REPORT

Use of the Little-Known Local Obsidian Source of Ojo Zarco at La Magdalena in Guanajuato, Mexico

Blaine K. Burgess, Daniel E. Pierce, and Jeffrey R. Ferguson

Excavations conducted by Beloit College in 1958 and 1960 identified the site of La Magdalena in the Bajío of Mexico. Investigators have since highlighted three primary phases of occupation at La Magdalena, two of which were proposed to have been culturally influenced by Teotihuacan or Tula. Modern research in the Bajío mostly diverges from those postulations of distant connections, supplanting them with local patterns that hold much more explanatory power. Archaeometric studies are pivotal in this regard but have thus far been infrequently used. This research analyzes the obsidian assemblage from La Magdalena and finds a nearly ubiquitous utilization of a local obsidian source known as Ojo Zarco. These findings merit a reevaluation of obsidian in the eastern Bajío and argue for more archaeometric studies that elucidate local procurement patterns.

Keywords: Bajío, obsidian, archaeometry, La Magdalena

Las excavaciones realizadas por Beloit College en 1958 y 1960 identificaron el sitio de La Magdalena en el Bajío de México. Los investigadores destacaron tres fases principales de ocupación en La Magdalena, dos de las cuales se propusieron haber sido culturalmente influenciadas por los principales centros de Teotihuacan y Tula. La investigación moderna en el Bajío diverge en su mayoría de esas postulaciones de conexiones distantes y las ha suplantado con patrones locales que tienen mucho más poder explicativo. Los estudios arqueométricos son fundamentales en este sentido, pero hasta ahora se han utilizado con poca frecuencia. Esta investigación analiza el conjunto de obsidiana de La Magdalena y encuentra una utilización casi ubicua de una fuente local de obsidiana conocida como Ojo Zarco. Estos hallazgos ameritan una reevaluación de la obsidiana en el Bajío oriental y más estudios arqueométricos que eluciden los patrones de obtención locales.

Palabres clave: Bajío, obsidiana, arqueometría, La Magdalena

In 1962, William Simpson Godfrey Jr. and Beatriz Braniff de Torres concluded their manuscript titled *Archaeology of the Bajío* with this statement: "The authors [have] speculated beyond present knowledge, only hoping that future investigations will be stimulated by our flights of fancy." The current research is an outgrowth of their work in that it chemically characterizes the obsidian at the site of La Magdalena.

La Magdalena, located in the Bajío of Mexico, was excavated in 1958 and 1960 by Godfrey and students from Beloit College (Wisconsin, USA; Godfrey and Braniff de Torres 1962). They identified three phases through similarities in material culture to that found elsewhere in the Basin of Mexico. In this report, we add to the growing body of archaeometric literature in the Bajío by chemically characterizing the obsidian at La Magdalena. This research is also meant to breathe new life into a decades-old museum collection, recognizing the utility of insufficiently studied older collections. We summarize

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the results of a study of obsidian procurement and briefly hypothesize about its use at La Magdalena. Overall, our data indicate that a vast majority of the obsidian does not compositionally match any known obsidian source in the comparative database at the University of Missouri Research Reactor (MURR). Rather, most are chemically consistent with a single geological sample from an obsidian source known as Ojo Zarco. Artifacts from the Ucareo and Zaragoza obsidian sources were also identified, but in significantly smaller numbers.

The Site

La Magdalena is located in eastern Guanajuato, north of the eastern Michoacán Highlands (Figure 1). Excavations revealed a plaza/patio architectural style with three main structural zones (Figure 2). Three phases of occupation were delineated from ceramic typology and construction events (Raleigh 1986). La Magdalena was previously dated to the Postclassic and interpreted as a miniature version of the Corral Complex at Tula (Brown 1985). We summarize findings from field records (Table 1) and add our obsidian analysis in this report.

Phase II was the first robust occupation at La Magdalena. The Bajío Tradition (AD 400–900) was the culmination of population and political complexity (Cárdenas García 1999) and roughly corresponds to the Classic period. It was initiated by agriculturalists, with kinship sociopolitical organizations bolstered by exchange and accompanied by circular structures, mounds, sunken patios, and platforms (Filini and Cárdenas García 2010).

