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Julia Commander April 15, 2013

Ancient Central American Stone Metates in the Michael C. Carlos Museum: Aspects of Use

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An abstract of
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of Emory University in partial fulfillment
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Abstract

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Collections of Ancient Central American artifacts commonly feature metates, stone tools traditionally used for grinding. As suggested by contextual evidence from excavation sites, metates played a role in various spheres of society, from domestic settings to high-status burials. Understanding the versatile nature of the tool requires an investigation of the range of styles and characteristics observed in the objects. This paper examines a group of metates in the Michael C. Carlos Museum and focuses on traits potentially related to physical and non-physical aspects of their use. Traits of interest included rock type, iconography, and use wear. While previous categorizations of metates have suggested that the object's degree of iconographic elaboration can reveal its use history, results from this study do not support a division based on levels of symbolic decoration. Considering multiple traits of a metate and drawing comparisons between examples emphasizes a varied spectrum of uses for these multifaceted tools. Traits that emerge as indicators of use type include use-polish and morphological proportions.

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Acknowledgements

I would like to thank my adviser, Dr. Dietrich Stout, and my committee members, Renee Stein, Dr. William Size, and Dr. Liv Nilsson Stutz, for their invaluable advice, guidance, and time contributions throughout this project. I would also like to thank Dr. Rebecca Stone for sharing her expertise on the subject and Kathryn Etre for her suggestions and assistance with object access.

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I. Introduction

The archaeological record that a culture leaves behind can contain any mixture of everyday objects and rare, specialized goods. Discerning the difference between the everyday and the elevated, however, is not always a straightforward task. In the case of Ancient Central American stone metates, archaeologists and art historians alike have noted the diverse roles of the fascinating objects. These tools are an essential component of food processing as well as an outlet for cultural expression. This paper will examine and compare the physical characteristics of a group of metates through descriptive observations and microscopic analysis. The question guiding this analysis will be how to discern between the different uses that these objects served in the past.

The Michael C. Carlos Museum houses an extensive collection of Ancient American art, with particular strength in Costa Rican art, an area often overlooked in past research (Sheets 1992). The collection contains a sample of stone metates, or grinding tools. These stone platforms are generally shaped like small tables, although size and morphology vary. When paired with a hand stone, known as a mano, they make useful instruments for grinding plants, grains, or minerals. This tool's integral role in the processing of natural substances made it important both practically and symbolically in various cultures throughout the region. The metates included in the collection range from plain to elaborately decorated, with some marked by wear and others apparently unused (Stone-Miller 2002). It has been argued that the concept of an "art-tool" applies to several metates (Graham 1992). This concept refers to objects that imitate or represent the form of a tool but transcend functional purposes to serve as ritual or burial objects. Ancient Central American artists employed great skill and

technique to achieve complex designs in volcanic stone, and the attention they lavished on these objects make them a particularly interesting avenue of inquiry (Stone-Miller 2002).

This project involves an analysis of the stone metate group in the Carlos collection and an investigation of which characteristics can help identify a metate's use in society. Traits studied include rock type, iconography, and evidence of use. In addition to researching traits and facets of use, the goal of establishing a consistent basis for naming rock types contributed to the understanding of the collection. Based on the literature, the hypothesis developed for this study was that a higher degree of iconographic elaboration and rock types with lower vesicular densities would be associated with sparse evidence of physical use as a grinding tool. Metate designs that incorporate symbolically powerful effigy figures may lend themselves to more abstract uses than food processing, and the use of a rock type that fails to maximize physical efficiency may indicate functional priorities other than grinding. Object examinations for this study were carried out in the Carlos Museum's Parsons Conservation Laboratory.

Discussing style and function

Terms such as ceremonial, functional, ritual, utilitarian, nondomestic, etc. are used unevenly across the literature and even disparately within single works. An object's style includes the expression of features that are not directly related to functional efficiency, whether these features are adjunct and additional or isochrestic and unavoidable (Wobst 1977). However, the choices made about adjunct and isochrestic style can have functional properties as well. Joan Lingen, in her analysis of iconography in stone sculpture, established the dichotomy of ceremonial versus

functional for her research (1986). In this instance, she draws a division between metates that have effigy features, which are ceremonial, and those that do not, which are functional. Applying this terminology to the discussion of function and use would problematically lump together metates used for the grinding of ceremonial substances and metates that served ceremonial purposes through symbolism alone. At the same time, many effigy metates are capable of grinding and could have been highly functional. This dichotomy also enforces the view of concrete functions, ignoring the function of "information exchange" often encoded in stylistic choices (Wobst 1977). Terms centered on iconography would also be problematic in this discussion since they are based on the assumption that the perceived high quality and craftsmanship of a metate means it was necessarily used in special ceremonial contexts.

In another case, Michael Snarskis briefly touches upon how tripod metates are "found in contexts that sometimes suggest nondomestic roles- the preparation of special, ceremonial foodstuffs or drugs" (1981, 51). The assumption here that meshes poorly with questions of function and use is the idea that ceremonial activities and the domestic sphere are always separate. Additionally, attempts to understand an object outside of the context of its original excavation site is difficult using spatially oriented language.

Terminology

To move away from stylistic, iconographic, and contextual descriptors, the terms employed to discuss types of use in this paper will be *physical* and *non-physical*. Indicators of an object's use as a tool for grinding substances will emphasize its physical use, regardless of the object's associated iconographic elaboration. Non-

physical use will encompass metates whose function was symbolic, spiritual, or otherwise manifested without involving the labor of grinding. While the role of a metate could have had both physical and non-physical components, objects not engaged directly in grinding draw nearer to the category of an art-tool, where they are only representative of the grinding action (Graham 1992). Signs of physical and non-physical use may not be mutually exclusive to each other, but the patterns and relationships between factors can inform a better understanding of the objects. The terms physical and non-physical will help to distinguish between aspects of use.

II. Overview of metates in Central America

The artifacts of Central America include a diverse range of objects that are representative of multiple indigenous cultures (Coe 1962). Metates are common tools found throughout the area. The metates from this region span a wide array of styles that vary in terms of decorative elements, size, and morphology. Observing the artistic skill and rich symbolism in some objects raises the question of whether these specimens transcended their utilitarian function in society. This literature review will examine the standards for drawing conclusions about the functions of a metate in the context of physical and non-physical use. Focusing on the material characteristics and wear patterns of metates helps to uncover their use histories and facilitate an understanding of the role the tools played in peoples' lives.

Historical context of the Central American region

Central American archaeology faces the challenges of piecing together the themes shared across the region's diversified ecosystems and cultures. Modern-day

Costa Rica, Nicaragua, and Panama were home to several archaeologically distinct traditions situated in environmental niches as varied as tropical forests, arid highlands, and rocky coastlines. One uniting factor of these landscapes is the “almost continuous volcanic mountain range from northern Costa Rica through Central Panama” (Lingen 1986, 2). The key archaeological zones consist of Guanacaste-Nicoya, the Atlantic Watershed, and Diquìs (Snarskis 1981). Metates and manos are frequent finds at sites in these regions, with some of the earliest examples appearing along coastal river settlements dating back to 870 B.C. (Drennan 1996). Microbotanical remains associated with these early sites suggest that the metates were often used for grinding maize, but analyses of grinding surfaces have revealed traces of other food products such as manioc and cacao (Drennan 1996). Additionally, metates and manos provided a means of transforming the naturally occurring pigments and drugs used in the region into powders ready for use or ingestion (Stone-Miller 2002).

Although each archeological zone demonstrates artistic trademarks particular to their culture, the categories of effigy metates and basin metates are represented in all three areas (Snarskis 1981). Effigy metates incorporate elements of stone sculpture into the design of the tool, and depictions of culturally significant animals are a recurring feature. This style was prominent in Period IV (300 B.C. – 500 A.D.) and declined sharply during Period V (500 A.D. – 1000 A.D.) (Snarskis 1981). Basin metates are more stark in design and do not have figural attributes. These large bowl-like forms preceded the appearance of effigy metates, and showed up more frequently again after Period V.

The shape of basin metates is common in Mesoamerican assemblages, but artistic development does not occur in Mayan culture to the extent it does in ancient Costa Rican areas (Stone-Miller 2002). Mesoamerican society was dependent upon maize, a coarse grain that requires strenuous effort and tough tools to grind (Duffy 2011). Mayan metates found at the site of Aguateca, Guatemala were clustered in domestic spheres, sometimes side by side with each other or spindles (Inomata and Stiver 1998). The findings at this site support metates as mundane tools for daily jobs. In Costa Rica, however, maize was a specialty crop and not a staple (Stone-Miller 2002). The grinding of high-status foodstuff, such as maize and cacao, “merited special treatment” and thus aesthetic interest was heightened (Stone-Miller 2002, 138). The inclusion of effigy metates in the high-status burials of elite society members in Costa Rica around 300-500 A.D. points not only to the development of metates as an aesthetic tradition, but also to the potential of metates as a symbol. This time period witnessed “increases in population and social stratification” due to a growing reliance on agriculture, and so elite society members bore objects “symbolic of food preparation and its ceremonial redistribution” to emphasize their power (Snarskis 1981, 29).

