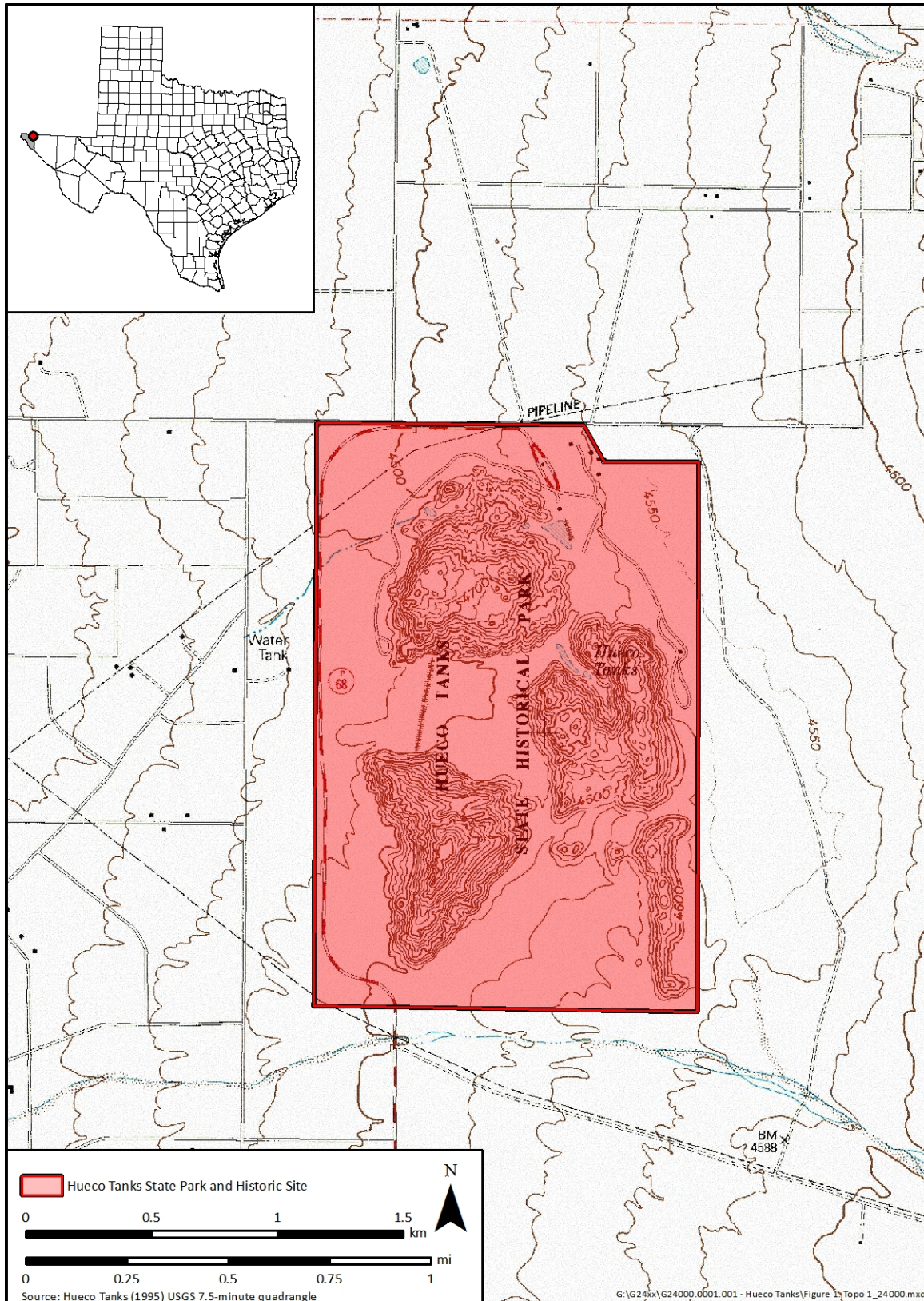


Figure 1.1. Location of Hueco Tanks State Park and Historic Site in northeastern El Paso County, Texas.

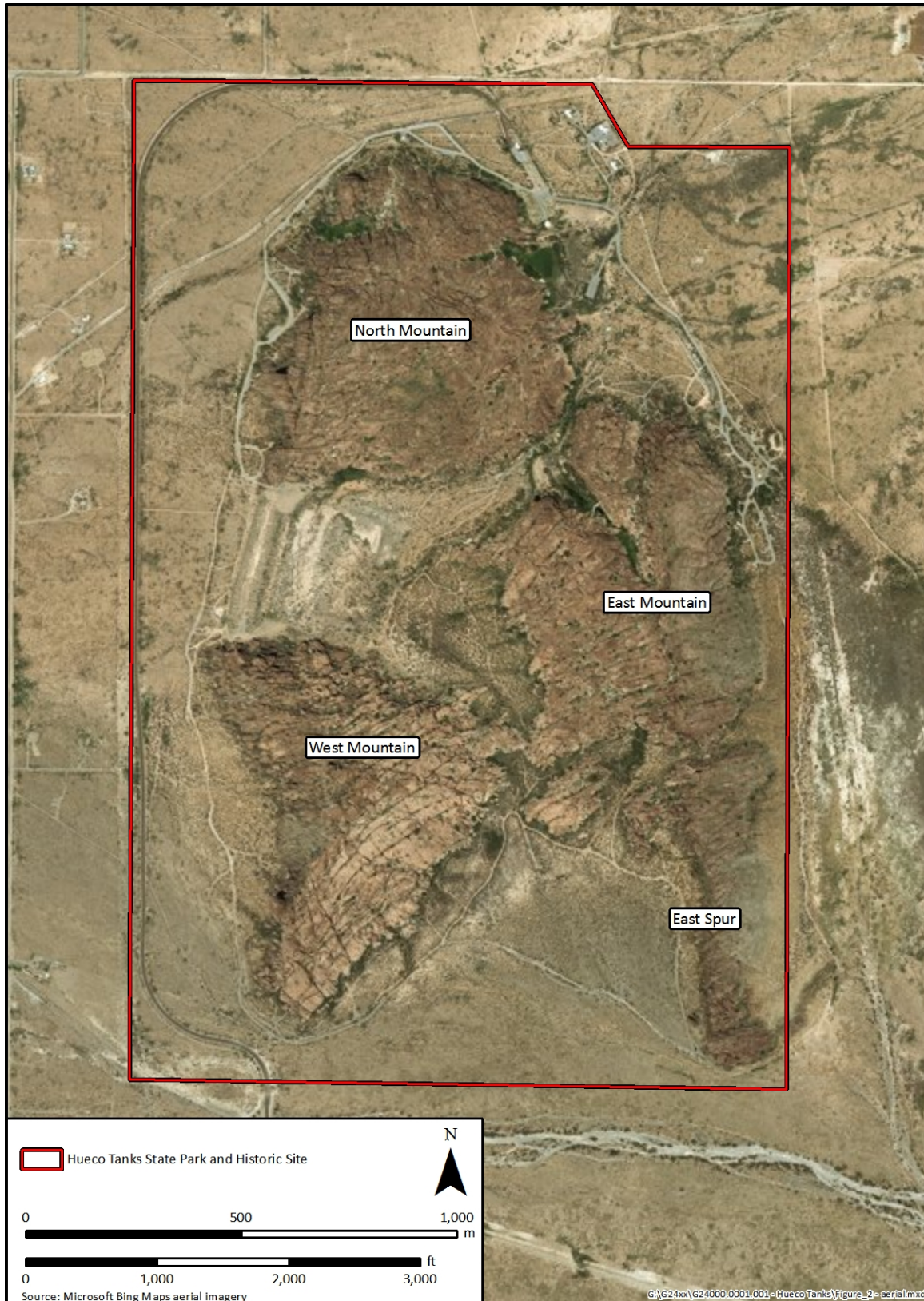


Figure 1.2. Locations of the four mountains within Hueco Tanks State Park and Historic Site.

documented additional pictograph panels during the course of the inventory survey. The results of the 1999 rock art survey suggested that additional rock art panels were likely to be preserved in areas of the park that had not yet been studied intensively. Furthermore, digital enhancement of rock art inventory photographs revealed the presence of additional pictographs, and indicated that rock surfaces that appear to be undecorated have the potential to contain pictographs not readily visible to the unaided eye.

To further the goals of promoting sound management decisions based on current and relevant data and information, this project was conducted to provide a systematic and comprehensive survey of all current bouldering problems within the park. The project consists of detailed digital photography of all bouldering problems currently open to recreational use and enhancement of the survey photographs using a decorrelation stretch image enhancement algorithm (DStretch [Harman 2005]) to elucidate the presence of faint or faded pigments on the natural rock surface. This project was conducted by Versar, Inc., for TPWD to contribute to the management of the park's cultural and recreational resources and was performed under Texas Antiquities Permit 7586.

This effort was facilitated by TPWD Director of Cultural Resources Michael Strutt, Regional Cultural Resources Coordinator Tim Roberts, and Park Superintendent Ruben Ocampo and Assistant Office Manager Maria Valles of Hueco Tanks State Park and Historic Site. Fieldwork was primarily conducted between March 24 and June 8, 2016, by Principal Investigator Christopher Goodmaster of Versar, Inc., Climbers of Hueco Tanks Coalition Chairman and commercial climbing guide Ian Cappelle, and commercial climbing guide Sid Roberts. The field team benefited from the assistance and expertise of Program Director Myles Miller of Versar, Inc., and teaming partners Dr. Jon Harman (DStretch), Dr. Lawrence L. Loendorf (Sacred Sites Research, Inc.), Laurie White (Whitelight Images), and Mark D. Willis Archaeological Consulting. Dr. Virginia Hatfield of Hatfield Archaeological Services, LLC, performed comprehensive DStretch analysis of survey photographs and management of field data. The remainder of this report summarizes the environmental and cultural context of Hueco Tanks State Park and Historic Site, the field and data processing methods utilized during this survey, and a discussion of the Native American rock imagery identified and documented during this survey.

Chapter Two

Environmental and Cultural Context

The porphyritic syenite mountains of Hueco Tanks have attracted human attention for over 10,000 years. Rising nearly 500 feet above the surrounding landscape, this unique and rugged terrain has provided shelter, water resources, and raw materials to many generations of people inhabiting the region. This chapter summarizes the natural environment and provides a synopsis of the prehistoric occupation of the area.

Geology and Physiography

Hueco Tanks State Park and Historic Site is located within the Mexican Highland subdivision of the southeast part of the Basin and Range physiographic province (Fenneman 1931:326–438). The Basin and Range province is characterized by generally linear, parallel mountain ranges separated by broad, flat, fault-bounded structural depressions, or basins. The park is located at the northeastern margin of the Hueco Bolson, one of the individual basins composing the Basin and Range province that extends generally northwest-to-southeast for approximately 130 miles (Fenneman 1931:387–388; Heywood and Yager 2003). In the vicinity of Hueco Tanks, the Hueco Bolson is bounded on the east by the Hueco Mountains (the dissected western escarpment of the Diablo Plateau [Sellards et al. 1932:53]) and on the west by the Franklin Mountains.

The Hueco Mountains and adjacent foothills surrounding Hueco Tanks consist primarily of horizontally bedded Paleozoic-age sedimentary rocks deposited between the Silurian and the Permian periods (Collins and Raney 1991). Volcanic intrusions during the Eocene and early Oligocene periods created a series of igneous sills, dikes, laccoliths, and plugs across the region between approximately 48 and 32 million years ago. Hueco Tanks represents one of these igneous intrusions and comprises a dome-shaped porphyritic syenite laccolith and adjacent sill formed approximately 32.8 million years ago (Henry et al. 1986). Following the intrusion of these igneous formations, expansion of the crustal plate and widespread faulting during the Oligocene epoch resulted in the underlying basin and range structural geology. Subsequent erosion during the Neogene and Quaternary periods over the last 25 million years has resulted in erosion of the adjacent mountain ranges and deposition of vast quantities of alluvial, colluvial, and eolian sediments within the Hueco Bolson, yielding the broad, generally flat basin topography characterizing the region today (Gustavson 1991).

The park is located on a gentle west-sloping surface of alluvial sediments that have accumulated from erosion of the western flank of the Hueco Mountains approximately 1 mile to the east. The alluvial fan surface on which the park is situated occupies an elevation range of approximately 4,470 to 4,550 feet (ft; 1,362 to 1,387 meters [m]) above modern sea level (amsl). Three of the four massive rock outcrops that compose the park were designated North Mountain, East Mountain, and West Mountain by Forrest Kirkland in 1939. The fourth major landform, a linear ridge extending south from the southeast corner of East Mountain, has been previously referred to as South Mountain or, more recently, the East Spur. The tallest of these is West Mountain, rising approximately 470 ft (143 m) above the surrounding terrain to a height of approximately 4,900 ft

(1,493 m) amsl. The East Spur, by comparison, reaches a maximum height of only 130 ft (39.6 ft) above the surrounding ground surface to a maximum elevation of approximately 4,670 ft (1,423 m) amsl. Within these rock outcrops are narrow, steep-sided canyons, rock outcrops, talus slopes, and meadows of varying scales.

Prehistoric Cultural Context

The prehistory of the Jornada Mogollon region encompasses several cultural periods and phases (Table 2.1). The following discussion of the prehistoric culture history of the region is adapted and modified from comprehensive overviews by Miller (2005, 2017a) and Miller and Kenmotsu (2004). A recent analysis of 3,800 radiocarbon dates, combined with a review of the past two decades of archaeological work on Middle and Late Archaic period occupations across Fort Bliss and the greater Jornada region, has substantially revised our understanding of the settlement, subsistence, and social trends of the 5,000-year-long Archaic time interval (Miller 2017a). A revised phase sequence has been developed that includes two Middle Archaic Period phases (Tularosa and Keystone) and three Late Archaic phases (Fresnal, Arenal, and Hueco) with revised beginning and end dates. Formative Period phases were revised in a similar manner based on a review of 1400 radiocarbon dates (Miller 2005). Pre-contact through historic period accounts are available in Miller (2001), Seymour (2002), and Peterson and Brown (1994). The rock art and prehistoric use of Hueco Tanks spans most of the temporal periods listed in Table 2.1.

Table 2.1. Prehistoric and historic cultural sequence of the Jornada region

Cultural Period/Phase	Time Interval	Reference
Pre-Clovis	ca. 50,000–11,000 B.C.	MacNeish and Libby 2003
Paleoindian	ca. 11,000–6000 B.C.	Amick 1994a; Miller and Kenmotsu 2004
Clovis	ca. 11,000–9000 B.C.	
Folsom	9000–8200 B.C.	
Plano/Cody	8200–6000 B.C.	
Early Archaic	6000–4000 B.C.	Miller 2017a
Middle Archaic	4000–1400 B.C.	Miller 2017a
Tularosa	4000–2500 B.C.	
Keystone	2500–1400 B.C.	
Late Archaic	1400 B.C.–A.D. 500	Miller 2017a
Fresnal	1400–750 B.C.	
Arenal	750–300 B.C.	
Hueco	300 B.C.–A.D. 500	
Formative	A.D. 500 - 1450	Miller 2005; Miller and Kenmotsu 2004
Mesilla	A.D. 500–1000	
Early Doña Ana	A.D. 1000–1150	
Late Doña Ana	A.D. 1150–1300	
El Paso	A.D. 1300–1450	Miller and Graves 2009, 2012
Precontact	A.D. 1450–1580	Beckett and Corbett 1992; Seymour 2002
Protohistoric	A.D. 1580–1659	Miller 2001; Seymour 2002
Historic	A.D. 1659–present	Peterson and Brown 1994

Pre-Clovis Tradition (~50,000 to 11,000 B.C.)

The existence of pre-Clovis occupations in North America, or a “Pre-Projectile Point Horizon” as it is occasionally referred to, has been the subject of considerable debate since Alex Krieger (1953, 1962, and 1964) first suggested that pre-Clovis lithic traditions (40,000 to 15,000 B.C.) existed in Texas and elsewhere throughout the United States.

Claims of pre-Clovis manifestations in the Jornada Mogollon region were resurrected in the 1990s and generated a substantial amount of controversy (Chrisman et al. 1996; MacNeish 1993; MacNeish and Libby 2003; MacNeish and Marino 1993). MacNeish and Libby (2003) claim that a pre-Clovis occupation exists based on excavations at Pendejo Cave, a deeply stratified rockshelter located on McGregor Range east of Orogrande, New Mexico. Zones C1 through O exhibited a well-stratified sequence of radiocarbon dates ranging between 12,000 and ~50,000 years in age. These strata contained large quantities of Pleistocene faunal material, well-preserved plant remains, and other ecofacts that were purportedly in association with hearths, stone artifacts, modified animal bones, human skin impressions, and human hair.

Claims of pre-Clovis occupations are based primarily on the presence of a small quantity of crudely manufactured stone artifacts, a very small number of bones with fractures or marks that could be suggestive of human modification, hearth features constructed of stones differing petrologically and chemically from the limestone rock formations composing the natural setting of the cave, and the presence of hair and skin imprints claimed to be of human origin.

An independent evaluation of the site conducted in 1995 by Fort Bliss archaeologists and Tom Stafford of the University of Colorado resulted in a revised interpretation of the stratigraphic sequence. In addition, 15 accelerator mass spectrometer (AMS) radiocarbon dates were obtained from rodent pellets collected from well-documented columns in two exposed profiles in the shelter. The results of this study have not been reported, but preliminary analyses suggest that the stratigraphic sequence and assumed integrity of the layered deposits may require substantial reconsideration (see Miller and Kenmotsu 2004). Extensive packrat middens are present throughout the shelter, and preliminary results of the radiocarbon dating suggest that the degree of disturbance in the deposits is greater than previously assumed. If proven that valid cultural occupations exist in the lower strata, such findings would contribute to a reevaluation of pre-Clovis cultures in North America. The series of independent studies conducted so far, however, do not support the argument for a Pleistocene human presence in the region.

Paleoindian Period (11,000 to 6000 B.C.)

The earliest conclusively documented evidence of prehistoric human occupation in the Jornada region occurs during the Paleoindian period. Paleoindian adaptations have been viewed as a tradition of small, highly mobile bands with a subsistence economy centered on hunting large game animals such as mammoth and bison (Judge 1973). The period is subdivided into three sequential traditions marked by functional and stylistic differences in tool kits that are thought to reflect changing hunting and settlement adaptations: the Clovis and Folsom complexes of the early Paleoindian period and the Plano/Cody complex of the late Paleoindian period.

Recognition of Paleoindian sites in the Jornada region has been principally accomplished through cross dating distinctive lanceolate projectile point forms with those found at chronometrically dated habitation and kill sites in adjacent regions of the Great Plains. Paleoindian culture is

represented primarily by isolated finds of projectile points and by a small number of open-air sites located within the Tularosa Basin and Hueco and Mesilla bolsons. Substantial numbers of Paleoindian artifacts have been documented across the Jornada region; however, the number pales in comparison with the number of sites from later time periods. Several sites have been investigated, but few have been fully reported.

At the present time, no absolute chronometric dates have been obtained from contexts or features in secure association with Paleoindian materials in the Jornada. The only radiocarbon dates falling within this period were obtained from deposits of charred material deeply buried in floodplain alluvium of the Rio Grande Valley north of Las Cruces, New Mexico. The samples were collected during geomorphic studies of Quaternary-aged surfaces in the valley (Gile et al. 1981), and the deposits from which the samples were obtained were not described. Additional early dates have been obtained from Fresnal Shelter, Burnett Cave, and Hermit Cave in the Sacramento-Guadalupe mountain chain; although in each case, the association of the date and any human occupation or material culture remains inconclusive (Miller and Kenmotsu 2004).

The environment during this period was characteristic of the Late Pleistocene-Holocene transition: moist woodlands and continual stream flow in mountains and other high elevation settings, and standing lakes and marshes throughout the interior basins. Evidence from packrat middens suggests juniper-oak woodlands along with grassland savannahs in the basins during the early part of the period. Increasingly drier conditions prevailed until 6000 B.C., when woodlands were displaced by Chihuahuan, desert scrub communities and large game animals became extinct (Van Devender 1990).

Clovis Complex: Knowledge of Clovis occupation in the Jornada Mogollon region has been obtained almost entirely through rare, isolated finds of the distinctive, fluted lanceolate projectile points characteristic of the period. However, few Clovis points and even fewer Clovis sites have been documented (Meltzer and Bever 1995). Two habitation sites of this period have been reported from the Jornada Mogollon region. Beckett (1983) notes the presence of Clovis tools mixed with later Paleoindian materials at a site in Rhodes Canyon in New Mexico's southern Tularosa Basin. Weber and Agogino (1997) reported a substantial Clovis occupation at Mockingbird Gap in the northern Tularosa Basin.

The excavators noted the presence of several suspected living surfaces; approximately one hundred whole and partial Clovis points were recovered during the investigations, as well as a substantive quantity of small mammoth bone fragments. Otherwise, very few artifacts or occupations attributable to this period have been recorded during the course of numerous professional archaeological surveys on Fort Bliss and many other areas of the region; it appears that Clovis manifestations are exceptionally rare within the Jornada Mogollon region. The nature of Clovis settlement types, hunting and subsistence adaptations, mobility patterns, or technological organization in the Jornada remain almost entirely unknown.

Folsom Complex: Folsom manifestations in the Jornada region are much better known than their Clovis predecessors. Numerous Folsom points and occupation sites have been recorded during archaeological surveys. Although they have been found in many topographic zones, including mountains, alluvial fans, and plateaus, most Folsom materials have been documented near playa basins, major and minor drainages, and the margins of the Rio Grande Valley, which may

indicate an adaptation of hunting game animals near water sources. Several excavations of Folsom components have been undertaken during the past decade, including at a site in Fillmore Pass on Fort Bliss (Stiger n.d.), Boles Wells in the Tularosa Basin (Mauldin and O'Leary 1994), and Padre Canyon sites 41HZ504 and 41HZ505 in the Hueco Bolson southeast of El Paso (Mauldin and Leach 1997). The nature of Folsom tool forms, subsistence adaptations, and mobility patterns in the region have also been the subject of serious investigation (Amick 1994a, 1995, 1996).

Due to the absence of stratigraphically ordered deposits, most Folsom components are mixed with later occupations, making inferences concerning Folsom technological adaptations tentative. Most analyses have focused on tool forms and debitage attributes characteristic of the period. Lithic assemblages typically contain very high proportions of high-quality, fine-grained materials including chert, chalcedony, and obsidian. Raw materials such as nonlocal obsidians, Chuska chert, Edwards Plateau chert, and Alibates chert (Amick 1994b; Miller and Kenmotsu 2004), obtained from sources up to 450 km away, have been identified in Folsom assemblages from the Tularosa Basin and Hueco Bolson. The presence of these materials suggests either long-term population movements or trade with other groups.

Through the analysis of tool forms and detailed studies of raw material types, important insights into regional mobility patterns of Paleoindian groups and functional aspects of their settlements are beginning to emerge. The common presence of nonlocal raw materials among discarded tool assemblages suggests that the tools had been manufactured elsewhere and transported to the sites in final form. Likewise, debitage collections often consist of predominantly local materials, indicating that the inhabitants were manufacturing tools, or 'gearing up' for the next round of group movement and hunting forays. Based upon the distribution of distant and local raw material sources, assemblage content, and the relative scarcity, but large size, of Folsom components in the Jornada region, Amick (1994a, 1996) has argued that Folsom sites in the region were residential or 'home base' localities oriented toward hunting game animals other than bison. This pattern differs from the Southern Plains, where sites were more logistically organized and oriented towards the hunting of bison. Unfortunately, the nature of any contemporaneous, supplemental foraging activities of Folsom hunters within the Jornada region is not well understood.

Late Paleoindian to Plano and Cody Complexes: A variety of tool traditions have been recognized for the late Paleoindian period and are collectively referred to as the Plano and Cody complexes (Wheat 1972). Meserve, Golondrina, Angostura, Eden, and Scottsbluff type projectile points characterize the period. Isolated Plano/Cody projectile points and tools are common in the Hueco Bolson and Tularosa Basin (Miller and Kenmotsu 2004). Plano/Cody components are found in many topographic zones, including mountains, alluvial fans, and plateaus, but most finds have been documented near playa basins, major and minor drainages, and the margins of the Rio Grande Valley, which may also indicate an adaptation of hunting game animals near water sources.

Environmental changes that occurred during the Early Holocene brought about several changes in human adaptation at the close of the Paleoindian period. The persistent drying trend continued, with a resultant demise of large game mammals, expansion of plant communities adapted to drier conditions, and constriction of perennial water sources. These changes undoubtedly contributed

to large-scale changes in subsistence strategies, requiring a diversification of the Paleoindian subsistence base, with a greater focus on exploitation of plant foods. Such changes, and accompanying shifts in settlement and technology, mark the onset of the Archaic period at circa 6000 B.C.

Early Archaic Period (6000 to 4000 B.C.)

The Early Archaic is one of the least understood time periods of the Jornada prehistoric sequence. Early Archaic occupations have been defined primarily based on projectile point styles and a few insubstantial deposits or features. The overall number of projectile points found does not greatly outnumber those of the preceding Paleoindian period. Few firmly dated Early Archaic contexts have been identified in the Jornada and have primarily involved deeply buried features or rockshelter deposits. However, these deposits have yielded little data concerning subsistence, settlement, and technology (Miller and Kenmotsu 2004).

Projectile technology emphasizes a change from the lanceolate forms of the preceding Paleoindian period to stemmed forms such as Jay, Bajada, and Uvalde. Along with the adoption of these stemmed projectile point forms came a noticeable change in the use of coarser-grained raw materials for the manufacture of projectiles. Additional technological changes include the utilization of rock or caliche for heating elements in thermal features and the use of groundstone.

The factors causing such changes are still unknown, although they may be related to changes in prey selection and hunting practices, restricted home ranges that caused an increase in local raw material use, reduced emphasis on tool maintenance and an increase in tool reliability, or a combination of these factors. Though speculative, the settlement and subsistence of the Early Archaic can be characterized by an absence of structures, use of larger burned-rock features on the alluvial fans and other hearth features in all environmental zones, use of artifacts, and changes in projectile point technology and raw material utilization. These data suggest an adaptation of seasonally mobile, small band, hunter-gatherers (Miller and Kenmotsu 2004).

Middle Archaic Period (4000 to 1400 B.C.)

The Middle Archaic period includes two phases, Tularosa and Keystone. Fundamental subsistence, settlement, and technological adaptations established in the Early Archaic tend to be maintained through the first half of the Middle Archaic during the Tularosa phase.

Tularosa phase (4000–2500 B.C.): The first half of the Middle Archaic, designated as the Tularosa phase, is essentially a continuation of Early Archaic lifeways with the addition of new projectile point designs, including the appearance of San Jose-Pinto cluster projectile points. Otherwise, the fundamental subsistence, settlement, and technological adaptations established in the Early Archaic were maintained through the first millennium of the Middle Archaic. The rarity of radiocarbon dated contexts and diffuse nature of settlement across the landscape indicates that the Jornada region was inhabited lightly and intermittently during this interval. These observations mirror similar conclusions for the Middle Holocene period in adjacent regions, suggesting that populations declined in the lowland deserts during this period of harsh environmental conditions.

Keystone phase (2500–1400 B.C.): Coinciding with the end of the Altithermal and the beginning of more favorable climatic conditions, 4500 cal. BP represents a watershed period in the Archaic

prehistory of the Jornada region. There is a pronounced increase in the number of sites and features across all landforms, a factor reflected by a marked increase in radiocarbon age estimates. Village settlements with groups of three or more domestic structures appeared during this period, as exemplified by the discovery in the late 1970s of pithouses at Keystone Dam Site 33, located along the lowermost terrace of the Rio Grande Valley in northwest El Paso, Texas. In tandem with these first village settlements, the earliest evidence of maize horticulture appears, although the strength of the evidence is subject to debate. Pit features are one of the more distinctive facilities of Keystone phase settlements. These pits include several variants, the function of which remains unclear, although it appears that the pits served as both storage and baking facilities.

Village settlements were only one component of a broader seasonal settlement system that included camps, communal plant baking facilities, and ritual features. The Keystone phase witnessed the introduction, development, and spread of several technologies. Plant baking pits became formalized constructions with standardized components of baking pit, soil borrow pit, and burned rock discard midden. Contracting stem projectile points are a hallmark of the Keystone phase and are mostly found at sites dating between 4500 and 3000 cal. BP.

Evidence of group aggregation and communal feasting is found among the burned rock middens of the mountain foothills. The first visual expressions of cosmology in the form of rock art and mobiliary art, perhaps accompanied by placemaking, occurred during this pivotal interval of the Jornada Archaic.

Late Archaic Period (1400 B.C. to A.D. 500)

The Late Archaic period includes three phases, Fresnal, Arenal, and Hueco. The Late Archaic is both a time of continuity and change from the preceding Middle Archaic Keystone phase, and several technological innovations and changes in settlement adaptations characteristic of the period presage developments during the Formative period.

Fresnal Phase (1400–750 B.C.): The Late Archaic Fresnal phase was a period of incipient agriculture but is otherwise poorly known. Chronologically, the Fresnal phase is contemporaneous with the revised dating of the San Pedro phase in southern Arizona (Mabry 1998; Gregory 2001), and as the San Pedro phase brackets the expansion of agricultural settlements and introduction of notched projectile point forms in the Sonoran Desert, so does the Fresnal phase mark similar changes in the Chihuahuan Desert of southern New Mexico and west Texas.

The presence of early agriculture has been firmly established by the series of radiocarbon dates on maize from Fresnal, Tornillo, and High Rolls shelters (Carmichael 1982; Lentz 2006; Tagg 1996; Upham et al. 1987). All of the dated maize is from dry caves and shelters in the mountains, and it is unknown whether maize agriculture first occurred in the favorable environments of the mountains or whether the apparent absence at lowland settlements is due to poor preservation of macrobotanical and pollen remains. Despite the evidence for early agriculture, the Fresnal phase cannot be considered an agricultural or even a predominantly horticultural period, but rather was a period of a broad-spectrum subsistence economy that included plant baking, wild plant foods, and hunting. Faunal assemblages from Fresnal phase deposits in High Rolls shelter (Akins 2006) and combined Fresnal and Hueco deposits in Fresnal shelter (Wimberley and Eidenbach 1981)

show a heavy emphasis on artiodactyl hunting with extensive processing occurring in and around the shelters. In contrast, faunal collections from rockshelters situated at lower elevations in the Organ and Hueco mountains consist of predominantly leporid and small mammal remains (Dawson 1993; Harris 1995).

The rate of site formation increases over the preceding Middle Archaic, settlements expand throughout several environmental zones, and seasonal variations in settlement types are apparent, particularly between the desert basins and higher elevation settings in the foothills and uplands of surrounding mountains. The distribution of plant baking pits expands throughout new niches, including lower elevation alluvial fans and canyons. In the lowland basins, numerous settlements consisting of clusters of huts and hearths date to this period, but settlements are often mixed with earlier and later components, and the nature of settlement and technology are poorly known. Projectile technology is marked by the introduction of side-notched varieties generally classified under the San Pedro Cluster, including small and large varieties.

Arenal Phase (750–300 B.C.): The Arenal phase is a distinctive interval in the middle of the Late Archaic sequence during which several major features and settlement types essentially disappear from the radiocarbon record for a period of four centuries (Miller 2017a). An analysis of over 2,000 radiocarbon dates from the Archaic era identifies a clear decline in, and in some instances the near abandonment of, the use of certain features, technologies, subsistence practices, and, it is assumed, various landforms. The interval coincides with a flat region of the radiocarbon calibration curve, but the drastic decline in dates for certain features, subsistence practices, and site types cannot be attributed solely to calibration curve effects.

The Arenal phase was a 450-year-long hiatus in the radiocarbon record of plant baking pits and storage pits. The radiocarbon record also reveals a particularly steep decline in the use of rockshelters. Moreover, in contrast to the preceding Fresnal and subsequent Hueco phases of the Late Archaic sequence, the Arenal phase was distinctly non-agricultural. Only two of 84 Archaic period dates associated with maize fall within this interval, and one has a 200-year standard error that yields a calibrated 2-sigma age range spanning portions of all three Late Archaic intervals. The rarity of subsurface storage pits compared to the preceding and following phases is further evidence of this apparent hiatus in farming practices throughout the region. The reason for the decline of plant baking pits is unclear, since the technology and practice of earth oven baking existed from the Early Archaic period and has persisted through modern times.

Environmental conditions may have played a role in the profound settlement changes of the Arenal phase. Evidence from cave speleothem, pollen sequences, and fire-related alluvial chronologies (Frechette and Meyer 2009; Jimenez-Moreno et al. 2008; Polyak and Asmerom 2001) suggest that wetter climatic conditions prevailed during this period. Settlements are often situated near playas in a pattern reminiscent of the Middle Archaic period.

