Ancient Mesoamerica (2025), **36**, 512–517
doi:10.1017/S0956536125100643

CAMBRIDGE UNIVERSITY PRESS

Special Section

A Granitic Ground Stone Tool Quarry in Belize: Using Chaine Operatoire as a Context for Framing Future Research

Joan S. Schneider
Colorado Desert District, California State Parks, USA (retired)

Abstract

Archaeological interest in analyses of ground stone tools (GST) was minimal until fairly recent times. Often these typically heavy artifacts were noted, but not collected as parts of archaeological assemblages. Most archaeologists did not recognize that GST were sometimes manufactured and could be considered in light of *chaîne-opératoire* lithic theory, in the same manner as their flaked-stone counterparts. The articles in this Compact Section are focused on a newly discovered granite ground stone quarry and manufacturing area in Belize. The subject is exceptional for two reasons: (1) granite ground stone quarries have not yet been studied elsewhere and (2) this is the first ground stone quarry to be discovered in Belize. The Mountain Pine Ridge batholith quarries are compared with previous quarry studies in the U.S. Southwest, Mexico, and Guatemala and suggestions made for future avenues of research in Belize.

Resumen

El interés arqueológico en los análisis de molinas piedra del suelo (GST) fue mínimo hasta tiempos bastante recientes. A menudo se observaron estos artefactos típicamente pesados, pero no se recogieron como partes de los conjuntos arqueológicos. La mayoría de los arqueólogos no reconocieron que las herramientas de piedra molida a veces se fabricaban y podían considerarse a la luz de la teoría lítica de Chaîne-Opératoire, de la misma manera que sus contrapartes con piedra de hojalata. Los documentos en este volumen se centran en una cantera de granito y área de fabricación de granito recientemente descubierto en Belice. El tema es excepcional por dos razones: (1) Las canteras de piedra de granito aún no se han estudiado en otro lugar y (2) esta es la primera cantera de piedra del suelo que se descubre en Belice. Las canteras de batolitismo de montaña Pine Ridge se comparan con estudios de cantera anteriores en el suroeste de los U.S. y México y Guatemala, y sugerencias hechas para futuras vías de investigación en Belice.

Archaeological interest in analyses of ground stone tools (GST) was minimal until fairly recent times. Often these typically heavy artifacts were noted, but not collected, as parts of archaeological assemblages. Most archaeologists did not recognize that GST were often shaped, sometimes manufactured, and could be considered in light of the *chaîne opératoire* (or in English: chain of operation; or more colloquially: life story) of culturally modified objects that starts from knowledge of where source material is located on the landscape through the harvesting of that material, the manufacturing stages, to use(s), renovation, recycling, discard, and disposal. The *chaîne-opératoire* theoretical approach originated in France in 1966 with the work of French anthropologist André Leroi-Gourhan (Darvill 2021). It has been used intermittently by archaeologists in an attempt to elevate lithic analyses beyond the common use of typology. Typology, as an analytical tool, has its limitations in that it is imposed upon lithic collections by the analyst and represents only their view of the characteristics of artifacts.

The use of a cognitive and behavioral approach in lithic analyses (such as in *chaîne opératoire*) relies heavily on ethnographic observations, geological knowledge of a region, experimental archaeology, and the experiences and intuition of the archaeologist. For the study of GST, this approach has become incorporated since the discovery that quarries for ground stone tools exist on the landscape (e.g., Huckell 1986). There have been criticisms of this approach (see Delage 2017). However, the articles in this section fit well into this theoretical framework and the discovery of the Mountain Pine Ridge granite quarries may not have been connected to the use of granitic processing tools or building blocks in this part of the Mayan region if the *chaîne-opératoire* approach had not been brought to the forefront.