Variation in the decorative elaboration of metates serves as one of the indicators of social inequality in the archaeological record and supports the idea of chiefdoms as the primary social structure in the region. Along with gold, jadeite celts, and shell jewelry, large metates “reconfirm[ed] the elite’s legitimacy” through symbolic language (Hoopes 2005, 18). These extremely ornate forms of effigy metates, known as flying-panel metates, are characterized by a flat tabletop surface supported by intersecting, incised panels depicting complex anthropomorphic allegories. The flying panel metates

often served as funeral biers in the richest tombs, blurring the line between effigy style tools and grave furniture (Snarskis 1981). While the evidence of social inequality is clear from luxury grave goods, it is unclear whether these elite remains represent chiefs who controlled resources through political force or shamans who maintained a spiritual power over agriculture (Hoopes 2005). Either way, the high-status metates played a role in a "politico-religious complex associated with the control of agricultural lands and the processing and redistribution of foodstuffs" (Snarskis 1981, 29).

Iconography and representations of shamanism

The religious system of shamanism that was pervasive throughout the Ancient Americas is tightly linked to the iconography of metates. One of the key focal points of shamanism is the visionary experience achieved through altered consciousness, and "a primary aspect of altered consciousness is often the direct kinesthetic experience of becoming an animal, or watching an animal change into other animals and beings" (Stone-Miller 2004, 48). Shamans undergo animal transformations, turning into their spiritual counterparts. Certain powerful animals from the Costa Rican environment appear commonly to shamans in trance states, such as jaguars and crocodiles, and these animals are frequently evidenced in many kinds of artwork (Stone-Miller 2004). The decorative features of metates are no exception. The imagery relies heavily on depictions, both figurative and abstract, of these types of animals. The tetrapod jaguar metate is an example that is widespread throughout the Costa Rican archaeological record, and a myriad of examples survive today (Stone-Miller 2002). Each jaguar metate has certain standard characteristics such as four legs, a curved tail, and a head that is connected to the front of the grinding platform. Although they share these

recognizable characteristics, they also have unique differences of platform shape, rim decoration, and facial features. Another iconographic representation recorded on some metates is a central row of angular protrusions running along the underside of the grinding platform. This simplified pattern refers symbolically to the scutes on the back of a crocodile (Stone-Miller 2002). Crocodiles, which often appear as shamans' spiritual counterparts, played a vital role in ancient Costa Rican cosmology where their backs represented the earth (Graham 1981).

While shamanistic animal imagery makes a clear visual connection to religious beliefs, there are also more subtle incorporations of the ideology in metate art. The curved-platform tripod metates of the Guanacaste-Nicoya region have distinctive design elements and shapes. Their three triangular legs often feature geometric renderings of animals and many have effigy heads. Curiously, the curved rectangular grinding platform holds most of its visual interest and incised patterns on the underside, the part that faces the ground (Figure 1). This trait honors the shamanistic belief in the primacy of the earth since the metate is decorated not for the benefit of people, but for the ground beneath (Stone-Miller 2002). Even the concept of using a metate to grind substances is laden with shamanistic undertones of transformation and connection with the natural world. Natural resources including hallucinatory entheogens, prestigious foods, and pigments, are transformed through the action of the metate into a usable product (Stone-Miller 2002). This act of transformation means that the use of a metate, even for everyday purposes, can be infused with ceremonial significance.



Figure 1: Geometric designs on metate underside

Metate characteristics and physical use

Observable characteristics of metates provide insight into their use histories. Physical use and morphology have been connected through several studies of functionality. In order to use a metate in the physical sense, it must have a morphology that is conducive to the process. Jenny Adams, in a study that combined ethnographic and experimental procedures, concluded that a large surface area for the grinding platform was the key to highly efficient grinding (1993). Increased surface area also confers benefits to the grinder by allowing them to move with fewer restrictions and in turn, less physical stress. An additional interesting point that Adams highlights is the use of “wear-management techniques,” where, in a conscious effort to extend the life of their

tools, grinders will rotate the mano as they grind, alternating the proximal and distal edges (1993, 336). This process results in a thin-edged mano that shows wear on both sides. In another study primarily concerned with mano shape, the author characterizes the differences in the wear down processes of one-handed and two-handed manos and ties these patterns to an upswing in the reliance on maize subsistence (Morris 1990).

Although Adams' study of morphology stresses the size of the grinding platform, this does not exclude small metates and manos from physical uses. Miniature or "toy" metates are sometimes found with the residue of a "red mineral thought to have been used in painting ceramics" (Graham 1981, 115). Miniatures, showing signs of use through surviving residues, suggest that the size of a metate was likely specialized for various practical uses. Residue analysis also played a central role in Lisa Duffy's questioning of the prominence of maize in ancient Mesoamerica (2011). In her study, she chose to examine morphology and the presence of residues in a collection of Mesoamerican metates. She found traces of maize on all forms of metates in the sample, of which the flat platform types were the most common and operated through a smoother, reciprocal-motion mechanism unlike the deep trough shapes (Duffy 2011). The assessment of maize reliance led another group to demonstrate that the frequency of manos recovered, regardless of shape or context, could be used to approximate "agricultural dependence" (Hard, Mauldin, and Raymond 1996, 291). The considerations of size, body motion, and controlled wearing of manos support the idea that grinding metates were designed with physical efficiency in mind, although less efficient forms could still serve as tools as evidenced by the widespread food residue findings.

In addition to morphology and residues, another characteristic that is used to infer physical function is use wear. Some Ancient American archaeologists, including Frederick Lange, suggested that metates were actually seats placed in burials as furniture (1992). Michael Snarskis, however, refutes this idea based on examples of metates with heavy surface grinding wear, even approaching the edges, and the nearby presence of equally worn manos (1981). Snarskis also attempts to convey the look of wear more descriptively, saying that a small mano-metate set “shows use-polish on its flat surface and battering at the extremities” (1981, 59). Although he did not pursue “use-polish” as a quantifiable term, its usage made a key distinction between weathering and use wear. Sophie de Beaune also readily uses the term “polish” as an indicator of specific areas of wear on Neolithic stone tools (2004).

Early examples of effigy metates were large oval shapes, featuring patterns of trophy heads around the rim, and they bore the wear marks of a pestle rather than a mano (Graham 1981). This wear suggests the grinding of roots or pigment instead of tough grains. The concentration of design elements on the rims, legs, underside, or head of metates also suggests its physical purpose since the incisions and pecked holes are deliberately located away from the working surface (Stone-Miller 2002). Some later effigy metates, with small grinding surfaces and possibly inefficient shapes, show signs of use wear on their platforms as well (Stone-Miller 2002). Research is lacking on the practicality of grinding materials softer than maize using a decorated metate, and it is also sparse in terms of understanding specific wear patterns. Distinguishing use patterns between “corn, wood, bone, and shell grinding [is] not absolute,” although it may be possible given further study (Odell 2000, 308).

Metate characteristics and non-physical use

Non-physical use of a metate, conversely, may be suggested by absence of use wear. The symbolic idea of a tool has its own functionality and usefulness. Mark Graham conveniently describes these objects as “art tools” or “tool symbols” which can confer power through their embodiment of usefulness (1992, 165). Focusing on the flying panel metate tradition of the Atlantic Watershed region, Graham points out the regulated syntax of the panel images and the effectiveness of the objects’ communication, whereas plain metates are “mute” (1992, 186). In another writing, Graham points out that this advanced level of stone figuration “represents stages and themes of ritual activity, including human fertility and sexuality, religious contemplation and curing, and acts of human sacrifice” (1981, 131). Towards the end of Period IV, artists started to express these narratives through freestanding sculpture while metates as a symbol of food declined in a more centralized society. Yet at the peak of their power, metates in elite graves, whether appearing as biers or grinding platforms, could be used by the dead in the afterlife and thus perpetuate elite status (Stone-Miller 2002). Speaking on the transformation of a shaman into a jaguar, which is a common metate theme, Nicholas Saunders writes, “in this ‘other’ state of being, the shaman transcends society’s normal rules, [and] visits the dead” (1998, 33). This idea of ritualistically transcending normal, everyday function is a vital process of the metate as well as the shaman, both of which are often represented as the powerful jaguar.

Other features of non-physical and ritualized uses include the deliberate uselessness of an object that has been “killed.” Prior to placement in a tomb, some metates were altered in order to prepare them for use in a fundamentally different world

(Stone-Miller 2002). Kill holes in the center of a grinding platform would ensure a state change and passage to the afterlife (Graham 1992). In less extreme cases, metates are often included in tombs without a matching mano, which deprives them of their working ability once buried in this world (Stone-Miller 2002). The emphasis on these metates is "symbolism, rather than pure function" (Stone-Miller 2002, 136).