Regional influences have been studied in the Bajío. Thin Orange ceramics and Pachuca obsidian at La Negreta, Queretaro, and Santa María del Refugio (Filini and Cárdenas García 2010) represent proposed rare correlations with Central Mexico. In more distant areas like Jalisco (Beekman 2010) and La Quemada in Zacatecas (Torvinen and Nelson 2020), as well as much of Guanajuato, these correlations are dated just prior or during the Epiclassic (AD 700–900). More substantial connections also existed, such as El Rosario's murals dated to AD 200–250 (Helmke and Nielsen 2021:36). Compositional and petrographic analyses on Thin Orange ceramics in the Bajío have mostly produced evidence of local imitations (Faugère et al. 2019), but ceramic/chronological work has suggested

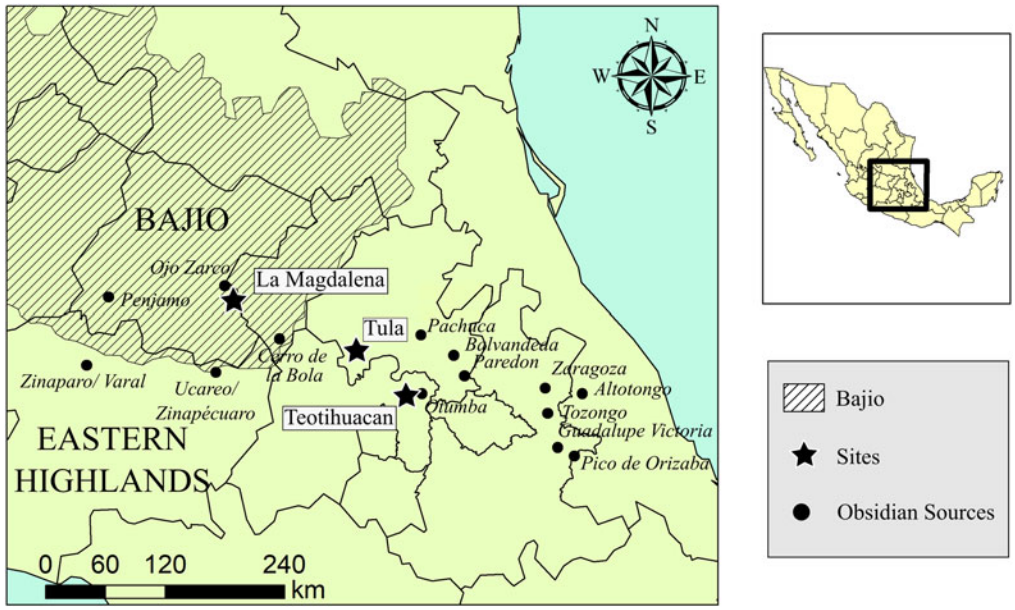

Figure 1. La Magdalena in the eastern Bajío of Mexico, showing the main polities and various obsidian sources.

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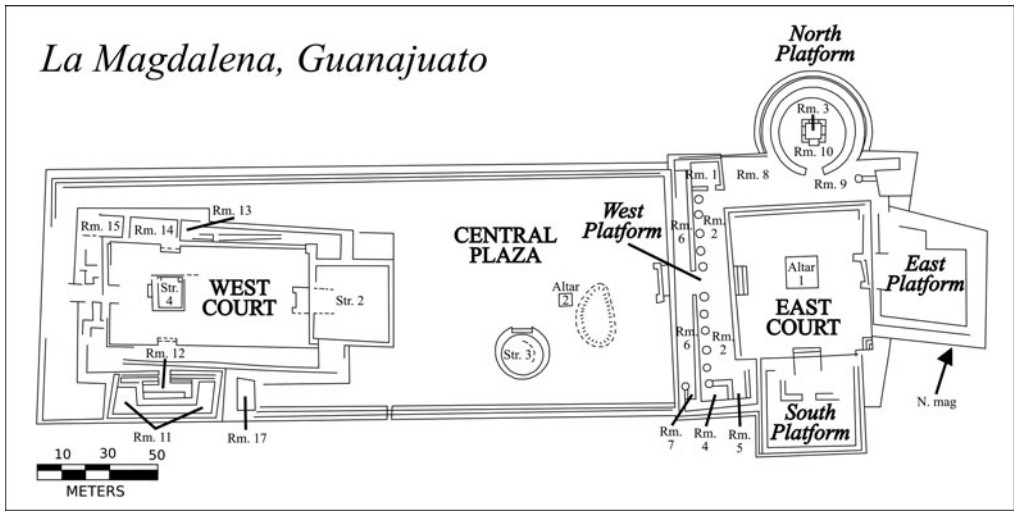

Figure 2. Drawing of La Magdalena modified from Raleigh (1986).

new lines of inquiry concerning relationships with Central Mexico, as well as other local traditions (Healan and Hernández 2022).