By adopting this theoretical viewpoint, archaeologists and ethnographers realized that knowledge of and access to raw material, production, craft economies, values (both tangible and intangible), distribution, use, discard, and recycling were elements that could be studied in the same manner as those of flaked-stone and other technologies, thus adding important insights regarding human interactions, knowledge of the

Email: joanschn@gmail.com
Cite this article: Schneider, Joan S (2025) A Granitic Ground Stone Tool Quarry in Belize: Using Chaine Operatoire as a Context for Framing Future Research. *Ancient Mesoamerica* 36:512–517. https://doi.org/10.1017/S0956536125100643.

© The Author(s), 2026. Published by Cambridge University Press.

https://doi.org/10.1017/S0956536125100643 Published online by Cambridge University Press

landscape, and communication networks to interpretations of both regional and local archaeological and ethnographic records (cf. Hayden 1987; Nelson 1986; Searcy 2011; Searcy and Pitezel 2018).

It is rare that granitic quarries are studied, except in terms of the production of historical-period building blocks, columns, statuary, and monuments. All articles in this section are focused on one subject: granitic stone—a kind of igneous rock that is extremely abundant in much of the world but is relatively rare in the Maya region (Belize, El Salvador, Guatemala, Mexico, and Honduras). For this reason, and others, this Compact Section is exceptional because it includes aspects of the *chaîne opératoire* including the geology of the region, the knowledge of ancient people who knew where granite with specific characteristics was available on the landscape, the manner in which the granite was probably quarried, how the granitic tools were manufactured as judged from waste products, and the possible modes of distribution of quarry products. In the following sections, each article is discussed within the framework of *chaîne opératoire*.

Starting with the question of how the ancient Maya knew where granitic material was available on the landscape and how this knowledge may have been passed on, generation to generation, is an analysis based on a very strong foundation of geological study in the region that used both pXRF and petrography (Brouwer Burg et al., this section). It is rare that such a thorough comparative collection of data is made available to the archaeological researcher! These data make it potentially possible to understand many aspects of the dynamics of trade, travel, economics, and social organization of ancient Maya societies in the Maya lowlands because there is already a reasonable understanding of where most ancient communities were located, how and why public and domestic structures were constructed, and the plans and layouts of these communities. With the rediscovery of the Mountain Pine Ridge quarries, at least one source of many of the granitic household tools and building materials used within these communities is known; thus the reconstruction of travel and trade networks and perhaps even social structure is possible (links of the *chaîne*).

It has been hypothesized that quarrying stone, especially for GST production, was predominately a male occupation, at least the for the initial stages of production (Cook 1973; Cremony 1868; Searcy 2011; Schneider 2020) and that the knowledge of where to go to obtain the best stone and how to make GST was passed on in a patrilineal manner (Searcy 2011). The physical labor of moving, manipulating, and shaping large boulders or blocks of stone generally requires upper-body strength; the final stages of shaping are more refined and may have included other members of a household in an environment separate from the quarry.

Near Pacbitun, Belize, a workshop site was studied that was an important link in the *chaîne* (King and Powis, this section). This site represents at least a part-time craft industry of finishing granitic tools. Having engaged in the replication of stone metates, manos, bowls, and pestles, I have personally experienced the labor requirements of the final stages of tool finishing—it takes a long, long time and results in a great deal of muscle exhaustion (Schneider 1993a:Appendix A; Schneider and Osborne 1996). Ethnographic literature suggests that roughout tool shapes were often transported from quarries to domestic environments for finishing by the periodic labor of members of a household (Hayden 1987; Searcy 2011). However, as discussed by Spenard et al. in this section, it was an industrial-sized workshop and not a domestic sideline! Careful excavation techniques and keen observations led the authors to several conclusions: (1) that the workshops were used repeatedly; (2) that the workers cleared off their work areas after several episodes of work (not surprising); (3) that broken and discarded products were used to form a wall that perhaps functioned as a workstation and/or a wind break and/or had a shade covering of some type. At most residential sites it is difficult, if not impossible, to archaeologically recover the tiny bits and granules generated from the tedious finishing process; thus this link in the *chaîne* has not been previously reported. At these workshop sites, however, because of the concentration of that work (finishing) and careful study of stratified units, that part of the *chaîne* is clearly demonstrated.