Metate stone type

Central American artists made specific decisions during the creation of a metate in order for it to be physical useful and efficient or successfully symbolic. The desired outcome and eventual use of an object can influence the choice of rock type for raw material. One study of the Hohokom metates notes that cultural tradition had established distinct uses for different stone types:

> [Manos and metates] can be categorized as two different but complementary tool systems consisting of a set of manos and metates for preparing wild plant products and another set for grinding corns. The former is a slab grinding system that incorporated fine-grained (non-vesicular) materials and a round or oval mano; the later includes a rectangular mano and a trough metate usually made from vesicular igneous materials (Bostwick and Burton 1993, 358).

The texture of the grinding platform makes a difference in the results of grinding, and this trait is used to manipulate the experience of working with various substances. The volcanic stone that metates are made from is notably "heavy, brittle, and porous" (Stone-Miller 2002, 133). With a brittle stone, breakage on the microscopic edges of vesicles, or air bubbles, is likely to be induced by the grinding mechanism, which often results in an easier grinding process. However, breakages during grinding can also lead to stone particles getting mixed in with food or powders and altering the final product.

Andesite, basalt, and granite are common types of igneous rocks in the Central American region. Each type occurs in different variations of composition and texture. Even small differences in andesite's structure, for instance the density and size of vesicles, can change the way a stone reacts when the tool is used for grinding. Therefore, not only the type of stone but also its detailed description can inform an understanding of a metate's uses.

Experimental studies on the methods of metate production detail a procedure of chipping followed by pecking (Odell 2000). The process is subtractive, and starting with a large chunk of stone involves planning ahead. This is a time-consuming endeavor, with fourteen hours recorded as the starting point for making a basic metate (Stone-Miller 2002). As in the studies of mano morphology, experimental grinding processes have shown that wear on the stones, after 53.5 hours, produced noticeable changes in shape and appearance (Wright 1993). This study brought up the idea that while metates have survived in the record far longer than any tools made from organic materials, they actually have a relatively short working lifespan. Reshaping and making new metates would have been a common occurrence due to physical wear and tear.

Applicability of present study within previous research

Studying the physical attributes of metates helps to contextualize them without a complete reliance on information gathered from the excavation. Costa Rica has a history of looting and unauthorized exhumation, and Graham notes that archaeologists rarely saw flying panel metates within their original burials (1992). This delay in the establishment of an ethical archaeological system is one of several contributing factors to the oversight of Costa Rica in the canon of Central and South American artwork.

Graham makes the point that even Gustav Stomsvik, an art-historian lamenting the overlooked beauty of metates, keeps his focus squarely on the plain Mesoamerican versions instead of the fantastical, symbolic creations of Costa Rica (1992). The chiefdom system of ancient Costa Rica is an additional contributing factor in the oversight of the area since historians view the cultures as less capable of complex social patterns and traditions. Archaeologist Payson Sheets, however, sees the chiefdom system as a triumph and the dearth of research in Costa Rica as a persistence of colonial attitudes (1992). The complexity and stability of the region, Robert Drennan argues, are evident in their "resilience in the face of natural disasters" since the region is "periodically devastated by volcanic eruption" (1996, 110). While many art historians have been striving to fill this information gap, most archaeological and empirical research on metates is not focused on Costa Rican styles in particular. For now, conclusions from comparable cases studies of Mesoamerican objects must supplement background information.

While metate styles vary across the cultures of ancient Costa Rica, they all reflect similar social stratification systems, common emphases on shamanistic beliefs, and a resistance to remaining purely utilitarian. Although the excavation records for many of these objects are sparse or missing altogether, they do not have to remain shrouded in mystery. Previous scholarship centered in the art history world has focused on the highly developed iconography and symbolism of these unique pieces. When an understanding of the imagery is combined with an examination of physical traits, a clearer picture of the object begins to emerge. Several experimental studies of wear and mechanics focus on metates from other regions of Ancient America, and since volcanic

stone remains the most common material, comparisons may prove beneficial. Morphology, use wear patterns, and rock type have the potential to supplement iconography as indicators of an object's history of physical or non-physical use.

Given the demonstrated insufficiency of research discussing ancient Costa Rica, the current project examining the aspects of metate use will contribute to the ongoing effort to increase the body of knowledge about this intriguing region. The Carlos Museum, with its unique depth in its Central American art collection, provides an ideal resource for the exploration of such questions. As with many museum collections, limitations in terms of sample size and the representation of random variation arise. Though there are several comprehensive studies of Costa Rican metate imagery, the details of their use are less frequently discussed in large samples.

III. Materials and Methods

Sample

The Michael C. Carlos Museum houses 20 objects categorized as metates in the archive. 18 of these metates came from the region of Central America. The other 2 metates, examples from North America, were excluded from the current study on the basis of their dissimilar cultural history. The earliest examples date to Period IV, with the mode time frame being listed as Period IV-V. William C. and Carol W. Thibadeau are the most prominent collectors who contributed to the museum's collection of Central and South American Art, including the metates. Collectors purchase objects based on their personal preferences, so the assembled collection does not display random variation or completely reliable provenance records. While the small sample available

for study may not be statistically representative of metates in general, the range of the objects provides an interesting opportunity for description and comparison.

Preliminary procedures

18 object files were pulled from the museum archives. Files included information regarding acquisition, measurements, rock type, prominent stylistic features, treatment history, and any previous analyses. Acquisition dates for the objects ranged from 1979 to 1992. While basic acquisition reports were consistent throughout the files, the supplemental information varied in terms of content present and degree of descriptiveness. The labeling of rock type, in particular, varied widely from perfunctory to specific.

Based on the rock type recorded in the files, the objects were separated into 4 groups. Groups of 4 and 5 were selected to facilitate comparative petrographic analysis along with ease of movement in the laboratory space. Group 1 consisted of stone categorized as andesite; group 2 consisted of andesites that had additional descriptors of structure or texture; group 3 consisted of stone categorized as microdiorite or basalt; group 4 consisted of materials labeled stone. Groups were pulled from storage in succession.

Before individual examination, each object was photographed at multiple views including the grinding platform (Appendix B).

Observation procedures

Each metate was measured by length, height, and width of grinding platform using a flexible tape measure. Length of the metates was defined as the maximum distance across the top surface, including any protruding features. With effigy metates,

this measurement could be called “head to tail.” The height of each metate was measured as the maximum distance from the metate at rest on the ground to its highest point. The width of the grinding platform was measured perpendicular to the length measurement, and it varied between being a true width measurement or diameter according to the rectangular or rounded nature of the platform shape. To provide an index of the proportions of each metate, its length was divided by its height.

Colors were recorded using The Geological Society of America’s rock color chart, consisting of Munsell color chips in natural tones. Color was matched on an unweathered surface, a weathered surface, and the grinding platform of each metate using the overhead lighting in the laboratory space. These matching locations were chosen to assist in the identification of rock type as well as to provide an indicator of discrepancies between the grinding platform and other surfaces. The presence of use-polish was identified by a pattern of smoothness and sheen, visibly distinct from other surfaces, concentrated at the center of the grinding platform and tapering outwards towards the platform edges. This pattern served to indicate physical grinding use of a metate. The absence of use-polish was noted as a consistency of texture and luster throughout the object’s surfaces.

Iconographic features of the metates were recorded in 2 categories: geometric incisions and effigy features. Geometric incisions consisted of abstract lines and shapes pecked into the edges, legs, or protrusions of the metates. Effigy features were those that represented an animal or person in entirety or a distinctive part of an animal. Some features, such as a string of round trophy heads or the square scutes of a crocodile, tread the line between abstraction and representation, yet the protruding structures and

depth of carving distinguish them from simpler incisions. Both incisions and effigy features are recorded as either present or absent.

To quantify the porosity of the stone, a drop of distilled water was placed on an unweathered surface and timed as it spread and soaked into the material completely. Any residues or discolorations on the stone were noted as well.

Microscopic analysis procedures

Guidelines for the petrographic analysis were based on Loren Raymond's *Petrography Laboratory Manual* (1984). Areas of interest included: texture (crystallinity, granularity, constituent relationship), structures, and individual mineral descriptions. A stereo boom microscope was used in conjunction with an external fiber-optic illuminator in order to accommodate the differing sizes of the metates and reach the unweathered surfaces. Each metate was initially viewed at the lowest magnification (10 x 0.7) before moving on to the highest magnification available (10 x 4). Percentages of vesicle structures and mafic minerals were estimated by taking an average of the density at 3 different locations. Examples of microscopic views are shown in Figures 2 and 3.