Phase III includes major site modifications. Ceramics include Red-on-buff and White Brushed traditions that are similar to Red-on-buff and Blanco Levantado at Tula dated to the Terminal Corral phase (about AD 900; Healan et al. 2021). A type of Red-on-buff ceramic known as Coyotlatelco is broadly hypothesized to have originated either in the Basin of Mexico (Sanders 1986) or to the northwest in regions like the Bajío (Manzanilla 2005). No matter its origin, Coyotlatelco is associated with the earliest occupations at Tula (Healan et al. 2021) and elsewhere. A neutron activation analysis (NAA) study of Coyotlatelco manufacture confirmed local production and the presence of "important subregional stylistic and morphological differences" (Crider et al. 2007:139). The addition of these ceramics and the columnar architecture (see Table 1) are consistent with Tula's relationship in the eastern Bajío (Beekman and Christensen 2011: 157).

Table 1. Summary of Construction Phases.

Phase	Construction	Architecture	Materials and Features	Proposed Influencer
I (AD <500)	North Platform Structure 2 Core of Altar 2	Circular architecture		
II (AD 500–950)	East Platform South Platform Structure 3 Altar 2 Plaza Structure 2 and North Platform modified	Patio and central altar	Burials Teotihuacan ceramics Copal Censer lid	Teotihuacan
III (AD 1050–1260)	West Court Structures 1, 2, 3 modified Altar 2 demolished Plaza filled in with *tezontle*	Structure 1 columns	Red-on-buff, White Brushed ceramics Toltec pipes	Tula

Source: Based on Raleigh (1986).

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Methods

A total of 600 obsidian artifacts were excavated from La Magdalena, including 21 prismatic blades, 13 projectile points, 3 scrapers, 9 bifaces, and 554 pieces of debitage (this category includes utilized flakes, shatter, and any byproducts of reduction). Due to time constraints, only 443 of the 600 artifacts, including all the formal tools and a significant percentage of the debitage, were chemically analyzed. The debitage was randomly sampled, resulting in the analysis of 397 of the 554 pieces.

A Bruker Tracer V-I ED-XRF was operated at 50 kV and 35 μA, with instrument specifications including a rhodium X-ray tube, a thermoelectrically cooled silicon drift detector, and synchronous X-ray filters including copper (150 μm), titanium (300 μm), and aluminum (50 μm; Ferguson 2012). The instrument is calibrated based on 37 well-characterized obsidian sources built from previous instrument measurements (Glascock and Ferguson 2012). Each artifact was analyzed for 20 s to detect five elements: rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb). Data from known Mesoamerican obsidian sources were collected under the same parameters to affirm adequate instrument measurements (see Supplemental Table 1).

Results

Three obsidian sources were identified: Ucareo, Zaragoza, and Ojo Zarco. Ucareo and Zaragoza are well documented and were frequent sources of obsidian in Mesoamerican prehistory. The lesser-known third source is Ojo Zarco, located approximately 25 km northwest of La Magdalena. Davis and Brown (1989) were the first to describe this source in field surveys, noting the obsidian was black, free of inclusions, and consisted of nodules ranging from the size of tennis balls to basketballs. Obsidian from this source can also appear gray and brown under certain lighting conditions (Figure 3).

Ojo Zarco obsidian has only been sparsely documented in Texas (Hester et al. 2017; Hughes and Hester 2009), and its use in the Bajío has been referenced anecdotally (Cárdenas García 1999; Migeon 2016). Artifacts show Zirconium (Zr) concentrations ranging from approximately 1,000 to 1,200 ppm (Figure 4). The one accessible geological sample from Ojo Zarco

Figure 3. Photos of Ojo Zarco debitage. (Color online)