From an anthropological viewpoint, "value" can be considered on a continuum ranging from monetary, to trend-setting (popularity), to labor or energy investment, to the esoteric and ideological. Alabama, Belize is an ancestral Maya village where granite rocks and slabs were used in its construction. Alabama has a granite ball court, granite "megalithic" architecture, and many other features of granite form the core of the community (Peuramaki-Brown et al., this section). Originally the authors hypothesized that granite was obtained from a nearby source (the Cockscomb Basin pluton) and that granite from this source was exported to nearby communities, thus fueling demographic and economic growth of the community on which the authors' research focused. No evidence of quarrying, however, could be found at the Cockscomb Basin pluton. It became apparent that the local people split large boulders, found in and near drainages, to obtain their structural granite and carried out the work using quartzite and quartz hammerstones. The majority of their manos and metates were also made from granite boulders found in nearby secondary deposits. However, through the use of handheld X-ray fluorescence (XRF), some milling implements (manos and metates) were found to be made from non-local granites, including Mountain Pine Ridge material! While the data derived from the Alabama research failed to support the authors' hypothesis, several pieces of information can be used to further understand the importance of the Mountain Pine Ridge quarries including the value of the Mountain Pine Ridge granite in terms of its characteristics that might make it of sufficient value to be transported to distant communities (Spenard et al., this section).

If specific granite sources were exploited for manos, metates, and other uses and other sources of granite were ignored, it becomes clear that there were specific characteristics of the exploited stone that encouraged its use, and it was not always proximity. Following this trend of thought, tracing the GST material leads us toward the exploration of travel to and from the exploited granite sources, trade of the products made from those sources, and the range of distribution of GST and other products within the exchange network. Brouwer Burg et al. (this section) explore various

https://doi.org/10.1017/S0956536125100643 Published online by Cambridge University Press

models of exchange mechanisms and how they might apply to the Mountain Pine Ridge quarries and/or other quarries in the Maya region. The authors state that the majority of GST from the middle reaches of the Belize River Valley that were tested using handheld XRF were made from Mountain Pine Ridge granite. Moreover, tools from the same granite source were carried or traded into the wider Maya region that included parts of modern-day Guatemala and Mexico (Gunn et al. 2020; Halperin et al. 2020). When various models of exchange are considered, it may be that the granite from the Mountain Pine Ridge was acquired by locals and worked into final shape at home workshops and/or in dedicated workshops by part-time craftsman in either an unorganized or an organized fashion before the results were used in personal households or distributed via some type of marketing strategy. The authors' testing of various models of exchange drew no single conclusion, as might be expected, i.e., exchange took a variety of forms. The possibilities were dependent on the locations where ground stone assemblages were recovered. What is obvious is that the *distance* to the quarry was not an important factor in the distribution and use of Mountain Pine Ridge granite. Why? What characteristic (i.e., prestige and/or practical value) made the Mountain Pine Ridge granite so popular? Was it easier to shape? Was it superior functionally; perhaps more abrasive or requiring less renovation? Was appearance or longevity a factor in its preferential distribution and use? These are questions that further research and experimental archaeology might address.

Particularly interesting in the *chaîne opératoire* is the consideration of gifting as a form of exchange and distribution. Does the value of a gift relate to the distance that gift traveled? What role does tradition play? Even today, among families with an Indigenous heritage, it is common that metates and manos (and other GST made of stone, such as *molcajetes* and *tejolote* [spice-grinding implements]) are family heirlooms and are passed down through generations (Searcy 2011; Searcy and Pitezel 2018; J. Schneider personal experience ca. 2015). Researchers associated with the Mountain Pine Ridge project might consider visiting modern-day Maya households in the immediate region and elsewhere to inquire if such heirlooms reside in those households.