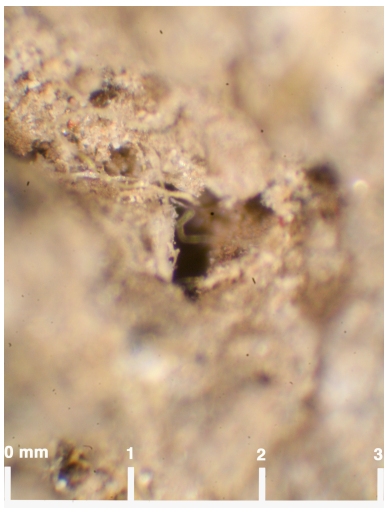


Figure 2: Vesicle with fiber

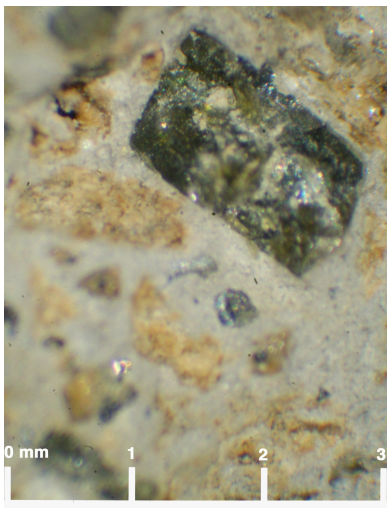


Figure 3: Biotite mica phenocryst

To provide succinct yet descriptive names for rock types that would be useful for comparisons, modifiers for specific textures and structures were included. Porphyritic textures where phenocrysts were relatively larger than a fine groundmass were noted. Rocks with an average of 5% or higher vesicle density were considered to be in the vesicular category.

In addition to petrographic analysis, worked and weathered surfaces were visually scanned for signs of residues or traces of pigment. Photographs of residues, as well as the grain and individual phenocrysts, were taken using a digital camera attachment for the microscope (Appendix B).

All data was compiled into a Microsoft Excel spreadsheet in order to facilitate comparisons.

IV. Results

Relevant data can be found in Appendix A. Descriptive information gathered from all 18 metates is summarized in Table 1, while characteristics potentially related to physical and non-physical use are summarized in Table 2. A detailed expansion of each object can be found in Appendix B.

Information from object files

All metates are generally sourced to the regions of Central America, Costa Rica, Panama, Guanacaste-Nicoya, Atlantic Watershed, Central Highlands, Veraguas, Honduras, and/or Diquìs, with Central America and Costa Rica as the most common areas cited. The objects are dated from 1-1520 C.E., with 300-700 C.E. as the most common range.

Morphology and measurements

In terms of shape and size, 10 metates rest on 4 legs and the remaining 8 have 3 legs. One metate is paired with its mano, an oblong hand stone measured as an approximate rectangle. The metates with the smallest grinding platforms, both measuring 6.9 cm and titled as “miniatures,” have a single, solid leg that resembles 3 joined together. The third smallest metate is not labeled as a miniature and resembles the jaguar effigy style of the mid-sized metates. The average height of the metate group was 14.6 cm, with a minimum of 6.5 cm and a maximum of 32.4 cm. The average length of the metates was 34.1 cm, with a minimum of 11.0 cm and maximum of 76.5. The average grinding platform width was 19.0 cm, with a minimum of 6.9 cm and a maximum of 52.0 cm. None of the minimums/maximums correspond to single metate that is the smallest/largest.

The ratio of height-to-length remains fairly consistent throughout the group, with an average of 0.5, a minimum of 0.3, and a maximum of 1.6. The differences between the minimum and maximum are shown in Figure 4. The lowest height-to-length ratio is low to the ground and exceptionally stable, with short, rounded legs. The highest ratio corresponds to one of the miniature metates, which the records suggest to be a toy for children. This metate cannot stand reliably on its joined leg and instead rests oriented sideways.



Figure 4: Examples of low (left) and high (right) height/length ratio

Rock type, grain size, vesicle percentage, and permeability

Three metates were considered diorites on the basis of granularity, structures, and mineral composition. The diorites generally had a larger grain size, ranging from around 1-4mm, that was more consistent throughout the stone sample than the mixed grain sizes seen in the andesites. The other 15 metates consisted of various andesites, ranging in texture from granular to porphyritic, with and without vesicles. The 6 porphyritic metates have a difference of several magnitudes in size between phenocrysts and groundmass, which gives the stone a particular spotted appearance.

Vesicle distribution was often uneven and occurred in striations or clusters, which may account for the permeability not trending along with the vesicle density. The timing ranged from 2-30 sec and had an average of 10.7 sec. The metates with the longest times, 23.3 sec and 30 sec, were also found to have waxy residues in various spots on the underside of the grinding platform, and these types of residues could change the manner in which water behaves on the surface.

Incisions and effigy features

In terms of decoration and iconography, 13 of the metates had geometric incisions present, and 10 of them displayed some form of effigy feature. The most frequent type of effigy decoration was the jaguar head, legs, and tail, which was a pattern observed in 6 cases. Incisions and effigy motifs often occurred together, with 8 metates having both types of stylistic additions (Figure 5). Incisions occurred by themselves in 6 objects, although effigy features without accompanying incisions only occurred on 2 objects.



Figure 5: Jaguar effigy metate with geometric incisions

Use-polish and grinding platform color

The presence of use-polish was observed on the grinding platforms of 9 metates. An example of a use-polished surface is shown in Figure 6. In 8 of these cases, a significant discrepancy in color was also noted between the regular weathered surfaces and the grinding platform surface. This color disparity was also noted in 1 case where there was no observed use-polish.



Figure 6: Grinding platform with use polish

V. Discussion

A synthesis of these results concerning individual features reveals some interesting associations in the metate group. In their recorded titles, 10 of the metates have the word “ceremonial” as a modifier, while 1 is labeled “utilitarian.” It is interesting to note that every instance of a ceremonial distinction is supported by iconographic descriptors, although the reverse does not hold true with every decorated metate being labeled ceremonial. Returning to the categories of physical and non-physical use, we must consider not only iconography or another isolated feature but instead examine the relationships between the various aspects.

The group is diverse in terms of size and proportion as shown by the absence of an absolute smallest or largest. Different proportions may be suited to different functional needs. The low height-to-length ratio appears more conducive to physical use because it forms a solid base on which to grind, as opposed to high height-to-length ratios, which combine a small working surface with an unstable base. The metate with the lowest ratio shows signs of use-polish from grinding, as do some objects in the

middle of the spectrum. The metates with two highest height-to-length ratios are not associated with this type of wear. This relationship suggests that a prerequisite of stable morphology may need to exist before efficient physical use is a possibility. The efficiency of certain morphological types fits in with experimental studies stressing the importance of grinding surface area (Adams 1993). When handling the metates, the difference between the minimum and maximum height-to-length ratios is a clear factor in achieving a stable stance, and the high ratio shape does not withstand even small physical disturbances.

The 6 vesicular stones have a rougher feel generated by the increased presence of microscopic grinding edges. These edges break substances apart during grinding, so the rougher material would make the metate more physically effective as a tool (Stone-Miller 2002). Vesicle density and use-polish do not appear to be correlated with each other, yet all 6 vesicular andesite objects possess complex effigy features. Perhaps the ease of carving, as opposed to the ease of grinding, dictates the choice of stone type in some cases. The granularity of the stone chosen for metates appears unrelated to any of the other factors studied presently, and the predominance of fine-grained stone is not exclusive to the elaborately decorated examples or the polished examples.

The elaborately decorated metates and the use-polished metates are often one and the same. Out of the 8 metates that exhibit use-polish, 5 objects also have effigy features. The color differential between the grinding platform and weathered surfaces, which can be an effect of the use-polishing or residue build-up on the working area, also exists alongside effigy features. This finding does not support the initial hypothesis of

the study that the iconographically elaborate metates would bear sparse evidence of physical use.

These results do not fall in line with the dichotomies established on the basis of effigy and incision design features alone (Lingen 1986). The additional factors of morphological proportions, use-polish, and rock type and quality that are considered in this study lead to a blurring of the distinction between categories. Indicators of physical functions, like use-polish, and indicators of non-physical functions, like iconography, overlap and occur together within the same specimens. This overlap hints at multiple functions expressed through a single object and a spectrum of possible uses. As opposed to rigid typologies, the current data supports further holistic analyses in the vein of Michael Snarskis's examination, where he argued for the presence of use-polish and grinding behavior on large metates that had been mistaken for decorative seats (1981).

Interestingly, the results showed not only the overlap of elaborate iconography and grinding behaviors, but also the potential combination of non-artisan metates and non-physical uses. The absence of use-polish and signs of grinding on relatively unadorned examples points to symbolic functionality through the form of the metate itself and not the representations of powerful animals and motifs. These cases where function is tied to the representation of a general metate template exemplify the art-tool idea of power through the embodiment of usefulness (Graham 1992).

While the analytical framework of looking for cases of physical and non-physical use reveals a mixture of functions instead of clear-cut categorizations, the process begins to tease apart the layers of metate uses. Understanding potential uses of

metates as practical and symbolic entities allows the story and the cultural importance of the object to begin emerging. Refinement of study techniques can contribute to continually improving comprehension of the subject.