The Arenal phase is clearly an anomalous interval in the Late Archaic sequence. The phase has only recently been identified and accordingly there has been little targeted research on sites and material culture of the period. Aside from the general patterns observed in the radiocarbon record and a small sample of hut structures and settlements, the period is poorly known.

It is important to note that the absence of certain features, technologies, and subsistence practices does not mean that the Jornada region was abandoned during the Arenal phase. In relation to the

subsistence trends described in the preceding historic context, several lines of evidence show that there was a shift, or reversion, to a more residentially mobile settlement organization similar to that of the Middle Archaic. In light of the environmental data suggesting a wetter interval and the archaeological data indicating that populations of the Arenal phase reverted to more mobile hunter-gatherer adaptations, it is possible that the territorial domains of Arenal phase groups included large areas of the deserts and uplands of New Mexico and Chihuahua.

Hueco Phase (300 B.C.–A.D. 500): The Hueco Phase follows the Arenal phase and is the final or terminal phase of the Archaic period sequence. As defined by Miller (2017a) in space and time, the Hueco phase delineates a period of increasing incorporation of maize into the diet, an expansion and intensification of settlement throughout both mountain highlands and desert basins, and population growth prior to the introduction of ceramic technology and the bow and arrow. There is a marked increase in dated contexts of this period, including a significant rise in the numbers of dated house structures, pits, and dates on corn remains. The first intensively occupied village settlements appear during this period and village settlements exhibit a greater formality of site structure and community organization that reflect the presence of increasingly formal social arrangements.

The Hueco phase is considered analogous to the Early Agricultural period of southern Arizona. While evidence for small-scale horticulture and maize consumption was observed among settlements of the earlier Fresno phase, it is during the Hueco phase that agriculture was consistently integrated into regional subsistence practices. Settlements are situated along the fertile valleys of the mountain uplands and typically have dozens of large storage and refuse pits and the first formal storage facilities in the form of bell-shaped pits appear at this time. These features frequently have exceptionally high macrobotanical and pollen recovery rates for maize (Campbell and Railey 2008; Wiseman 1996). Hunting continued to provide a substantial contribution to the diet, but data from rockshelters hint that the Hueco phase was the beginning of a long and continual decline of artiodactyl populations in the highlands (Akins 2004). Also notable is that basal-notched projectile forms appear during the Hueco phase (Miller 2017b). How this manner of hafting reflects changing hunting and mobility practices remains unknown.

Domestic structures at lowland Hueco phase settlements become slightly more formal and have greater numbers of interior postholes, hearths, and storage pits. Equally significant is that these village settlements exhibit a greater formality of site structure and community organization that reflect the presence of increasingly formal social arrangements. The first villages with formal arrangements of houses and shared extramural areas appear during the Hueco phase. LA 91759 on Fort Bliss provides an example of a Hueco phase village settlement (Graves et al. 2014). The excavated portion of the site revealed a compact cluster of four to six pithouses (two unexcavated rectangular stains may be pits). A few small hearths and pits are present around the houses, but the majority of features are situated in a communal activity area to the east of the house cluster. The spatial arrangement of the houses and extramural features reflects an occupation by a larger, more complex social group than typical Late Archaic sites.

Formative Period (A.D. 500 to 1450)

The Formative period encompasses several important transitions in settlement adaptations. These include a relatively rapid succession of changes in architectural form, settlement structure,

subsistence, and technology, including a trend of decreasing mobility coupled with increasing agricultural dependence and specialization that culminated in puebloan occupations between A.D. 1300 and 1450. These developments have almost universally been perceived in terms of increasing agricultural dependence. However, evidence from the Jornada region also suggests that prehistoric populations may have become more agriculturally specialized between A.D. 1300 and 1450.

The Formative period sequence has recently been revised (Miller 2005) and now includes four subperiods: the Mesilla phase (A.D. 200/400 to 1000), the Early Doña Ana phase (A.D. 1000 to 1150), the Late Doña Ana phase (A.D. 1150 to 1300), and the El Paso phase (A.D. 1300 to 1450). In the following discussion, normative characteristics of each phase are presented first, followed by a more detailed review of specific adaptive trends that occurred throughout the Formative period. It should be noted that in many instances adaptive trends crosscut phase boundaries and that the phase system often masks such variability in the archaeological record.

Mesilla Phase (A.D. 500–1000): The Mesilla phase is characterized by the appearance of the El Paso brownware ceramic tradition with Alma Plain as a rare intrusive ware. Other intrusive ceramics (predominantly Mimbres whitewares and other Mogollon wares) appeared in the region after A.D. 600, but were not common. Painted pottery (El Paso Bichrome) also made its first appearance late in this phase. Pithouses were constructed during this period (Lehmer 1948) but were generally similar to the huts of the Archaic period (Hard 1983a). Structures become increasingly formal after A.D. 600. Sites generally are larger and more numerous and contain more artifacts than sites from the earlier Archaic period.

Whalen (1977, 1978, and 1994) uses survey data for the region to propose a site typology based on size, number of features, and the presence of ceramics, chipped stone, and groundstone. Though the characteristics change through time, Whalen (1994) suggests that artifact variety and site size distinguish residential sites from camps. Mesilla phase sites for all environmental zones show a slight association between sites and playas in the central basin. Because all types of sites are found in all zones, Whalen (1994) believes that the subsistence practices of the Mesilla phase were based primarily on hunting and foraging, supplemented by agriculture, and that occupation of the bolson was residential in nature.

Other archaeologists see the Mesilla phase as a continuation of the subsistence and settlement practices of the Late Archaic (Carmichael 1986; Hard 1983b; O'Laughlin 1979, 1980). Carmichael's (1986) work in the area differs in some respects from Whalen's (1994), especially in defining the role of the Hueco Bolson in cultural development. Carmichael (1986) believes that the basins of the region could not have been the whole area utilized by prehistoric groups. These basin areas were nonresidential in nature rather than being used by sedentary peoples. Residential sites were probably located outside of the basins, most likely near the Rio Grande, and were defined as sites containing trash middens. Hard (1983b) proposes a settlement-subsistence model in which differences in environment influence choices for seasonal rounds and activities. Hard (1983b) believes that winter and spring sites were located on the mountain alluvial fans, while the central basin was used for foraging. The summer and fall seasons saw the central basin used for temporary residences.

More recent work by Mauldin et al. (1998) suggests that Mesilla phase peoples may be characterized as residential foragers. The central basin and alluvial fans are thought to have been components in a residential foraging strategy in which groups lived throughout the region as hunter-gatherers. After A.D. 600, feature-related activities in the central basin drastically decreased. Mauldin et al. (1998) believe that this may indicate a shift in the settlement and subsistence practices of prehistoric groups to a less intensive, logistical use of the central basin.

In summary, Carmichael (1986), Hard (1983b), and Whalen (1994) characterize the Mesilla phase population as increasing over the previous Archaic period, utilizing all environmental zones, and showing trends toward sedentism. Pottery was introduced, and may have been important for cooking and storage of wild plant resources as well as cultigens. Groundstone inventories indicate increasing use during this phase. Settlement is thought to have been seasonal, with huts utilized as summer abodes and deeper pithouses used as winter residences. Subsistence was based on generalized hunting (rabbits and small game) and the foraging of wild plant resources. Early in this phase, agriculture may have been more opportunistic, with increasing reliance coming later in order to offset environmental variability that increased the risk of not having enough food to survive the winter (Wills 1988).

Early and Late Doña Ana Phases (A.D. 1000–1150 and 1150–1300): The Doña Ana phase was originally defined by Lehmer (1948) and was further characterized by Carmichael (1986). As defined by Lehmer (1948), Doña Ana phase sites are characterized by the presence of El Paso Bichrome and El Paso Polychrome pottery associated with adobe surface construction. Debate continues about the ability to distinguish Doña Ana phase occupations within the archaeological record (see Carmichael 1986; Hard et al. 1994; Mauldin 1993; Mauldin et al. 1998; Miller 1989, 1990). Early Doña Ana phase occupations have been described at the Gobernadora, Ojasen, and North Hills sites (Miller 1989, 1990; Shafer et al. 1999). These sites have informal pithouses and burned-rock activity areas. Scarborough (1986) excavated a late Doña Ana phase pithouse village. Data from this site indicate the use of deep, square-shaped formal pithouses and the utilization of discrete trash middens, suggesting a more sedentary existence than earlier time periods. Cultigens such as corn, squash, and beans were recovered, as well as large amounts of rabbit bone.

One other site from this period has been excavated in the region (Kegley 1982). The site contained evidence of formal pit structures with plastered hearths, as well as evidence for changing social organization defined by the presence of a very large pit structure, believed to be a communal house. Research by Whalen (1977, 1978, 1981) indicates that this period (which he defined as the Transitional Pueblo period) is characterized by increasing population levels and a shift of settlement areas to runoff zones located on lower alluvial fans of the Franklin, Hueco, and Organ mountains.

Overall, the changes that occurred during the Doña Ana phase include the introduction of polychrome pottery, rapid population increase, artifact changes that include larger manos and metates, decreased projectile point sizes with larger forms still in use, and changes in intrusive ceramic types from Mimbres to Chupadero and Chihuahuan wares. The increasingly formal pit structures eventually led to the later pueblo architecture of the El Paso phase. Another crucial change that occurred during this time was the shift from a general use of all areas within the region to concentrated use of specific environmental zones. These areas included the Rio Grande

and the distal alluvial fans of local mountain ranges (transition zone) that are notable for their abundance of water and arable land for growing cultigens.

El Paso Phase (A.D. 1300-1450): The final and most intensive prehistoric use of the region occurred during the El Paso phase (also referred to as the Pueblo period). This phase is characterized by an increase in the number of small and large residential sites, increased artifact densities, and a clustered settlement pattern (Carmichael 1986; Whalen 1977, 1978), as well as the introduction of small triangular projectile point forms.

Several excavated El Paso phase sites provide data on subsistence and settlement (Miller and Graves 2009, 2012). Varied settlement patterns and different structure types are suggested by data from Hot Well Pueblo, a 100-plus room village located near the eastern edge of the Hueco Bolson (Bentley 1993; Brook 1970; Lowry 2005); La Cebraña, a small pueblo located near the Rio Grande (Bradley 1983); Firecracker Pueblo (O'Laughlin 2001), located on the alluvial fans of the Franklin Mountains; and other pueblos throughout the region (Brook 1980; Gerald 1988; Lehmer 1948). In addition, individual surface room structures are a common feature of El Paso phase settlements (Batcho et al. 1985; Browning et al. 1992; Dering et al. 2001).

Hueco Bolson survey data indicate important changes that occurred during the El Paso phase. Whalen (1977, 1978, 1980), who documented a cluster of large sites along the alluvial fans of the Franklin and Hueco mountains, suggests that a shift in settlement patterns from earlier phases may indicate increased use of the lower alluvial fans for farming activities. Carmichael (1986) documented similar areas in the northern Hueco Bolson that he suggests were established during the Doña Ana phase. He argues that the sites are part of a larger regional exchange network related to Casas Grandes in Mexico (Carmichael 1986).

Mauldin (1986) developed a settlement-subsistence model for the El Paso phase based on Hard's (1983a) work with the Mesilla phase, but assumed more dependence on agriculture. Mauldin (1986) suggests a division between primary villages and secondary villages. Primary village locations were near reliable water sources on mountain slopes, but populations and intensity of use fluctuated during the year.

Subsistence at these sites was based primarily on agriculture. Secondary villages, which were located on both mountain slopes and in the central basin near playas, were associated with late summer residential occupations based on hunting and foraging. Small sites (e.g., campsites and limited activity sites) were not included in this or other models of settlement and subsistence for the region. The debate over the role of agriculture and its importance to subsistence for this period is unresolved, as is the degree of sedentism.

Thus, the El Paso phase is characterized by peak population levels, diverse artifact assemblages, use of pit structures, individual surface rooms, aboveground pueblos, and dependence on agriculture, but not to the exclusion of hunting and foraging. Residential permanency at sites during wet years and seasonal movement during periods of dryness or lean years is postulated. Alternatively, a seasonal sedentary lifestyle alternating between the desert floor, alluvial fan, and riverine habitation may have been the norm.

Post-Pueblo / Precontact Period (A.D. 1450 to 1581)

While the Jornada Mogollon ceased to exist as a cultural entity sometime around A.D. 1450, it is unlikely that the region was totally depopulated (Miller 2001). Several researchers have suggested that a major shift in subsistence strategy has resulted in the general lack of recognizable evidence in the archaeological record after A.D. 1400 to 1450 (Beckett and Corbett 1992). The Protohistoric period has been used as a general temporal assignment for cultural remains dated between approximately A.D. 1400 and 1800. To refine temporal definition of archaeological remains post-dating A.D. 1450, the term Precontact period is used in this text.

The Precontact period is herein defined as the relatively brief (approximately 130 years) span between what appears to be abandonment of the El Paso phase pueblo settlement system and the first documented encounter between Native Americans and Spanish explorers. Several cultural groups may have used the area during the Precontact period. According to Beckett and Corbett (1992), the Chinarra, Concho, Jano, Jcome, Manso, Suma, Piro, and Tarahumara tribes may have occupied the region. Unfortunately, archaeological evidence delineating these groups has not been found or recognized.

Protohistoric Period (A.D. 1581 to 1659)

This period is not well defined for the Jornada Mogollon region, although recent research suggests that sites of this period can be identified (Miller 2001; Seymour 2002). Though poorly defined in the literature, the Protohistoric period represents the temporal span between the first European/Native American contact and the Historic, or settlement period. Many of the aboriginal groups inhabiting the region during the Precontact period may also have been present during the Protohistoric period. However, contact between Native Americans and Europeans undoubtedly wrought changes to aboriginal lifestyles. Not only did the introduction of new materials such as metals revolutionize subsistence activities, but also a defensive (and offensive) posture was initiated among some Native American groups. This posture often resulted in a changed campsite preference that, along with changes in material culture, is potentially visible in the archaeological record.

Without the discovery of metal arrow points or worked glass, Protohistoric components are very difficult to identify. Radiocarbon dating of Protohistoric period sites is often unreliable and inconclusive. While it is well known that the Sacramento and San Andres mountains, and for that matter all of the Tularosa Basin region, were once part of the Mescalero Apache homeland, recognizable evidence of their presence remains elusive.

The Mescalero Apache represent the only documented aboriginal Protohistoric inhabitants of the Tularosa Basin region. Apache occupation of the basin persisted into the Historic period; their control of the local area thwarted settlement until around 1860. Hence, within the confines of the Tularosa Basin, the Protohistoric period may technically extend into the mid-1800s. Since the regional Protohistoric-Historic period division complicates discussion of Apache use of the basin, portions of the following review may overlap that of the Historic period.

First documented by Spanish explorers, and more recently confirmed archaeologically (Sale and Laumbach 1989), the Apache once roamed freely throughout the region. Sometime around A.D. 1500, these nomads infiltrated and took control of the Tularosa Basin. Their hostility and tactics in warfare successfully discouraged Spanish colonization.

Judging from reports of military campaigns against the Apache, Indian trails were once an easily recognized feature on the Tularosa Basin landscape. Locations frequented in the San Andres Mountains, including San Nicolas Spring, Salinas Peak, and Hembrillo Canyon, would presumably be linked to Sierra Blanca, Fresnal Canyon, and Dog Canyon to the east by well-worn Apache footpaths. These frequented areas would have also provided access into the current project area and beyond (e.g., the Guadalupe Mountains).

In the San Andres Mountains of New Mexico, several features have been radiocarbon dated to this period (Sale 1991). Hembrillo Canyon forms a natural pass through the San Andres Mountains north of Lake Lucero, linking the Tularosa Basin to the Jornada del Muerto and Rio Grande Valley. As a favored campsite of the Mescalero Apache, the canyon has provided much of the evidence of Apache activity near the project area. Apache pictographs suspected to relate an 1880 encounter between Victorio's band and U.S. military forces have been documented in Hembrillo Canyon (Sale and Laumbach 1989), and several firing positions associated with that battle have been recently recorded.

Regionally, the Protohistoric period terminates in 1659 with permanent establishment of Spanish missions in the El Paso area by Fray Garcia (Peterson and Brown 1994). The Tularosa Basin, however, constitutes an exception within the overall regional chronology. Due primarily to the Apache threat, permanent settlement did not occur in the basin until the early to middle 1800s. With the signing of the Treaty of Guadalupe Hidalgo in 1848, and the subsequent establishment of military forts for protection, the local area gradually became safe for settlement by Euro-Americans.

Historic Period (A.D. 1659 to present)

The date used for the onset of the Historic period is based on developments within the El Paso and Rio Grande valley areas. By 1659, Fray Garcia had established the first missions in El Paso and the Pueblo Revolt of 1680 resulted in the establishment of the Ysleta and Socorro missions and San Elizario presidio (Peterson and Brown 1994).

The Tularosa Basin continued to be an exception to the regional chronology; it was not until the eighteenth century that reports of Spanish activity in the area were documented. Spanish campaigns against the Apache are documented for the years of 1771, 1775, and 1776 in the Tularosa Basin (Sale 1997). The first Mexican settlement in the Tularosa Basin occurred around 1845, when a water-powered sawmill was constructed along Tularosa Creek to produce vigas for the church in old El Paso. According to local informants, transport of the vigas required three trips, the first of which proved costly, in terms of lives and oxen, at the hands of the Mescalero Apache. The Tularosa Basin remained an uncharted territory until after the signing of the Treaty of Guadalupe Hidalgo in 1848, which brought this portion of the region under the jurisdiction of the United States government.

Hueco Tanks, Rock Art, and Jornada Prehistory and History

The prehistoric and historic (including Pre-contact and Protohistoric) culture history of the Jornada region has been thoroughly rewritten over the past decade. Moreover, certain rock art styles and elements of the Jornada region have been dated by absolute chronometric methods and through relative cross-dating methods. In terms of contemporary studies of rock art, the essential

issue is that the prehistoric cultural sequence has been refined and enhanced to such an extent that we can now begin to cross-match rock art stylistic traditions and their constituent symbols and iconographic content with changes in settlement, subsistence, social organization, and beliefs. These developments will be explored further in the analytical and interpretive discussions of Chapter Eight.

Chapter Three

Survey and Documentation Methods

The investigations reported in this document were designed to provide TPWD with comprehensive information for the management of cultural and recreational resources at Hueco Tanks State Park and Historic Site. This work was undertaken with two primary management goals:

1. To survey all currently open bouldering problems within the park for the presence of Native American rock imagery using digital image enhancement techniques.
2. To provide documentation of identified Native American rock imagery located on or near currently open bouldering problems.

The first objective was accomplished by conducting a comprehensive digital photographic survey of all rock surfaces containing currently open bouldering problems and analyzing those photographs using DStretch image enhancement software. The second objective was accomplished by thorough documentation of all identified Native American rock art imagery located on or near bouldering problems. These goals were achieved using the methods described in this section.

Survey Methods

All rock surfaces containing currently open bouldering problems were identified, located, and surveyed during the course of fieldwork. The three primary climbing guidebooks published for Hueco Tanks (Crump et al. 1985; Sherman 1995; Wilder 2004) were reviewed. Published bouldering problems were cross-referenced with the most recent list of closed problems, dated June 2015, issued by the park administration. All open bouldering problems were located using the two most recent and comprehensive guidebooks available for Hueco Tanks (Sherman 1995; Wilder 2004) and the expertise of two local commercial climbing guides with extensive knowledge of the park and the bouldering locations within it.

All rock surfaces supporting open bouldering problems were systematically photographed using a Canon® EOS 5D Mark III™ digital single-lens reflex (DSLR) camera, typically with a Canon® 17–40mm f/4L USM lens. In addition, a Canon® G12™ digital camera modified for in-field use of the DStretch program was used to review high probability areas and potential Native American rock imagery in the field. High resolution DSLR survey photographs were collected in a stepwise fashion, typically moving systematically across a boulder surface from the beginning to the end of each problem, generally with some overlap between photographs for continuity in the review process and to aid in locating any potential Native American rock imagery identified during the image enhancement process. For rock surfaces that support overlapping problems, the rock surface was photographed multiple times, once for each published problem. This was to ensure that, within the photographic database, each bouldering problem was recorded in its entirety. The location of each bouldering problem was recorded via a global positioning system (GPS) receiver

and field-corrected on a tablet using high-resolution aerial imagery of the area in a Geographic Information Systems (GIS) interface.

Due to the audacious names often appointed to bouldering problems, some of which may reasonably be considered lewd or offensive by the general public, a numbering system was adopted at the beginning of the field survey to avoid use of popular or familiar bouldering problem names. A three-part serial number was assigned to each published problem, referencing the most recent Hueco Tanks climbing guidebook (Wilder 2004), in the format: PAGE NUMBER–AREA NUMBER–PROBLEM NUMBER. For example, the classic Martini Roof problem in the Upper Lost Boulders area (Wilder 2004:44) was denoted as Problem 44-01-06 during this survey. The goal of this protocol is not to belittle the climbing subculture or diminish the significance of these place names and cultural or historical references but to avoid offending readers of the resulting information, which will eventually be publically accessible.

In cases where unpublished problems were observed, an “X” was incorporated into the problem number and unpublished problems were designated X1, X2, X3, and so forth within the closest published area. An example in the aforementioned Upper Lost Boulders area is the unpublished problem between Problems 44-01-30 and 44-01-33, denoted as Problem 44-01-X1. Several of the bouldering areas documented during this survey have been developed since the release of the most recent guidebooks. To remain consistent with the numbering system outlined above, the guidebook page number portion of the label was substituted with XX and the unpublished areas were designated X1, X2, X3, and so forth as they were documented. Unpublished problems within these areas were sequentially numbered X1, X2, X3, and so forth, as described above. As an example, the recently developed Bloodline problem was designated as XX-X1-X1 for purposes of this survey.

Image Enhancement Methods

Soon after the advent of satellite technology and the acquisition of satellite imagery data in the 1970s, the National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL) began development of image enhancement algorithms for application in multispectral satellite imagery processing and interpretation. The technique of “decorrelation stretching” was first introduced by Soha and Schwartz (1978), building upon earlier work by Taylor (1974) in applying principal-component transformations to enhance satellite image data. Following the principal-component transformation, contrast enhancements were applied to the statistically independent (decorrelated) principal-component images. Soha and Schwartz’s decorrelation stretching served to augment the process by retransforming the enhanced image data back to the original image pixel coordinates for display. This serves to improve the visual interpretability of the enhanced image data. The technique was initially applied to imagery collected by early generations of the Landsat systems (Gillespie et al. 1986) and later to Advanced Spaceborne Thermal Emission and Reflectance Radiometer (ASTER) satellite imagery (Alley 1996) and images recorded by the Mars Rover system (NASA JPL 2004).

Shortly thereafter, in the early 1980s, archaeologists and cultural heritage specialists began to digitize analog photographic records and apply digital enhancement techniques to aid in the study of rock art (e.g., Rip 1983). In the mid- to late 1990s, with the advancement and proliferation of micro-computing hardware and software and the increasingly common use of digital recording techniques, the rock art research community began to more fully investigate the utility of digital

image manipulation for the enhancement of rock art imagery (Buchner et al. 2000; Mark and Billo 1999, 2002). Further development in the mid-2000s adopted the decorrelation stretch technique and refined it for use specifically in rock art research (Harman 2005). The decorrelation stretch algorithm was soon implemented as a software plugin to ImageJ, a public domain and distributable full-featured image processing program, and the technique was dubbed DStretch.

The DStretch process consists of applying a Karhunen-Loeve transform to the color data of a digital image. This transform diagonalizes the covariance (or optionally the correlation) matrix of the colors. Next, the contrast for each color is stretched to equalize the color variances. The colors are then uncorrelated and fill the colorspace. The decorrelation stretch calculation produces a 3-x-3 transformation matrix that is then applied to the colors in the image. Finally, the inverse transform is used to map the colors back to an approximation of the original image. DStretch supports several different colorspace. The shape of the color distribution of an image can be manipulated to effect the decorrelation stretch result, and numerous colorspace have been developed to yield visually different results (Table 3.1). Once a colorspace is selected for an image, the image is converted from the original colorspace (red-green-blue [RGB]) to the selected colorspace and the calculation and transformation are performed. The enhanced colors are then converted back to RGB and are recomposed into a digital image.

Table 3.1. DStretch Colorspaces and Associated Color Enhancements*

Colorspace	General Purpose	Pigment						Remarks
		Red	Yellow	Black	White	Blue	Green	
CRGB	X	X	-	-	-	-	-	
LAB	X	-	-	X	X	-	-	
LABI	-	-	-	-	-	-	-	Inverted LAB enhancement
LBK	-	-	-	X	-	-	-	
LBL	-	-	-	X	-	-	-	
LDS	X	-	X	-	-	-	-	
LRD	-	X	-	-	-	-	-	
LRE	-	X	-	-	-	-	-	Works well on faint reds
LWE	-	-	-	-	X	-	-	
LYE	-	-	X	-	-	-	-	Yellow displays as dark brown
RGB	X	-	-	-	-	-	-	
RGB0	-	X	-	-	-	-	-	
YBG	-	-	-	-	-	-	X	
YBK	-	-	X	X	-	X	-	
YBL	-	-	-	X	-	-	-	
YBR	-	X	-	-	-	-	-	Better reds than YDS
YDS	X	-	X	-	-	-	-	See YBR for better reds
YDT	X	X	X	-	-	-	-	Closer to LDS than YDS
YRD	-	X	-	-	-	-	-	
YRE	-	X	-	-	-	-	-	
YUV	X	-	-	-	-	-	-	
YWE	-	-	-	-	X	-	-	
YYE	-	-	X	-	-	-	-	Yellow displays as dark brown

*adapted from Harman (2005) and Hein (2015)

The DStretch algorithm has also been adapted for use on some Canon® digital point-and-shoot cameras that support specific versions of the Canon Hack Development Kit (CHDK). Software operated from the camera's Secure Digital (SD) media card allow DStretch enhancements to be applied to images and viewed on the camera LCD screen. More recent developments of DStretch allow the software to be operated on mobile platforms (Apple® iPhone™ and Google® Android™) for use on mobile phones, tablet computers, and other mobile devices. These options allowed for the investigation and review of specific areas noted during the course of fieldwork; however, the results of computer-based DStretch analysis on high-resolution images collected with the DSLR were of superior quality and form the basis for recording and interpretation of the rock art imagery encountered during this survey.

Each 23-megapixel survey photograph recorded with the DSLR was processed with DStretch and reviewed for the presence of Native American rock art imagery or pigment remnants. The photographs were processed and reviewed in 23 colorspace to enhance and clarify faint or faded pigments applied to the natural rock surface (see Table 3.1). Potential Native American rock art imagery or indications of possible pigment remnants were flagged during DStretch analysis. These flagged locations were revisited by the survey team for a more detailed inspection, which often included use of additional in-field DStretch analysis and collection of supplementary, targeted DSLR photographs for additional computer-based DStretch analysis. When a location was confirmed to contain Native American rock art imagery or pigment remnants, a standardized documentation of the location was conducted.

Rock Imagery Documentation Methods

Locations of Native American rock art imagery and pigment remnants identified during this survey were documented in a standardized manner. These protocols included collecting photographs at a variety of scales to adequately record any pigment or rock art imagery, the location, and the relationship to nearby bouldering problems. In addition, standardized measurements and descriptions of the imagery and characteristics of its immediate environment such as features of the rock surface, directional aspect, superimposition of design elements, and present condition of the rock surface and the pigment were recorded.

Each confirmed rock art imagery and pigment remnant location was recorded with a sub-meter accurate Trimble® GeoXH™ GPS receiver. Due to the complex terrain, GPS data were often recorded with a horizontal offset, typically 3–15 m away from the primary location at a secondary location offering improved satellite reception. Horizontal offsets were then measured to the rock imagery location via tape measure and compass. Differential correction of GPS data using multiple base stations generally yielded 15–50 centimeter (cm) horizontal locational accuracy. Differentially corrected GPS locations recorded with a horizontal offset were then shifted within a GIS interface to compensate for the original horizontal offset.

Confirmed imagery and pigment remnant locations were assigned panel numbers in accordance with the existing Hueco Tanks rock art panel numbering system. Selected rock art imagery panels containing stylistically identifiable elements and motifs were also professionally illustrated in scale panel drawings. Native American rock art imagery panels and pigment remnants identified and documented during the survey are summarized in the following chapters.

Structure-from-Motion Photogrammetry Methods

In several cases, Structure-from-Motion (SfM) photogrammetry was used to augment the standardized mapping and documentation methods described above. SfM photogrammetry is a relatively recent digital photography processing technique developed for capturing highly detailed, three-dimensional (3D) data of almost any surface using digital images. This method can also be used to create orthophotographs (relatively distortion-free digital images that retain scale and orientation information), a technique useful for photographic documentation in spatially-restricted areas, such as small alcoves and narrow crevasses, or on curving or undulated surfaces. Sets of overlapping high-resolution digital images served as the basic dataset for SfM modeling. Digital image sets were processed using Agisoft PhotoScan Pro using a standardized workflow. The software was used to first align the overlapping digital images and establish match points between the images. Pointclouds (sets of individual 3D data points characterizing the surface) were then computed, and surfaces were generated by triangulating between the individual points within in the pointclouds. Once the 3D surfaces were computed, photo-realistic texture was generated by creating a mosaic of the original digital images, which in turn were then projected onto the 3D models. In addition to the resulting 3D models, 2D products such as orthoimages were created to augment the traditional photographs and drawings.

Survey Results

Approximately 1,901 published bouldering problems exist within Hueco Tanks State Park and Historical Site based on the two most comprehensive bouldering guidebooks (Sherman 1995; Wilder 2004). As of June 2015, 172 of these bouldering problems are within areas indicated as closed by the Public Use Plan and park administration for erosion control, rock art protection, or other resource conflicts and therefore were not part of the survey scope; however, 18 of these closed bouldering problems were documented during this survey. An additional 122 previously unpublished bouldering problems were also identified and documented. In total, 1,869 bouldering problems were documented during this survey. All of the bouldering problems were surveyed using the methods described in this chapter. The following four chapters review the results of the bouldering problem surveys and rock art documentation.

Chapter Four

North Mountain: Survey and Documentation Results

Based on guidebook data, 688 published bouldering problems exist on North Mountain (Sherman 1995:26–159; Wilder 2004:42–117). Of these published problems, 90 problems are indicated as closed by the Public Use Plan and park administration as of June 2015 for erosion control, rock art protection, or other resource conflicts and therefore were not part of the survey scope; however, 18 of the closed bouldering problems were documented during training exercises for this project. An additional 21 previously unpublished bouldering problems were identified and documented during the survey of North Mountain. In total, 637 bouldering problems on North Mountain were surveyed during this effort (Figure 4.1). As a result of this survey, 19 Native American rock art imagery or pigment remnant locations were identified and documented on North Mountain (Table 4.1). Imagery was identified and documented at 16 locations on North Mountain within or near currently open bouldering problems and three locations adjacent to currently closed problems. Four of the images are within previously recorded rock art panels, while the other fifteen elements were discovered during the current project.