Additionally, water transport on the Belize River might have been employed. Although water depth might have been minimal, successfully guiding a wood or tule raft carrying a heavy load downstream is still possible with little effort (cf. Schneider and Osbourne 2012).

Mountain Pine Ridge granite quarries from an interregional perspective

When Jon Spenard first contacted me about his team's discovery, I was dubious. I thought: "why would people want to use granite for GST when vesicular basalt was available?" I subsequently learned that no vesicular basalt outcrops occur in Belize; for the ancient Maya, it was a choice between limestone and granite for their GST! Granite is commonly used for GST in the U.S. Desert West but these tools (as far as we understand today) were made from local granitic cobbles and boulders that are plentiful in secondary deposits along rivers and streams and in alluvium. I emphasize: "as far as we know" no primary granitic bedrock quarries for GST have been identified.

Granite quarries are known to exist for building blocks, building facades, flooring, monuments, tombstones, statuary, and kitchen and bathroom countertops throughout the world where granite is available. Milling-implement quarries of common sandstone, arkosic sandstone, thermally altered sandstone, quartzite, coquina (beach rock), limestone, andesite, rhyolite, volcanic tuff, and vesicular basalt have been identified and studied (see Schneider 1993b:Appendix F); there are likely outcrops and veins of other rock types that have not yet been recognized. Granitic GST quarries are now known to exist and will be the subject of intensive study in the near future.

In order to understand and complete the *chaîne* of the Mountain Pine Ridge GST, a number of research questions must be asked and answered. First, why was this particular granite preferred over other granites in Belize for GST? This is hinted at in the article by Peuramaki-Brown et al. (this section). Second, are there characteristics of the outcrops themselves that facilitated quarrying and dictated the final forms of the products of the quarry? Third, how were the blocks of quarried stone shaped to their final form? Fourth, were the quarried blocks further worked at quarry locations or transported elsewhere for subsequent stages of production? Fifth, where does the quarrying and production of granite GST in Belize fit into the framework of different types of craft specialization (Costin 1991; Mallory 1986; Sheafer and Hester 1986; Sheets 2006:49). Sixth, what substances were processed with the granite GST? It is generally accepted that corn, chiles, melons, beans, and squashes were staple subsistence items in Maya households; corn processing on GST is well documented, but now we know that manioc was dried and ground to powder, likely using GST (Cognato and Ponce 2017; Sheets 2006; Sheets et al. 2012:273). And "malanga" (another root) may be an additional contender. What other uses might be attributed to granite GST? Perhaps agave was scraped on these tools. At what point in their use were GST discarded? Seventh, how were GST discarded? Were they recycled or repurposed? Below, two of these questions are further explored.

Stone texture

I have postulated that one important characteristic of primary source GST quarries is what geologists call *stone texture* (Schneider 2002a, 2002b). This is not the chemical/mineralogical signature, nor hardness or composition of the stone that can be identified through XRF or several other methods, but rather the physical character of stone: is it uniform in composition, with all the crystals the same size and composition? Are the crystals closely packed? Does it have voids? These characteristics can be determined through thin-section petrography.

Granites are plutonic rocks composed of closely packed crystals of relatively hard minerals such as quartz and feldspars with lesser amounts of other minerals such as biotite, muscovite, and hornblende. The major crystal components are usually close to the same size and are cemented together. Granitic surfaces are susceptible to polishing by

https://doi.org/10.1017/S0956536125100643 Published online by Cambridge University Press

abrasion, either intentionally or through use. It is these polished surfaces that attract our attention in the case of recognizing bedrock milling features; those polished-through-wear surfaces that reflect light and are extremely smooth, as archaeologists know by touch. It is the capacity of granite to readily acquire polish, as well as its hardness, that makes it favored for the smooth and reflective surfaces of tombstones and kitchen countertops.