Limitations and future directions

Methods used in this study that could be modified and improved include permeability and the quantification of use-polish. The measure of determining permeability was complicated by the interference of wax and similar resistant coatings (Figure 7) on the metates, which have differential areas of weathering and surface treatment. The quantification of use-polish through a size comparison of unweathered vesicles and grinding platform vesicles, worn wider by action, may be a promising area of inquiry. In this study, vesicle size seemed to remain roughly comparable across surface areas of the metate, yet the measurement scale was insufficient to rule out the possibility of a differential.

Analysis of residues, a technique shown to yield information about the physical grinding of plants, food, and pigments, is another potential avenue of questioning (Graham 1981, Morris 1990, Duffy 2011). The current study included the collection of minimal descriptive data concerning residues and a thorough chemical analysis was beyond the present scope. The disparate levels of cleaning and coating of object surfaces in museum collections could present challenges for the reliability of residue analyses.

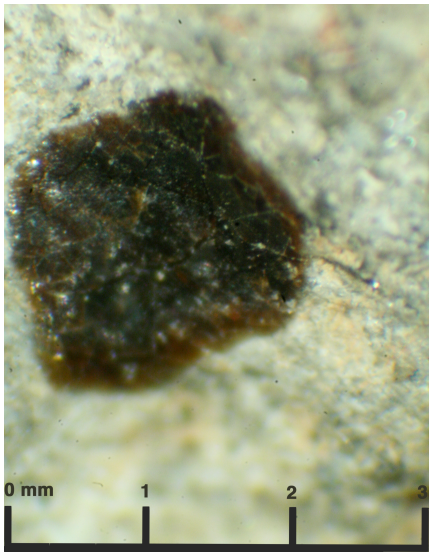


Figure 7: Waxy residue on metate

VI. Conclusion

The initial hypothesis that set iconographically elaborate, smooth stone metates apart from those used as grinding tools was not supported by the data. Rich decorations and practical usage are not mutually exclusive, and they occur together in various combinations and degrees. The presence of symbolic style elements does not necessarily pin an object in the realm of the purely symbolic art-tools. Metates are multifaceted and multifunctional objects in daily life, ritual life, and the afterlife. Grasping all of these functions cannot rely on one factor alone. A comparative synthesis including, but not limited to, rock type, morphology, iconography, and use wear creates a basis for understanding the interplay of functions. The difficulty of distinguishing between physical and non-physical use when an object has evidence of both aspects continues to be problematic when lacking the contextual information of an excavation site. Nonetheless, the application of measures such as functional morphology and use-

polish evidence can demonstrate the specific uses of individual metates as well as the complex social and cultural functions of this fascinating object type.

Appendix A. Tables

Table 1. Metate descriptions

Accession #	Title	Region	Date (A.D.)	Height (cm)	Length (cm)	Width (cm)	Legs
1979.58.8A	Utilitarian Metate with Mano	CA, CR, GN	1-500	9.8	37.2	24.8	4
1979.58.8B	Utilitarian Metate with Mano (Mano)	CA, CR, GN	1-500	5.7	19.3	8.6	n/a
1991.2.217	Miniature (Child's?) Metate	CA, Honduras	600-900	17.6	11.0	6.9	3
1991.2.218	Miniature (Child's?) Metate	CA, Honduras	600-900	10.7	12.9	6.9	3
1991.4.39	Jaguar Metate with Incisions	CA, P, CR, Veraguas	300-700	10.0	27.7	12.0	4
1991.4.44	Oval Ceremonial Metate with Monkey Figures	CA, CR, AW	300-700	10.7	18.4	14.6	4
1991.4.45	Oval Ceremonial Jaguar Effigy Metate	CA, CR, AW, Diquìs	300-700	10.8	28.0	16.5	4
1991.4.48	Oval Ceremonial Jaguar Effigy Metate	CA, CR, AW	300-700	14.0	47.0	23.5	4
1991.4.49	Rectangular Ceremonial Jaguar Effigy Metate	CA, CR, AW	300-700	17.8	48.2	19.7	4
1991.4.161	Oval Metate with Bird Nubs	CA, CR, AW	300-700	14.29	31.8	24.1	4
1991.4.162	Small Rectangular Jaguar Effigy Metate	CA, CR, AW	300-700	10.8	29.6	14.8	4
1991.4.204	Oval Ceremonial Metate with Female effigy legs	CA, CR, AW	300-700	28.2	76.5	52.0	4
1991.4.211	Jaguar Metate (Grinding Stone)	CA, CR, AW, Diquìs	800-1520	6.5	19.5	11.0	4

1991.4.378	Large Tripod Ceremonial Metate with Geometric Patterning	CA, CR, GN	1-500	21.0	48.9	24.1	3
1991.4.379	Small Tripod Ceremonial Metate with Geometric Patterning	CA, CR, GN	1-500	14.0	25.7	14.3	3
1991.4.380	Large Ceremonial Parrot Effigy Metate	CR	300-700	32.4	62.2	26.7	3
1991.4.386	Small Ceremonial Parrot Effigy	CA, CR, GN	300-700	16.2	33.0	14.9	3
1991.4.549	Ceremonial Metate with Crocodile Scutes on Underside	CA, CR, AW, CH	300-700	12.1	38.7	30.5	3
192.15.100	Tripod Metate	CA, CR	300-700	14.5	32.0	15.0	3

CA: Central America; CR: Costa Rica; P: Panama; GN: Guanacaste-Nicoya; AW: Atlantic Watershed; CH: Central Highlands

Table 2. Use-related factors

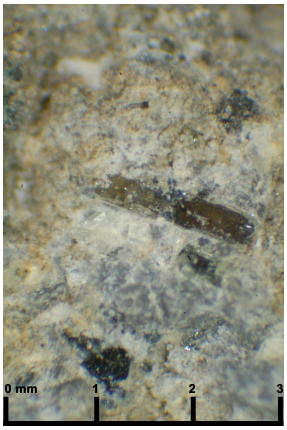
Accession #	Height/ Length	Vesi -cles (%)	Perme -ability (sec)	Rock type	Incised design	Effigy feature	Use polish	Color: weath-ered	Color: GP
1979.58.8A	0.3	0	18.0	Diorite	0	0	1	10 YR 6/2	10 YR 6/2
1979.58.8B	n/a	1	19.0	Diorite	n/a	n/a	1	10 YR 6/2	
1991.2.217	1.6	0	2.2	Diorite	0	0	0	10 YR 6/2	10 YR 6/2
1991.2.218	0.8	1	18.0	Porphyritic andesite	0	0	0	10 YR 7/4	10 YR 7/4
1991.4.39	0.4	0	2.0	Andesite	1	1	0	10 YR 6/6	10 YR 7/4
1991.4.44	0.6	10	3.2	Vesicular porphyritic andesite	1	1	0	10 YR 6/2	10 YR 6/2
1991.4.45	0.4	7	7.7	Vesicular andesite	1	1	0	10 YR 4/2	10 YR 4/2
1991.4.48	0.3	9	3.5	Vesicular porphyritic andesite	1	1	0	10 YR 6/2	10 YR 6/2
1991.4.49	0.4	10	8.6	Vesicular porphyritic andesite	1	1	1	10 YR 5/4	10 YR 6/2
1991.4.161	0.5	3	8.0	Andesite	1	0	0	10 YR 5/4	10 YR 5/4
1991.4.162	0.4	1	4.0	Porphyritic andesite	1	0	0	10 YR 6/2	10 YR 6/2
1991.4.204	0.4	5	6.2	Vesicular porphyritic andesite	0	1	1	10 YR 5/4	10 YR 4/2
1991.4.211	0.3	3	7.7	Andesite	1	1	0	5 Y 6/4	10 YR 5/4
1991.4.378	0.4	3	30.0	Andesite	1	0	1	10 YR 5/4	10 YR 4/2
1991.4.379	0.5	2	23.3	Andesite	1	0	1	10 YR 5/4	5 YR 2/2
1991.4.380	0.5	7	3.0	Vesicular andesite	1	1	1	10 YR 6/7	10 YR 4/2
1991.4.386	0.5	5	7.5	Diorite	1	1	1	5 YR 4/4	5 YR 2/2
1991.4.549	0.3	1	7.4	Andesite	0	1	1	10 YR 8/2	N5
1992.15.100	0.5	3	12.1	Andesite	1	0	1	10 YR 7/4	10 YR 4/2

Appendix B. Object catalogue

Each entry includes a description of the rock type, prominent iconographic features, and areas of wear or residue. Object photographs are complemented by a select microscopic view to show the general grain or interesting characteristics.