Table 4.1. Rock Imagery Documented on North Mountain Bouldering Problems

Panel Number	Bouldering Problem Number	Description	Closure status
N60	50-03-02	Quadruped	OPEN
N61	50-03-10/11	Pigment smudges	OPEN
N62	52-04-06	Pigment dots in hueco	OPEN
N63	59-07-09	Pigment remnants in huecos	OPEN
N18G1*	59-07-15	Pigment smudge	OPEN
N64	60-08-06/07	Red abstract linear and filled ovoid design	CLOSED
N65	60-08-07–12	Red abstract rayed ovoid element; pigment remnants	CLOSED
N66	72-15-01	Pigment remnants/lines in two huecos	OPEN
N67	72-15-05	Pairs of parallel lines in large hueco	OPEN
N68	72-15-05	Smudge (line?) And circle in hueco	OPEN
N19D5*	72-15-06/07	Linear smudges in hueco	OPEN
N19D7*	72-15-23	Triangular or ovoid shape	OPEN
N19D2*	72-15-25	Pigment remnants	OPEN
N69	82-19-29	Rectangular geometric design in hueco	CLOSED
N70	85-20-01	Pigment smudge	OPEN
N71	88-23-02	“Y” in water stain	OPEN
N72	88-23-06	Step-fret design	OPEN
N73	102-31-08	Four lines/smudges adjacent to water stain	OPEN
N74	108-33-X1	Pigment smudges along vertical crack	OPEN

*previously recorded

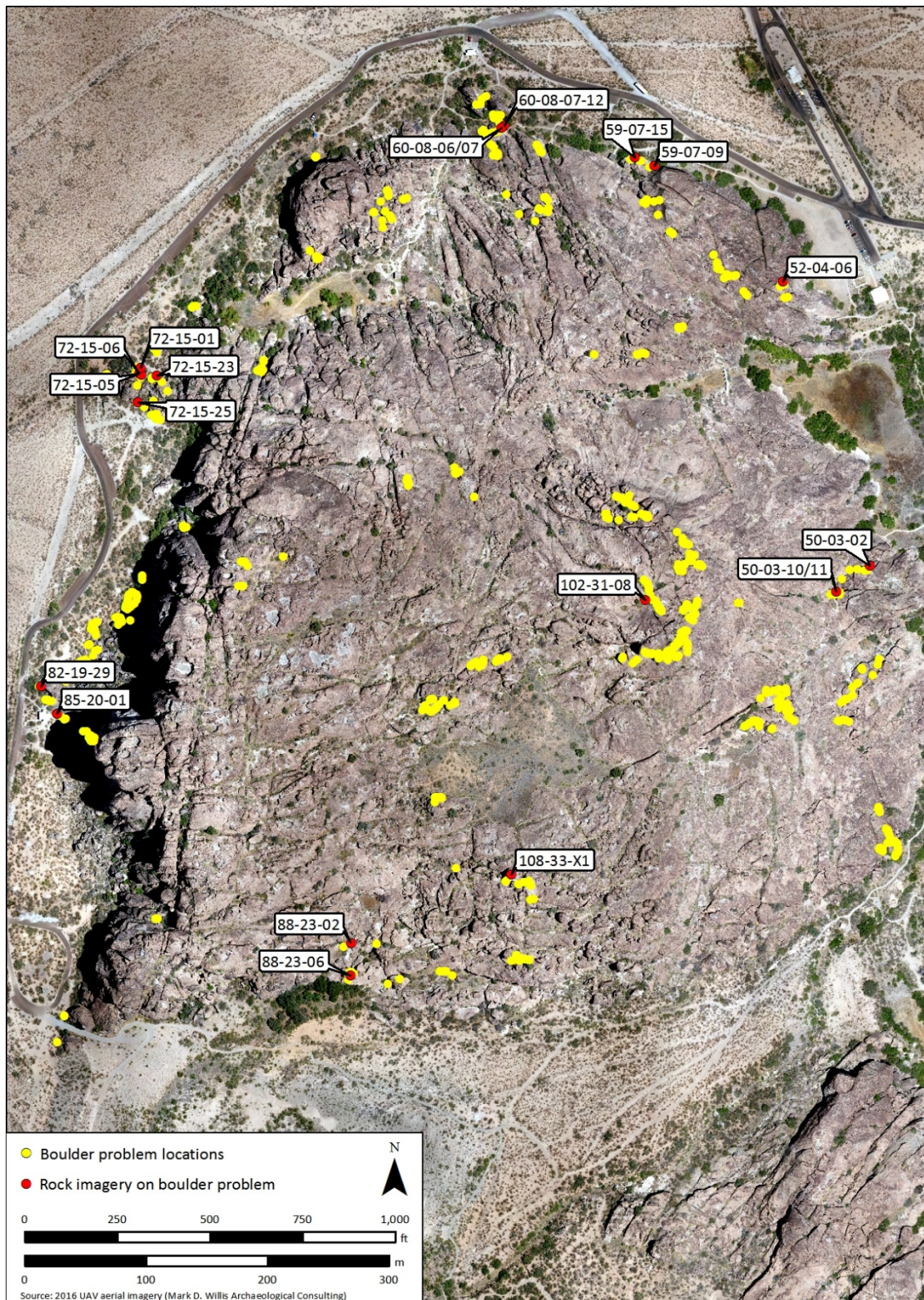


Figure 4.1. Locations of bouldering problems and rock imagery documented on North Mountain.

Panel N60

Panel N60 is located within a north-facing alcove approximately 2 m west (right) of Problem 50-03-02. The panel is approximately 10 m east (left) of previously recorded rock art site N17V, but it has not been previously identified or recorded. The panel consists of a single reddish-brown outlined quadruped zoomorphic element (Figure 4.2), possibly representing a horse. The figure is approximately 8 cm wide by 7 cm tall and is located in a shallow concavity approximately 30 cm wide on the ceiling of the overhang. This panel is within a published bouldering area; however, the area appears to receive relatively little recreational use. No chalk is present in the vicinity. The pictograph appears to be relatively intact, although portions of it are faded. No spalling is present on the pictograph, and the rock surface appears to be stable. No obvious vandalism is present on the pictograph or the immediate vicinity. Very minor abrasion is observed across the quadruped's hindquarters; this damage does not appear to be intentional.



Figure 4.2. Panel N60: original (top) and enhanced in the CRGB colorspace (bottom).

Panel N61

Panel N61 is located under a northwest-facing overhang between Problems 50-03-10 and 50-03-11 and is approximately 1.5–2 m above a cluster of boulders beneath the overhang. The panel consists of approximately 20 faint reddish-brown dots or fingertip smudges with no apparent order or patterning along the lower margin of a broad, shallow concavity in the rock surface (Figure 4.3). This panel is within a published bouldering area; however, the area appears to receive relatively little recreational use. No chalk is present in the vicinity. The pigment appears to be relatively intact, although faded. No spalling is present on the pigmented area, and the rock surface appears to be stable. Three mud dauber wasp nests are present on the nearby rock surface; one approximately 2 cm away from an area of pigment. No obvious vandalism is present on the pigment or the immediate vicinity.

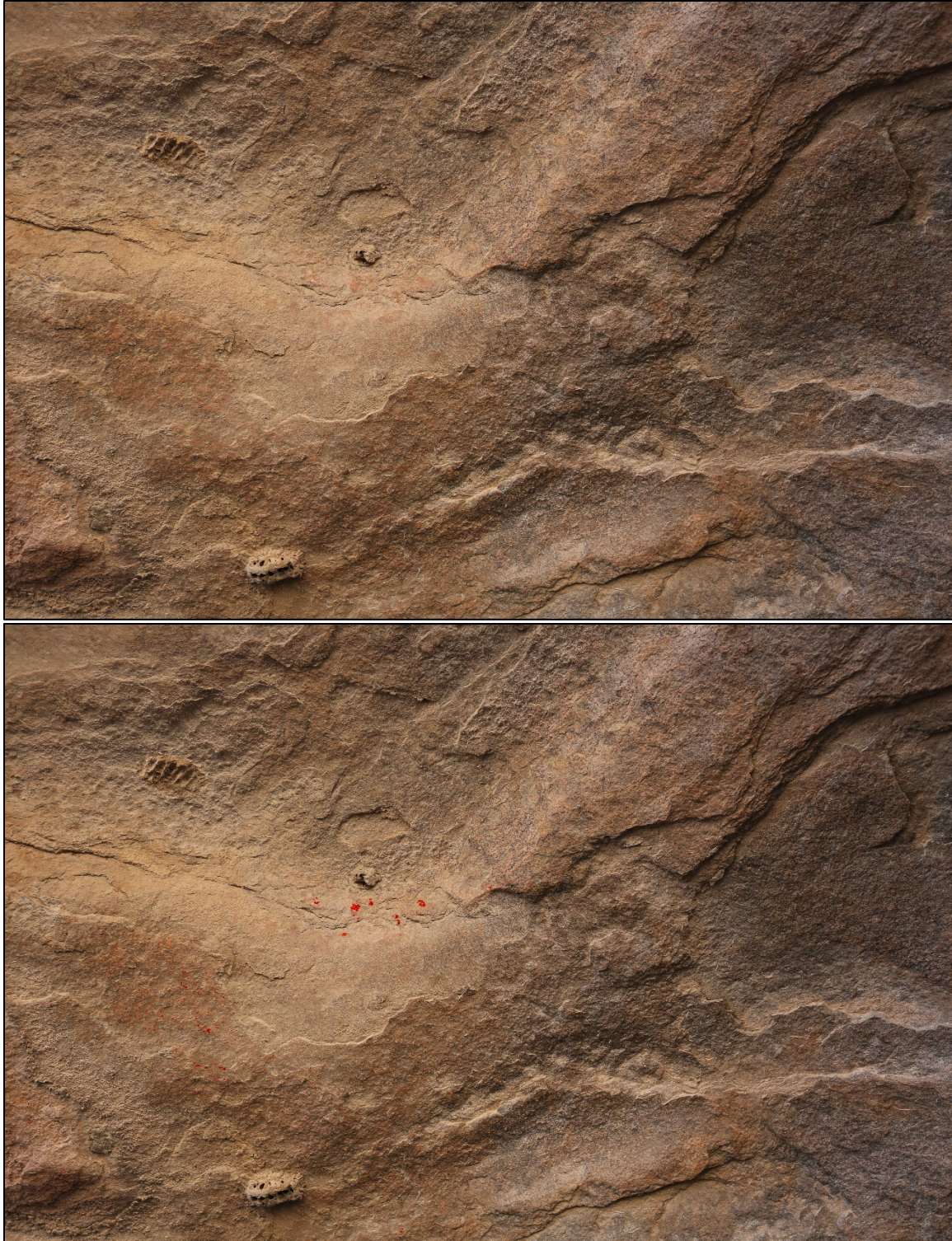


Figure 4.3. Panel N61: original (top) and enhanced in the CRGB colorspace (bottom).

Panel N62

Panel N62 is located within an east-facing alcove along bouldering problem 52-04-06. The panel consists of approximately 37 very faint reddish-brown dots across the interior surface of a south-facing hueco measuring 22 cm tall by 16 cm wide (Figure 4.4). The dots are generally aligned in eight columns, and the upper edge of the hueco appears to be demarcated by a curving line. The panel is approximately 128 cm above the slightly sloping slab surface that forms the floor of the sheltered overhang. This panel is located on a bouldering problem within an active bouldering area, and a minor amount of chalk is present within and near the panel. The pigment that forms the imagery is very faded, and some natural spalling of the rock surface is evident in the immediate vicinity. A minor amount of historic (axle grease) and modern (black and white paint) graffiti is present within the alcove but is not located on or immediately adjacent to the panel.

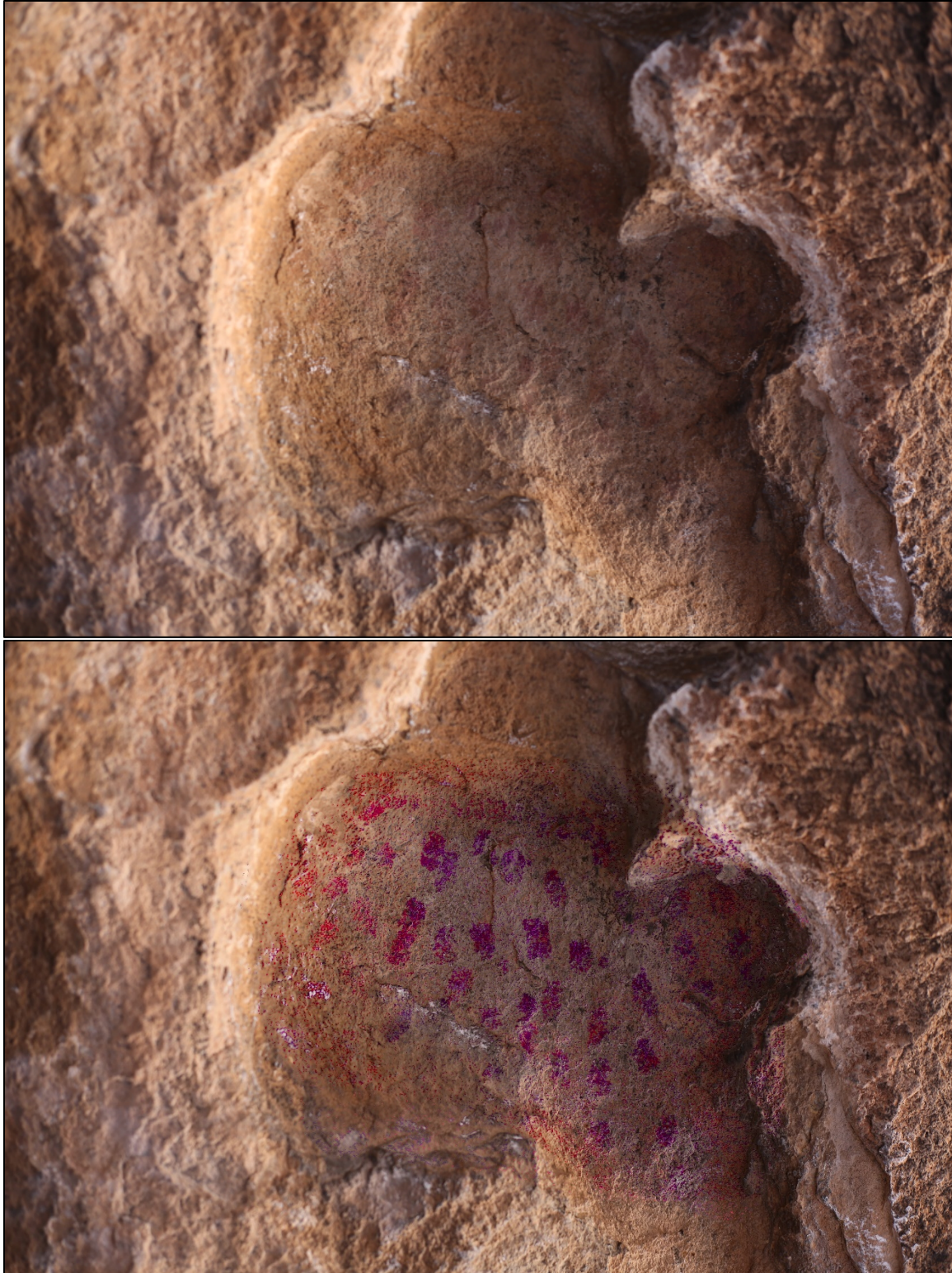


Figure 4.4. Panel N62: original (top) and enhanced in the LDS colorspace (bottom).

Panel N63

Panel N63 is located on a vertical north-facing exposed outcrop at ground level directly beneath bouldering problem 59-07-09. The outcrop supports numerous huecos, four of which contain very small remnants of red and reddish-brown pigment (Figure 4.5). The panel is approximately 110–195 cm above the current ground surface. Although the majority of Area 59-07 is closed to climbing due to the presence of Native American rock art imagery, Problem 59-07-09 remains open to recreational climbing activities. This bouldering problem, however, appears to receive relatively little recreational use. No chalk is present in the vicinity. The pigment that formed the imagery is largely exfoliated, with only small remnants of pigment, each less than 1 square centimeter (cm²) in area, evident across the extensively exfoliated and smoke-stained surface. Numerous historic and modern names, initials, and dates are engraved on the rock surface in the immediate vicinity of the panel.



Figure 4.5. Panel N63: original (top) showing small pigment remnants and enhanced in the YYY colorspace (bottom).

Panel N18G1

Previously recorded panel N18G1 is located on a slightly overhanging boulder approximately 2.5–3.0 m southwest (right) of Problem 59-07-15. The panel consists of a large red pigment smudge, approximately 65 cm wide, within an 80-cm wide white mineral stain (Figure 4.6). Three to four generally linear features, each approximately 1 cm wide, extend downward from the bottom of the smudge, likely finger streaks resulting from the application of the pigment to the rock surface. Two possible circles and a possible series of five parallel lines, not apparent during the visual inspection of the panel or in unenhanced photographs, may be present on the lower portion of the mineral stain. In addition, two faint 2.5-cm long smudges are located along the margin of the mineral stain, one to the left and one to the lower left of the primary smudge area. This panel is within a published bouldering area and is adjacent to a currently open problem; however, the area appears to receive relatively little recreational use. No chalk is present in the vicinity. The pigment that forms the imagery is faded, and some rock spalling is evident around the margin of the mineral stain. Charcoal smearing is also evident on the panel, some is likely of historic or modern age, indicated by an apparent sideways “FP” in the lower portion of the mineral stain. The origins of the additional charcoal smears and the fine, scratched lines across the panel are unknown. Numerous historic and modern names, initials, and dates are engraved on the rock surface in the vicinity of the panel.



Figure 4.6. Panel N18G1: original (top) and enhanced in the CRGB colorspace (bottom).

Panel N64

Panel N64 is located on the southeast side of a ground-level boulder between Problems 60-08-06 and 60-08-07. The panel is a single red abstract form approximately 40 cm above the current ground surface. The pictograph consists of a 1-cm wide vertical line with an 8-cm wide and 12-cm tall filled oval on the upper end (Figure 4.7). The total height of the element is approximately 35 cm. Two 1-cm wide lines extend out from the approximate midpoint of the element at 30-degree angles. The total width of the element is approximately 15 cm. This area is currently closed to climbing activities due to the presence of Panel N64 and nearby Panel N65 (see below). Although outside of the project scope, these panels were documented during the training exercises for this project and are therefore included in this report. A moderate amount of chalk is present within some of the overhanging portions of the boulder surface, but no chalk was observed on the imagery panel. A moderate amount of spalling and exfoliation are evident across the boulder surface, including areas immediately adjacent to the panel. Numerous historic and modern names, initials, and dates are engraved on the boulder surface. Graffiti includes a rayed circle above HENRY R. BARNES -1914-; Eloy PIERSON(?); and a list of names: Bob, Lucy, Ethel Bailey, Gladys Bailey, and Ralph Matthew and a date (Feb. 5, 1933) near the top of the boulder. No graffiti is present in the immediate vicinity of Panel N64.



Figure 4.7. Panel N64: original (top) photo and enhanced in the LDS colorspace (bottom).

Panel N65

Panel N65 is located on the southeast side of a ground level boulder within a slight overhang bordered by Problems 60-08-07 through 60-08-12. The panel comprises a reddish-brown abstract design and several pigment smudges and line remnants approximately 100–200 cm above the current ground surface. The abstract element of this panel is a solid painted ovoid form with four visible vertical lines appended to its upper side and one longer vertical line that bifurcates the figure and continues below it (Figure 4.8). A vertical line to the left of the design may have once served to define its margins. The figure is approximately 26 cm wide by 26 cm in maximum height. Six lines extend vertically from the upper margin of the main portion of the pictograph, which exhibits an extensive amount of spalling or exfoliation that has removed most of the central and lower portions of the image. Several additional lines and small areas of pigment exist across the panel, but no additional stylistic elements or motifs can be clearly discerned through the digital enhancement process. As previously noted, this area is currently closed to climbing activities due to the presence of this panel and nearby Panel N64. A moderate amount of chalk is present within some of the overhanging portions of the boulder surface, but no chalk was observed on the panel. An extensive amount of spalling and exfoliation are evident across the panel. Numerous historic and modern engraved initials are present on the panel, including a 40-cm-wide engraved bird motif.



Figure 4.8. Panel N65: original (top) photo of abstract ovoid element and enhanced in the CRGB colorspace (bottom).

Panel N66

Panel N66 is located on a vertical northeast-facing exposed surface at ground level directly beneath bouldering problem 72-15-01. The vertical face supports numerous huecos, two of which contain linear remnants of faint reddish-brown pigment. The two adjacent huecos are located along the upper margin of a boulder that serves as a pedestal to an overlying boulder (Figure 4.9). The west (right) hueco, measuring 30 cm wide by 16 cm tall, contains a 6-cm-long horizontal pigment smudge or line remnant. The east (left) hueco, measuring 30 cm wide by 21 cm tall, contains a 13-cm horizontal line with a perpendicular line extending downward approximately 7 cm from the horizontal line. The panel is approximately 150 cm above the current ground surface. Problem 72-15-01 appears to receive relatively little recent recreational use. No chalk is present in the vicinity. The pigment that forms the imagery is very faded. Moderate to extensive surface exfoliation is evident across the rock surface; however, no evidence of historic or modern graffiti or vandalism was observed in the immediate vicinity of the panel.

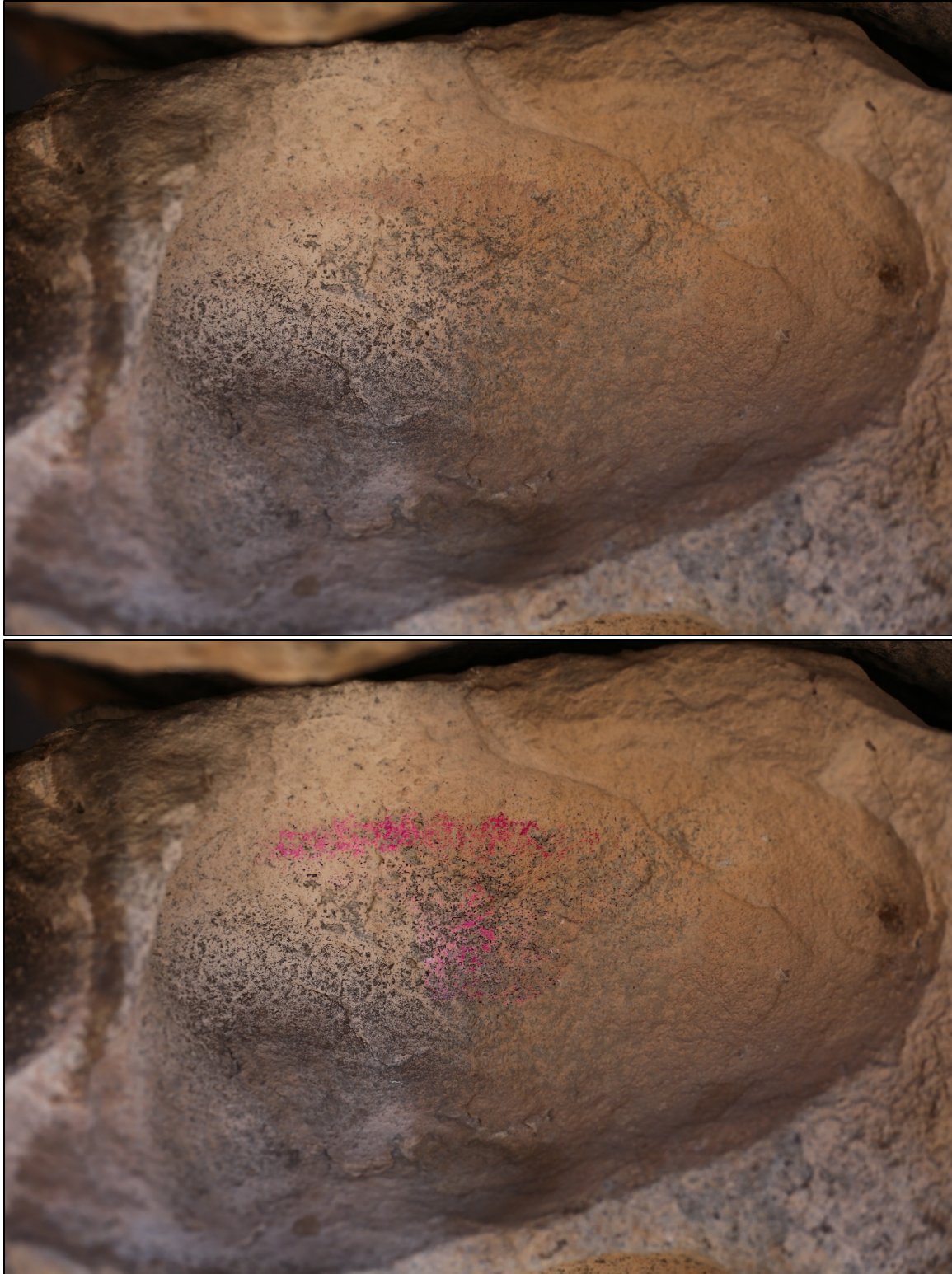


Figure 4.9. Panel N66: original (top) and enhanced in the YDT colorspace (bottom).

Panel N67

Panel N67 is located within a horizontal downward-facing hueco on the northeastern arête (i.e., corner) of a large boulder. The generally semi-spherical hueco is approximately 120 cm in diameter and 20 cm deep. Panel N67 contains five pairs of faint reddish-brown parallel lines, each approximately 10–15 cm long (Figure 4.10). The panel is approximately 60 cm above the current ground surface and is directly beneath Problem 72-15-05, an open bouldering problem within an active bouldering area. A moderate amount of chalk is present along the problem as a whole, but only a minor amount of chalk was observed along the edge of the hueco that contains Panel N67. The pigment that forms the imagery is very faint. No extensive spalling or exfoliation was observed on the panel. A minor amount of engraved graffiti is present south (left) of Problem 72-15-05, but none was observed on Panel N67.



Figure 4.10. Panel N67: original (top) and enhanced in the CRGB colorspace (bottom).

Panel N68

Located on the east-facing side of a large boulder, Panel N68 occupies a 78 cm tall by 62 cm wide hueco approximately 130 cm above the ground surface (Figure 4.11). A 5-cm diameter faint reddish-brown circle, possibly with a 5-cm slightly curving line extending downward from the bottom of the circle, is located in the upper right portion of the hueco. Several pigment smudges or linear remnants, each 2–5 cm long, occupy the upper left portion of the hueco. The panel is located along Problem 72-15-05. A chalked hold is located immediately above the hueco, and shoe rubber is evident near the lower edge of the feature. The pigment composing the imagery is very faint. Moderate to extensive spalling or exfoliation was observed on the boulder surface, but little spalling or exfoliation is evident on the panel. A minor amount of engraved graffiti is present on the boulder surface south (left) of Problem 72-15-05, but none was observed on Panel N68.

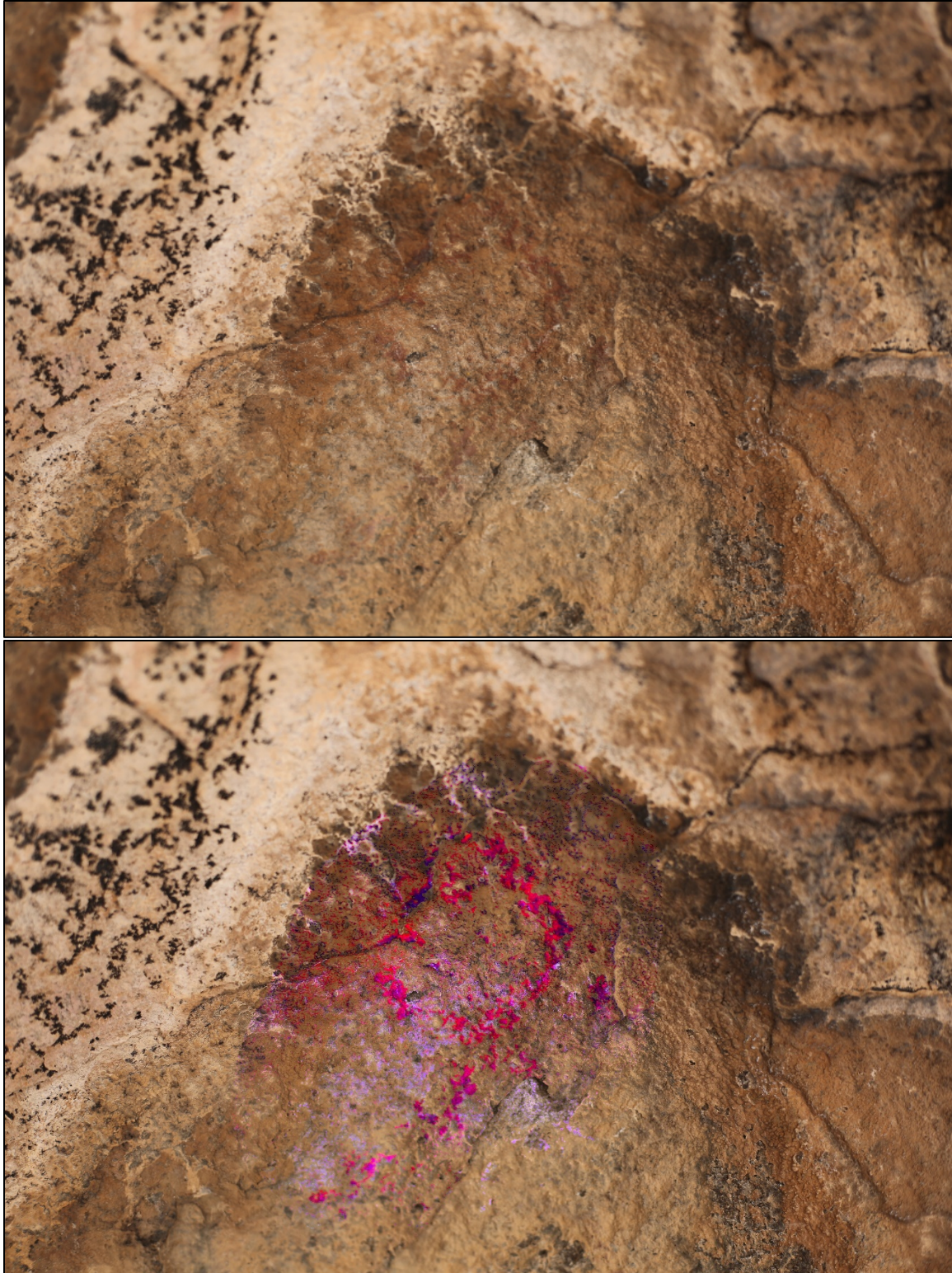


Figure 4.11. Panel N68: original (top) photo of circular element and enhanced in the YDS colorspace (bottom).

Panel N19D5

Previously recorded Panel N19D5 is located on the north face of a large boulder and occupies a 50 cm tall by 70 cm wide hueco approximately 155 cm above the ground surface. The panel comprises a 5-cm wide reddish-brown smudge or line approximately 32 cm long and a generally perpendicular smudge extending west (left) about 12 cm near the approximate midpoint of the wider line (Figure 4.12). One additional possible pigment smudge, approximately 2 cm long, is located along the easternmost (left) edge of the hueco. The panel is located between Problems 72-15-06 and 72-15-07. A moderate amount of chalk was present along both of the problems, but only a minor amount of chalk was observed on the edge of the hueco containing the imagery panel. The pigment that forms the imagery is readily visible. Sparse to moderate spalling or exfoliation was observed on the boulder surface, and no spalling or exfoliation is evident on the panel. A minor amount of engraved graffiti is present on the boulder surface along Problem 72-15-06 east (left) of Panel N19D5, but no graffiti is present on the panel.



Figure 4.12. Previously recorded panel N19D5: original photo (top) and enhanced in the CRGB colorspace (bottom).

Panel N19D7

Previously recorded Panel N19D7 is located under an east-facing overhang of a small boulder. The panel consists of a small, generally triangular or ovoid shape approximately 7 cm wide by 4 cm tall situated 74 cm above the underlying slab surface (Figure 4.13). An indistinct pigment smudge may exist immediately to the north (left) of the more well-defined pictograph. The panel is located approximately 2 m south (right) of Problem 72-15-23, an active and well-chalked problem that extends along the boulder's arête. A 2-cm-long chalk smudge is located approximately 20 cm north (left) of the imagery. The pigment that forms the pictograph is visually apparent, but the possible pigment smudge is very faint. Little spalling or exfoliation was observed on the boulder surface, and little spalling or exfoliation is evident on the panel. No graffiti or other signs of vandalism are present on the Panel N19D7 or in the vicinity of Problem 72-15-23.



Figure 4.13. Previously recorded panel N19D7: original photo (top) and enhanced in the CRGB colorspace (bottom).

Panel N19D2

Panel N19D2 is located within a broad, shallow concavity measuring 135 cm by 107 cm under a ground-level overhang approximately 135 cm above the current ground surface. The panel consists of four faint reddish-brown pigment smudges and line remnants (Figure 4.14). A 14-cm long line extends near the bottom of the panel. A 16-cm long smudge occupies the west (right) side of the panel. Two small smudges, measuring 2.5 cm and 1.5 cm in length, are located in the northeast (left-central) portion of the panel. The panel is located below Problem 72-15-25, which extends up the east-facing side of the boulder. Previously recorded rock imagery Panel N19D2 is also located on the roof of this overhang; however, it is unclear if this imagery was identified and recorded as part of Panel N19D2. Although Problem 72-15-25 is an open and published bouldering problem, the southwest face of this boulder has been closed to climbing due to the presence of rock art imagery, bedrock features, and buried archeological deposits. As a result, this problem appears to receive little recreational use and no chalk was evident in the vicinity. The pigment composing the imagery is very faint with the exception of the two small pigment smudges, which are relatively bold. The panel has experienced moderate to extensive spalling or exfoliation. A moderate amount of abrasion has occurred on the panel. The origin (prehistoric or historic/modern) and intention of this abrasion is unknown.

