ARTICLE IN PRESS

Quaternary International xxx (2017) 1–14

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

Spatial and temporal distributions of exotic and local obsidians in Central Western Patagonia, southernmost South America

César Méndez [a,*], Charles R. Stern [b], Amalia Nuevo Delaunay [a], Omar Reyes [c], Felipe Gutiérrez [d], Francisco Mena [a]

[a] Centro de Investigación en Ecosistemas de la Patagonia. Moraleda 16, Coyhaique, Chile
[b] Department of Geological Sciences, University of Colorado, Boulder, CO 80309–0399, USA
[c] Centro de Estudios del Hombre Austral, Instituto de la Patagonia, Universidad de Magallanes. Bulnes, 01890, Punta Arenas, Chile
[d] MSc Archaeology Program, Universidad de Chile, Ignacio Carrera Pinto 1045, Ñuñoa, Santiago, Chile

ARTICLE INFO

Article history:
Received 21 June 2017
Received in revised form
14 August 2017
Accepted 29 August 2017
Available online xxx

Keywords:
Obsidian
Lithic procurement
Mobility
Hunter-gatherers
Central Western Patagonia
Holocene

ABSTRACT

Central Western Patagonia (CWP) is a key area for assessing long-distance procurement of high-quality obsidians throughout the Holocene given that almost all relevant types represented in the archaeological record are exotic to this region. By using surface and stratigraphic obsidian artifacts from archaeological sites compared to standards from known sources in Patagonia, this paper discusses the spatial and temporal distribution of this lithic material. Sampling was oriented to assemblages from deposits with radiocarbon-based time frames (10,700 – 300 cal BP). This paper presents geochemical (ICP-MS) analyses of 178 samples from 58 archaeological sites at 11 surveyed areas located along the Pacific coast, the Andean forest, and eastern steppe. Out of six potential sources, the Chaitén Volcano source (Los Lagos Region, Chile) dominates exclusively the occurrence of obsidians along the coastal fringe, while the Pampa del Asador source (PDA, Santa Cruz Province, Argentina) largely dominates (86% of samples) obsidian in the eastern steppe and the forest/steppe ecotone. This broad distribution is explained by the presence of the densely forested Andean mountain range acting as a biogeographical barrier. East of the Andes, we recorded an absolute dominance of PDA south of 45°30′S, while more variability prevailed north of this point. The highest diversity of obsidians was recorded in the Cisnes River valley, probably because it is located closer to other alternative northern sources (Telsen/Sierra Negra, Sacanana and Angostura Blanca, all in Chubut Province, Argentina) and because it also hosts a local low-quality obsidian type. Based on this distribution, we discuss obsidian procurement behaviors by considering obsidian frequency and tool/debitage-class representation with increasing distance. We use the analysis of fall-off curves based on the distance of studied locations from the sources and include the use of least-cost paths for providing the most likely procurement routes. No obsidian diversification was recorded during the Holocene, hence the main driver for its procurement seems to be the distance from the source rather than the antiquity of its knowledge. Alternative procurement behaviors are discussed, specifically direct acquisition, exchange, and/or sporadic visits as mechanisms for explaining the archaeological patterns throughout the Holocene.

1. Introduction

The procurement and circulation of goods is closely tied to the movement of people and the transmission of ideas. Since archaeologists seldom access to these domains, we must rely on material proxies such as the distribution of exotic items and try to define their movement patterns to attempt to interpret them in behavioral terms (i.e., Gamble, 1999; Meltzer, 1989; Salomon, 1985). Central Western Patagonia (CWP; Aisén Region, Chile; 44° to 49°S) is a key area for assessing long-distance procurement of toolstones in the broader region of the southern cone of South America since all high-quality obsidians used by past hunter-gatherers are exotic (Méndez et al., 2008–9, 2012). Thus, obsidian samples, independent of their abundance, tool/debitage class or technological attributes, are regarded as highly relevant in the assemblages from

* Corresponding author.
E-mail address: cesar.mendez@ciep.cl (C. Méndez).

http://dx.doi.org/10.1016/j.quaint.2017.08.062
1040-6182/

which they were obtained, given that they provide information on specific decisions related to high-quality toolstone procurement, group mobility, and territoriality. Patagonia has a total of nine major geochemically recognizable obsidian sources that have been analyzed following the same methods (Stern, 2017 see this issue). Only a very minor percentage of obsidian artifacts from archaeological assemblages come from a limited number of minor or unknown sources (Méndez et al., 2012; Stern, 2017); thus, they should be considered of less importance in comparative trends. Additionally, the Patagonian region was occupied by mobile societies throughout the Holocene (e.g., Borrero, 1994–5; McEwan et al., 1997), and as such, it provides a suitable context for assessing the evolution of procurement behaviors among groups with similar decision-making regarding the use of landscapes at different temporal and spatial scales. However, it is worth noting that pedestrian movement was not exclusive to this region, given that mobility along the Pacific coast was accomplished using canoes (Reyes et al., 2015) and that horse was adopted during the seventeenth century AD by inland societies (Nuevo Delaunay et al., 2017). Hence, this paper targeted contexts with known time frames for discussing such behavioral patterns.