1979.58.8A



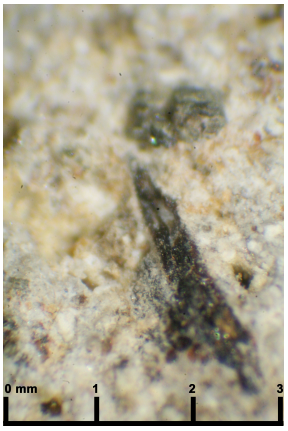


Diorite is light gray (N7) color with areas of pale yellowish brown (10 YR 6/2) weathering. Grinding surface is evenly pale yellowish brown (10 YR 6/2). Rock texture is holocrystalline, medium-grained, and granular. No prominent vesicles are visible, yet the surface is pitted from weathering. Individual minerals include feldspar (1-2 mm, euhedral, prismatic, white), biotite mica (1 mm, euhedral, tabular, black, 6%), olivine (1-2 mm, subhedral, equant, dark green, 4%), and amphibole (1- 1.5 mm, euhedral, acicular, black, 4%).

The grinding platform is thick (6 cm) and low to the ground. The grinding platform has an asymmetrical oval shape. Edges show chips and breakages. A spot of white, powdery residue is on the outer edge of grinding platform. 2 areas of waxy residue are on the metate, located on the bottom of 1 foot and the outer edge of grinding platform.

1979.58.8B (mano)



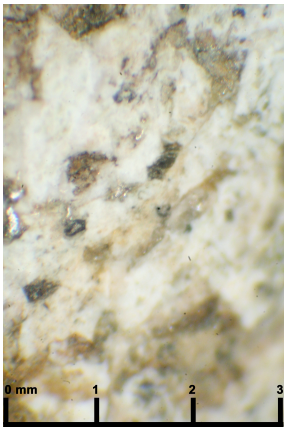


Diorite is light gray (N7) color with areas of pale yellowish brown (10 YR 6/2) weathering. Rock texture is holocrystalline, medium-grained, and granular. Vesicles are 0.5 mm with 1% density. Individual minerals include feldspar (1-2 mm, euhedral, equant, white), biotite mica (1-2 mm, euhedral, tabular, black, 4%), olivine (1-1.5 mm, subhedral, equant, dark green, 4%), and amphibole (1-1.5 mm, euhedral, acicular, black, 1%).

One side of the oblong hand-stone is noticeably smoother and less convex than the other side. The smooth side has an area of residue (4 cm) with fibers.

1991.2.217



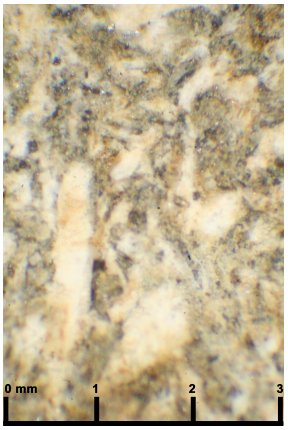


Diorite is white (N9) with dark yellowish brown (10YR 6/2) weathering. Grinding platform is evenly dark yellowish brown (10YR 6/2). Rock texture is hypocrystalline, medium-grained, and granular. No prominent vesicles are visible, yet the surface is pitted from weathering. Individual minerals include feldspar (0.5-2 mm, subhedral, equant, white, twinning) and biotite mica (0.5-1 mm, subhedral, tabular, black, 6%) along with quartz in the groundmass.

The grinding platform is a curved rectangular shape with a rounded protrusion at the front end. Metate has several spots of orange, waxy residue including 1 (5 cm) on the grinding platform.

1991.2.218



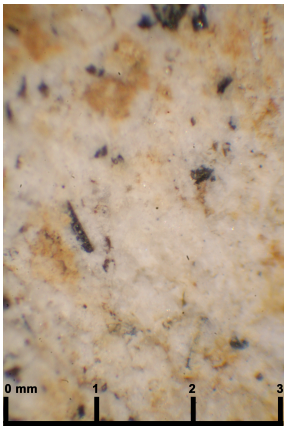


Porphyritic andesite is pale yellowish brown (10YR 6/2) with areas of grayish orange (10YR 7/4) weathering. Grinding platform is evenly grayish orange (10YR 7/4). Rock texture is hypocrystalline, fine-grained, and porphyritic. Vesicles are 1-2 mm on both unweathered and weathered surfaces with 1% density. Individual minerals include feldspar (1-1.5 mm, euhedral, prismatic, white), and biotite mica (0.5-1 mm, euhedral, equant, black, 20%). Magnetite and garnet are present as accessory minerals.

Grinding platform is a curved rectangle. Legs are conjoined near the top and uneven, causing the grinding platform to rest at a slant. The front leg has long, black markings that resemble paint.

1991.4.39



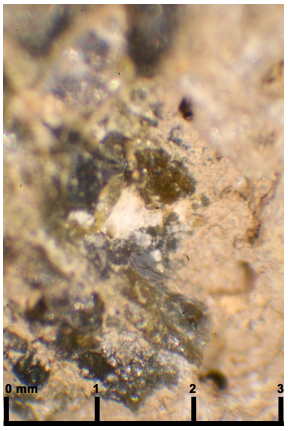


Andesite is very pale orange (10YR 8/2) with areas of dark yellowish orange (10YR 6/6) weathering. Grinding platform is grayish orange (10YR 7/4). Rock texture is hypocrystalline, fine-grained, and granular. No prominent vesicles are visible, yet the surface is pitted from weathering. Individual minerals include quartz (1-2 mm, euhedral, equant, colorless), amphibole (1-4 mm, euhedral, equant, black, 8%), and biotite mica (0.5-1 mm, euhedral, tabular, black, 2%).

Grinding platform is round and bowl-shaped with jaguar head and tail. Grinding platform edges, legs, and head have incised geometric designs. Underside of grinding platform has traces of red powder and a dark residue spot (5 mm).

1991.4.44



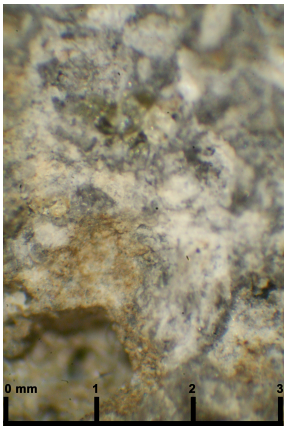


Vesicular porphyritic andesite is light gray (N7) with areas of pale yellowish brown (10YR 6/2) weathering. Grinding platform is evenly pale yellowish brown (10YR 6/2). Rock texture is holocrystalline, fine-grained, and porphyritic. Vesicles are 0.1-1 mm on unweathered surfaces and 1-5 mm and 1-5 mm on weathered surfaces with 10% density. Individual minerals include feldspar (0.5-1 mm, euhedral, equant, white), and olivine (1-2 mm, subhedral, equant, dark green, cleavage, 8%).

Grinding platform is oval with incised geometric edge. Legs are connected in sets of 2, making parallel “U” shapes at opposite ends of the metate. Leg shapes have pecked designs of a monkey figure. The grinding platform has fibers within the vesicles as well as traces of red powder. Spots of pale yellow clay stand out on the grinding platform.

1991.4.45





Vesicular andesite is medium light gray (N6) with dark yellowish brown (10YR 4/2) areas of weathering. Grinding platform is evenly dark yellowish brown (10YR 4/2). Rock texture is holocrystalline, fine-grained, and granular. Vesicles are 1-5 mm on weathered surfaces, usually coalescing, with 7% density. Individual minerals include feldspar (0.5-1 mm, subhedral, equant, white), amphibole (1-1.5 mm, euhedral, acicular, black, 3%), and olivine (0.5 -1 mm, subhedral, equant, dark green, cleavage, 1%).

Grinding platform is oval with a raised edge, decorated by a jaguar head and tail. Grinding platform edge has incised geometric designs. Underside of tail has an area of dark brown residue, and underside of platform has a trace of red powder.

1991.4.48



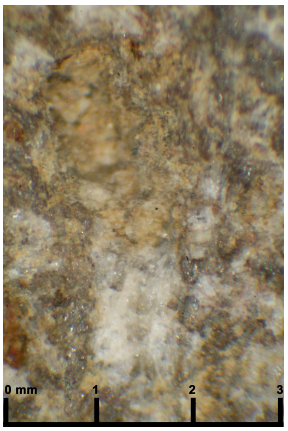


Vesicular porphyritic andesite is light gray (N7) with area of pale yellowish brown (10YR 6/2) weathering. Grinding platform is evenly pale yellowish brown (10YR 6/2). Rock texture is holocrystalline, medium-grained, and porphyritic. Vesicles are 1-2 mm on both unweathered and weathered surfaces with 9% density. Individual minerals include feldspar (1-3 mm, euhedral, prismatic, white), biotite mica (1-3 mm, euhedral, tabular, black, 6%), and olivine (1-1.5 mm, euhedral, equant, dark green, 6%). Larger inclusions of biotite mica (5-10 mm) are present on tail, feet, underside, and teeth.

Grinding platform is oval with edges curving up, decorated by jaguar head and tail. Face, neck, tail have incised geometric designs. Grinding platform has light and dark spots of residue (2 mm).