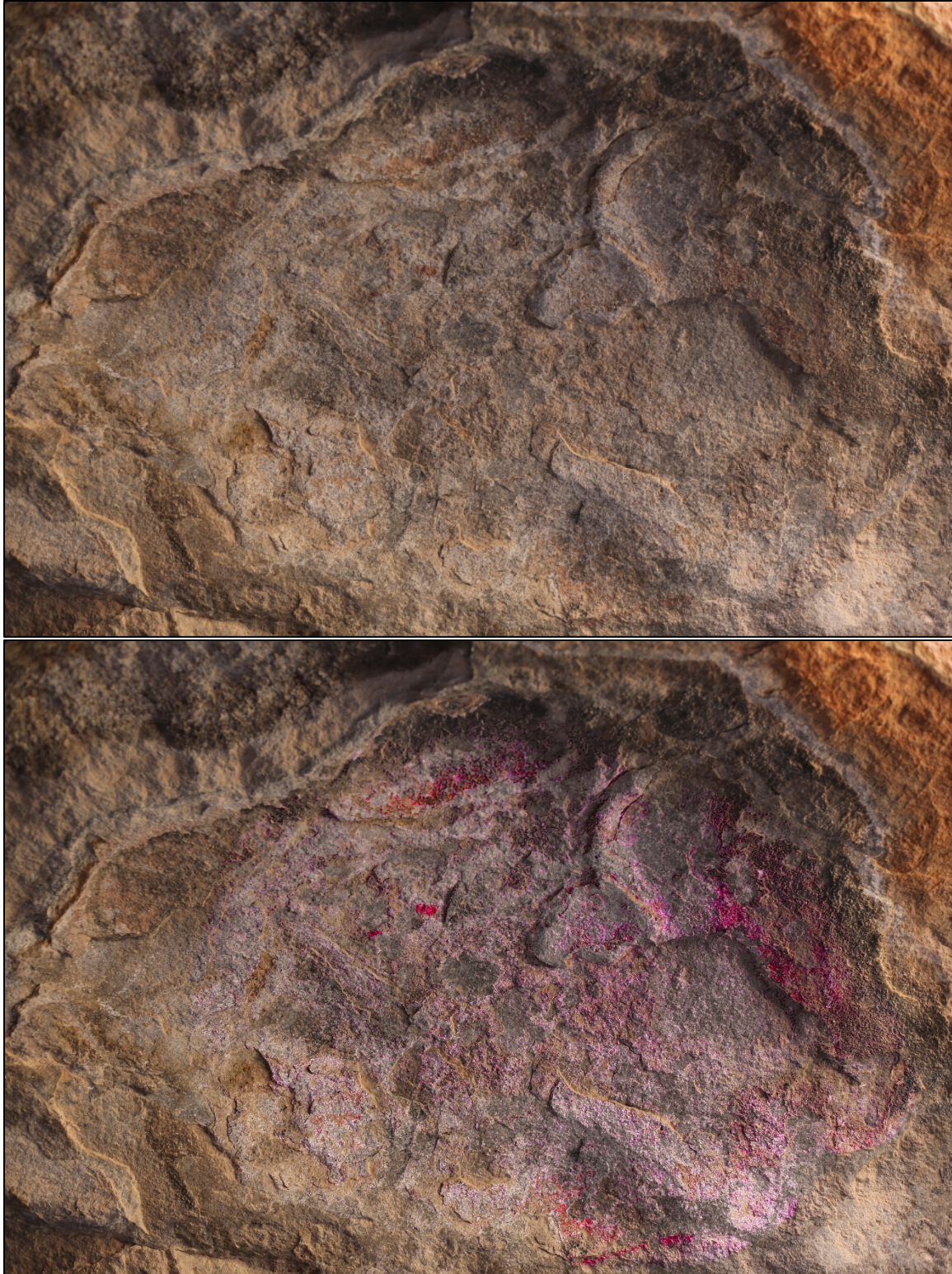


Figure 4.14. Panel N19D2: original (top) photo and enhanced in the CRGB colorspace (bottom).

Panel N69

Panel N69 is located on the southwest face of a large boulder at ground level northeast of the End Loop restroom facility. The panel is within a hueco approximately 72 cm wide by 64 cm tall and 130 cm above the current ground surface. It consists of the remnants of a segmented or partitioned rectangular form composed in reddish-brown pigment (Figure 4.15). It comprises 11 to 12 vertical lines, each about 1 cm wide and 2–5 cm apart, extending down from a generally perpendicular horizontal line 40 cm in length. The pigment composing the panel is faint, and the lower portion of the element is extensively exfoliated. Problem 82-19-29 is located approximately 50 cm north (left) of the panel. The problems located on the north face of this boulder are closed due to erosion of archeological deposits in that area. It was initially unclear if Problem 82-19-29 was part of the closure and was thus included in this documentation. The problem is located on the southwest face of the boulder as opposed to the explicitly closed problems on the north face; however, the presence of a closure sign southwest of the boulder along a former trail indicates that the area is in fact currently closed to climbing activities. The panel and surrounding boulder surface have experienced moderate to extensive spalling or exfoliation. No graffiti was observed in the immediate vicinity of Panel N69.



Figure 4.15. Panel N69: original (top) and enhanced in the CRGB colorspace (bottom).

Panel N70

Panel N70 is located on the polished southwest face of a ground-level boulder behind the End Loop restroom facility. The panel consists of a 30-cm red pigment smudge approximately 150 cm above the modern ground surface. Digital enhancement of the pigment indicates that the smudge comprises at least 12 vertical lines each approximately 1.5-cm wide, likely the result of applying the pigment to the rock surface by touching or wiping with a pigment-covered hand or fingers (Figure 4.16). Although Problem 85-20-01, located approximately 2 m northwest (left) of the panel, is a published and currently open bouldering problem, it appears to receive little recreational use. No chalk is present on either Problem 85-20-01 or this panel. The pigment composing the imagery is faint and difficult to discern from the natural reddish-brown mineral staining present on the rock surface. The panel and surrounding boulder surface has experienced minor to moderate spalling or exfoliation. Modern and historic graffiti, typically in the form of fine, engraved or scratched initials, is present across the panel and the boulder surface in general. In addition, a 38-cm long black arrow pointing to the left has been painted across the panel. The origin of the arrow and the rationale for its placement are unknown.



Figure 4.16. Panel N70: original (top) and enhanced in the LDS colorspace (bottom).

Panel N71

Panel N71 is located on a south-facing wall under a cantilevered overhang approximately 60 cm above a sloping slab surface. The panel comprises a single Y-shaped pictograph element in faint red pigment applied within a white mineral stain that extends from the shelter ceiling to a crevice along the base of the wall (Figure 4.17). The element measures 19 cm tall by 10 cm wide; however, pigment extends an additional 45 cm below the pictograph along the white mineral stain. This is likely due to periodic water flow across the rock surface that has displaced traces of the pigment. Problem 88-23-02, extending along a roof crack approximately 1.5 m above the panel, exhibits a minor amount of chalk. No chalk is present on the rock imagery panel. No spalling or exfoliation was observed on the boulder surface or on Panel N71. No graffiti or other signs of vandalism are present in the vicinity.



Figure 4.17. Panel N71: original (top) and enhanced in the YRD colorspace (bottom).

Panel N72

Located at the base of the southwest face of a boulder near ground level, Panel N72 consists of a faint reddish-brown geometric design measuring 10 cm by 12 cm (Figure 4.18 and Figure 4.19). The panel occupies the upper portion of a 34-cm wide by 28-cm tall concavity approximately 60 cm above the gently sloping slab surface. Panel N72 is located in close proximity to Problem 88-23-06, an active problem within a published and open bouldering area. Although the published problem indicates a jump start “to a hueco 8.5 feet [2.6 m] up the south face” (Sherman 1995:108; cf. Wilder 2004:88), a lower start to the problem (or perhaps an additional, unpublished problem) has been developed in proximity to Panel N72. This is evidenced by chalked holds lower on the boulder face, including a chalked hold approximately 10 cm above the imagery. The pigment composing the imagery is faint and difficult to discern from the natural rock surface. The surrounding boulder surface has experienced minor to moderate spalling or exfoliation, but the panel has not experienced such natural weathering and is relatively well-preserved. No graffiti or other signs of vandalism are present in the vicinity. The geometric design present on Panel N72 represents a linear series of step-fret elements common to prehistoric and historic Southwestern textile, ceramic, and rock art designs.

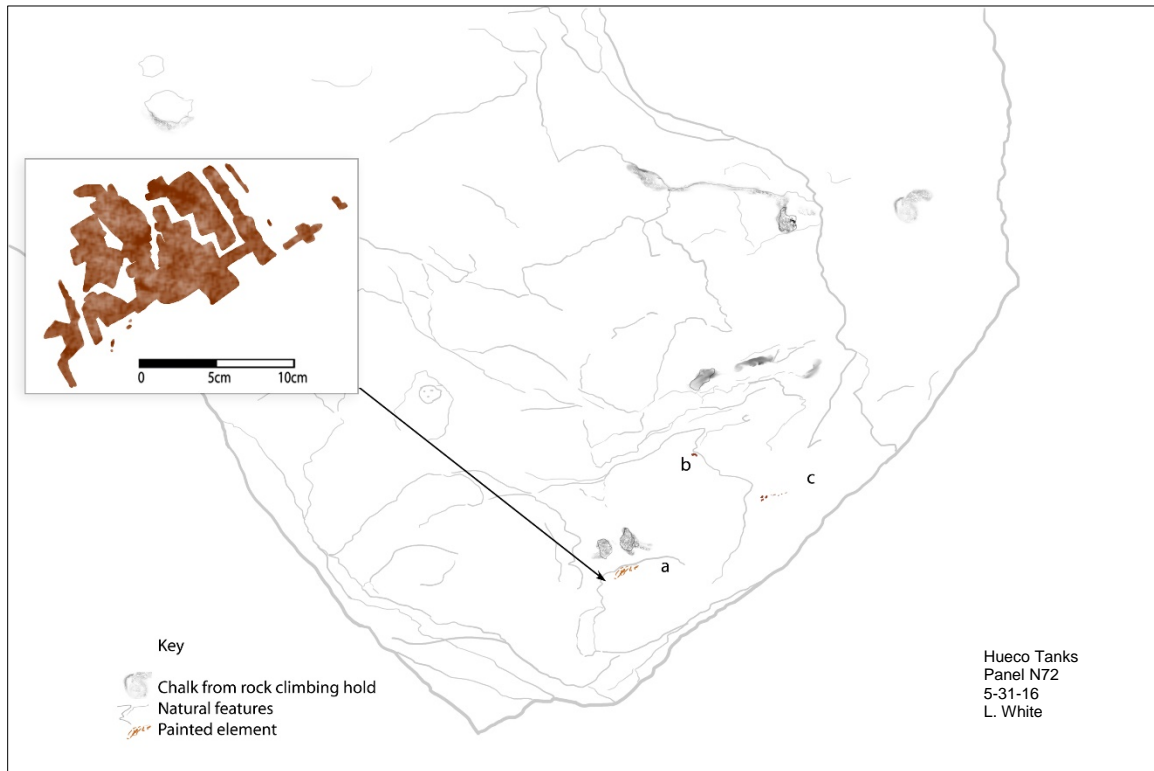


Figure 4.18. Illustration of Panel N72 (by Laurie White).

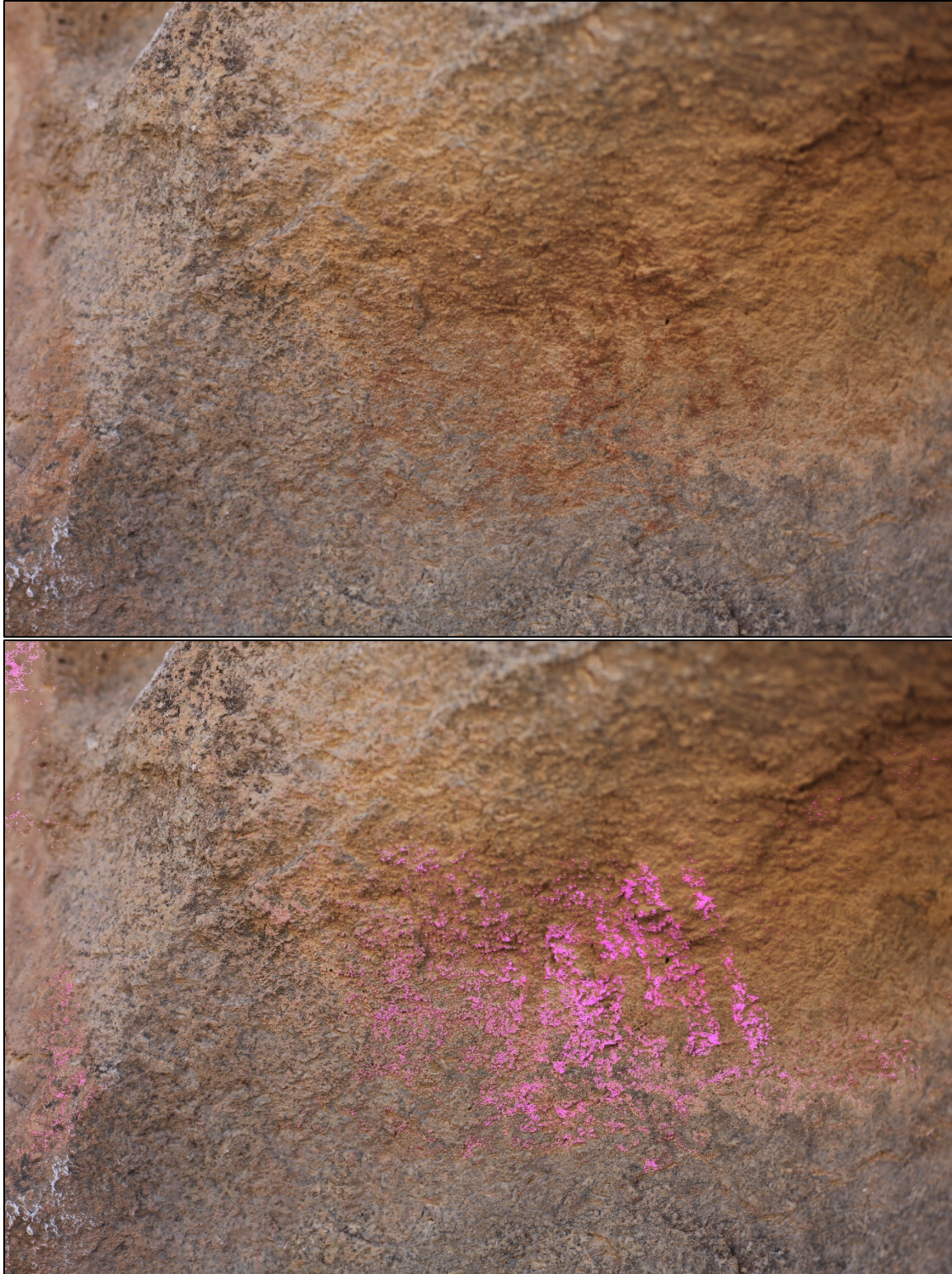


Figure 4.19. Panel N72: original (top) and enhanced in the YYE colorspace (bottom).

Panel N73

Located along a slightly overhanging northeast-facing wall of a canyon, the panel consists of faint red pigment smudges 176–193 cm above the current ground surface and 3–13 cm south (left) of a black mineral stain extending down the wall from a prominent runnel above the panel. Four of the discontinuous smudges are generally linear, with an additional broad, amorphous area of pigment to the lower left of the more linear smudges (Figure 4.20). This suggests possible application of the pigment by touching or wiping the rock surface with a pigment-covered right hand. Panel N73 is along Problem 102-31-08, an active and published bouldering problem within a popular bouldering area. A chalked hold exists approximately 12 cm above and slightly left (southeast) of the panel. The surrounding rock surface has experienced minor to moderate spalling or exfoliation, but the panel has not experienced such natural weathering and is relatively well-preserved. Some graffiti and other signs of vandalism are present in the vicinity, but none impact Panel N73.

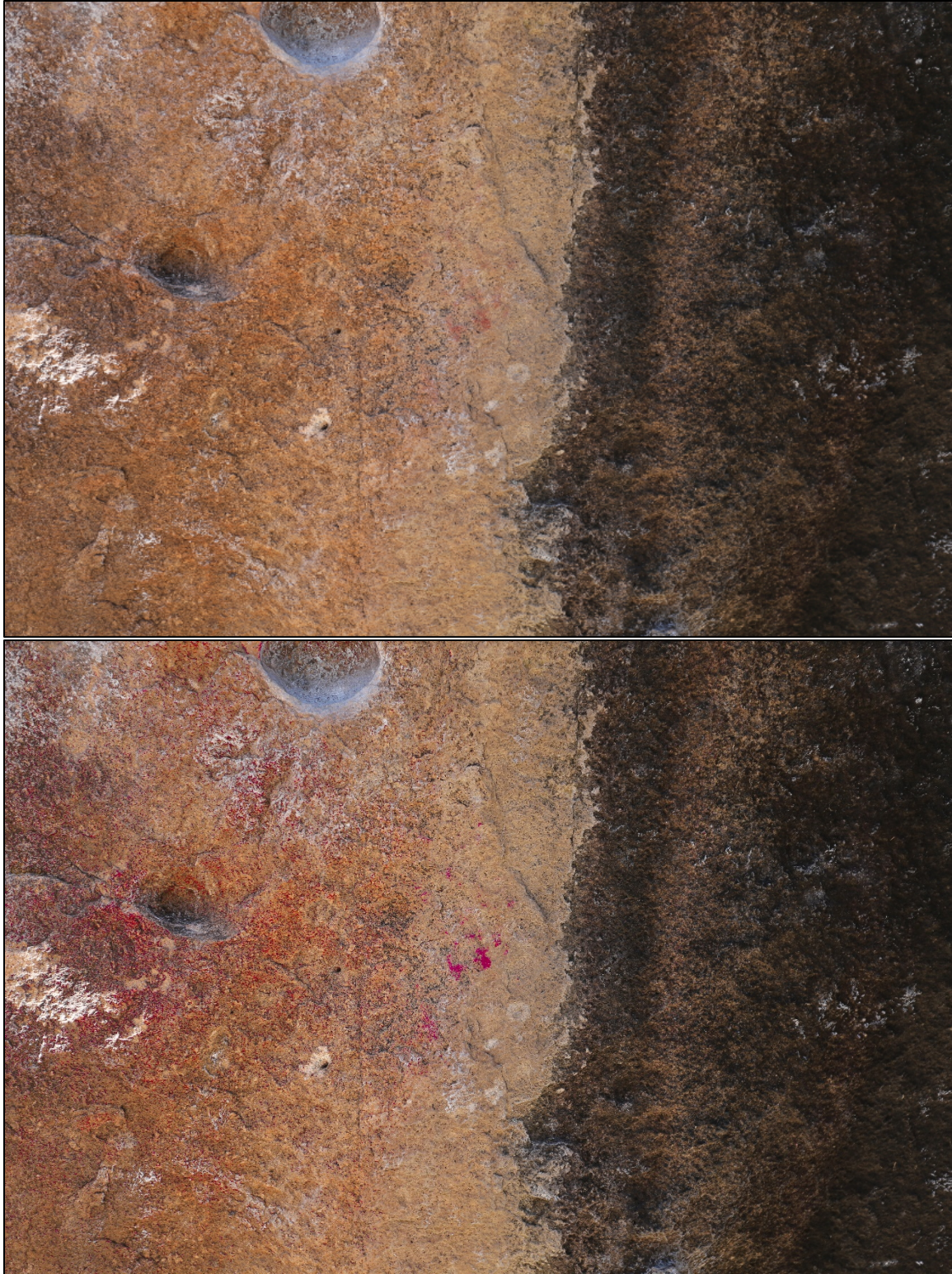


Figure 4.20. Panel N73: original (top) and enhanced in the YDT colorspace (bottom).

Panel N74

This panel consists of red pigment smudges that occupy a prominent vertical crack along the roof of a south-facing overhang. The pigment smudges generally extend 10–22 cm from the crack; however, several additional smudges occur 42–56 cm away from the fissure (Figure 4.21). The smudges generally occur 182–266 cm above the current slab surface. Panel N74 occurs approximately 35–60 cm west (left) of unpublished Problem 108-33-X1, which is itself located approximately 2.9 m east (right) of Problem 108-33-02. The presence of a minor amount of chalk on and immediately adjacent to several of the pigment smudges indicates that some climbing activity has taken place on the panel. The portion of the overhang roof encompassing Panel N74 is specifically noted as an area that should be avoided by climbers in both of the popular bouldering guidebooks (Sherman 1995:150; Wilder 2004:108), indicating prior observation of this pigment by responsible climbers. Moderate to extensive spalling and exfoliation is evident across the overhang. No graffiti or other signs of vandalism are present in the vicinity.

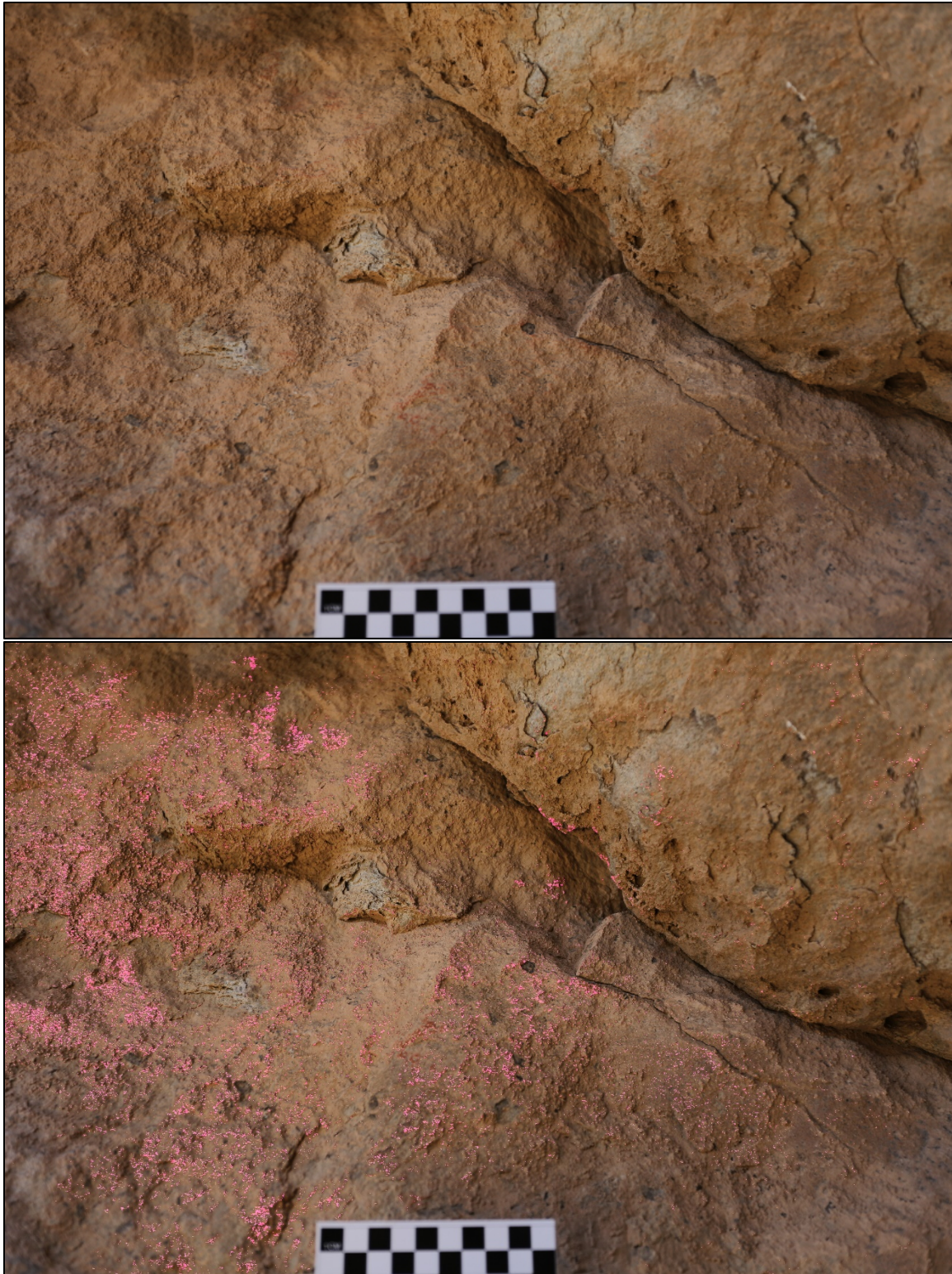


Figure 4.21. Panel N74: original (top) photo of pigment smudges and enhanced in the YYE colorspace (bottom).

Chapter Five

West Mountain: Survey and Documentation Results

West Mountain hosts 339 published bouldering problems (Sherman 1995:316–371; Wilder 2004:223–273). Although two areas of West Mountain are closed to climbing due to the presence of Native American rock art imagery, none of the published bouldering problems on West Mountain are indicated as closed by the Public Use Plan or park administration as of June 2015. An additional 53 previously unpublished bouldering problems were identified and documented during the survey of West Mountain. In total, 392 bouldering problems on West Mountain were surveyed during this effort. As a result of this survey, Native American rock art imagery was identified and documented at three West Mountain locations within or near currently open bouldering problems (Table 5.1; Figure 5.1).

Table 5.1. Rock Imagery Documented on West Mountain Bouldering Problems

Panel Number	Bouldering Problem Number	Description	Closure status
W37C*	238-09-01	Geometric design previously documented by Davis and Sutherland (1977:94)	OPEN
W14B1*	254-17-01 & 02	Extensive panel initially documented by Kirkland in the 1930s (Kirkland and Newcomb 1967:Plate 124)	OPEN
W14C*	254-17-04	Geometric designs initially documented by Kirkland in the 1930s (Kirkland and Newcomb 1967:Plate 124)	OPEN

*Previously recorded

Panel W37C

Previously recorded Panel W37C is located within an offset crack at ground level on the east side of West Mountain. The panel consists of numerous faint lines and a zigzag applied in red pigment measuring approximately 40 cm by 80 cm across a slightly concave surface of the rock (Figure 5.2). Initially recorded during the 1972 rock art inventory of the park, Davis and Sutherland (1977:94) describe the panel as “located in [sic] the south face of a 3-foot-wide crack in the rock mass.” Based on current observations and mapping efforts, the location of the panel can more accurately be described as the north face of a large boulder offset approximately 0.46–0.76 m (1.5–2.5 ft) from the adjacent rock outcrop by a large vertical crack. Due to the restricted space in which the imagery is located, undistorted single-frame photography of the panel was difficult. Therefore, correctly scaled and oriented orthoimagery of the panel was generated using the SfM technique (Figure 5.3). Panel W37C is located approximately 40–80 cm west (right) of Problem 238-09-01, which extends from ground level along the arête of the boulder. The problem does not appear to receive much recreational use, as no chalk or other evidence of recent climbing activity was noted along the problem or in the vicinity of Panel W37C. The pigment that forms the pictograph is faint. No spalling or exfoliation of the rock surface was observed on the panel. No graffiti or other signs of vandalism are present on Panel W37C or in the vicinity of Problem 238-09-01.

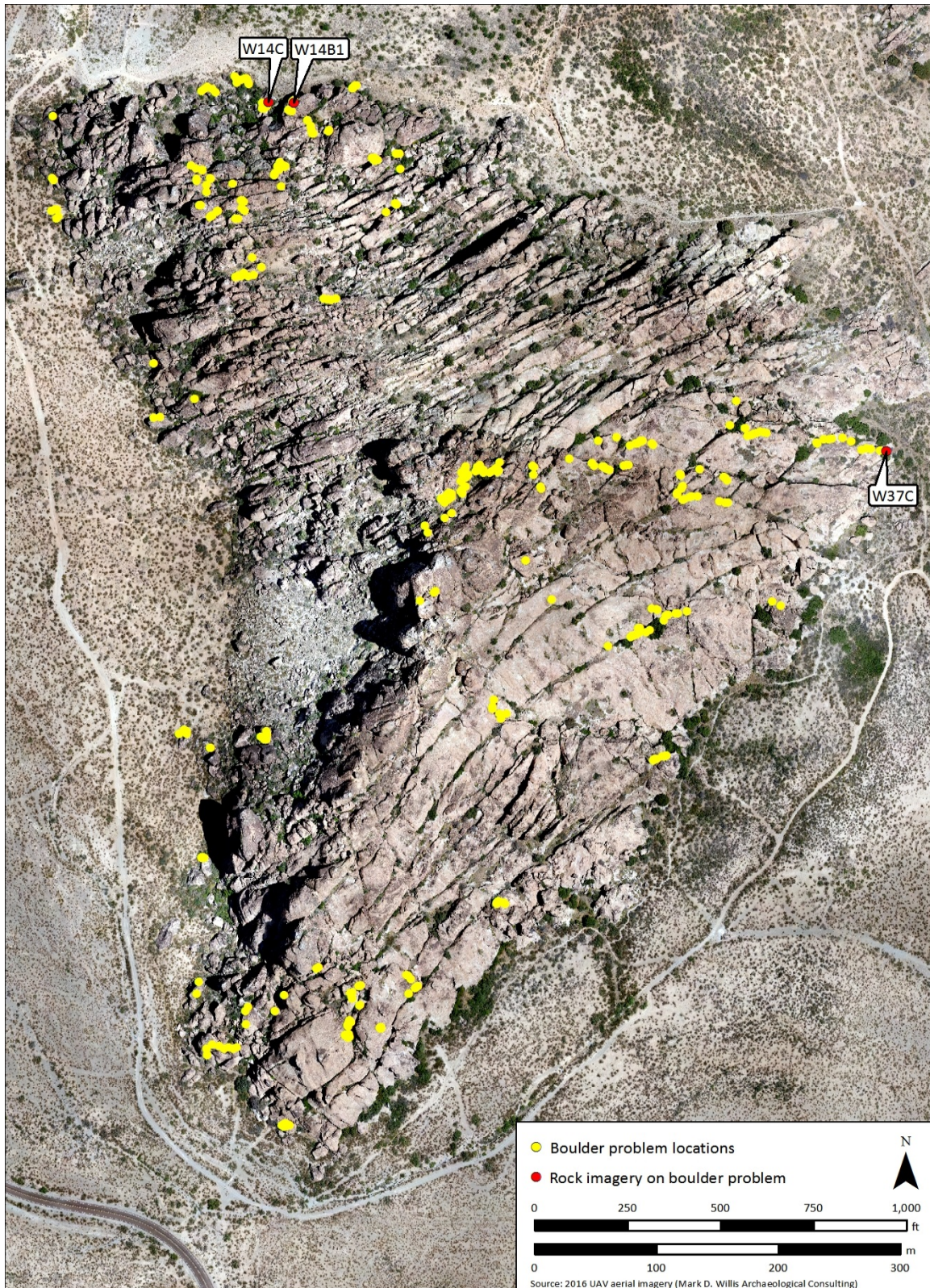


Figure 5.1. Locations of bouldering problems and rock imagery documented on West Mountain.



Figure 5.2. Previously recorded Panel W37C: original (top) photo and enhanced in the YRE colorspace (bottom).

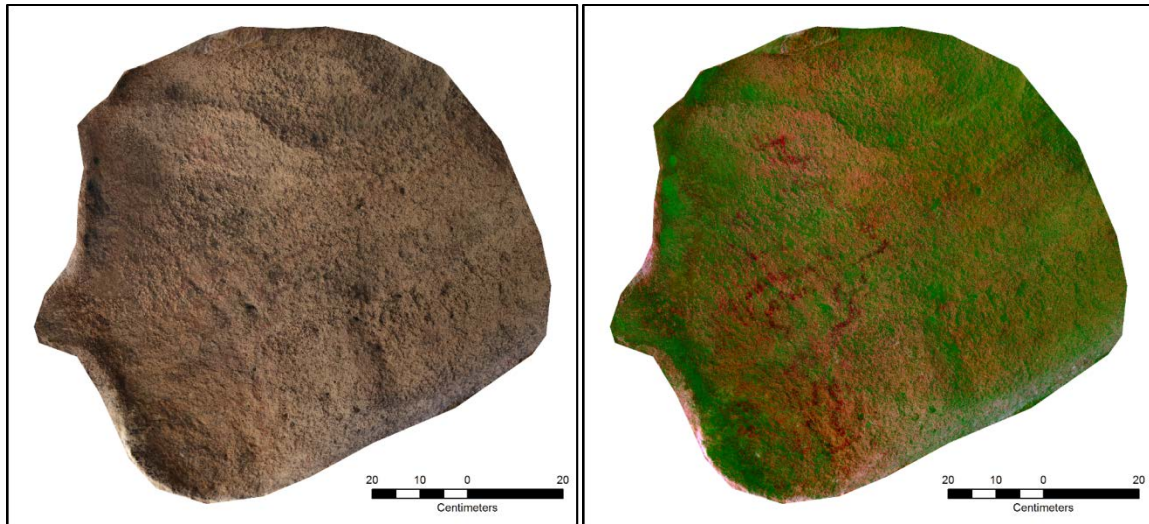


Figure 5.3. SfM orthoimages of previously recorded Panel W37C: original orthoimage (left) and enhanced in the RGB0 colorspace (right).