When abrasive surfaces are needed for efficient processing (dependent upon material being processed and the intended function of GST), polish is an obstacle to efficiency. For example, if the processing involves grinding corn, mesquite beans, seeds of wild plants, bones, or clay, highly polished surfaces are not efficient. When GST surfaces become polished through wear, those surfaces need to be periodically refurbished or resurfaced in order to maintain their abrasiveness and thus task efficiency. Archaeologists recognize this as "re-pecking"; they observe small pits (divots) on polished surfaces of GST, purposely made using a pointed hammer or pecking stone.

Some non-granitic stones used for GST are self-sharpening to various degrees, as has been postulated (Horsfall 1987; Schneider 2002a, 2002b). Textural characteristics make that possible. For example, the sizes and shapes of vesicles within vesicular basalt provide an ever-sharp cutting capability to metate grinding surfaces (and the types of vesicles are reflected in the values of the metates, according to Horsfall [1987]). In sandstones and andesites, large grains or crystals cemented within a finer-grained matrix ensure continuing natural abrasiveness, even with heavy wear. In these cases, newly exposed larger/sharper grains facilitate the work of grinding when the finer-grained matrix is more rapidly worn away during processing tasks. This is true for sandstones and metasandstones of various types. For some non-vesicular igneous materials, larger phenocrysts within a finer-grained groundmass act similarly, i.e., in andesites and rhyolites. In the case of coquina, a very young sedimentary stone with extremely coarse inclusions of complete or fragmented shells of marine invertebrates, an eternally abrasive working surface is present.

Granite might be preferred over limestone for GST because of its hardness, but why was Mountain Pine Ridge granite preferred over other granitic sources for GST? If the above hypothesis is correct, i.e., that there is a textural character of the granite that makes it especially suitable for GST, what is it about the Mountain Pine Ridge granite that makes it preferred and so widely distributed within Belize? Is texture the characteristic that makes it preferable for GST used repeatedly for everyday tasks in Maya households of the past and present? This will be determined by a combination of experimental archaeology and thin-section petrography.

Stone presentation

Or was the granite at the Mountain Pine Ridge quarries preferred due to a structural component of the batholith so that, with natural jointing and weathering, certain sizes and shapes of blocks were naturally available? Although I have not yet visited the quarry sites in Belize, photographs show a distinctive jointing pattern. (*Jointing* refers to the manner in which cracks in an outcrop occur. Specific jointing patterns can facilitate the separation of blocks of stone from the quarry face, whether the jointing is horizontal or vertical.) Outcrops that have a jointing pattern that facilitates the release of stone blocks in sizes that approximate the physical size and shape of a mental template for ancestral Maya GST would certainly have been favored. This is a pattern at several outcrops quarried for GST in the U.S. Southwest (Schneider 1993a, 1993b, 1996; Schneider et al. 1995; and in other regions Schneider et al. 2025)

From the point of view of a stoneworker, one reason why a naturally shaped block of stone might be preferred for producing a finished GST is the difficulty of achieving a flat working surface for processing whatever substance was needed. At the Ironwood Quarry, where andesite was worked to make metates, huge blocks of stone were first tested and then worked to produce a specific shape. A flat surface was chosen to be the processing surface and then the remainder of the block was worked to form the finished GST (Schneider 2020). At the Mountain Pine Ridge quarries, it appears that the jointing pattern provided a naturally flat surface; all that was needed to make a metate was to be able to pry a slab of granite from the outcrop, and then shape the GST by trimming the excess material from the slab. Was this the reason why Mountain Pine Ridge quarry materials were so prevalent among all the metates analyzed in Belize? To answer this question, it would be relatively easy to compare the Mountain Pine Ridge batholith natural configurations to other granitic outcrops in Belize.