1991.4.49





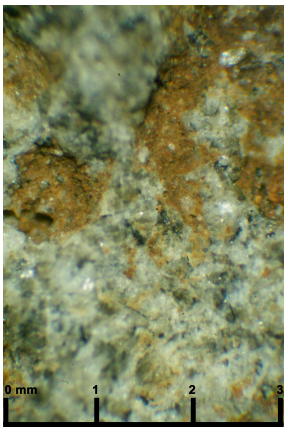
Vesicular porphyritic andesite is pale yellowish brown (10 YR 6/2) with areas of moderate yellowish brown (10YR 5/4) weathering. Grinding platform is pale yellowish brown (10YR 6/2). Rock texture is holocrystalline, medium-grained, and porphyritic. Vesicles are 1-3 mm on unweathered surfaces and 1-5 mm on weathered surfaces with 11% density. Individual minerals include feldspar (1-4 mm. euhedral, prismatic, white,

cleavage), biotite mica (1-1.5 mm, euhedral, tabular, black, 7%), and olivine (1-1.5 mm, euhedral, equant, dark green, 3%).

Grinding platform is a curved rectangular with jaguar head and tail. Legs, tail, and edges of grinding platform have geometric incisions. Underside of grinding platform has spot of black residue. Grinding platform has spots (5 mm) of red and white residue.

1991.4.161



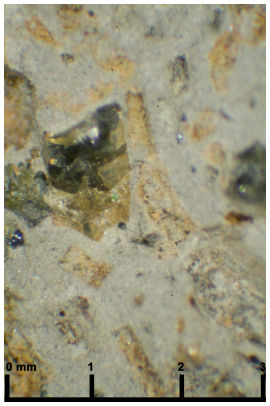


Andesite is medium gray (N5) with areas of moderate yellowish brown (10YR 5/4) weathering. Grinding platform is evenly moderate yellowish brown (10YR 5/4) weathering. Rock texture is holocrystalline, fine-grained, and granular. Vesicles are 0.25-1 mm on unweathered surfaces and 1.5-2 mm on weathered surfaces with 1% density. Individual minerals include feldspar (0.5-1mm, euhedral, prismatic, white, cleavage), and olivine (0.5-1 mm, subhedral, equant, dark green, cleavage, 5%).

Grinding platform is oval and bowl-shaped. Edge of grinding platform has incised geometric patterns and square protrusions at the front and back edges. Underside of grinding platform has dark waxy residue with fibers.

1991.4.162



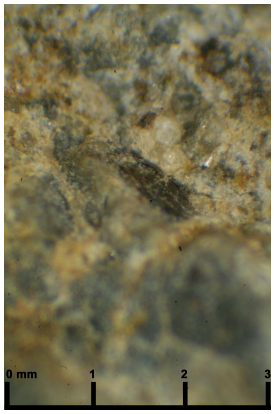


Porphyritic andesite is light gray (N7) with areas of pale yellowish brown (10YR 6/2) weathering. Grinding platform is evenly pale yellowish brown (10YR 6/2) weathering. Rock texture is holocrystalline, fine-grained, and porphyritic. Vesicles are 0.5-1 mm on both unweathered and weathered surfaces with 1% density. Individual minerals include feldspar (0.5-1mm, euhedral, equant, pale yellow, twinning), olivine (1-2 mm, anhedral, round, dark green, cleavage, 6%), and amphibole (0.5-1 mm, euhedral, acicular, black, 5%).

Grinding platform is rectangular with a raised edge, decorated by jaguar head and tail. Grinding platform edge, legs, and tail have incised geometric patterns.

1991.4.204





Courtesy of the Michael C. Carlos Museum of Emory University. Photo by Michael McKelvey.

Vesicular porphyritic andesite is medium light gray (N6) with moderate yellowish brown (10YR 5/4) areas of weathering. Grinding platform is dark yellowish brown (10YR 4/2). Rock texture is holocrystalline, medium-grained, and porphyritic. Vesicles are 1-2 mm on weathered surfaces and 2-7 mm on unweathered surfaces with 5% density. Individual minerals include feldspar (2-4 mm, euhedral, prismatic, white, twinning, 20%), amphibole (1-1.5 mm, euhedral, acicular, black, 3%), and biotite mica (1.5-2 mm, subhedral, equant, black, 3%).

Grinding platform is oval and bowl-shaped, decorated with an edge of pecked trophy head shapes and protrusions at the front and back edge. All 4 legs are shaped into human female figures. Metate has areas of red dirt and spots (3-5 mm) of white powder on underside.

1991.4.211





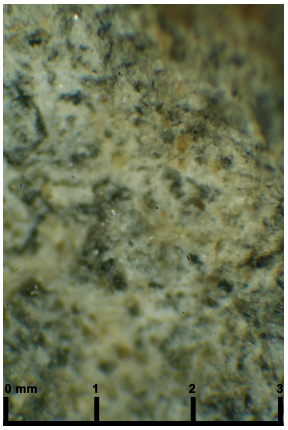
Andesite is pale reddish brown (10YR 5/4) with areas of dusky yellow (5YR 6/4) weathering. Grinding platform is pale reddish brown (10YR 5/4). Rock texture is hypocrystalline, fine-grained, and granular. Vesicles are 0.5-1 mm on both unweathered and weathered surfaces with 3% density. Individual minerals include feldspar (1-2 mm,

subhedral, equant, white, twinning), biotite mica (1-4 mm, euhedral, tabular, black, 6%), and olivine (1.5-2 mm, subhedral, equant, dark green, 4%).

Grinding platform is oval with jaguar head and tail. Grinding platform edge has incised geometric designs. Grinding platform has traces of red and yellow powders.

1991.4.378



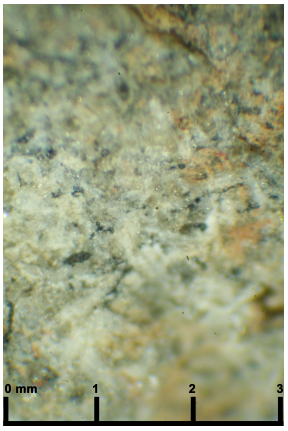


Andesite is medium light gray (N6) with areas of moderate yellowish brown (10YR 5/4) weathering. Grinding platform is dark yellowish brown (10YR 4/2). Rock texture is holocrystalline, fine-grained, and granular. Vesicles are 0.25-0.5 on unweathered surfaces and 1-3 mm on weathered surfaces with 3% density. Individual minerals include feldspar (0.5-1 mm, subhedral, equant, off-white, twinning), and amphibole (0.5-1 mm, euhedral, acicular, black, 17%).

Grinding platform is a curved rectangle with 2 notch-shaped designs protruding from the front edge. Legs, underside, and the front end of the top surface have incised geometric designs. All 3 legs have pecked holes within the design. Underside of grinding platform has a coating of red, powdery residue and 2 spots (2 mm) of dark, waxy residue.

1991.4.379



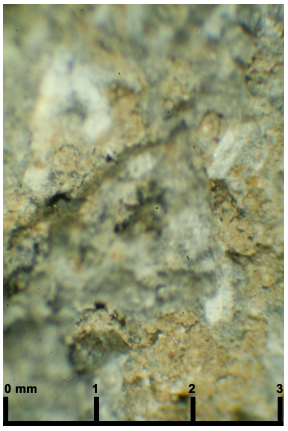


Andesite is medium light gray (N6) with areas of moderate yellowish brown (10YR 5/4) weathering. Grinding platform is dusky yellowish brown (5YR 2/2). Rock texture is holocrystalline, fine-grained, and granular. Vesicles are 0.5-1 mm on unweathered surfaces and 1-3 mm on weathered surfaces with 2% density. Individual minerals include plagioclase feldspar (0.5-1 mm, euhedral, equant, gray, twinning), and amphibole (0.5-1 mm, euhedral, acicular, black, 25%).

Grinding platform is a curved rectangle with 2 notch-shaped designs protruding from the front edge. Legs, underside, and the front end of the top surface have incised geometric designs. Front leg has pecked holes within the design. Underside of grinding platform has traces of red powder and spots (2 mm) of black residue.

1991.4.380



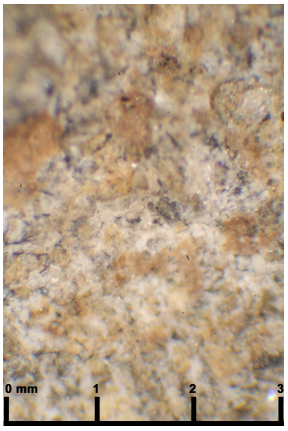


Vesicular andesite is light gray (N7) with areas of pale yellowish brown (10YR 6/7) weathering. Grinding platform is dark yellowish brown (10YR 4/2). Rock texture is holocrystalline, fine-grained, and granular. Vesicles are 1 mm on unweathered surfaces and 3-7 mm on weathered surfaces with 5% density. Individual minerals include plagioclase feldspar (0.25-0.5 mm, euhedral, equant, off-white, twinning), and amphibole (0.5-0.75 mm, euhedral, acicular, black, 17%).