Panel W14B1

This previously recorded panel was initially designated by Forrest Kirkland as Panel 14C (Kirkland and Newcomb 1967:Plate 124). The panel number was reassigned as W14B1 during the 1999 rock art survey due to the proximity of this panel to Panel 14B, approximately 7 m east (left) on the adjacent cliff face, as opposed to the remainder of Kirkland's Panel 14C, located approximately 27 m right (west) on an outlying boulder (described below). The original panel, as illustrated by Kirkland, extends approximately 6 m along a nearly vertical cliff face on the northern margin of West Mountain and consists of a wide variety of anthropomorphic and zoomorphic figures, as well as dots, zigzags, and other geometric motifs (Figure 5.4). The panel was temporarily submerged by the lake that was created during the brief period of commercial development at the site. The resulting high water mark is evident at a height of approximately 3.5 m along the top of the panel (Figure 5.5). Large portions of the panel and the adjacent rock surfaces were sandblasted prior to the 1972 rock art survey to remove modern graffiti from the rock surface (Davis and Sutherland 1977:26). An additional anthropomorphic figure in faint yellow pigment was documented on the easternmost (left) portion of the panel during the 1999 rock art survey.

During the current survey, pigment remnants were documented west (right) of the main portion of the panel as initially described by Kirkland, along Problems 254-17-01 and 254-17-02 (see Figure 5.5). A pigment remnant, approximately 2 cm long, is located within a hueco measuring approximately 21 cm tall by 14 cm wide along Problem 254-17-01 (Figure 5.6). A pigment remnant, approximately 24 cm tall and 3 cm wide, is also present adjacent to Problem 254-17-02 (Figure 5.7) along a generally smooth surface of the outcrop surface that has been extensively sandblasted during previous graffiti removal activities. These problems do not appear to receive much recreational use, as no chalk or other evidence of recent climbing activity was noted along either of the problems or in the vicinity of Panel W14B1. No recent graffiti or other signs of modern vandalism are present on Panel W14B1 or in the vicinity of Problems 254-17-01 and 254-17-02.

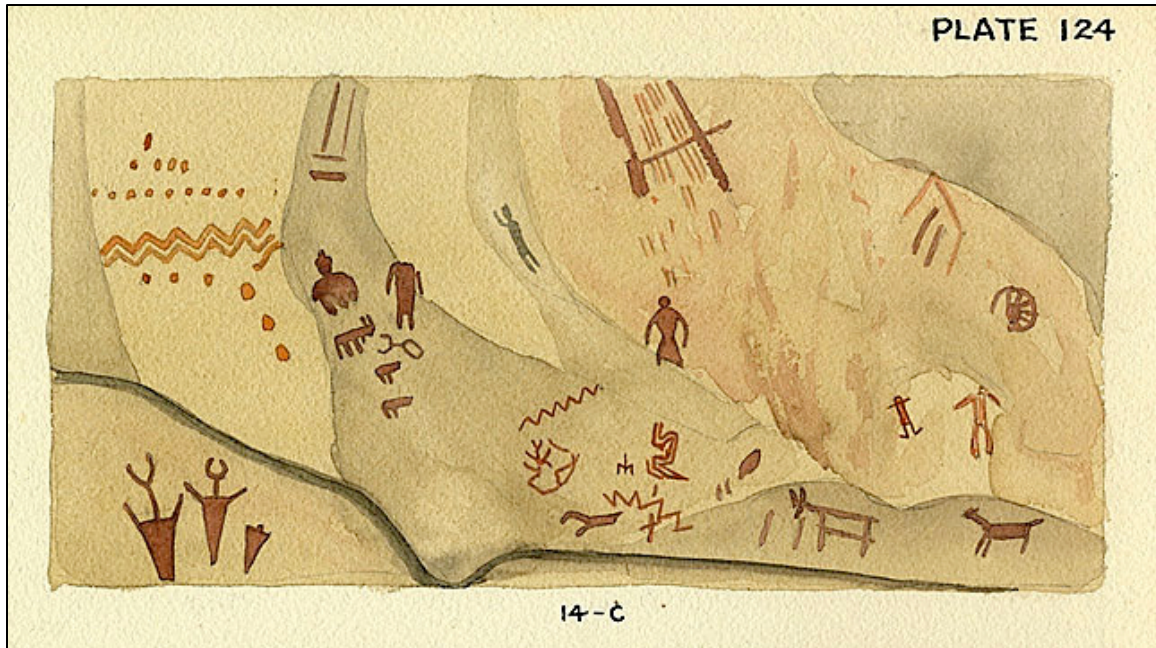


Figure 5.4. Panel W14B1 as documented by Forrest Kirkland in the 1930s (Kirkland and Newcomb 1967:Plate 124).



Figure 5.5. Relationship of previously recorded Panel W14B1 to Problems 254-17-01 and 254-17-02. Note also the waterline marking the area of the panel that was submerged when a reservoir was built near the site.



Figure 5.6. Pigment remnant in hueco along Problem 254-17-01 on previously recorded Panel W14B1. Original photo (top) and enhanced in the LDS colorspace (bottom).



Figure 5.7. Pigment remnant adjacent to Problem 254-17-02 on previously recorded Panel W14B1. Original photo (top) and enhanced in the YRD colorspace (bottom).

Panel W14C

This previously recorded panel was initially recorded by Forrest Kirkland as one of two panels designated Panel 14C (Kirkland and Newcomb 1967:Plate 124). The number of the larger adjacent panel, located approximately 27 m west on a north-facing vertical cliff (described above), was reassigned as W14B1 during the 1999 rock art survey due to the proximity of it to Kirkland's Panel 14B as opposed to the remainder of Kirkland's Panel 14C. The original panel, as illustrated by Kirkland, extends approximately 3.5 m along the south face of a boulder on the northern margin of West Mountain (Figure 5.8).

Numerous additional pigment remnants and design elements are located on the boulder surface outside of the area previously illustrated by Kirkland, particularly within the small alcove to the west (left) of the panel (Figure 5.9). Panel W14C contains a wide variety of geometric motifs and pigment remnants (Figure 5.10). The panel was partially submerged by the lake that was temporarily created during the brief period of commercial development at the site. The resulting high water mark is evident across the lower portion of the panel. The central portion of Panel W14C is extensively exfoliated, and moderate spalling and exfoliation has occurred in other areas of the surrounding rock surface. A single, large bedrock mortar is located immediately southeast of Panel W14C on an underlying boulder surface that supports the host boulder. Problem 254-17-04 is located on the southeastern arête of the boulder. Historic (axle grease) and modern graffiti are present within Panel W14C and the adjacent rock surface.



Figure 5.8. Panel W14C as documented by Forrest Kirkland in the 1930s (Kirkland and Newcomb 1967:Plate 124).

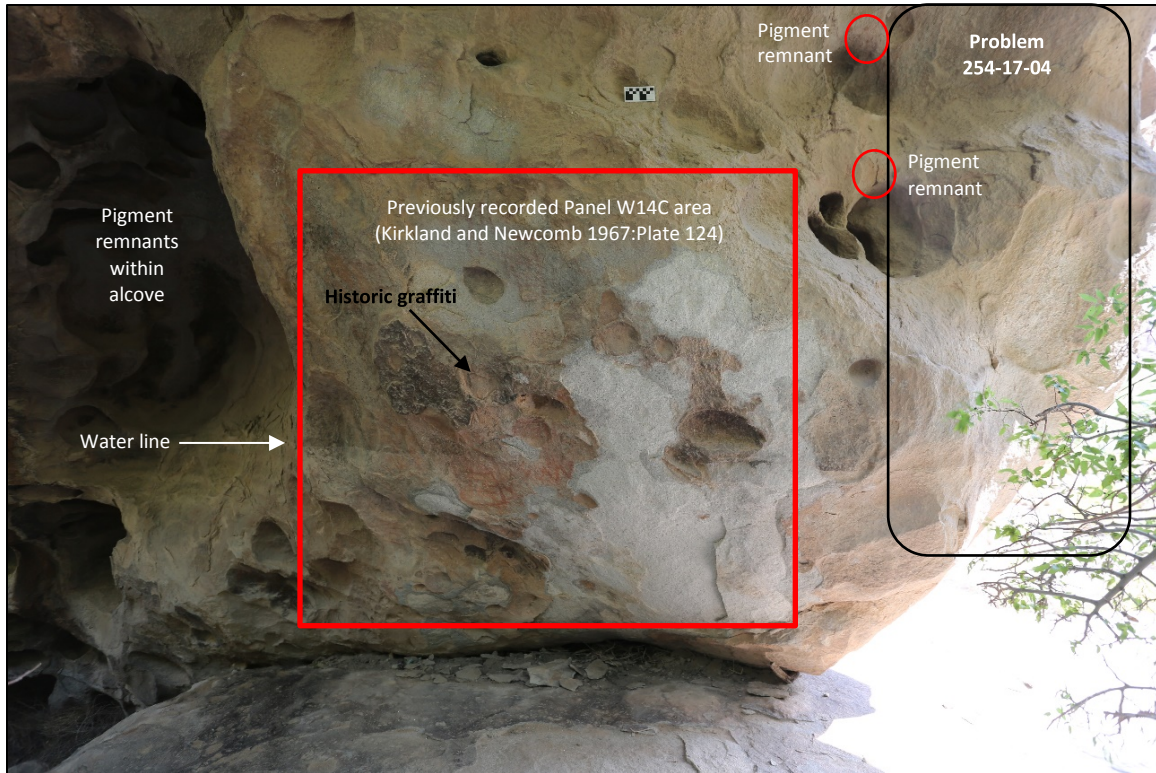


Figure 5.9. Relationship of previously recorded Panel W14C to Problem 254-17-04.

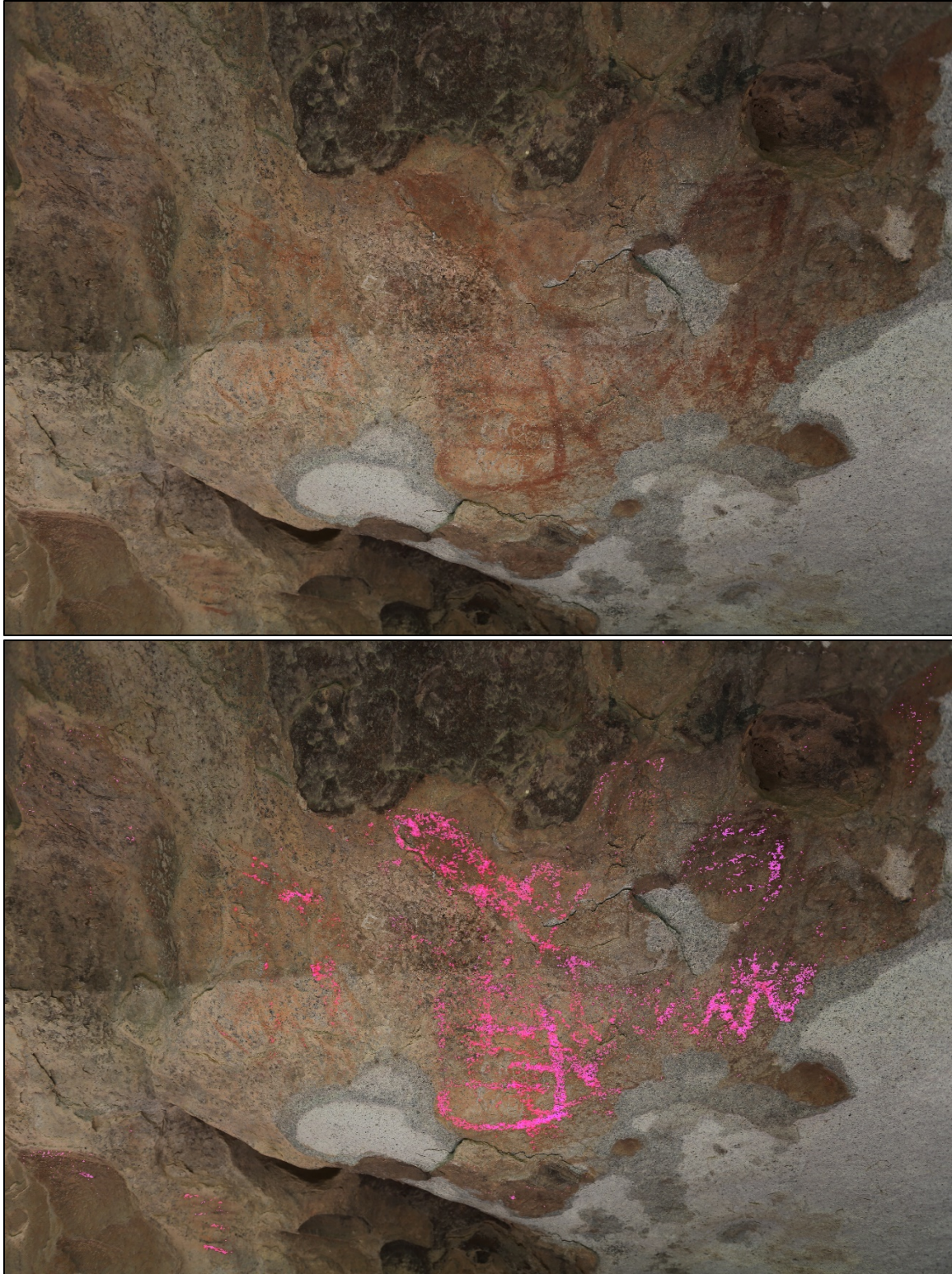


Figure 5.10. Portion of Panel W14C adjacent to Problem 254-17-02. Original photo (top) and enhanced in the YYE colorspace (bottom).

Chapter Six

East Mountain: Survey and Documentation Results

East Mountain contains 590 published bouldering problems (Sherman 1995:161–268; Wilder 2004:119–185). Of these published problems on East Mountain, 37 problems are indicated as closed by the Public Use Plan and park administration as of June 2015 for erosion control, rock art protection, or other resource conflicts and therefore were not part of the survey scope. An additional 44 previously unpublished bouldering problems were identified and documented during the survey of East Mountain. A total of 597 bouldering problems were surveyed during this effort on East Mountain (Figure 6.1). As a result of this survey, eight Native American rock art imagery and pigment remnant locations were identified and documented on East Mountain (Table 6.1; Figure 6.1).

Table 6.1. Rock Imagery Documented on East Mountain Bouldering Problems

Panel Number	Bouldering Problem Number	Description	Closure status
E75	124-04-02	Geometric design and pigment smudges in alcove, possible pigment smudges along fissure in overhang, several bedrock features (cupules and grinding areas) on slab below boulder	OPEN
E17R2B*	124-24-27	Previously recorded panel; includes a possible red mask or face design with zigzag or step-fret motif, geometric elements, pigment dots, smudges, and remnants, and some historic (axle grease) graffiti	OPEN
E76	132-06-X2	White mask or katsina face element	OPEN
E77	138-08-11	Red abstract lines and pigment smudges	OPEN
E78	174-24-02	Red parallel/zigzag lines	OPEN
E79	174-24-03	Red parallel lines	OPEN
E80	XX-X7-X1 Panel 1	Black antlered zoomorphic element	OPEN
E81	XX-X7-X1 Panel 2	Black abstract linear element	OPEN

*Previously recorded

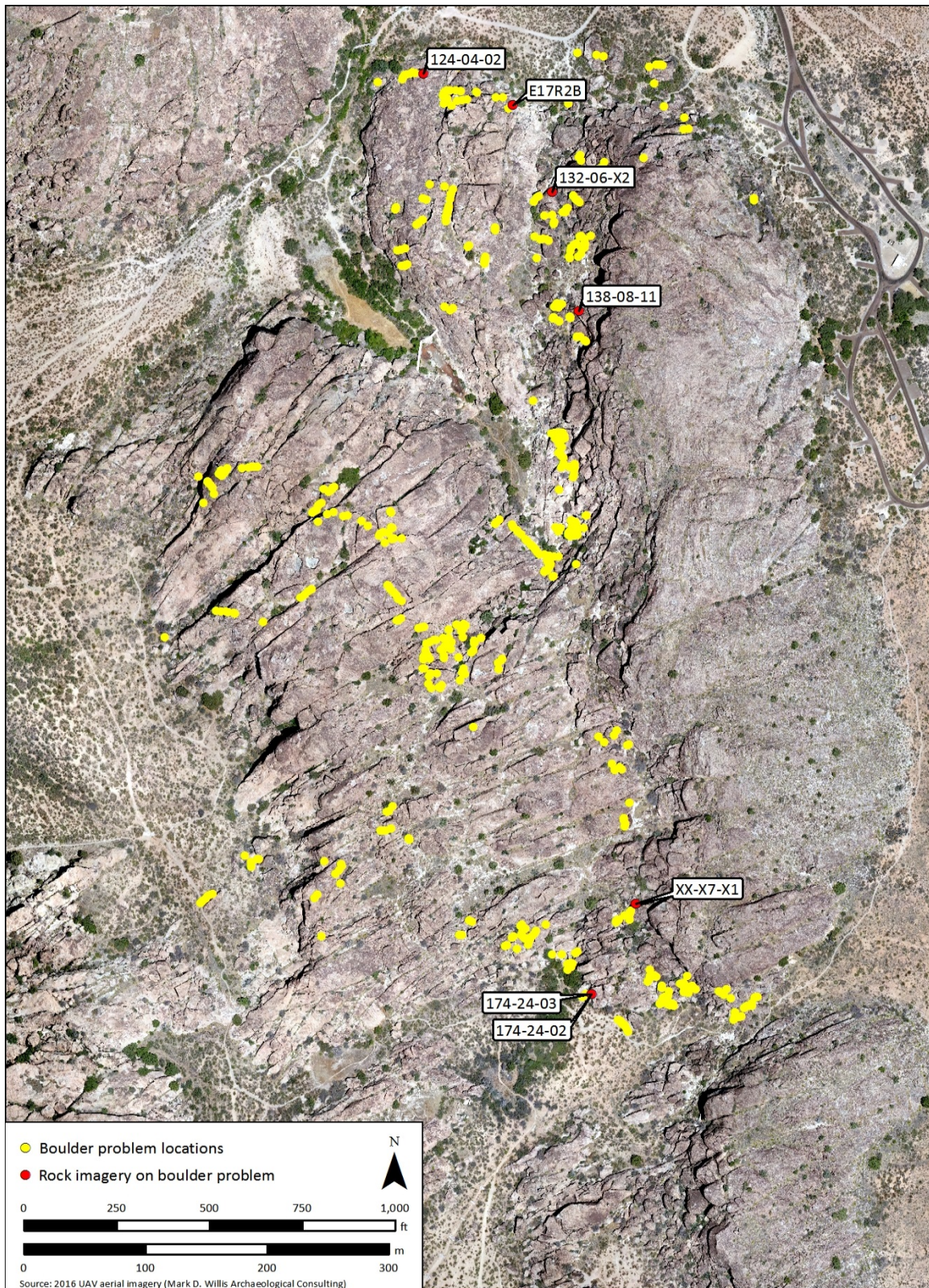


Figure 6.1. Locations of bouldering problems and rock imagery documented on East Mountain.

Panel E75

This panel is located within a northeast-facing alcove formed by a large boulder situated on the north margin of East Mountain. The location contains a red geometric design, isolated red pigment smudges on the ceiling of the alcove, and several bedrock features on the surface of the slab below the boulder (Figure 6.2). Several possible pigment smudges are also present above the alcove on the exterior surface of the boulder along a prominent horizontal fissure in the boulder. The red geometric design is generally rectangular in form and measures approximately 21 cm wide by 18 cm tall and consists of an incomplete outer line encompassing at least three vertical lines relatively evenly spaced within the outline (Figure 6.3).

Several bedrock features, including cupules and grinding areas (Figure 6.4), were observed on the slab surface below the overhang. Panel E75 occurs directly below Problem 124-04-02, which is located on the exterior surface of the boulder. No chalk was observed along Problem 124-04-02 or on Panel E75. Moderate spalling and exfoliation is evident across the exterior surface of the boulder, but none was observed on Panel E75. Numerous mud dauber wasp nests were observed across the interior of the alcove. No graffiti or other signs of vandalism are present in the immediate vicinity of Panel E75.

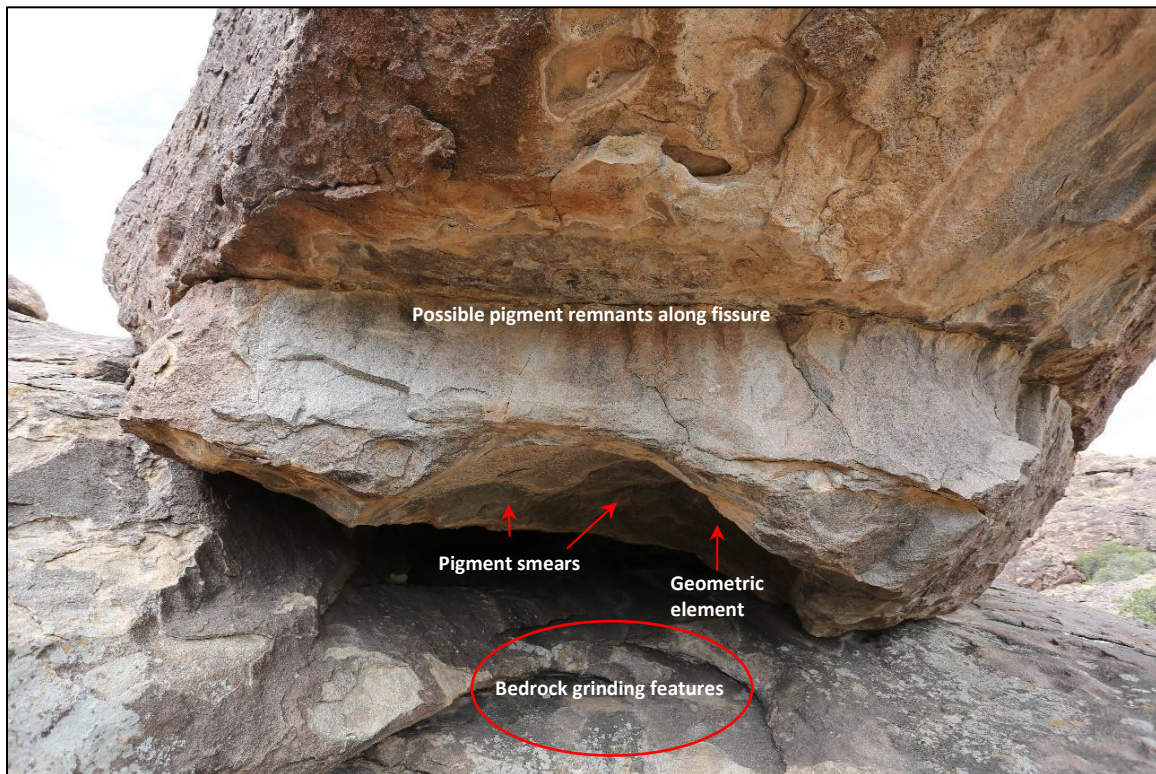


Figure 6.2. Overview of Problem 124-04-02 and Panel E75 on underside of boulder.



Figure 6.3. Geometric element on Panel E75: original photo (top) and enhanced in the YRD colorspace (bottom).



Figure 6.4. Cupule features (upper figure) and grinding surfaces (lower figure) on bedrock below Panel E75.

Panel E17R2B

This previously recorded panel is located on an east-facing vertical exposure above a sloping slab surface just above ground level on the north margin of East Mountain. Bouldering problem 124-04-27 extends across the approximate center of Panel E17R2B (Figure 6.5). This panel was previously noted during the 1999 TPWD rock art survey due to the presence of a partial red mask or face design, approximately 17 cm tall, with step-fret and other geometric design elements (Figure 6.6 and Figure 6.7). Several additional red pigment remnants and smudges are evident across the surrounding rock surfaces, including the overlying boulder. Additional red pigment lines and geometric designs and historic (axle grease) graffiti are located within an alcove and surfaces to the southwest (left) of this panel. No chalk was observed along Problem 124-04-27 or on the panel. Extensive spalling and exfoliation is evident across the rock surface that supports Panel E17R2B. No modern graffiti or other signs of vandalism are present in the immediate vicinity of Panel E17R2B.

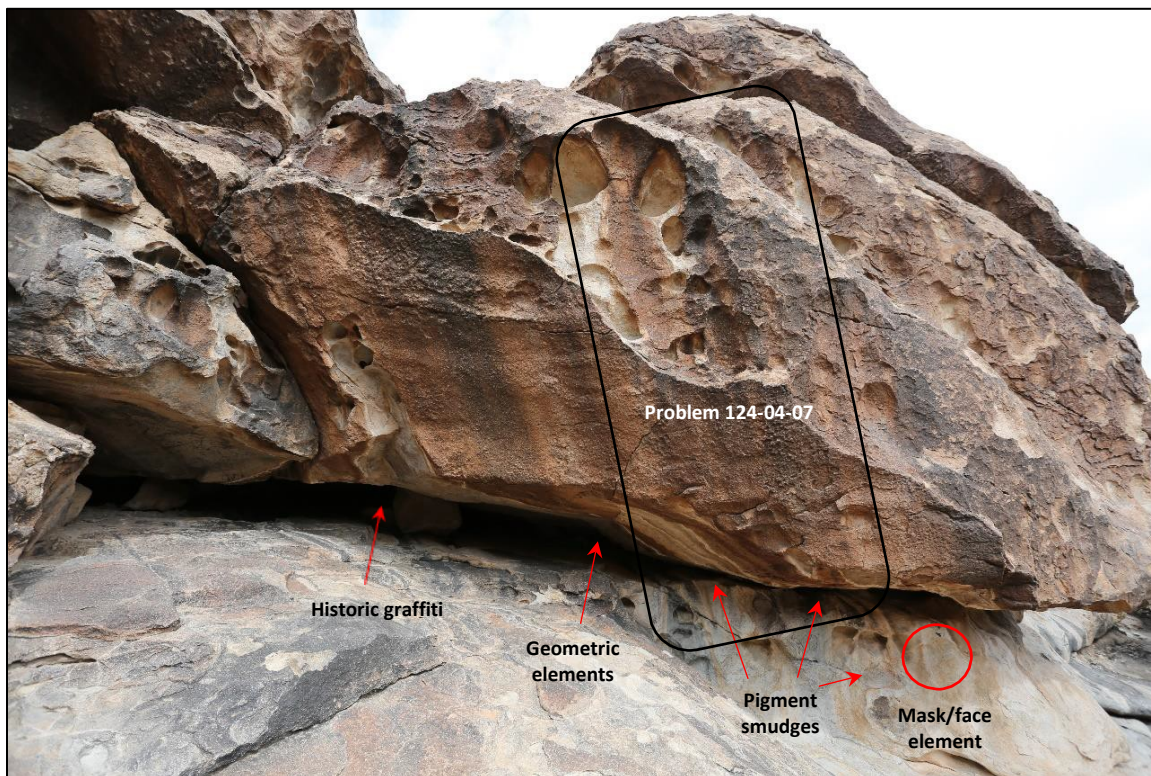


Figure 6.5. Overview of Problem 124-04-07 and previously recorded Panel E17R2B.

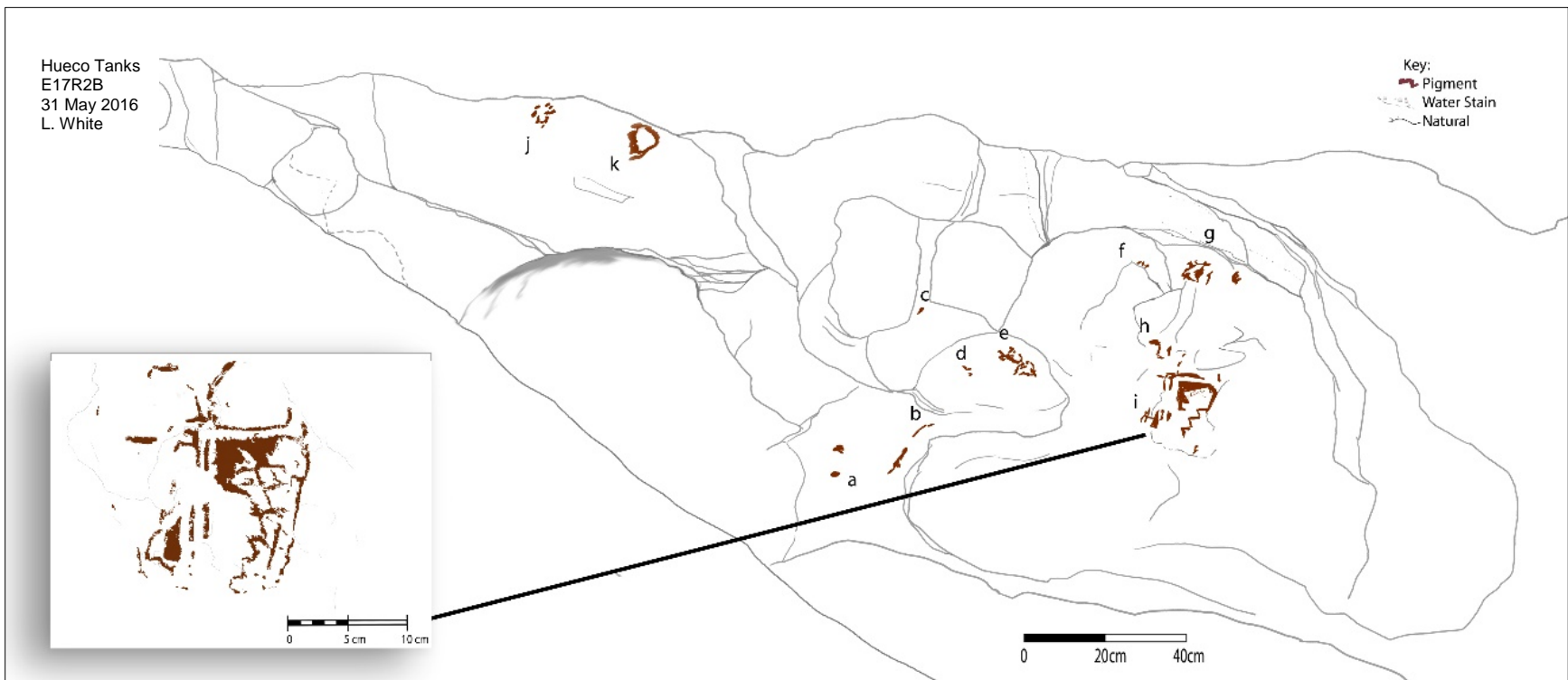


Figure 6.6. Illustration of Panel E17R2B (Drawing by Laurie White).



Figure 6.7. Geometric mask or face element on Panel E17R2B: original photo (top) and enhanced in the YRD colorspace (bottom).

Panel E76

Panel E76 is located near the northern end of a small north-trending canyon on the north flank of East Mountain. The panel occupies the recessed ceiling of a small alcove under a boulder with a slight vertical overhang that supports two unpublished bouldering problems: Problems 132-06-X1 and 132-06-X2 (Figure 6.8). Panel E76 consists of a single white mask or face design (Figure 6.9 and Figure 6.10) approximately 15 cm wide and 39 cm tall. The design incorporates a horizontally zoned face with three-part elliptical or almond-shaped eyes, two rows of possibly six dots each, and long curving horns or ears. While chalk was present on Problems 132-06-X1 and X2, no chalk was observed on Panel E76. No spalling or exfoliation is evident across the rock surface that supports the panel; however, the pigments that compose the imagery are faded. No modern graffiti or other signs of vandalism are present in the vicinity of Panel E76.