When Jon Spenard and his crew "(re)discovered" the granite quarries, the quarries and their locations were already well-known to modern-day local peoples, but not recognized as the source of stone for GST. The time depth of the quarrying at the Mountain Pine Ridge batholith (as with other GST quarries) is presently unknown. Were bedrock outcrops originally exposed on the surface and readily available? If so, how were stone blocks extracted from the bedrock exposures before metal tools were available? As the exposed bedrock was exploited through time, was it necessary for ancestral stoneworkers to dig stone from underground (i.e., mine the stone)?

Summary and conclusions

Here, more questions are asked than answered. However, as ground stone studies have advanced in recent years, so have technological means of extracting more information from GST expanded; residue studies, use-wear studies, compositional studies, and experimental studies have been used by researchers to answer some of those questions in other quarry contexts. Moreover, anthropological theoretical perspectives have advanced the study of GST with some success, thus bringing this artifact class to the level of inquiry that it deserves, given that these mundane tools were used on a daily basis in every household within most societies. For the Mountain Pine Ridge granite quarries, however, basic studies first need to be completed before more esoteric (and likely more interesting) research questions are asked and answered. The advantage of having a fairly complete and detailed geological database for the study region, is nothing short of an

https://doi.org/10.1017/S0956536125100643 Published online by Cambridge University Press

enviable starting point. To already know that some ancient Maya metates found at sites in Belize and adjacent regions of Guatemala and Mexico are made of stone from a single batholith is remarkable. Spenard and his colleagues will be able to learn a great deal about Maya society with these basic databases grounding their future research.

The Mountain Pine Ridge research group will ask and answer some basic questions and then proceed to use the *chaîne-opératoire* approach to GST to more fully understand the ancestral Maya: their travel and transportation routes, their social interactions, the market and domestic economic activities, levels of craftsmanship, and possibly ideological components of the Mountain Pine Ridge quarries as well as Maya households (sensu Searcy 2011). It is exciting work, especially for granite, a material which has not yet played a major part in the understanding of the complete *chaîne opératoire* for GST throughout the world.

References cited

Ardren, Tracy, and Justin Lowry
2011 The Travels of Maya Merchants in the Ninth and Tenth Centuries A.D.: Investigations at Xuenkal and the Greater Cupul Province, Yucatan, Mexico. *World Archaeology* 43:428–443.

Bullard Jr, William R.
1963 A Unique Maya Shrine Site on the Mountain Pine R Amidge of British Honduras.American Antiquity 29;98–99

Carbello-Pérez, Jared, Uroš Matić, Rachael Hall, Stuart T. Smith, and Sarah A. Schrader
2025 Tumplines, Baskets, and Heavy Burden? Interdisciplinary Approach to Load Carrying in Bronze Age Abu Fatima, Sudan. *Journal of Anthropological Archaeology* 77:101652. https://doi.org/10.1016/j.jaa.2024.101652.

Cognato, Clarissa, and Jocelyne M. Ponce
2017 Ancient Maya Manioc (*Manihot esculenta* Crantz) Consumption: Starch Grain Evidence from Late to Terminal Classic (8th–9th century C.E.) Occupation at La Corona, Northwestern Petén, Guatemala. *Journal of Archaeological Science: Reports* 16:276–286.

Cook, Scott
1973 Stone Tools for Steel-Age Mexicans? Aspects of Production in a Zapotec Stoneworking Industry. *American Anthropologist* 75:1485–1503.

Costin, Cathy Lynne
1991 Craft Specialization: Issues in Defining, Documenting, and Explaining Organization of Production. In *Archaeological Method and Theory*, edited by M. B. Schiffer, Vol. 3, pp. 1–56. University of Arizona Press, Tucson.

Cremony, John C.
1868 *Life among the Apaches*. A. Roman, San Francisco [Republished 1951 and 1954 by Arizona Silhouettes, Tucson].

Darvill, Timothy
2021 *The Concise Oxford Dictionary of Archaeology*. Oxford University Press. Electronic document, https://www.oxfordreference.com/display/10.1093/acref/9780191842788.001.0001/acref-9780191842788-e-760, accessed October 13, 2025.