Grinding platform is a curved rectangle with the head of a parrot decorating the front end. All 3 legs, edges of the grinding platform, ends of the grinding surface, and the underside are decorated with incisions. Legs and beak include pecked holes. Grinding surface has fibrous residue in vesicles. Rust-colored powdery residue is on the underside.

1991.4.386



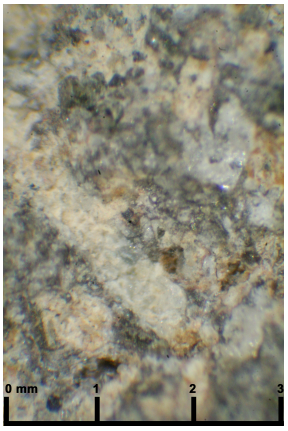


Diorite is medium light gray (N6) with areas of moderate brown (5YR 4/4) weathering, especially around legs. Grinding platform is pale brown 5YR 2/2). Rock texture is holocrystalline, medium-grained, and subporphyritic. Vesicles are 1 mm on unweathered surfaces and 2-3 mm on weathered surfaces with 5% density. The underside of the grinding platform has 2 areas of larger (3-5 mm) vesicles. Individual minerals include feldspar (1-1.5 mm, subhedral, equant, off-white) and amphibole (0.5-1 mm, euhedral, acicular, black, 17%).

The grinding platform is a curved rectangle shape with the head of a parrot decorating the front end. Head has a round, raised eye design and a line pecked through to show the beak. Incised geometric designs occur on the top of the grinding platform at the head and tail ends. Metate has 2 spots (2 cm) of dark residue on the grinding platform along with drips on the beak. Spots (1 cm) of white and amber waxy residue are also observed on the grinding platform and the underside. Smaller spots of white and red powder are on the grinding platform as well.

1991.4.549



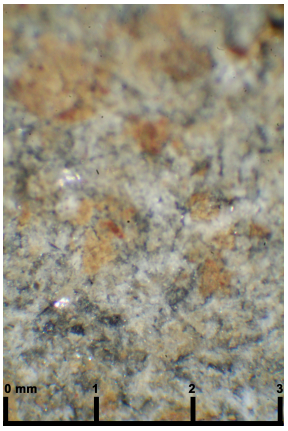


Andesite is light gray (N7) with areas of very pale orange (10YR 8/2) weathering. Grinding platform is medium dark gray (N5). Rock texture is holocrystalline, fine-grained, and subporphyritic. Vesicles are 0.5-1 mm on both unweathered and weathered surfaces with 1% density. Individual minerals include feldspar (0.5-1 mm, euhedral, prismatic, white), quartz (1-2 mm, subhedral, equant, colorless), and biotite mica (0.5-1 mm, euhedral, tabular, black, 8%).

Grinding platform is rectangular with a serrated pattern along the edges. Legs are cylindrical. 3 jutting square shapes run along the underside, suggesting a crocodile's back. Grinding platform has area of waxy residue with fibers. Underside of grinding platform has spots (2 mm) of dark waxy residue with fibers and spots (5 mm) of yellow, flaky residue.

1992.15.100





Andesite is light gray (N7) with areas of grayish orange (10YR 7/4) weathering. Grinding platform is evenly grayish orange (10YR 7/4). Rock texture is holocrystalline, fine-grained, and granular. Vesicles are 1-1.5 mm on unweathered surfaces and 2-3 mm on weathered surfaces with 3% density. Large (10mm) vesicles are clustered with groups of smaller vesicles on the grinding platform. Individual minerals include plagioclase feldspar (0.5-1 mm, euhedral, equant, off-white, twinning), and amphibole (0.5-1 mm, euhedral, acicular, 4%).

Grinding platform is a curved rectangle with 2 notch-shaped designs protruding from the front edge. Legs, underside, and the front end of the top surface have incised geometric designs. All 3 legs have pecked holes within the design. Grinding platform has traces of white residue. Underside of grinding platform has a spot (4 mm) of red residue and an area of dark waxy residue (15 mm).

References

Adams, Jenny L. “Toward Understanding the Technological Development of Manos and Metates.” *Kiva* 58, no. 3 (January 1, 1993): 331–344. doi:10.2307/30247403.

De Beaune, Sophie A. “The Invention of Technology: Prehistory and Cognition.” *Current Anthropology* 45, no. 2 (April 2004): 139–162. doi:10.1086/381045.

Bostwick, Todd W., and James H. Burton. “A Study in Sourcing Hohokam Basalt Ground Stone Implements.” *Kiva* 58, no. 3 (January 1, 1993): 357–372.

Coe, Michael D. “Costa Rican Archaeology and Mesoamerica.” *Southwestern Journal of Anthropology* 18, no. 2 (July 1, 1962): 170–183.

Drennan, Robert D. “Betwixt and Between in the Intermediate Area.” *Journal of Archaeological Research* 4, no. 2 (June 1, 1996): 95–132.

Duffy, Lisa. “Maize and Stone: A Functional Analysis of the Manos and Metates of Santa Rita Corozal, Belize.” University of Central Florida Orlando, Florida, 2011. http://caracol.cos.ucf.edu/include/files/chase/Duffy11.pdf.

Graham, Mark M. “Art-tools and the Language of Power in the Early Art of the Atlantic Watershed of Costa Rica.” In *Wealth and Hierarchy in the Intermediate Area: a Symposium at Dumbarton Oaks, 10th and 11th October 1987*. Dumbarton Oaks, 1992.

Graham Mark M. “Traditions of Costa Rican Stone Sculpture.” In *Between Continents/Between Seas: Precolumbian Art of Costa Rica*, edited by Suzanne Abel-Vidor. New York: H.N. Abrams, 1981.

Hard, Robert J., Raymond P. Mauldin, and Gerry R. Raymond. “Mano Size, Stable Carbon Isotope Ratios, and Macrobotanical Remains as Multiple Lines of Evidence of Maize Dependence in the American Southwest.” *Journal of Archaeological Method and Theory* 3, no. 3 (September 1, 1996): 253–318.

Hoopes, John W. “The Emergence of Social Complexity in the Chibchan World of Southern Central America and Northern Colombia, AD 300-600.” *Journal of Archaeological Research* 13, no. 1 (March 1, 2005): 1–47.

Inomata, Takeshi, and Laura R. Stiver. “Floor Assemblages from Burned Structures at Aguateca, Guatemala: A Study of Classic Maya Households.” *Journal of Field Archaeology* 25, no. 4 (December 1, 1998): 431–452. doi:10.2307/530638.

Lange, Frederick W. *Wealth and Hierarchy in the Intermediate Area: a Symposium at Dumbarton Oaks, 10th and 11th October 1987*. Dumbarton Oaks, 1992.

Lingen, Joan Kathryn. *Stylistic and Iconographic Study of Lower Central American Stone Sculpture*. University of New Mexico, 1986.

MacKenzie, W. S., C. H. Donaldson, and C. Guilford. *Atlas of Igneous Rocks and Their Textures*. 1st ed. Wiley, 1982.

Morris, Donald H. “Changes in Groundstone Following the Introduction of Maize into the American Southwest.” *Journal of Anthropological Research* 46, no. 2 (July 1, 1990): 177–194.

Odell, George H. “Stone Tool Research at the End of the Millennium: Procurement and Technology.” *Journal of Archaeological Research* 8, no. 4 (December 1, 2000): 269–331.

Raymond, Loren A. *Petrography Laboratory Manual, Volume 1: Handspecimen Petrography*. Geology-Services-International (GEOSI), 1984.

Saunders, N. *Icons of Power: Feline Symbolism in the Americas*. Psychology Press, 1998.

Sheets, Payson. “The pervasive pejorative in intermediate area studies.” In *Wealth and Hierarchy in the Intermediate Area: a Symposium at Dumbarton Oaks, 10th and 11th October 1987*. Dumbarton Oaks, 1992.

Snarskis, Michael. “The Archaeology of Costa Rica.” In *Between Continents/Between Seas: Precolumbian Art of Costa Rica*, edited by Suzanne Abel-Vidor. New York: H.N. Abrams, 1981.

Stone-Miller, Rebecca. “Human-Animal Imagery, Shamanic Visions, and Ancient American Aesthetics.” *RES: Anthropology and Aesthetics* no. 45 (April 1, 2004): 47–68.

Stone-Miller, Rebecca. *Seeing with New Eyes: Highlights of the Michael C. Carlos Museum Collection of Art of the Ancient Americas*. Michael C. Carlos Museum, Emory University, 2002.

Wobst, Martin. “Stylistic Behavior and Information Exchange.” In *For the Director: Research Essays in Honor of James B. Griffin*. Ann Arbor, Michigan: The University of Michigan Museum of Anthropology, 1977.

Wright, Mona K. “Simulated Use of Experimental Maize Grinding Tools from Southwestern Colorado.” *Kiva* 58, no. 3 (January 1, 1993): 345–355. doi:10.2307/30247404.