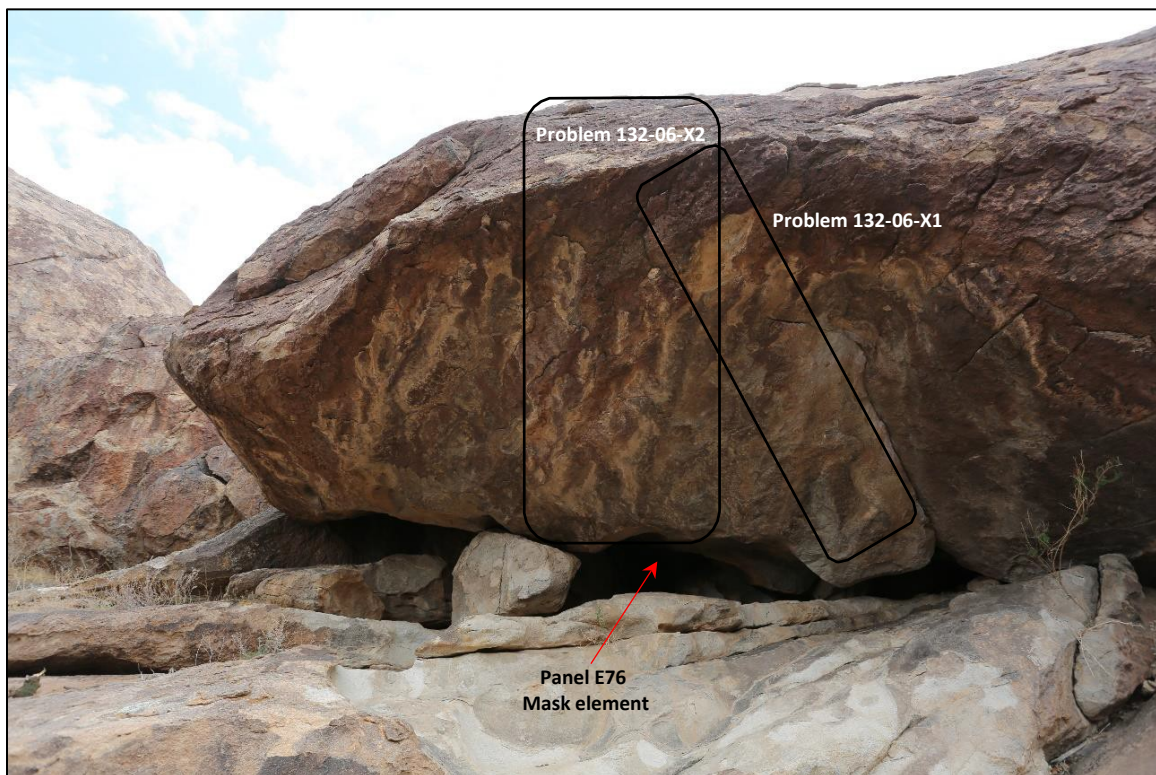


Figure 6.8. Overview of boulder with Problems 136-06-X1 and 136-06-X2 and newly discovered mask panel.

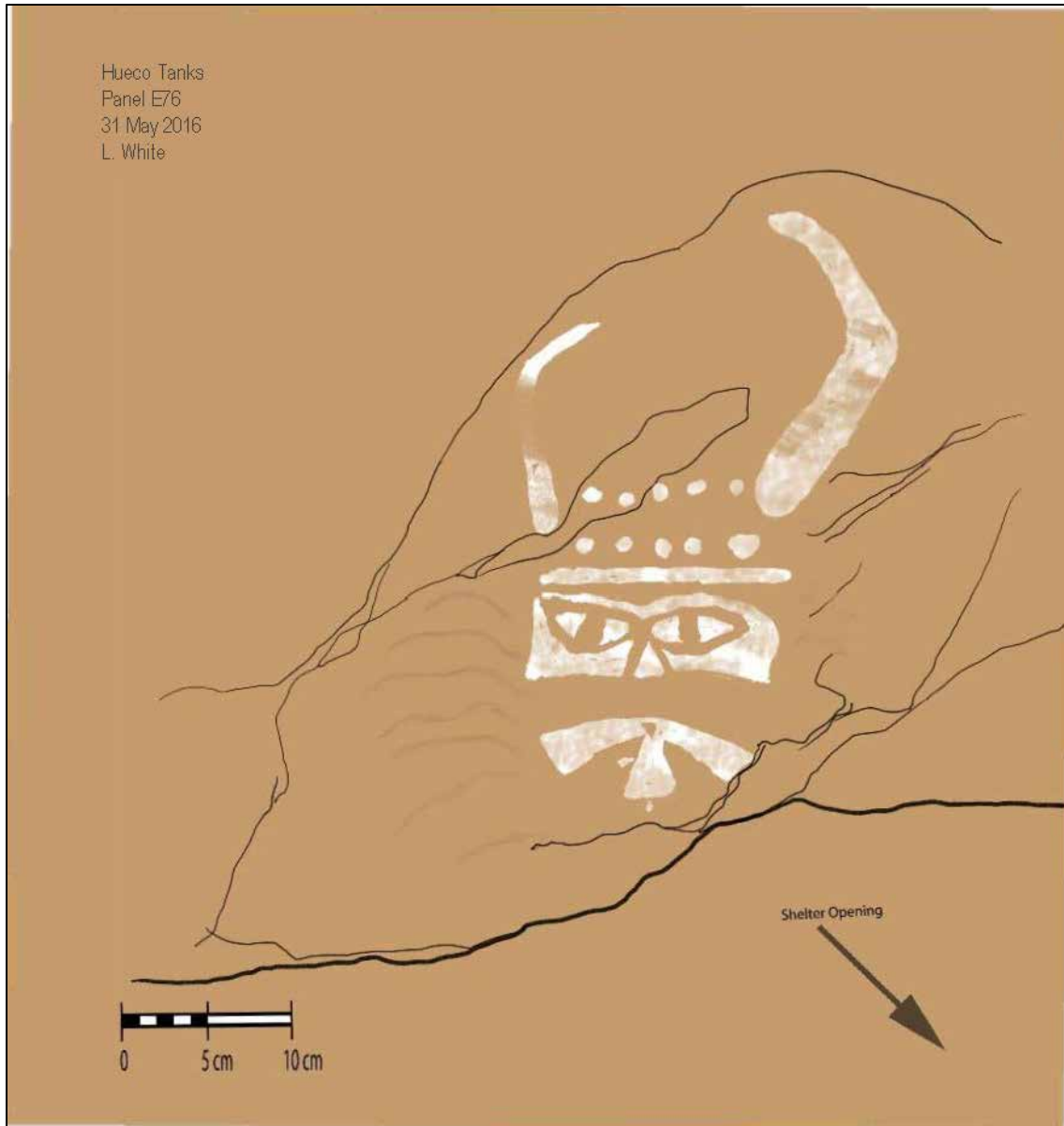


Figure 6.9. Illustration of mask element on Panel E76 (Drawing by Laurie White).

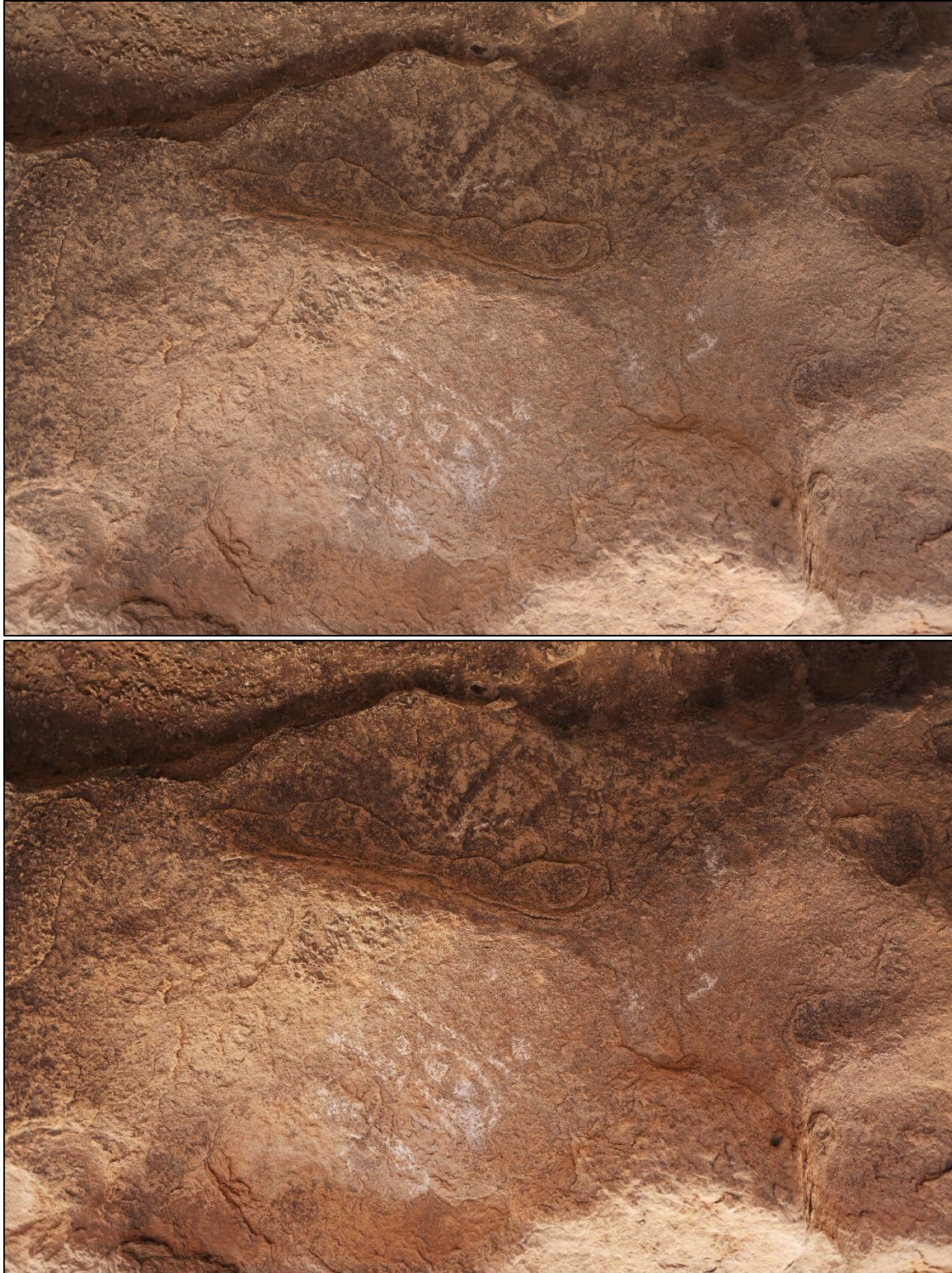


Figure 6.10. Mask face element on Panel E76: original photo (top) and enhanced in the LRD colorspace (bottom).

Panel E77

This panel is located in an alcove beneath the western wall of a narrow crevasse in the central portion of a small north-trending canyon on the north flank of East Mountain. It consists of a single red abstract geometric design and several pigment smudges (Figure 6.11) across the ceiling of the alcove to the north (left) of Problem 138-08-11.

The abstract geometric design measures approximately 10.5 cm in maximum width by 11 cm in maximum height and is composed of eight intersecting lines (Figure 6.12). Several red pigment smudges and line segments are also present at this location, including a series of three short parallel lines approximately 22 cm east of the geometric design. While climbing chalk was present on Problem 138-08-11, no chalk was observed on Panel E77. No spalling or exfoliation is evident across the rock surface that supports the panel, and the pigments present there are relatively well-preserved. No modern graffiti or other signs of vandalism are present in the vicinity of Panel E77.



Figure 6.11. Overview of Panel E77 showing geometric element and pigment smudges. Original photo (top) and enhanced in the RGB0 colorspace (bottom).



Figure 6.12. Geometric element of Panel E77. Original photo (top) and enhanced in the LDS colorspace (bottom).

Panel E78

Panel E78 is located under a boulder overhang near ground level on the south margin of East Mountain. The panel is approximately 2.3 m above the ground surface and approximately 1.6 m above a series of smaller boulders at ground level under the overhang (Figure 6.13). Panel E78 comprises possibly four sets of three very faint parallel red lines (Figure 6.14). Three of the line sets are drawn at opposing angles forming a zigzag pattern. The fourth set of lines is nearly vertical and is offset to the northeast (right) of the upper portion of the zigzagging lines. Each set of lines is approximately 20 cm long. The panel is approximately 1.8 m northeast (right) of Problem 174-24-02. While chalk was present on the adjacent bouldering problem, no chalk was observed on Panel E78. No spalling or exfoliation is evident across the rock surface that supports the panel; however, the pigments that compose the imagery are very faded and are largely imperceptible to the unaided eye. No modern graffiti or other signs of vandalism are present in the vicinity of Panel E78.



Figure 6.13. Overview of boulder with problem 174-24-02 showing location of rock art panel.



Figure 6.14. Geometric element of Panel E78. Original photo (top) and enhanced in the YYE colorspace (bottom).

Panel E79

Panel E79 is located on a boulder at ground level on the south margin of East Mountain (Figure 6.15). The panel is within bouldering Problem 174-24-03 and contains the remnants of approximately seven parallel lines, each approximately 6 cm long, located within a hueco 40 cm wide by 24 cm tall situated 1 m above the ground surface (Figure 6.16). Chalk is present along Problem 174-24-03 and on the margins of the hueco containing Panel E79. Some spalling and exfoliation is evident across the boulder surface; however, no spalling or exfoliation was observed within the hueco containing the imagery. The pigments that compose the imagery are very faded and are almost undiscernible to the unaided eye. No modern graffiti or other signs of vandalism are present in the vicinity of Panel E79.

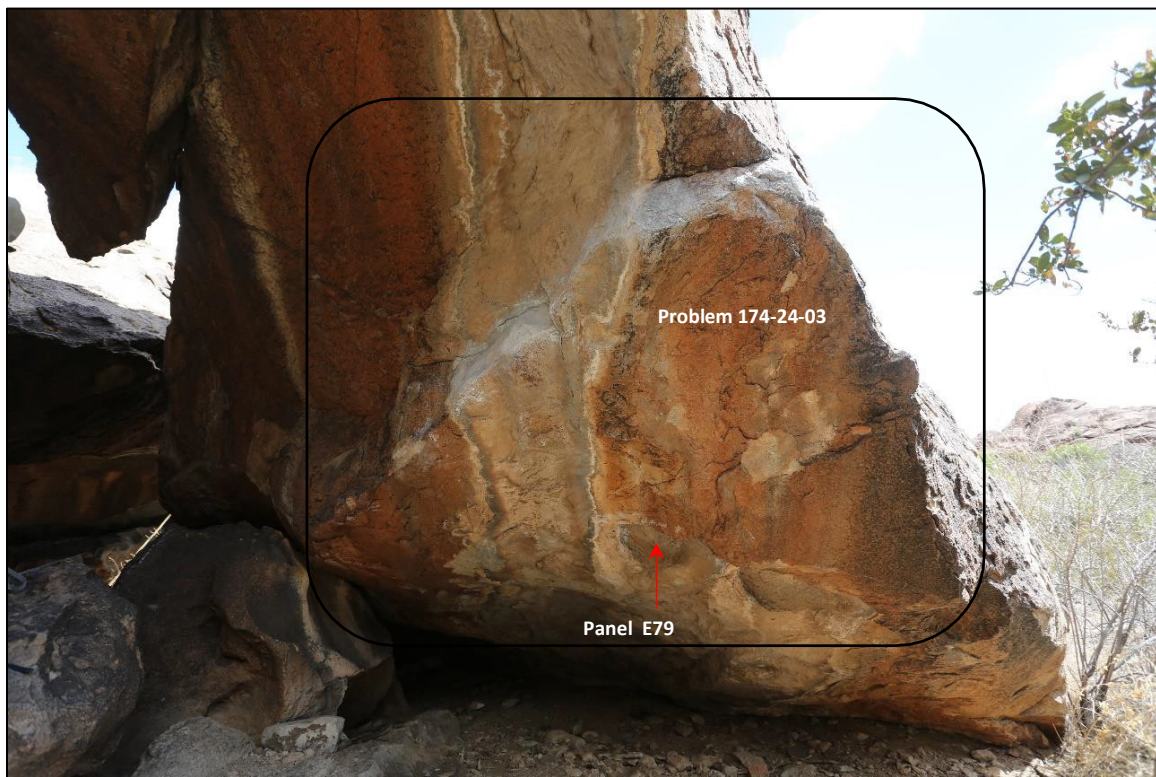


Figure 6.15. Overview of boulder with problem 174-24-03 showing location of rock art panel.



Figure 6.16. Panel E79. Original photo (top) and enhanced in the RGB0 colorspace (bottom).

Panel E80

This panel is in an unpublished bouldering area located within the southcentral portion of East Mountain. The panel is situated near the back of a large southwest-facing overhang formed by several large boulders approximately 2.5 m above the surrounding ground surface. The panel is located in the northeastern portion of the shelter overhang, approximately 1.6 m north (left) of an unpublished bouldering problem and 2 m above the shelter floor (Figure 6.17). Panel E80 comprises a single antlered zoomorphic figure measuring approximately 20 cm wide by 20 cm tall in black pigment (Figure 6.18). Chalk is present along the adjacent unpublished bouldering problem; however, no chalk is present on the imagery panel. Very little spalling or exfoliation is evident across the rock surface, and no spalling or exfoliation was observed within the imagery panel. The pigment that composes the body of the zoomorph is very faded, but portions of the antlers remain visible. No modern graffiti or other signs of vandalism are present in the immediate vicinity of the unpublished problem or Panel 1.

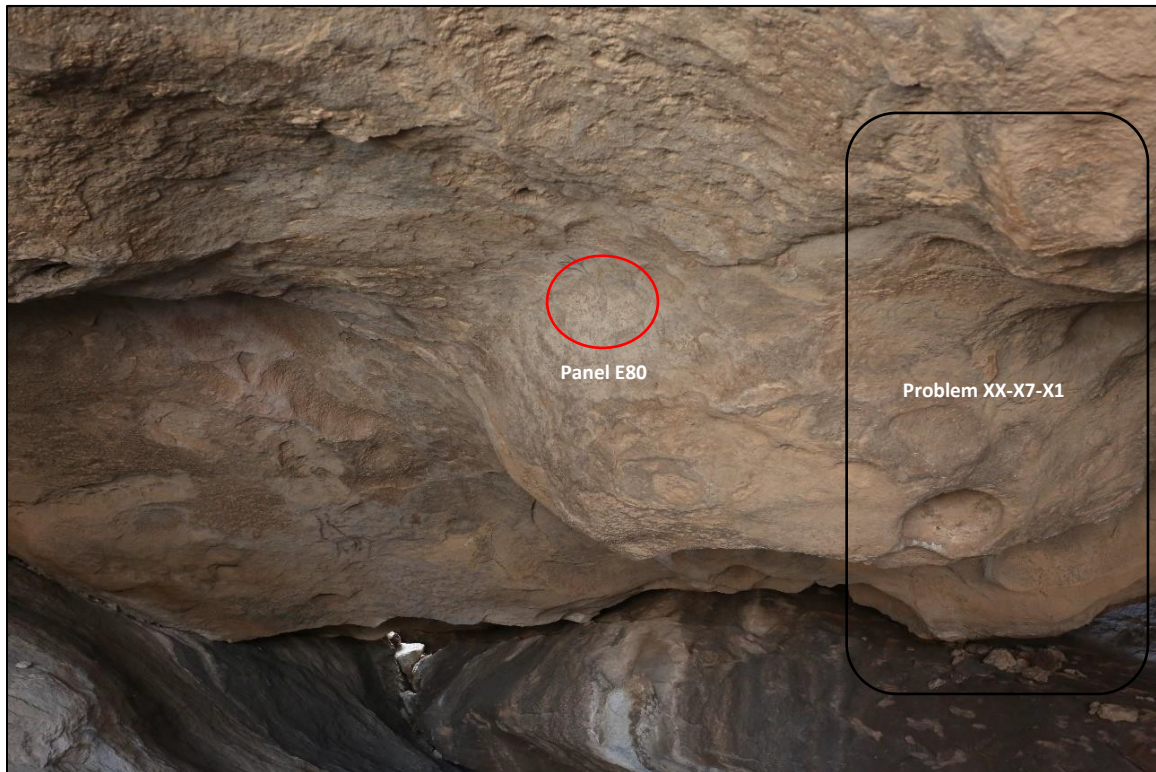


Figure 6.17. Overview of unpublished bouldering problem XX-X7-X1 showing location of Panel E80.

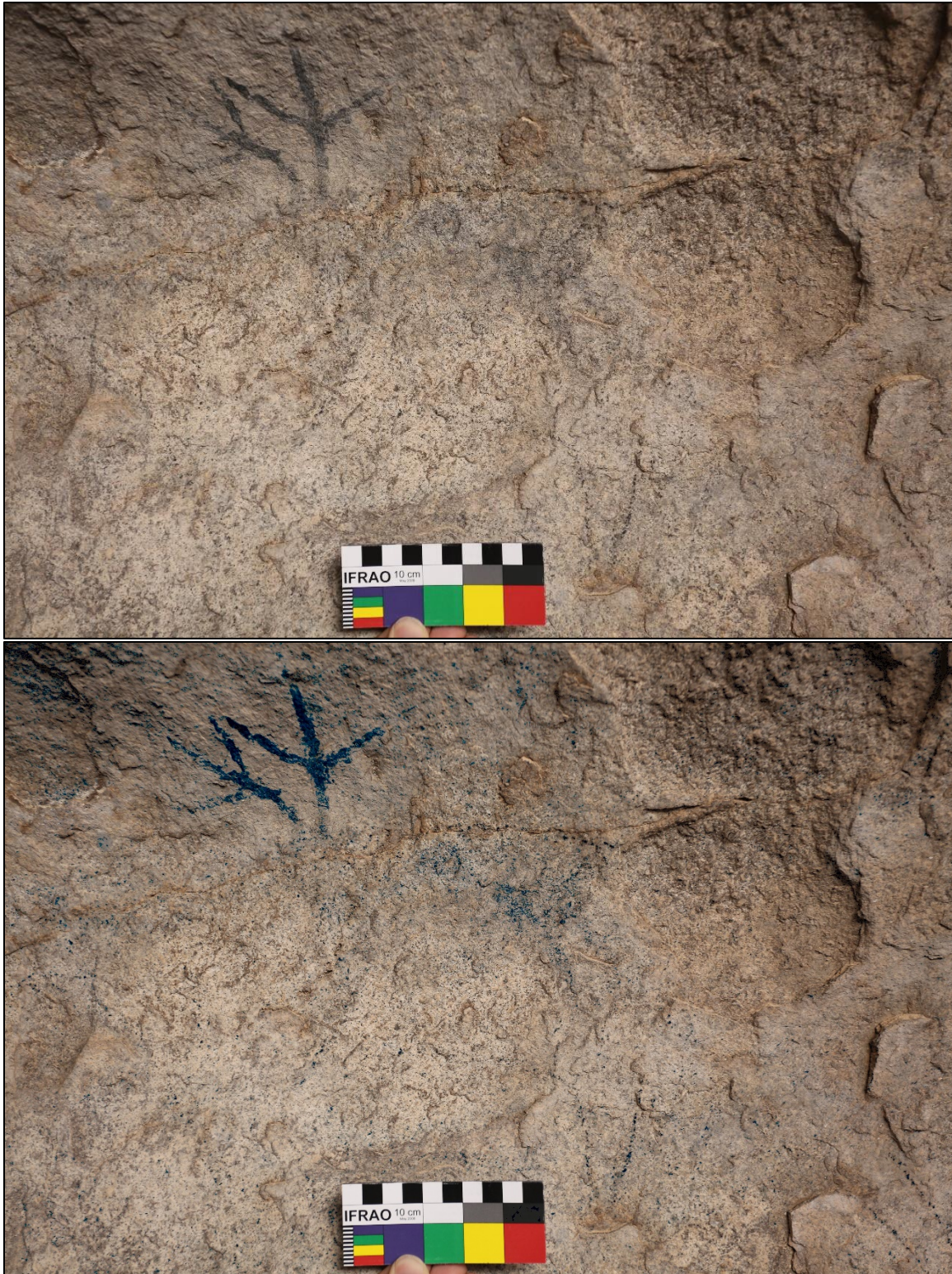


Figure 6.18. Zoomorphic element of Panel E80 at unpublished bouldering Problem XX-X7-X1. Original photo (top) and enhanced in the LBK colorspace (bottom).

Panel E81

This panel is located within an unpublished bouldering area in the southcentral portion of East Mountain. The panel is situated near the back of a large southwest-facing overhang formed by several large boulders approximately 2.5 m above the surrounding ground surface. The panel is located in the northeastern portion of the shelter overhang, approximately 2.9 m north (left) of an unpublished bouldering problem and approximately 80 cm above a sloping rock surface beneath the panel (Figure 6.19). Panel E81 comprises a single abstract element measuring approximately 20 cm wide by 30 cm tall in black pigment (Figure 6.20). Chalk is present along the adjacent unpublished bouldering problem; however, no chalk is present on the imagery panel. Very little spalling or exfoliation is evident across the rock surface and no spalling or exfoliation was observed within the imagery panel. The pigment that composes the element is slightly faded but remains visible. No modern graffiti or other signs of vandalism are present in the immediate vicinity of the unpublished problem or Panel E81.

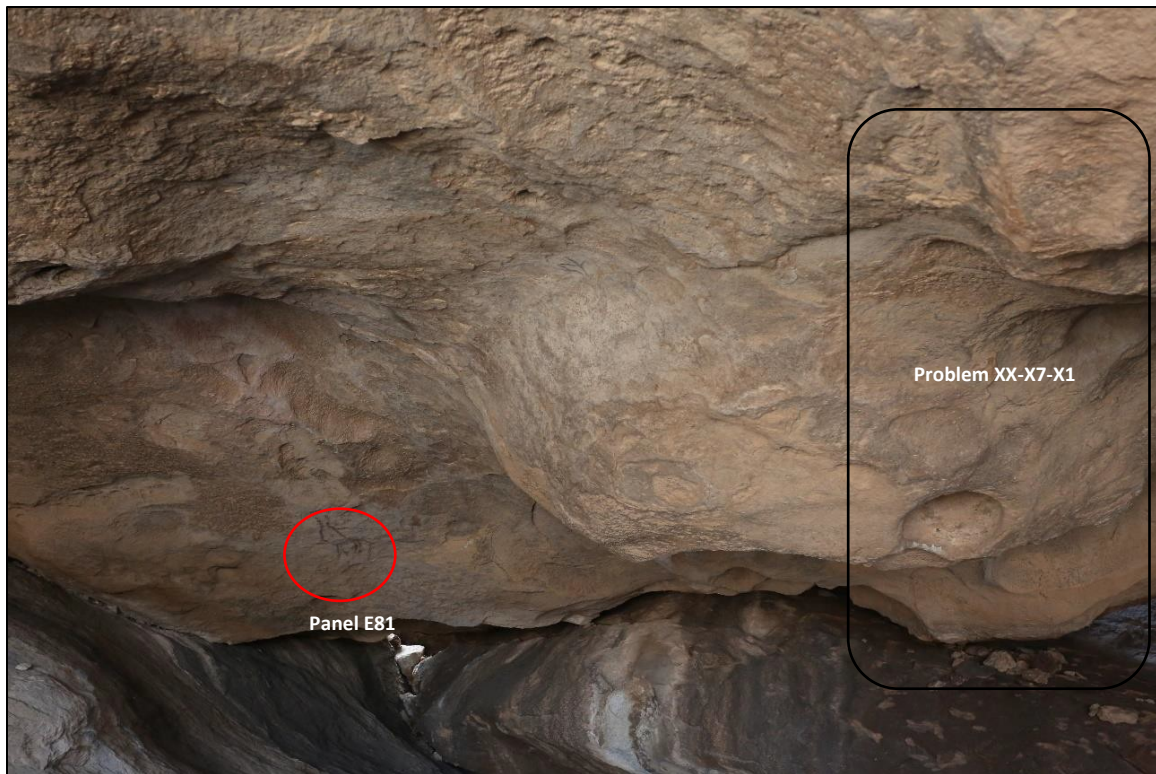


Figure 6.19. Overview of unpublished bouldering problem XX-X7-X1 showing location of Panel E81.



Figure 6.20. Zoomorphic element of Panel E81 at unpublished bouldering Problem XX-X7-X1. Original photo (top) and enhanced in the LBL colorspace (bottom).

Chapter Seven

East Spur: Survey and Documentation Results

Based on current guidebook information, the East Spur contains 284 published bouldering problems (Sherman 1995:269–315; Wilder 2004:187–219). Of the published problems on the East Spur, 28 problems are indicated as closed by the Public Use Plan and park administration as of June 2015 for rock art protection and therefore were not part of the survey scope. An additional 26 previously unpublished bouldering problems were identified and documented during the survey of the East Spur. Therefore, a total of 282 bouldering problems were surveyed during this effort on the East Spur (Figure 7.1). As a result of this survey, four Native American rock art imagery and pigment remnant locations were identified and documented on the East Spur (Table 7.1; Figure 7.1).

Table 7.1. Rock Imagery Documented on the East Spur Bouldering Problems

Panel Number	Bouldering Problem Number	Description	Closure status
SE82	192-03-21	Pigment smudge	OPEN
SE83	202-06-02	Possible red geometric element; dry-applied	OPEN
SE84	216-09-09	Red and black linear elements	OPEN
SE85	XX-X8-X1	Red geometric (zigzag) design	OPEN

Panel SE82

This panel is located on a west-facing bluff near the north end of the East Spur. The panel is located approximately 145 cm above the adjacent slab surface next to a small tree. This panel consists of a 20-cm-wide red pigment smudge within a hueco 80 cm wide by 62 cm tall (Figure 7.2). Published bouldering problem 192-03-21 extends from the underlying slab surface up the bluff wall immediately adjacent to the hueco that hosts the panel. In addition, previously recorded rock art panels SE24B–G are located approximately 4.7 m to the northwest (left) of Panel SE82. No climbing chalk is present along the adjacent bouldering problem, and no chalk is present on the imagery panel. Very little spalling or exfoliation is evident across the rock surface, and no spalling or exfoliation was observed within the imagery panel. The pigment that composes the element is very faded and barely visible to the unaided eye. Black graffiti, including names and a heart and arrow design, is also present within the hueco.

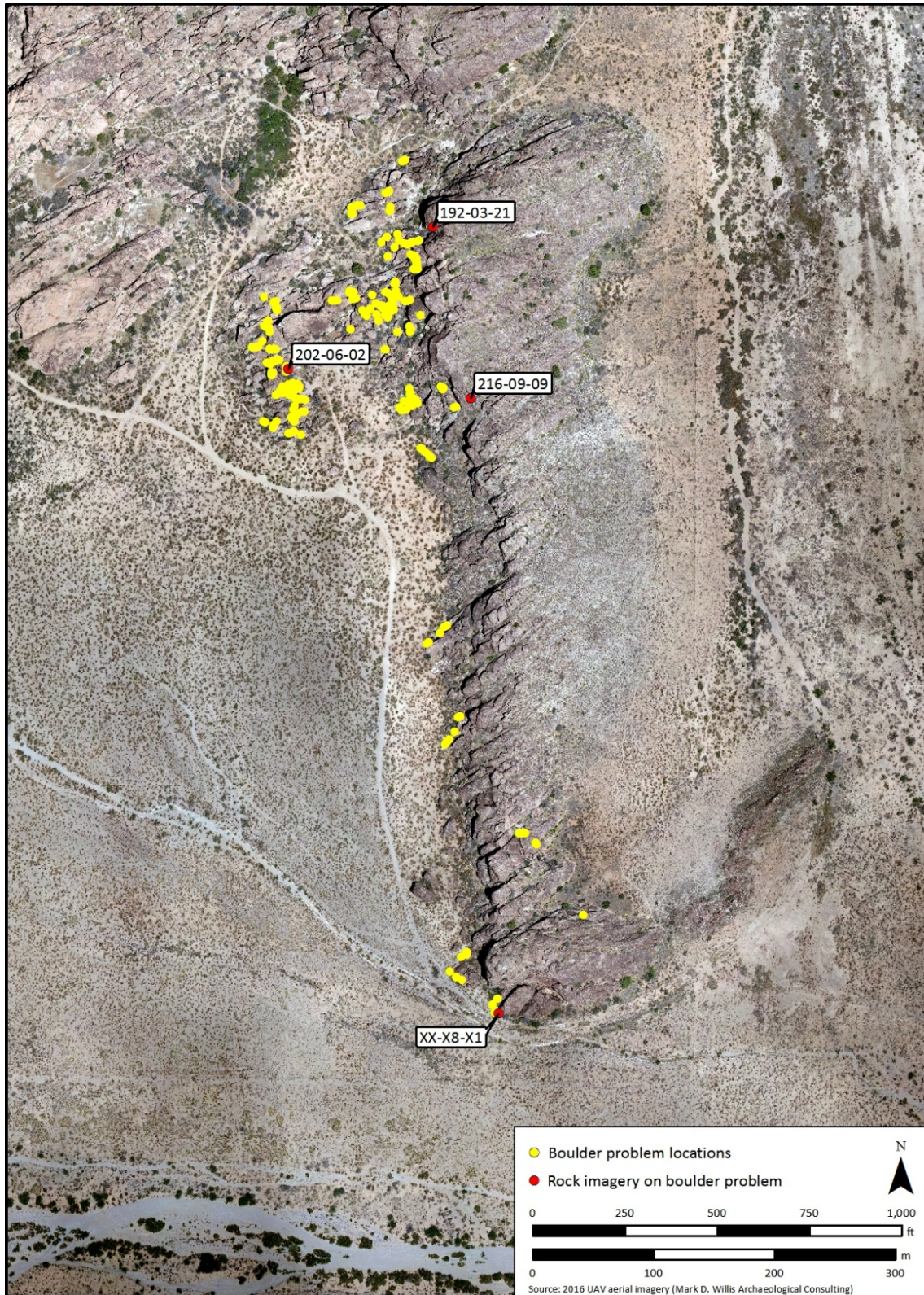


Figure 7.1. Locations of bouldering problems and rock imagery documented on the East Spur.