Delage, Christophe
2017 Once Upon a Time ...the (hi)Story of the Concept of the Chaîne Opératoire in French Prehistory. *World Archaeology* 49:158–173.

Gunn, Joel D., William J. Folan, and Maria del Rosario Domínguez Carrasco
2020 The Stones of Calakmul: Lithics and Other Technologies among the Maya at Calakmul, Campeche, during the Late and Terminal Classic and Their Cultural Implications. Centro de Investigaciones Universidad Autónoma de Campeche, Campeche. *Información* 17.

Halperin, Christina T., Jose Luis Garrido Lopez, Miriam Salas, and Jean-Baptiste LeMoine
2020 Convergence Zone Politics at the Archaeological Site of Ucanal, Peten, Guatemala. *Ancient Mesoamerica* 31:476–493. https://doi.org/10.1017/S0956536120000085.

Hayden, Brian
1987 Traditional Metate Manufacturing in Guatemala Using Chipped Stone Tools. In: *Lithic Studies among the Contemporary Highland Maya*, edited by Brian Hayden, pp. 8–119. University of Arizona Press, Tucson.

Horsfall, Gayel
1987 Design Theory and Grinding Stones. In: *Lithic Studies among the Contemporary Highland Maya*, edited by Brian Hayden, pp. 332–377. University of Arizona Press, Tucson.

Huckell, Bruce B.
1986 *A Ground Stone Implement Quarry on the Lower Colorado River, Northwestern Arizona*. Cultural Resource Series Monograph No. 3. USDI Bureau of Land Management, Phoenix.

Mallory J.K.
1986 "Workshops" and "Specialized Production" in the Production of Maya chert tools: a Response to Shafer and Hester. *American Antiquity* 51(1):152-158.

Mason, Otis T.
1889 The Beginnings of the Carrying Industry. *American Anthropologist* (old series) A2:21–46.

Mason, Otis T.
1896 Primitive Travel and Transportation. In *Annual Report of the United States National Museum for 1894*, Part 2, pp. 237–593. Government Printing Office, Washington, DC.

Nelson, Margaret
1987 Contemporary Specialization and Marketing of Manos and Metates in the Maya Highlands. In: *Lithic Studies among the Contemporary Highland Maya*, edited by Brian Hayden, pp. 148–159. University of Arizona Press, Tucson.

Rogers, Malcolm J. MS
1940 *Arizona Field Notes, Field Maps, and Site Record Sheets. On file at the Museum of Us*, San Diego.

Schneider, Joan S.
1993a Appendix A: Replication Experiments, pp. 310–343. In: Schneider, Joan S. 1993 *Aboriginal Milling-Implement Quarries in Eastern California and Western Arizona: A Behavioral Perspective*. Ph.D. dissertation, University of California, Riverside. [Published by Coyote Press.]

Schneider, Joan S.
1993b Appendix F: Reported Milling Implement Quarries, pp. 408–414. In: Schneider, Joan S. 1993 *Aboriginal Milling-Implement Quarries in Eastern California and Western Arizona: A Behavioral Perspective*. Ph.D. dissertation, University of California, Riverside. [Published by Coyote Press.]

Schneider, Joan S.
1996 Quarrying and Production of Milling, Implements at Antelope Hill, Arizona. *Journal of Field Archaeology* 23:299–311.

Schneider, Joan S.
2002a Milling Tool Design, Stone Textures, and Function. In: *Moudre et Broyer: L'interprétation fonctionnelle de l'outillage de mouture et de broyage dans la Préhistoire et l'Antiquité*, Vol. 1 *Méthodes*, edited by H. Procopiou and R. Treuil, pp. 31–53. Editions CTHS, Paris.