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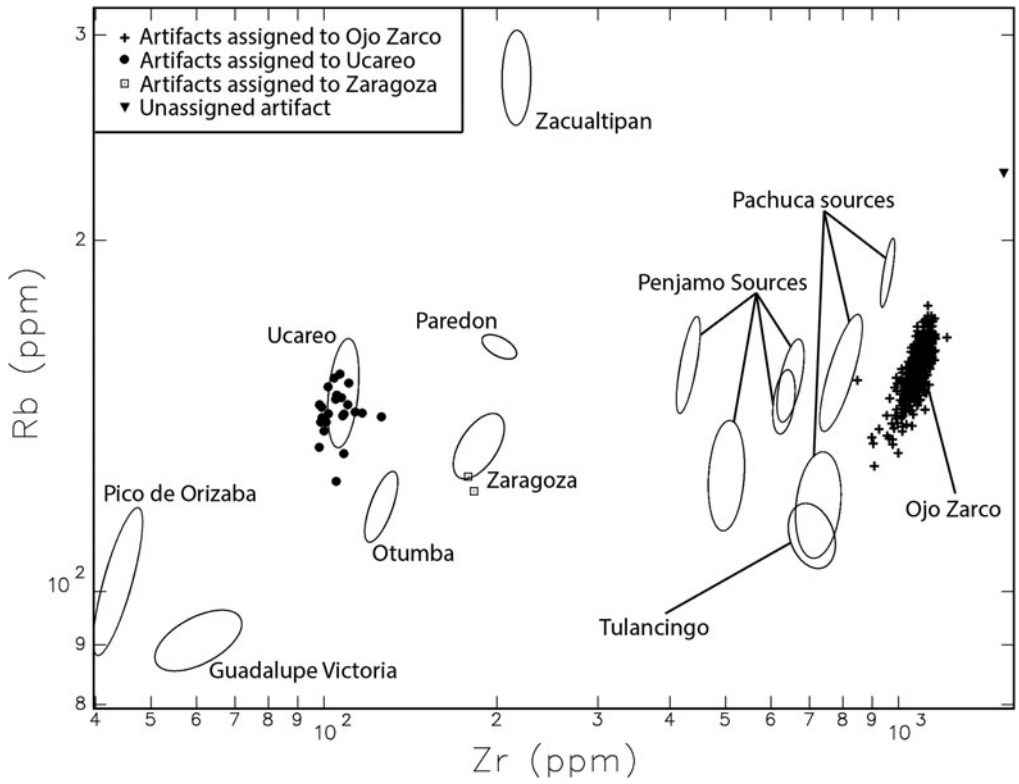

Figure 4. Rubidium versus zirconium concentrations for La Magdalena obsidian, with 90% confidence ellipses for obsidian sources.

consistently plots well within the data cloud for La Magdalena obsidian, affirming the source of these artifacts (Figure 5). Obsidian is the most common *reductive* artifact at La Magdalena, mostly originating from Ojo Zarco in the form of debitage, whereas ceramics are far more common (Table 2).

Discussion

Ucareo and Zaragoza are the sources of the nonlocal obsidian identified at La Magdalena. Zaragoza was widely distributed (e.g., García Cook et al. 2010) but is inconspicuous at La Magdalena. To the south in the Acámbaro Valley (about AD 50–320), blades from Ucareo were found in caches (Darras and Faugère 2010) and were also widely used (e.g., Pollard 2008). Procurement patterns of blade importation and local source utilization have been similarly reported at Postlassic Aztatlán sites with Volcán las Navajas (Pierce 2016).

Ojo Zarco's preponderance at La Magdalen has broad implications for the use of obsidian in the eastern Bajío and for archaeometric studies in the eastern Bajío. La Magdalena is hypothesized to be a ceremonial site based on evidence of ritual paraphernalia and contexts. Later occupations include modifications that may indicate habitation (see Table 1). It is therefore possible that both habitation and ceremonialism took place there, though they may not have been mutually exclusive. Technological analysis of the obsidian could thus elucidate site function.

If the Bajío Tradition was indeed kinship based, in which sociopolitical organizations were bolstered by exchange (Filini and Cárdenas García 2010), then a fluid exchange of goods might be expected. Two compelling implications follow. First, La Magdalena may be the lone example of Ojo Zarco procurement. If this is the case, more investigations should then continue to parcel out differences in access to local and imported obsidian. Second, Ojo Zarco may