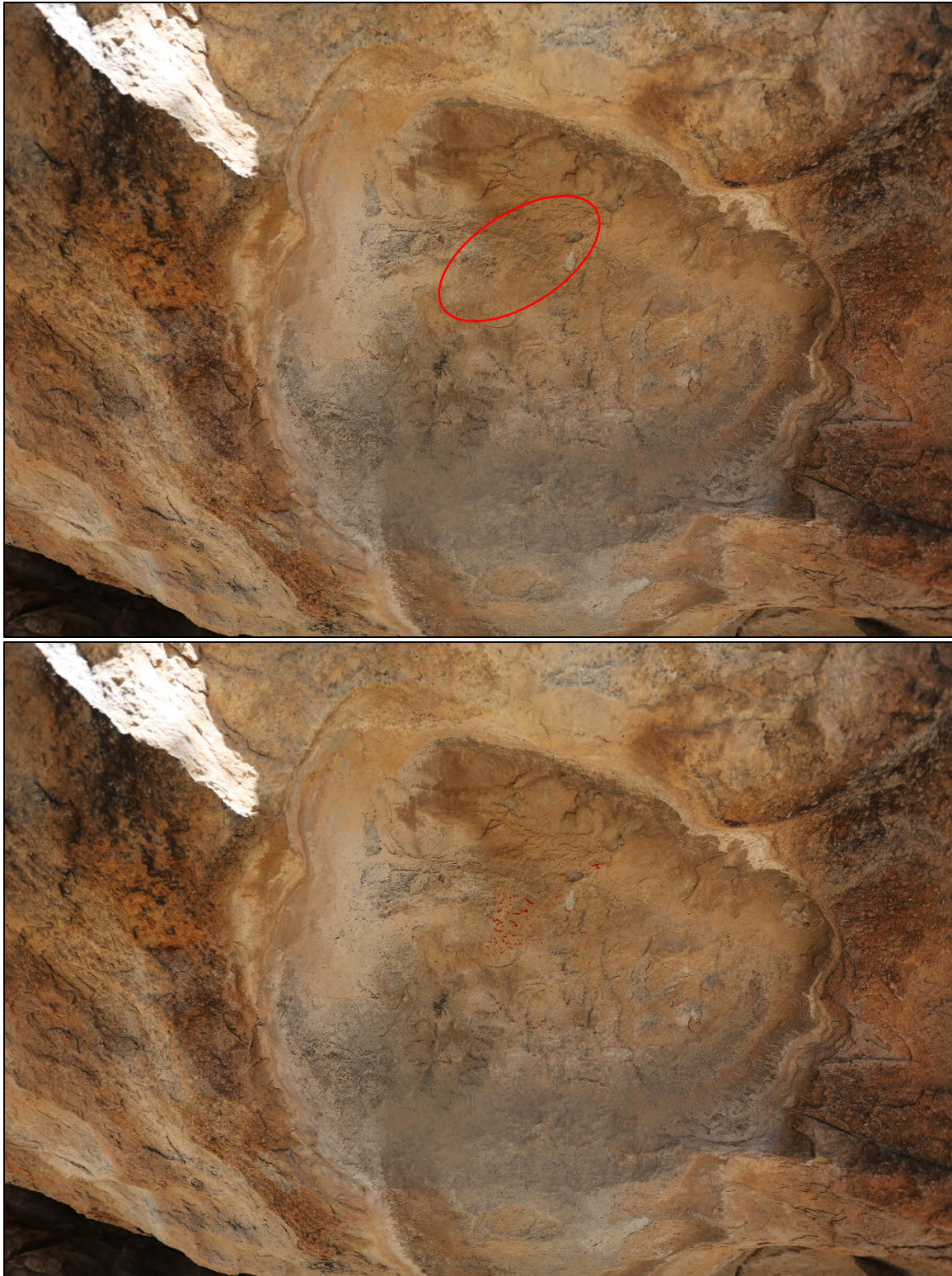


Figure 7.2. Pigment smudge of Panel SE82. Original photo (top) and enhanced in the CRGB colorspace (bottom).

Panel SE83

This possible imagery panel is located near the southern end of an east-facing overhang near ground level within the northwestern portion of the East Spur. This panel contains a single geometric element approximately 22 cm long and 12 cm tall (Figure 7.3) located approximately 94 cm above the underlying slab surface. This element is uncharacteristic of the majority of Native American imagery found in the area in that it appears to be a dry application resulting from abrading the rock surface with the pigment source, rather than preparing and applying a liquid pigment. This characteristic, coupled with the limited nature of the element, makes definitive identification of its Native American origin tenuous. Problem 202-06-02 is present along this exposure, and chalk was observed on the rock surface approximately 23 cm to the south (left) of this element. Modern graffiti is also present on the adjacent rock surfaces.

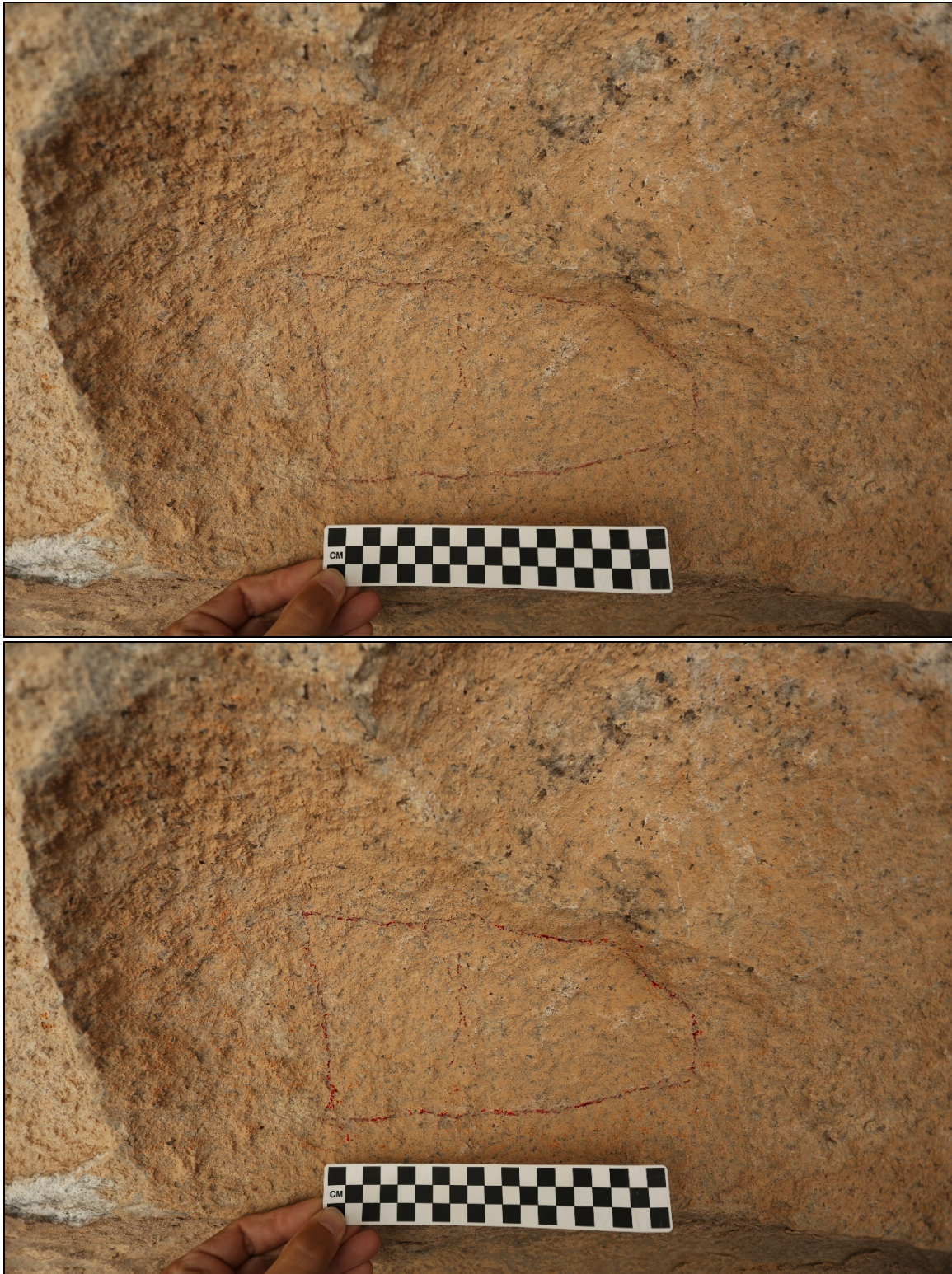


Figure 7.3. Possible Native American imagery at Panel SE83. Original photo (top) and enhanced in the CRGB colorspace (bottom).

Panel SE84

This panel is located within a large, west-southwest-facing shelter on the western side of the East Spur. The panel occupies the upper margin of the southeastern shelter wall adjacent to a prominent roof crack. The panel contains four generally parallel design elements, including two long red lines and one long black line, each approximately 2.8 m long, and the remnants of a red crenulated line (Figure 7.4). A 30-cm-long portion of a red zigzag line is located at the northeastern (left) end of the panel and is separated from the main panel by a large fracture (Figure 7.5). These elements are situated approximately 1.8 m above the shelter floor and approximately 7 m southwest (right) of previously recorded panel SE26B. Problem 216-09-09 is located approximately 1.3 m away from the panel and extends along the roof crack through the shelter and up the exterior cliff face. Climbing chalk is present along the adjacent bouldering problem; however, no chalk is present on the imagery panel. Extensive spalling and exfoliation is evident across the rock surface. The pigment that composes these elements is very faded and barely visible to the unaided eye. No modern graffiti was observed in the vicinity of Panel SE84.



Figure 7.4. Panel SE84: original photo (top) and enhanced in the CRGB colorspace (bottom).

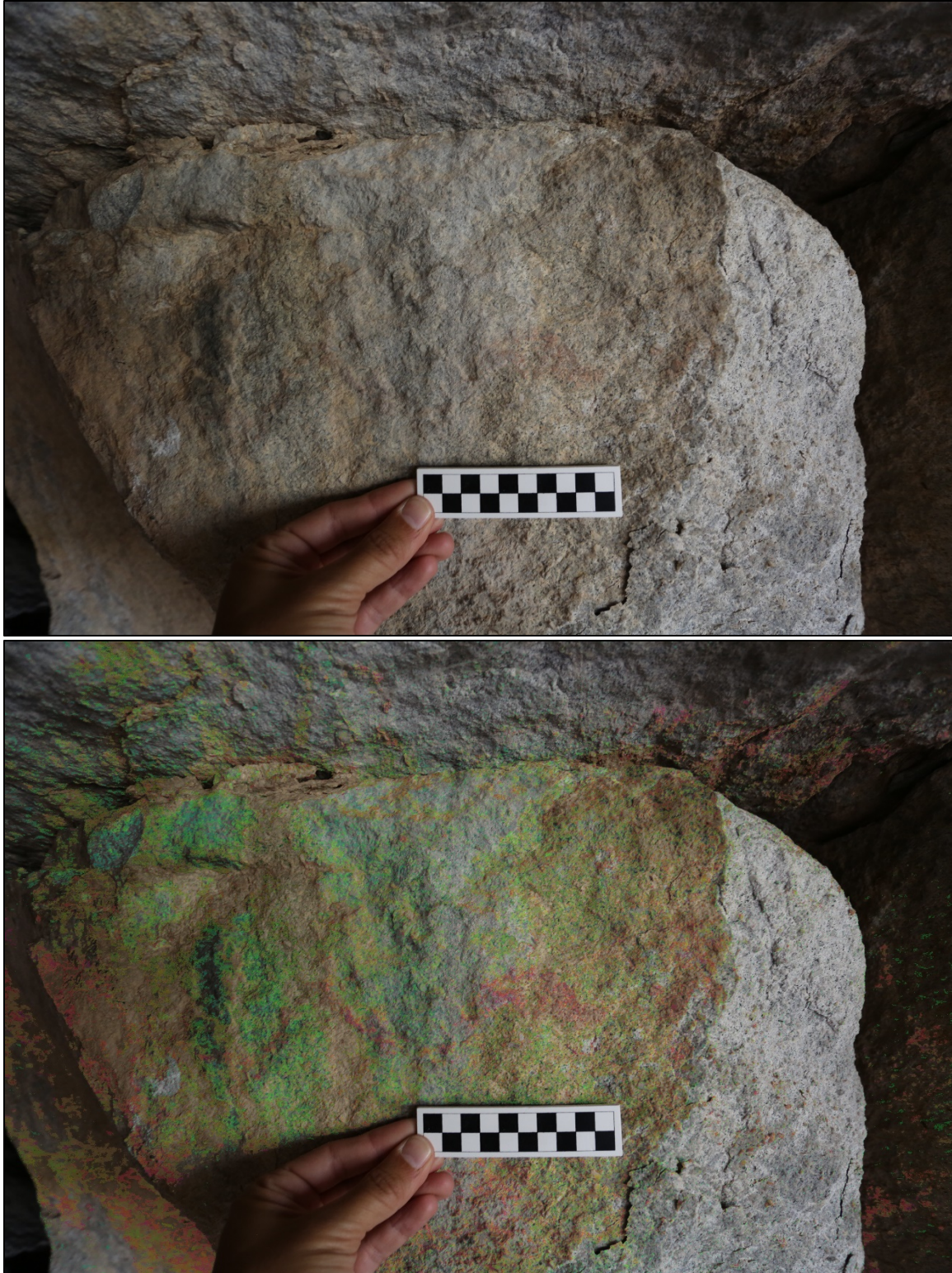


Figure 7.5. Zigzag element at northeast (left) side of Panel SE84. Original photo (top) and enhanced in the CRGB colorspace (bottom).

Panel SE85

This panel is located within an unpublished bouldering area at ground level near the south end of the East Spur. The panel is situated along the edge of an overhanging shelter roof 1.2–1.5 m to the south (right) of an adjacent unpublished problem. The pigmented area is approximately 1.4 m above the ground surface. It consists of the remnants of several opposing zigzag lines across a polished exterior edge of the shelter roof (Figure 7.6). The majority of the design elements are concentrated in an area approximately 20 cm tall by 16 cm wide; however, remnants of pigmented lines extend along the edge of the overhang for nearly 1 m. Climbing chalk is present along the adjacent unpublished bouldering problem; however, no chalk is present on the imagery panel. Moderate spalling and exfoliation is evident across the rock surface. The pigment that composes these elements is faded but remains visible. Evidence of previous graffiti removal efforts was observed within the shelter, and no additional graffiti was observed in the vicinity of Problem XX-X8-X1 or this panel.



Figure 7.6. Zigzag element of Panel SE85. Original photo (top) and enhanced in the LDS colorspace (bottom).

Chapter Eight

Analysis and Interpretation of Newly Discovered and Other Rock Art at Hueco Tanks

Rock climbers around the world consider Hueco Tanks to be one of North America's preeminent bouldering locations. Archaeologists have recognized Hueco Tanks for more than a century as extremely important for its rock art and associated village sites. With two such divergent views of the significance of Hueco Tanks, there will almost certainly be conflicts. The goal of this study was to determine if bouldering problems coincided with the locations of Native American rock art imagery. It is important, therefore, to establish a collaborative model incorporating both resources and their associated user groups for the cooperative use of Hueco Tanks State Park and Historic Site.

Hueco Tanks, Rock Art, and Jornada Prehistory and History

The first formally published account of Hueco Tanks was written by John Bartlett in 1854. Bartlett's account, along with another description by John Pope in 1855 made during an exploratory expedition for a transcontinental railroad route to the Pacific Ocean, were among the first published descriptions of a rock art site in North America. During the US/Mexico Border Survey in 1850, Bartlett visited and reported on the hundreds of rock art images discovered among boulder outcrops known as the Hueco Tanks, located east of El Paso, Texas.

Bartlett made several sketches¹ of the terrain at Hueco Tanks (Figure 8.1), and he described and drew several of the rock art panels he encountered (Figure 8.2):

Rambled over the great rock mass to see what could be of interest. Discovered several pools or tanks of clear and beautiful water, where it had collected from rains, or the melting snows....At one portion of the southern mass... there is an overhanging rock extending for some distance, the whole surface of which is covered with rude paintings and sculptures [petroglyphs], representing men, animals, birds, snakes, and fantastic figures. The colors used are black, red, white, and a brownish yellow [Bartlett 1854:I:171; brackets added].

They represent Indians with shields and bows, painted with a brownish earth; horses with their riders; uncouth looking animals; and huge rattlesnakes... Over these are figures of late travelers and emigrants; who have taken these means to immortalize their names; and let posterity know that they were on their way to California [Bartlett 1854:I:172].

¹ Unfortunately, all of Bartlett's original drawings of the rock art at Hueco Tanks and most of his landscape sketches are missing from the Bartlett Collection at the John Carter Brown Library, Brown University.



Figure 8.1. John Bartlett's sketch of Hueco Tanks dated March 29, 1851 (Image No. JRG145, John Carter Brown Library, Brown University).

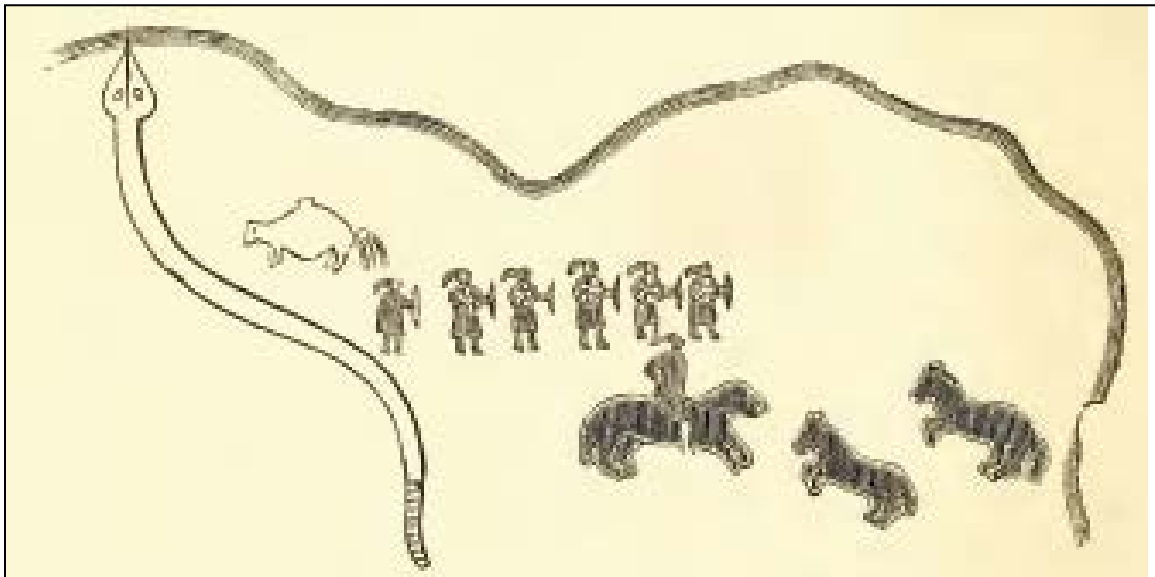


Figure 8.2. Image of Hueco Tanks pictograph from Bartlett's discussion (Bartlett 1854:I:172).

Since Bartlett's visit, Hueco Tanks and its later incarnation as Hueco Tanks State Park and Historic Site has been visited hundreds of times by rock art enthusiasts and photographers, avocational members of regional archaeological societies, art historians, ethnographers, and professional archaeologists. The current project is the most recent of this long history of rock art research and cultural resources management investigations (Bilbo and Sutherland 1986; Crimmins 1929, 1930, 1931; Davis and Toness 1974; Harry et al. 2001; Howard et al. 2010; Jackson 1938; Kirkland and Newcomb 1967; Ribas-Normand 2015; Schaafsma 1980; Sutherland 1975, 1976, 1995, 2006; Toness and Hill 1972).

The rock art at Hueco Tanks spans several millennia and includes recent and modern graffiti, historic graffiti and inscriptions, historic and protohistoric Native American paintings, and Jornada Mogollon style panels. Paintings of Archaic age include Shumla/Candelaria style elements, Chihuahua Polychrome panels, and various abstract geometric, zigzag, and zoomorphic designs. Rock art of the Early Archaic and Paleoindian periods may exist, although styles or methods associated with these periods are poorly understood (but see Loendorf et al. 2013 for an example of incised lines on a rockshelter ceiling at a site north of Hueco Tanks that may be of Paleoindian age).

As noted in Chapter Two, the prehistoric and historic culture history of the Jornada region has been thoroughly rewritten over the past decade. Moreover, certain rock art styles and elements of the Jornada region have been dated by absolute chronometric methods and through relative cross-dating methods. In terms of contemporary studies of rock art, the essential issue is that the prehistoric cultural sequence has been refined and enhanced to such an extent that we can now begin to cross-match rock art stylistic traditions and their constituent symbols and iconographic content with changes in settlement, subsistence, social organization, and beliefs.

While it is possible that incised lines and certain abstract elements may date to the Paleoindian or Early Archaic periods, the earliest consistently identifiable rock art dates to the Middle Archaic. It is during this time that the first widespread evidence of placemaking appears across the landscape of southern New Mexico and Trans-Pecos Texas in the form of shrines, caches, communal baking pits, and rock art. A flattened cactus stalk painted with sinuous designs in red and black pigment recovered by Burt Cosgrove (1947) from Ceremonial Cave in the Hueco Mountains less than 9 km west of Hueco Tanks was recently submitted for AMS dating and provided an age estimate of 4350 ± 50 BP (3100–2880 cal. B.C.; Miller 2013). The design is similar to wavy line pictograph designs recorded on the walls and ceilings of rockshelters throughout the region (Loendorf et al. 2013; Miller et al. 2012; Schaafsma 1980), including Panel W37A on West Mountain discussed below.

The uniformity of the zigzag elements and their distribution among rockshelters and crevices throughout the Jornada region reflects a common origin in belief that was inscribed across the prehistoric landscape, but the verification of the Middle Archaic age of the element requires further study. In fact, direct dating of a similar zigzag design at the Ruby Canyon site (Loendorf et al. 2016) north of the Guadalupe Mountains escarpment provided an age estimate of 3140 ± 60 (1540–1230 cal B.C.), which falls within the final centuries of the Middle Archaic Keystone phase and early centuries of the Late Archaic Fresnal phase, thus suggesting that the zigzag element had a long period of meaning and application in the region.

The first truly widespread evidence for placemaking on the landscape appears during the Late Archaic Hueco Phase, appearing in the form of rock art, shrines, and the ritual use of caves. This includes the cave shrine at the nearby Ceremonial Cave site where a remarkable collection of perishable items was recovered in 1929 and during the 1940s (Alves 1930; Cosgrove 1947). Several items from the cave have been dated, including hafted projectile points, curved throwing sticks, prayer sticks (pahos), and tablitas, or painted wood panels (Creel et al. 2014; Miller 2013). Most of the throwing sticks and hafted points date from 300 B.C. to A.D. 150 and establish that the primary period of use of the cave occurred during the Hueco phase. The presence of prayer sticks dating to this period further confirms the antiquity of the ritual deposits and establishes that ritual use of caves may have origins among the hunter-gatherer and early agricultural groups of the Hueco phase.

Several rock art styles and iconographic expressions may date to the Late Archaic (Schaafsma 1980), but the most distinctive traditions are the Diablo Dam or Shumla style and Chihuahua Polychrome Abstract style. Elements of the Chihuahua Polychrome Abstract style were observed on Panel W37A near Problem 238-09-01 of West Mountain. Diablo Dam style elements are present on Panel W14B1 near bouldering problems 254-17-01/02. Other more generic Archaic elements were observed, including zigzags and connected triangles discussed below.

Ritual use of caves continues throughout the ensuing Formative Period, as indicated by several dated tablita fragments from Ceremonial Cave and other caves in the Hueco, Sacramento, and Alamo Hueco mountains (Miller 2013). Goggle-eye or so-called Tlaloc entities, including painted images at Hueco Tanks and painted tablita fragments from these caves, are now dated to as early as A.D. 600 (Hyman et al. 1999; Miller 2013, Rowe 2005; Russ et al. 1990), establishing that new iconographic representations of new beliefs arrived in the region around the same time as profound changes in subsistence, projectile point, and ceramic technologies took place.

Historic Native American and European rock art and inscriptions are present at the Hueco Tanks. No panels or elements that could be conclusively assigned as Native American historic were encountered among the bouldering problems examined during the present survey. Several historic European inscriptions were noted near Panels N63, N18G1, N64, N65, and W14C.

Archaic Rock Art

Given the visually impressive nature of Formative Period rock art, unsurprisingly, most researchers have emphasized katsina faces or masks, goggle-eye figures, snakes, cloud terraces, and other paintings referred to by Jackson and Kirkland as Pueblo art, mainly because these figures are the most prominent and colorful at Hueco Tanks. Further, the dating of these figures has been an important tool for research into katsina ritual and its introduction into other parts of the southwestern United States (Adams 1991). An unfortunate result is that, despite the extensive range of studies completed at Hueco Tanks, few of the reports mention Archaic-age rock art or the abstract figures found at several sites in the park. An important outcome of this project was the re-discovery of sites with abstract figures because these images have counterparts on Fort Bliss and elsewhere in the Jornada region.

Panel E41

While not part of the current survey of bouldering problems, East Mountain Panel E41, for example, contains connected triangles in red paint (Figure 8.3) that are similar to connected triangles recorded at the Dripping Springs (LA 97768) and the Doña Ana (LA 66667) sites in southcentral New Mexico, and the Walt Canyon (LA 164932) and Roney (LA 28738) sites in southeastern New Mexico (Loendorf, White, Willis, and Miller 2014; Loendorf et al. 2015; Miller et al. 2012). There are more important comparisons, however, because all of these sites and the Hueco Tanks Panel E41 have good stands of desert tobacco (*Nicotiana obtusifolia*) growing at them. Based on the research at other regional sites, an association between connected triangle motifs and desert tobacco is an important finding but is not surprising as the triangle/tobacco combination is now commonly found at sites from Carlsbad to Silver City, New Mexico (Loendorf, Abdullayev, and White 2014).



Figure 8.3. Connected triangles in red paint at Hueco Tanks Panel E41.

Much more important are the painted quadrupeds at Hueco Tanks Panel E41 because similar quadrupeds, painted and pecked, are found at other regional sites. For example, the quadrupeds at Panel E41 resemble the quadruped at the White Rock site (41EP737) in the Franklin Mountains (Miller et al. 2012). The animals have rectangular to trapezoidal-shaped bodies with straight legs, back-sweeping horns, and tails oriented upward (Figure 8.4). They are thought to represent bighorn sheep. The White Rock site figure is penetrated by a spear or atlatl dart with what is identified as a Shumla projectile point, and the execution of the individual elements is similar to the Diablo Dam Style.

The age of Shumla projectile points has been used to date the Diablo Dam Style. Basal-notched Shumla points were originally thought to range in age from the Middle Archaic to Ceramic Period (2500 B.C. to A.D. 200), but recent analysis of radiocarbon dates directly associated with basal-notched dart points rather firmly dates the form between 350 B.C. and A.D. 400/500 (Miller 2017b) and within the Hueco Phase of the Late Archaic.

The importance of Hueco Tanks Panel E41 is the inclusion of connected triangles with the rectangular-body bighorn sheep. Using Plasma Oxidation AMS radiocarbon dating, Marvin

Rowe has dated the triangle forms at the Doña Ana site to an age of 1975 ± 95 B.P. (cal 65 B.C. to A.D. 145; Loendorf et al. 2015). This age fits within the estimated date for the quadruped at White Rock Shelter 2 and its associated Shumla projectile point.

Perhaps because the Doña Ana date is a few centuries older, it might indicate a transition from abstract to representational forms at the beginning of the Formative Period. Whether or not this is correct, Panel E41 is important because it suggests that painted quadrupeds and triangles are contemporary. Prior to the discovery at Panel E41, painted triangle sites associated with tobacco have not included any quadrupeds. Further, the association would not have been recognized without this survey.

Other Hueco Tanks panels are equally significant to the understanding of regional abstract rock art. It should be understood that these panels are not necessarily co-located with bouldering problems, but they were explored and recognized as important during this survey.



Figure 8.4. Left: quadruped in red paint at Hueco Tanks Panel E41; right: Panel 1 of Shelter 2 at the White Rock site showing quadruped pierced by an atlatl spear tipped with a Shumla-style projectile point. (note the smaller animal behind it).

Panels W37A and W37C

W37A, located on West Mountain, is an example of a panel located in the vicinity of a bouldering problem (Problem 238-09-01) and additional rock art panels (Panels W37C [see Chapter Five] and W37D). One painting at W37A is a multi-colored abstract form on the underside of a large boulder. Access to the panel is through a passage beneath a group of boulders that partially support the boulder with the painting. Panel W37C is within a narrow offset crevice with access from ground level. The rock ledge immediately above this panel hosts a series of cupules and an associated panel, W37D.

The painted panel at W37A is a large abstract form on the sloping underside of a boulder (Figure 8.5). There are at least three colors—red, white, and yellow—in the painting, which covers an area about two meters across. An initial assessment is that the panel represents the Chihuahuan

Polychrome Abstract style that is named for large abstract paintings on the ceilings of caves in Chihuahua, Mexico (Schaafsma 1997). However, a closer inspection of the painting finds that the W37A figures are made with bolder lines than most Chihuahuan Polychrome paintings that have more open space between the lines. The W37A painting includes an area of triangles and diamond-shaped forms like Chihuahuan Polychrome, but there are also parallel rows of curved forms or nested arc forms. There is also a long vertical line with crossing lines or one-pole ladder motif that is not common to Chihuahuan Polychrome sites.



Figure 8.5. Large abstract panel at W37A. Note the left side of the painting where the surface is exfoliating with pieces of rock falling that could contain paint samples.

The types of settings Panels W37A and W37C occupy are found across the Jornada region where boulders are naturally stacked against one another, creating protected pockets or shelters beneath them. They are also common locations for paintings. The White Rock Shelter site, discussed above, is a good example of another site where boulders are piled together with their undersides painted. Cupules are found at White Rock Shelter 4 and Shelter 5 in association with multi-colored zigzag lines (Figure 8.6). Similar abstract lines are found adjacent to cupules at nearby Panels W37C and W37D (Figure 8.7). The reason cupules are associated with abstract zigzag forms is not understood, but the identification of these examples is an important outcome of this study. Whatever the panel represents, it may be important to understanding regional abstract rock art. Portions of one side of the panel are exfoliating and falling to the ground. Future research near this panel should focus on finding fragments of the ceiling with paint on them as they might be suitable for dating with the Rowe Plasma Oxidation method.



Figure 8.6. Abstract zigzag line motifs associated with cupules at White Rock Shelter 4 (by Laurie White).