Schneider, Joan S.
2002b Stone Textures and Function: A Relationship between Milling Tools and Subsistence as Derived from Western American Quarries Data. In ASMOSIA 5, *Interdisciplinary Studies on Ancient Stone—Proceedings of the Fifth International Conference of the Association for the Study of Marble and Other Stones in Antiquity*, Museum of Fine Arts, Boston, June 1998, edited by John J. Herrmann Jr., Norman Herz, and Richard Newman, pp. 381–393. Archetype Publications, London.

Schneider, Joan S.
2020 Milling Implement Manufacturing at the Ironwood Quarry, Riverside County, California. *California Archaeology* 12:1–31.

Schneider, Joan S., and Jeffrey H. Altschul (editors)

https://doi.org/10.1017/S0956536125100643 Published online by Cambridge University Press

2000 *Of Stones and Spirits. Pursuing the Past of Antelope Hill*. Statistical Research and University of Arizona Press, Tucson.

Schneider, Joan S., Dash Batulzii, Susan H. Gilliland, and Gantulga Bayasgalan
2025 Sourcing Sandstone Ground Stone Tools from Neolithic Mongolia: A View from Ikh Nart Nature Reserve. *Journal of Archaeological Science: Reports* 67:105357. https://doi.org/10.1016/j.jasrep.2025.105357.

Schneider, Joan S., Michael K. Lerch, and Gerald A. Smith
1995 A Milling-Implement Quarry at Elephant Mountain, California. *Journal of California and Great Basin Anthropology* 17: 191–221.

Schneider, Joan S., and Richard H. Osborne
1996 A Model for the Production of Portable Stone Mortars and Bowls. *Pacific Coast Archaeological Society Quarterly* 32(4): 27–40.

Schneider, Joan S., and Richard H. Osborne
2012 The Use of Tule Watercraft for Transportation of Milling Implements and Other Heavy Goods in the Great Basin: Testing a Hypothesis Using Experimental Replication. In *No Stone Unturned: Recent Trends in Ground Stone Studies in the Great Basin and Beyond*, edited by Renée C. Kolvet and Meredith (Penny) Rucks, pp. 35–54. Nevada State Museum Anthropological Papers 27. Nevada State Museum, Carson City.

Searcy, Michael T.
2011 *The Life-Giving Stone: Ethnoarchaeology of Maya Metate Makers*. University of Arizona Press, Tucson.

Searcy, Michael T., and Todd Pitezel
2018 An Ethnoarchaeological Perspective on Ground Stone Production at the Santiago Quarry in the Casas Grandes Region of Chihuahua, Mexico. *Latin American Antiquity* 29:169–184.

Shaefer, Harry J., and Thomas R. Hester
1986 Lithic Craft Specialization and Product Distribution at the Maya Site of Colha, Belize. *World Archaeology* 23(1):79–97.

Sheets, Payson
2006 *The Ceren Site: An Ancient Village Buried by Volcanic Ash in Central America*. 2nd ed. Thomson Wadsworth, Belmont.

Sheets, Payson, David Lentz, Dolores Piperno, John Jones, Christine Dixon, George Maloof, and Angela Hood
2012 Ancient Manioc Agriculture South of the Ceren Village, El Salvador. *Latin American Antiquity* 23:259–281.

Tindale, Norman B.
1974 *Aboriginal Tribes of Australia*. University of California Press, Berkeley.

Tindale, Norman B.
1977 Adaptive Significance of the Panara or Grass Seed Culture of Australia. In *Stone Tools as Cultural Markers: Change, Evolution, and Complexity*, edited by R. V. S. Wright, pp. 345–349. Prehistory and Material Culture Series Vol. 12. Australian Institute of Aboriginal Studies, Canberra.

Vargas, Ramón Carrasco, Verónica A. Vázquez López, and Simon Martin
2009 Daily Life of the Ancient Maya Recorded on Murals at Calakmul, Mexico. *Proceedings of the National Academy of Sciences* 106:19245–19249. https://doi.org/10.1073/pnas.0904374106.

https://doi.org/10.1017/S0956536125100643 Published online by Cambridge University Press