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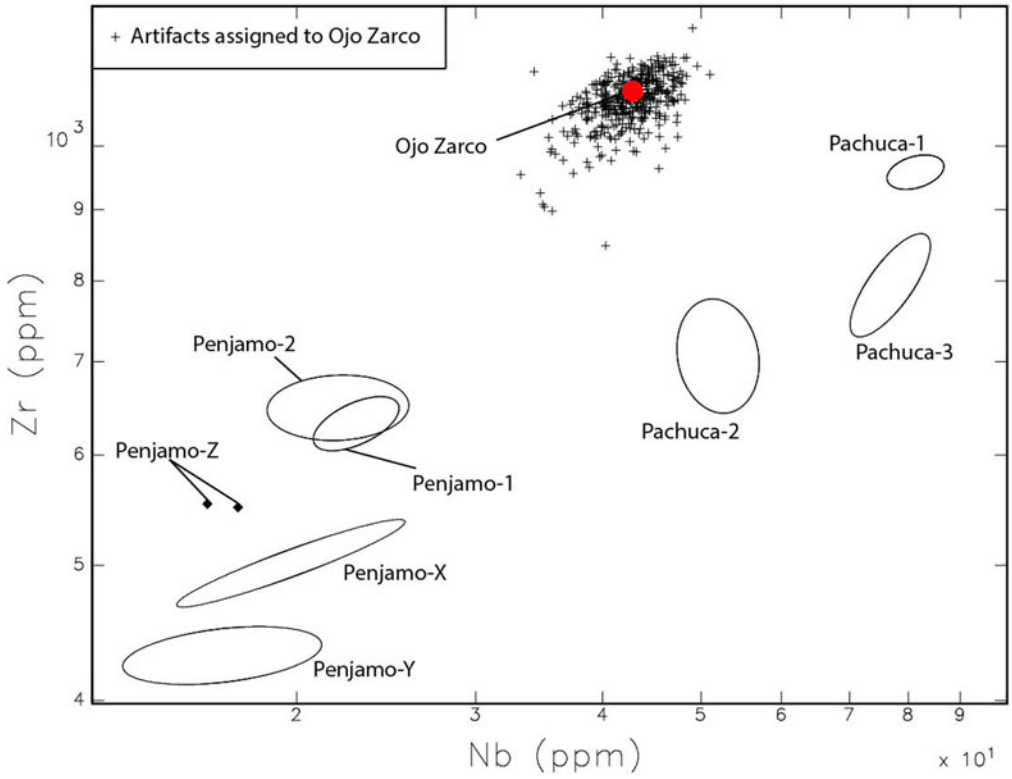

Figure 5. Zirconium versus niobium concentrations for obsidian artifacts and Ojo Zarco source (in red). (Color online)

not be a lone case at La Magdalena but was misidentified and is intermingled among obsidian assemblages throughout the region. If true, a reevaluation of regional obsidian studies is warranted.

For example, Faugère and colleagues (2019) note gray and green obsidian at El Mezquital–Los Azules in the Acámbaro Valley. Visual assessment concludes that the green obsidian is from Pachuca, whereas the gray remains unassigned. Although visual sourcing has proven to be effective in some regions (e.g., Braswell et al. 2000; Pierce 2015), it is complicated when sources in a region appear similar to each other. Geochemical analyses could be an important complement to better delineate where

Table 2. Count of Obsidian and Ceramics.

Artifact	Prismatic Blades	Points	Scrapers	Bifaces	Debitage	Total
Obsidian						
Ojo Zarco	2	12	3	9	392	418
Ucareo	19	0	0	0	3	22
Zaragoza	0	1	0	0	1	2
Unassigned	0	0	0	0	1	1
Unanalyzed	0	0	0	0	157	157
Total	21	13	3	9	554	$N = 600$
Ceramics						
Blanco Levantado	Type Counts Unknown					?
Red-on-buff						?
Total						$N = 9{,}029$

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lesser-known local obsidian sources may have been used.

Conclusion

La Magdalena obtained obsidian locally from Ojo Zarco and selectively imported Ucareo obsidian. This degree of use of Ojo Zarco obsidian found in La Magdalena has yet to be identified elsewhere. Therefore, we suspect that Ojo Zarco was procured for cost-effective and expedient purposes, whereas technologies such as blades were imported and overshadowed a minimal local blade industry. Ojo Zarco obsidian possibly retained some nonutilitarian value as well, however, because it was found in a burial in the Central Plaza. There is therefore still much to learn about the extent of Ojo Zarco procurement, use, and exchange. We suggest that a reevaluation of obsidian studies within the Bajío, particularly those that have been limited to visual sourcing, would be beneficial for archaeometric research and subsequent interpretations of local obsidian utilization.

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Data Availability Statement. Archival information concerning La Magdalena is curated at the Logan Museum of Anthropology in Beloit, Wisconsin.

Supplemental Material. To view supplemental material for this article, please visit http://doi.org/10.48512/XCV8468895.

Supplemental Table 1. La Magdalena Obsidian XRF Data.

Competing Interests. The authors declare none.

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