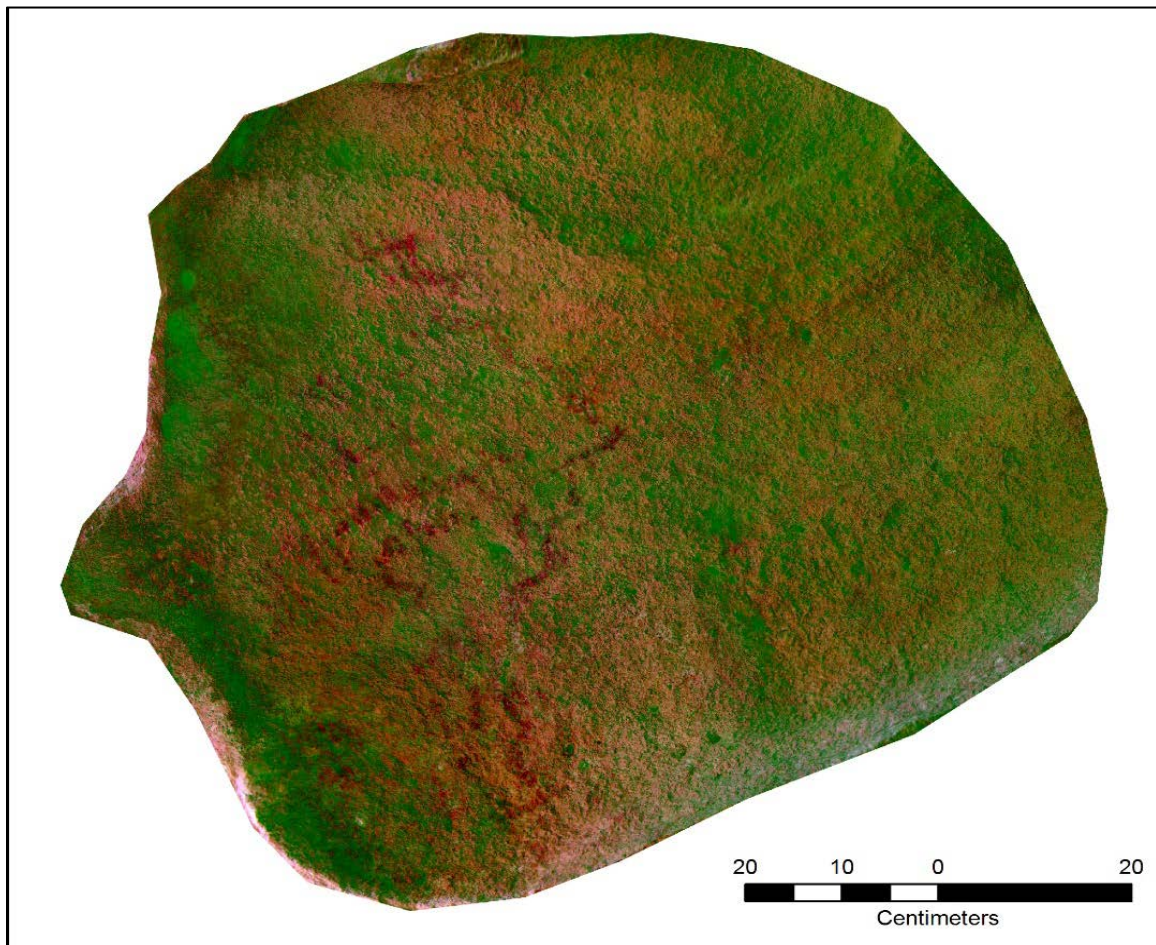


Figure 8.7. DStretch image of Panel W37C.

Panel N60

A single figure at Panel N60 (see Chapter Four) is located near a bouldering problem but is not within the direct path. It is a small quadruped situated in a niche or recessed area of the rock surface (Figure 8.8). The conchoidal-shaped niche measures 34 cm across with a depth of 14 cm. The small red figure is made in outline form. It is not a recognized quadruped type that is found at other regional sites, so comparisons are not possible. In fact, the figure is so generic that it is not clear what animal it represents. It does seem clear that its maker chose the niche for its placement on purpose, and in some ways it is reminiscent of the small figures tucked into niches in kiva walls (Schaafsma 2009). A nearby panel (N17V) to the west of Panel N60 occupies the ceiling and wall of an alcove and includes katsina faces or masks, roadrunners, and feline figures. There is also a human figure with a bow that appears to be shooting at another anthropomorph. The proximity of these two panels suggests that they are associated. These panels are not located directly within bouldering problems.

Panel W14B1

Niches or recessed areas in the wall are found at Panel W14B1, located on West Mountain (see Chapter Five). The main panel is a large painted area more than 10 m across located on a north-facing surface to the south of the dam that once held a reservoir. The left side of the panel, some distance from the bouldering problems 254-17-01 and 254-17-02, contains human and animal figures and abstract motifs in several colors. Forrest Kirkland previously illustrated this panel as 14-C (see Figure 5.4). Colorful and carefully crafted anthropomorphs that may be Diablo Dam style are found on a nearby panel (W14B) located higher on the rock face east of Panel W14B1 (Kirkland and Newcomb 1967:185). Many of these paintings were damaged by the water in the reservoir. To the far right (west), there are two niches or recessed areas in the wall. One is about 1.5 meters and the other 1.7 meters above the ground surface. Each has a small red line painted vertically inside the niche. It is clear that the lines are not eroded parts of some more complete figure, but instead they were intentionally placed in the niches. Apparently, they represent a ritual association with the rock surface.



Figure 8.8. Panel N60: original (top) and enhanced in the CRGB colorspace (bottom).

Panels N64 and N65

The area known as the Warm-Up Boulder, located on North Mountain, hosts multiple problems that contain two areas of rock art designated as Panels N64 and N65 (see Chapter Four). Both panels have been subjected to some impact by climbing activities; however, it is apparent that the panels have been subjected to many other human activities including graffiti, campfire smoke, general ground surface erosion, and abrasion of the rock surface. Pigment smears and eroded remnants of painted images are found on both panels, but the designs are very faded and many details are only visible through digital enhancement. One figure in red has vertical rayed lines protruding upward from a red ovoid form and other vertical lines that form a crude V shape (Figure 8.9). It is most likely part of a larger figure that is no longer recognizable. A second figure in red is a bulb-like form with a line below it that branches into the trident motif (Figure 8.10). It is also likely part of a larger figure that is no longer visible. It is difficult to offer substantive comments on these eroded forms except to suggest the surface once had imagery painted on it.

Historic names and dates, and some historic figures, are a part of the Warm-Up Boulder that may become an important part of the site's history. Archaeologists tend to avoid discussion about graffiti because they believe, often with good reason, that to focus on it is to give it credibility and will lead to more graffiti. Recently, however, researchers have started to study historic names and dates found in graffiti. Tim Urbaniak (2014) presents many examples of historic names and dates with discussion about their importance for historical research.

There are numerous examples, such as the Inscription Rock site at El Morro where Spanish conquistador and colonial governor Juan de Oñate inscribed his name on April 16, 1605, and Pompey's Pillar where explorer William Clark left his name on July 25, 1806. These sites with what rock art archaeologists would call graffiti are recognized as so important they are preserved as national monuments. There are other examples along trails or expedition routes that historians have used to identify a precise location for an historical route. Hueco Tanks, located along the Butterfield Trail and a stopping place for numerous expeditions, contains inscriptions of historic names and dates that are worthy of preservation.



Figure 8.9. DStretch image of a rayed figure on the wall of Panel N65.

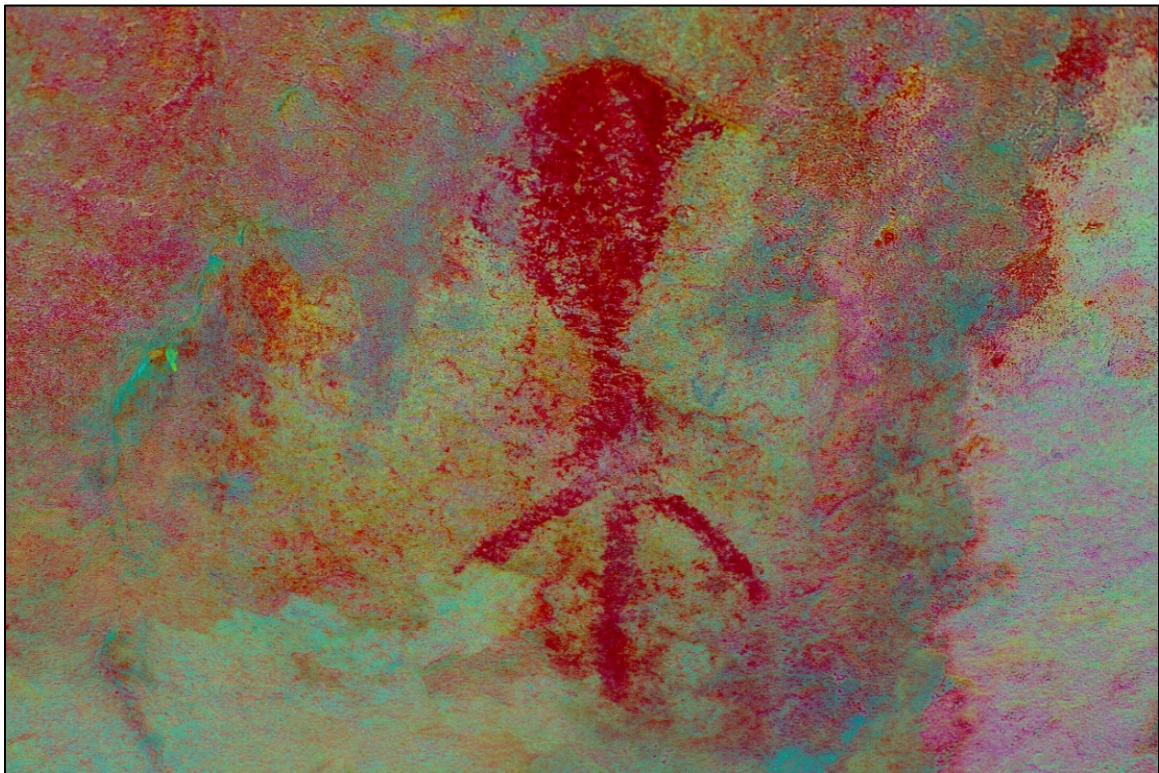


Figure 8.10. DStretch image of an oval-form with a trident base at Panel N64.

Ribas-Normand (2015) documented historic graffiti from the late 1840s at Hueco Tanks, noting that many graffiti names and dates were inscribed between 1848 and 1849, the time of the California Gold Rush when thousands of people migrating to the gold fields passed through the Butterfield-Overland stage stop at Hueco Tanks. While the names are not of particular fame or importance, he was able to link many of the names inscribed at Hueco Tanks with entrepreneurs, merchants, and even politicians in California during the late 1800s. Dozens of names and dates appear as graffiti at Warm-up Boulder at Hueco Tanks and throughout the park. While the significance of individual names and dates may never be known, it is incumbent upon rock art archaeologists to record them for the benefit of future researchers.

Formative Period Elements

Several new and previously recorded panels with characteristic elements of the Formative Period Jornada Rock Art Style were documented during the present survey. The new elements and their location or contexts add to the body of information on this important prehistoric Southwestern iconographic style.

Panel N72

Panel N72 on North Mountain (see Chapter Four) is a newly discovered pictograph located near the base of a boulder. The painting is a faint reddish-brown geometric design measuring 10 cm wide by 12 cm in height (Figure 8.11). The geometric design is series of linked step-fret designs that are typical of the Jornada Mogollon Rock Art Style. An unusual and interesting feature of this step-fret pictograph is that it was executed as a negative design. Such sequential step-fret elements linked by lines are a common iconographic element on primary design bands of El Paso Polychrome vessels (Figure 8.12, left), designs incised on abraders and marine shell, and Jornada rock art images, including one of the well-known goggle-eye images at Hueco Tanks (Figure 8.12, right). It remains uncertain whether they were a “shorthand” version of terrace elements that were used to fill the body portions of design fields or carried another meaning.

Mask Designs at Panels E17R2B and E76

Panel E17R2B (see Chapter Six) is a previously recorded panel located on an east-facing vertical exposure above a sloping slab surface just above ground level on the north margin of East Mountain. This panel was previously noted during the 1999 TPWD rock art survey. It is a geometric design in red paint measuring approximately 17 cm in height (Figure 8.13, upper photo). Several additional red pigment remnants and smudges are evident across the surrounding rock surfaces, including the overlying boulder. The image may represent a mask, a geometric step-fret design, and could even be part of a goggle-eye image. Much of the rock surface within and around the image has exfoliated, and it cannot be determined what additional painted surfaces were once present.

Panel E76 (see Chapter Six) is located near the northern end of a small north-trending canyon on the north flank of East Mountain. The panel occupies the recessed ceiling of a small alcove under a boulder with a slight vertical overhang that supports two unpublished bouldering problems. Panel E76 consists of a single white mask design approximately 15 cm wide and 39 cm tall. The design incorporates a horizontally-zoned face with a curved lower chin or mouth segment, elliptical or almond-shaped eyes with pupils, two rows possibly consisting of six dots each, and long curving horns.

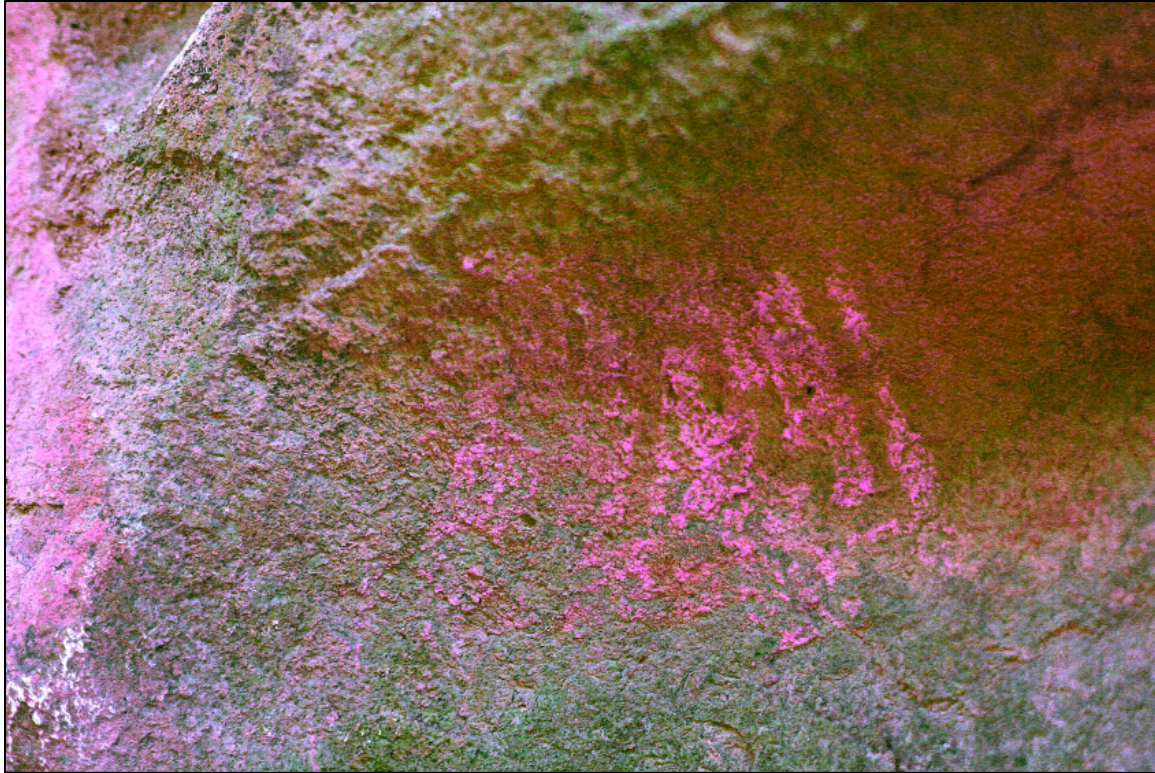


Figure 8.11. DStretch image of step-fret design on North Mountain Panel N72.



Figure 8.12. Left: El Paso Polychrome jar with step-fret design layout similar to Panel N72; right: Goggle-eye image with body of step-fret designs at Hueco Tanks (from Kirkland 1940).

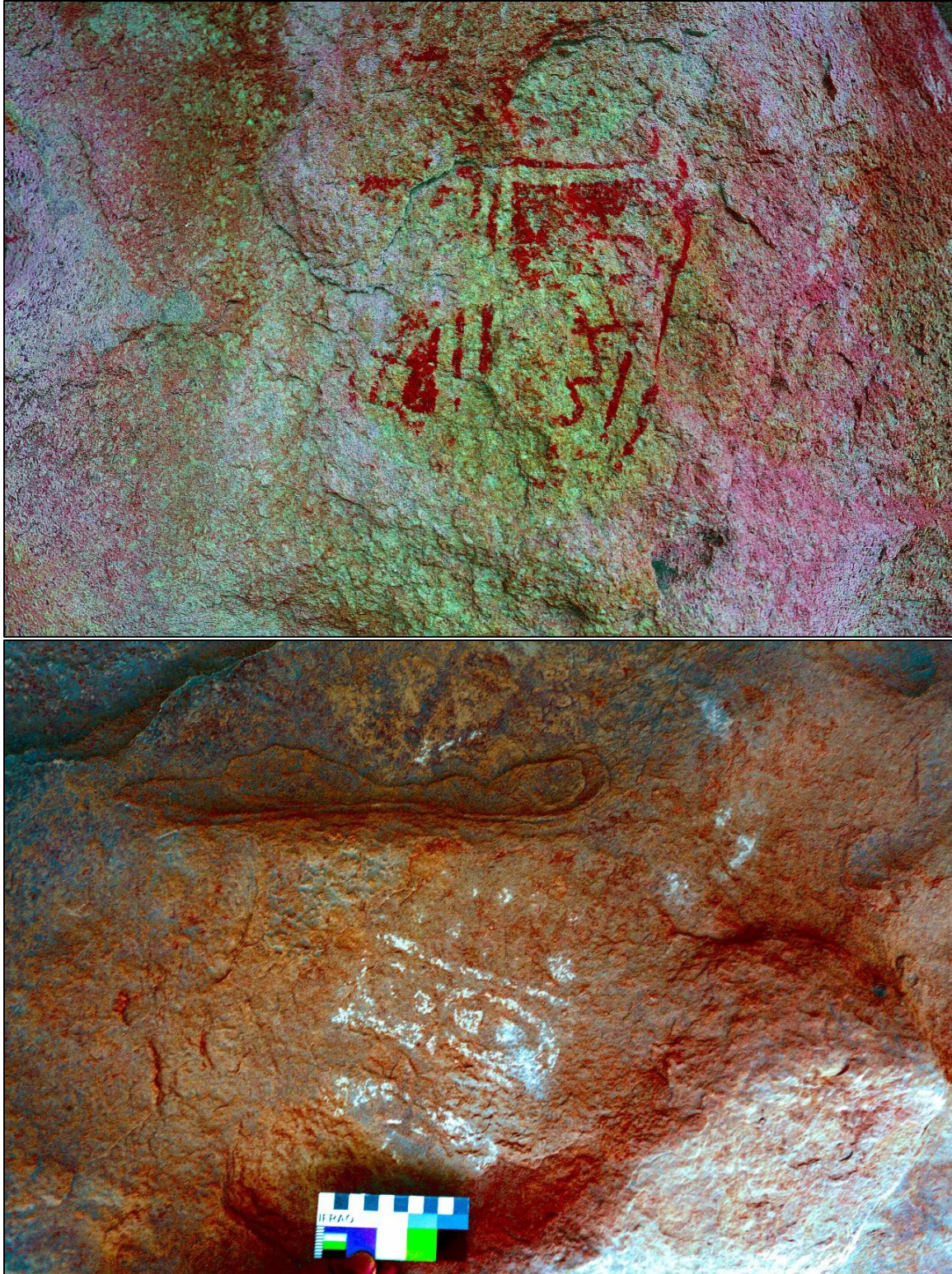


Figure 8.13. Mask images. Upper: previously recorded possible mask or face element on Panel E17R2B; lower: newly discovered and recorded mask image at Panel E76.

The zoned composition is similar to other masks at Hueco Tanks (Figure 8.14, left) and has eyes typical of those in other rock art compositions and on ceramic vessels, such as the reconstructed El Paso Polychrome olla from Madera Quemada pueblo (Miller and Graves 2009). The presence of pronounced horns is somewhat unusual for mask designs, but is not unprecedented. Panel 25C comprises a single mask design with extended horns. One of the most famous mask paintings in Cave Kiva at Hueco Tanks (Panel 30) has two long, curved horns extending from the face (Figure 8.14, right). Of particular interest is the sole use of white pigment on Panel E76. Only two other known mask designs at Hueco Tanks consist solely of white pigment: an abstract mask design on Panel 1D and Panel 24I.



Figure 8.14. Left: Examples of zoned mask images from Hueco Tanks (from Sutherland 2006:6,19); Right: Horned mask at Cave Kiva.

Pigment Smudges and Smears

The most common and spatially ubiquitous form of rock paintings encountered during the project consisted of amorphous smudges, smears, and fingerprint impressions of paint on various rock surfaces (Figure 8.15). Similar elements have been observed before at Hueco Tanks and at other rock art localities in the region, but the intensive examination of bouldering problems across hundreds of rock faces at Hueco Tanks led to the discovery of many additional examples of this form of paint application.

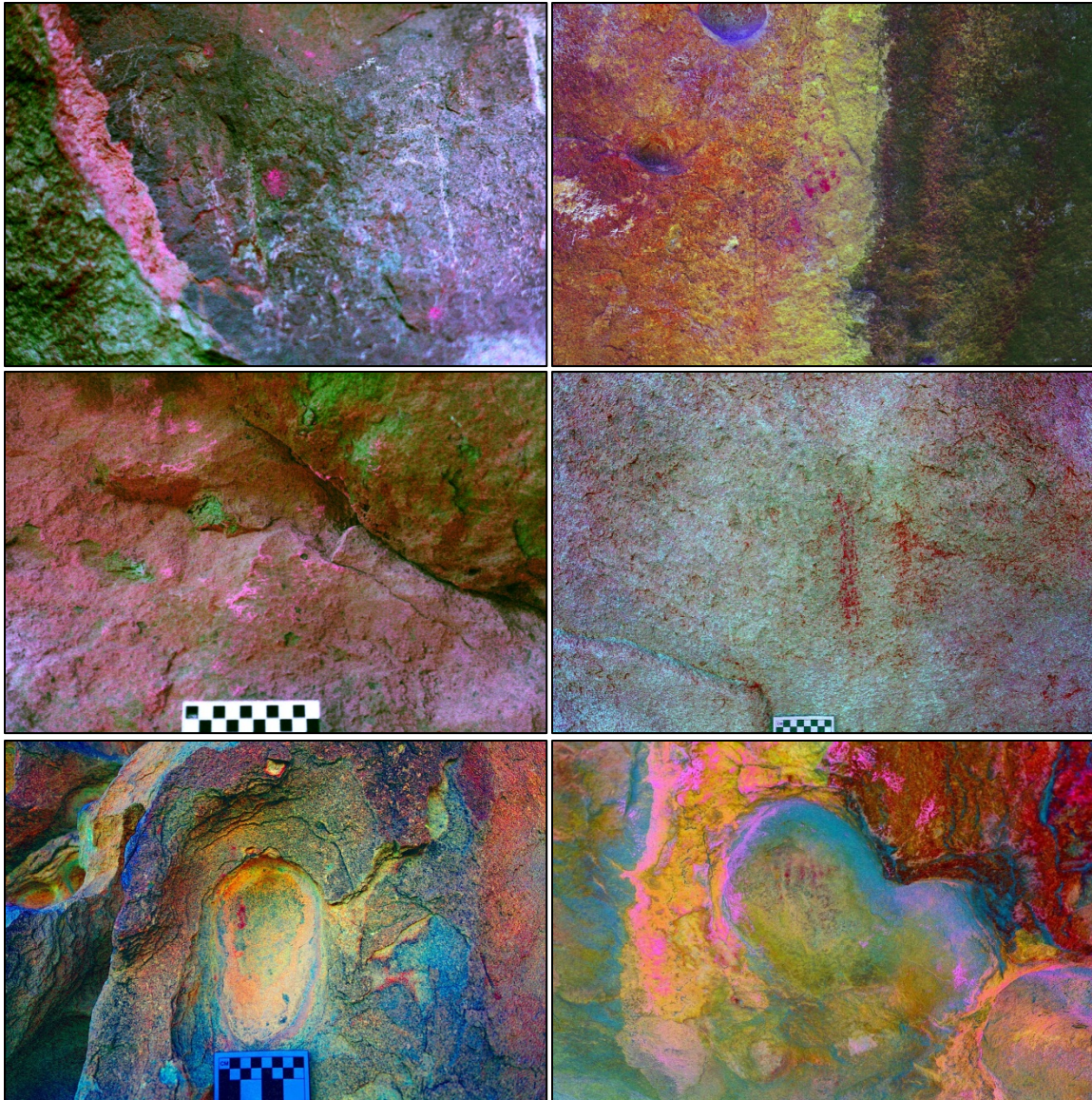


Figure 8.15. Examples of smudges and fingerprint smears(all are DStretch-enhanced images). In the lower two panels note the intentional placement of these elements within concavities of rock surfaces.

This form of rock painting is occasionally recorded during rock art inventories, but whether recorded or not, it is usually ignored in interpretive discussions. The minor and unimpressive smears and smudges tend to get eclipsed by the impressive galleries of goggle-eye figures, serpents, terraces, anthropomorphs, zoomorphs, masks, abstracts, and other elaborate and formal symbols at Hueco Tanks. However, given the counts and ubiquity of smears and smudges documented during the current project, it is suggested here that perhaps they too merit consideration and study. Their presence across dozens of boulder surfaces and intentional placement within concavities (Figure 8.15, bottom) indicate that the creation of this class of rock paintings was an intentional act and the potential significance of both the paintings and the reason for their creation has been overlooked.

Since the first investigations of the late 1800s and early 1900s, the archaeological, iconographic, and artistic studies of rock art at Hueco Tanks have focused on what was created at the end of ritual journeys—the elaborate pictographs and pictograph panels painted in the grottoes and caves and boulder shelters across the park. Yet the totality of ritual performance in the prehispanic, historic, and contemporary Southwest usually included components—both corporeal and ideational—of movement, travel, and connectivity. In Western terms, these are generally referred to as ritual (or religious) processions and pilgrimages. Several documented Southwestern ritual processions and pilgrimages involved as many or more prescribed actions as did the ultimate ritual performance (Colton 1964; Fox 1994; Parsons 1939). Purification and preparation rituals, procurement or manufacture of particular materials and items such as prayer sticks and pigments, visits to shrines, recitation of tribal songs and oral histories – one or more of such practices were part of the journey.

Southwestern beliefs, and the material culture, trails, art, and iconography created as expressions of those beliefs, is best understood via indigenous Pueblo concepts of center, emergence, place, movement, and connectedness. For example, Darling (2009) links oral tribal histories and sacred journeys narrated in Akimel O’odham (Pima) songs to material and physical traces of movement along ancient desert pavement trails in southern Arizona. Such practices result in a “cognitive geography” situated in both mind and landscape as the lines of words in songs and lines of trails across the terrain are relationally and metaphorically constitutive of each other. Other acts, such as the placement of shrine offerings and recitation of prayers, all contribute to the manner in which movement and connectivity enact and reify social memories (Anschuetz and Wilshusen 2010; Snead 2008; Van Dyke 2007, 2009).

In this sense, the rock art panels at Hueco Tanks cannot be separated in a geographic, nor an ideographic, manner from the people who created them and the settlements in which they lived. The Hopi perceive trails as metaphorical umbilical cords that spiritually link villages to outlying sacred places on the landscape (Ferguson et al. 2009), and certain ritualized trails connecting villages to other villages and to sacred places may have been viewed in a similar fashion by Jornada groups.

In light of these concepts and deeper understandings of Southwestern Native American belief and practice, it becomes apparent that the seemingly random and mundane paint smears may in fact convey meaning. Accordingly, if we momentarily redirect the conventional focus on major rock art panels and elements and consider the surprisingly numerous and ubiquitous paint smears documented at Hueco Tanks, and if we view the smears and smudges as a purposive expression of belief and action, we may begin to understand them as another significant class of rock paintings. It is very likely that the smudges and finger smears were part of some form of intentional act performed during the movement of actors between and among the boulders to arrive at the destination point. What compelled someone to leave an imprint of red paint on a rock surface or a series of finger-streaked lines within a concavity of boulder surface? We may never unravel whatever phenomenological or ontological concepts were involved in the creation of paint smudges and finger smears, but there is sufficient ethnographic, ethnohistoric, and archaeological data to lead us to a rational conclusion that they meant *something*.

A comprehensive documentation and GIS distributional and spatial analysis of smears and smudges may identify specific routes, accessible corridors, or least-cost pathways to caves and

shelters with rock art panels. If such analyses determine that the patterns of paint smears mark routes that served as pathways for ritual processions, we can develop an entirely new dimension to the study of rock art and ritual at Hueco Tanks. Admittedly, these ideas are conjectural at this point, and it is possible that the smears and smudges were nothing more than the current terms used to describe them imply: that they were simply paint smears and smudges. On the other hand, perhaps there is more to them than “meets the eye” so to speak, and the first step in a deeper understanding of this underclass of rock paintings is recognizing that they merit some level of consideration and study.

Chapter Nine

Summary and Recommendations

This report summarizes the survey and documentation of rock art found near or within bouldering problems at Hueco Tanks State Park and Historic Site, the field and data processing methods used during this survey, and a summary of the Native American rock imagery identified and documented during this effort. In total, 1,892 bouldering problems were surveyed within the park. As a result of this survey, 31 Native American rock imagery locations were identified and documented on or near currently open bouldering problems, and three rock imagery locations were identified and documented on or near currently closed problems (Table 9.1). Native American rock imagery identified and documented during this effort ranges from sparse pigment remnants to identifiable stylistic elements and symbols characteristic of known Archaic rock art styles and the Jornada Mogollon rock art style. All bouldering problems and any associated rock imagery locations encountered during this survey have been documented and their locations accurately mapped. New rock imagery panels documented during this survey have been incorporated into the existing TPWD panel numbering system, and proposed rock imagery panel numbers are included in Table 9.1 below.

Table 9.1. Summary of Native American rock imagery locations documented during the survey

Associated Boulder Problem No.	Proposed Panel No.	Rock Imagery Description	Closure status
North Mountain			
50-03-02	N60	single red quadruped outline	OPEN
50-03-10/11	N61	pigment smudges	OPEN
52-04-06	N62	pigment dots in hueco	OPEN
59-07-09	N63	pigment remnants in huecos	OPEN
59-07-15	N18G1	previously recorded pigment smudge	OPEN
60-08-06/07	N64	Red abstract linear and filled ovoid design	CLOSED
60-08-07-12	N65	Red abstract rayed ovoid element; pigment remnants	CLOSED
72-15-01	N66	pigment remnants/lines in two huecos	OPEN
72-15-05	N67	pairs of parallel lines in large hueco	OPEN
72-15-05	N68	smudge (line?) and circle in hueco	OPEN
72-15-06/07	N19D5	previously recorded linear smudges in hueco	OPEN
72-15-23	N19D7	previously recorded triangular or ovoid shape	OPEN
72-15-25	N19D2	previously recorded pigment remnants	OPEN
82-19-29	N69	rectangular geometric design in hueco	CLOSED
85-20-01	N70	pigment smudge	OPEN
88-23-02	N71	Y-shaped design in water stain	OPEN
88-23-06	N72	step-fret design	OPEN
102-31-08	N73	pigment lines/smudges adjacent to water stain	OPEN
108-33-X1	N74	pigment smudges along vertical crack	OPEN

Associated Boulder Problem No.	Proposed Panel No.	Rock Imagery Description	Closure status
West Mountain			
238-09-01	W37C	previously recorded geometric design	OPEN
254-17-01-02	W14B1	extensive panel initially documented by Forrest Kirkland	OPEN
254-17-04	W14C	geometric designs initially documented by Forrest Kirkland	OPEN
East Mountain			
124-04-02	E75	geometric design and pigment smudges in alcove, possible pigment smudges along fissure in overhang, several bedrock features (cupules and grinding areas) on slab below boulder	OPEN
124-24-27	E17R2B	previously recorded panel; includes a possible red mask or face design with zigzag or step-fret motif, geometric elements, pigment dots, smudges, and remnants, and some historic (axle grease) graffiti	OPEN
132-06-X2	E76	white mask or katsina face element	OPEN
138-08-11	E77	red abstract lines and pigment smudges	OPEN
174-24-02	E78	red parallel/zigzag lines	OPEN
174-24-03	E79	red parallel lines	OPEN
XX-X7-X1 Panel 1	E80	black antlered zoomorphic element	OPEN
XX-X7-X1 Panel 2	E81	black abstract linear element	OPEN
East Spur			
192-03-21	SE82	pigment smudge	OPEN
202-06-02	SE83	possible red geometric element; dry-applied	OPEN
216-09-09	SE84	red and black linear elements	OPEN
XX-X8-X1	SE85	red geometric (zigzag) design	OPEN

Summary and Recommendations

Thirty-one Native American rock imagery locations were documented on or near bouldering problems that are currently open for use by the bouldering community. Three rock art imagery locations were documented on or near bouldering problems that are currently closed to use.

It is clear that previously undocumented prehistoric Native American rock imagery is present at Hueco Tanks State Park and Historic Site. One recommendation that may be offered is that Hueco Tanks State Park and Historic Site supervisory and management staff could be trained in basic rock art survey and DStretch digital documentation methods so that they can examine any new areas developed for bouldering problems and monitor existing problems near known rock art panels. In addition, improved mapping efforts would be of benefit to the monitoring and preservation of rock art resources. Prior to this survey, TPWD staff did not have access to accurate locational information for bouldering problem locations. Several bouldering problems are located within or in close proximity to previously recorded rock imagery panels. Accurate documentation of bouldering problem locations and rock imagery panel locations will allow TPWD staff to more quickly and accurately recognize and address these resource conflicts.

TPWD representatives requested that no specific recommendations be presented in this report regarding the status of open bouldering routes near Native American rock art images. Accordingly no recommendations of which bouldering problems should be closed or allowed to remain open are offered here.

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