During the last decade, archaeological research teams working in CWP have managed to compile a series of obsidian provenance analyses from locations both along the Pacific coast and inland along the forest/steppe margin and the eastern plains (e.g., Stern, 1999; Stern and Porter, 1991; Stern et al., 2013; Reyes et al., 2017). However, this information, based on both surface-averaged (Méndez et al., 2008–9) and chronologically constrained stratigraphic assemblages (Méndez et al., 2012), featured only a limited distribution. This paper presents new and previously published geochemical analyses of obsidian artifacts from archaeological locations in CWP (Fig. 1), including areas with no prior sampling, and compares them to values of known sources that have been used in discussions of the spatial distribution of this exotic lithic material in broader Patagonia (e.g., Stern, 2004, 2017). Whenever possible, we selected samples from radiocarbon-dated contexts instead of surface artifacts. These data are used to discuss the spatial and temporal distributions of exotic and local obsidians in CWP and their implications for disentangling different procurement behaviors.

This paper discusses the variability in assemblages as a function of the distance from the source and the implications of having alternative sources at equivalent distances represented in the archaeological record (e.g., Barberena et al., 2011; Cortegoso et al., 2016; Méndez, 2004). By comparing these spatial trends with chronologically constrained assemblages, we investigate the antiquity of the use of obsidian in CWP and whether preferred sources varied over time (Méndez et al., 2012; Stern, 2017). In addition to distance and time, other variables such as the knapping quality of the specific obsidians are considered, though the large dominance of specific types across the region make this variable only relevant for specific areas. Finally, we discuss whether the frequency and tool/debitage class representation of obsidian artifacts in CWP meets the expectations for direct procurement, systematic exchange or other sporadic mechanisms that may account for the decisions involved in the manufacturing, use and discarding of high-quality exotic raw materials.

2. Regional setting and obsidian artifact distribution in CWP

The main geographic feature of CWP is the Andean mountain range (Fig. 2). To the west, a series of archipelagos and fjords form an abrupt and fragmented landscape, while to the east, the landscape is composed of extensive sedimentary plains, lakes and other glacial and volcano-related landforms. The almost continuous presence of the southern westerly winds produces a strong west-east precipitation gradient due to the rain shadow effect over the Andes (Garreaud, 2009). Because of this rainfall distribution, evergreen forests occur along the coast and western continental mountains, deciduous forests occur on the lee side of the Andes, and open semiarid steppes occur to the east (Luebert and Pliscoff, 2006). The paleoenvironmental records for the continental area suggest that the most significant climate and landscape changes occurred during the Pleistocene/Holocene transition and that the current phytogeographical distribution has not changed substantially since the early Holocene, except for minor fluctuations in the maximum easterly position of the forest steppe ecotone and changes in the density of the forest canopy (de Porras et al., 2012; 2014; Villa-Martínez et al., 2011). Coastal records also indicate a relative stable period in terms of forest distribution, coverage and species variability during the Holocene (Haberle and Bennett, 2004). Thus, for all human trajectories discussed in this paper we consider that no substantial changes in landscape and climate affected the overall access to obsidian sources or constrained the mobility of hunter-gatherers relative to the modern conditions.

The sources for obsidian in this region are either Andean or extra-Andean, and each of these types are chemically distinctive based on XRF and ICP-MS analyses of both source and extra-source samples (e.g., Stern, 2017). We discuss the distribution of obsidian from six sources (major and minor) of known geographical location between 42° and 48°S plus four potential unknown sources. Although other sources for obsidian are available in Patagonia both to the south and the north of the study area (Stern, 2017), the six obsidian types considered here are the only ones found among archaeological samples. The main obsidian type represented in CWP is the black-colored alkaline rhyolitic obsidian from Pampa del Asador (PDA; 47°49′S; 70°48′W; Stern, 1999, 2017). PDA cobbles (secondary sources) are found distributed over a large area in excess of 2000 km^2 in Santa Cruz Province, Argentina (Belardi et al., 2006; Espinosa and Goñi, 1999; Franco et al., 2017). Repeated analyses have concluded that there are four distinctive variants: PDA1, PDA2, PDA3ab, and PDA3c (Stern, 1999, 2004, 2017; García-Herbst et al., 2007). PDA obsidian artifacts have been recorded between 42° and 54°S from the eastern rim of the Andes to the Atlantic coast and from 12,100 calibrated years before present (cal BP) to historical times (Méndez et al., 2012; Morello et al., 2012; Stern, 2004, 2017; Stern et al., 2000; Paunero, 2003). PDA is by far the most represented source in Patagonia, and the PDA1 subtype accounts for the majority of archaeological artifacts, the widest distribution and the greatest antiquity (Stern, 2017). Within CWP, obsidian from this source has shown a strong relationship between increased distance and decreased frequency when comparing south-to-north equivalently sampled surface units (Méndez, 2004). This assessment considered the relative proportion of obsidian debitage versus other toolstones in assemblages recorded through surface surveys (in the range between 110 and 150 km^2) at sections of the Cisnes, Ibáñez, Jeinemeni and Chacabuco valleys (Méndez et al., 2008–9).

In northern CWP, especially in the Cisnes River valley, obsidian from the Somuncurá Plateau is also present. Metaluminous black obsidian from Sacanana (S; 42°30′S; 68°36′W) and translucent grey-green obsidian from Telsen/Sierra Negra (T/SN, previously referred to as T/SC; 42°18′S; 66°36′W) have been described in this area (Méndez et al., 2008–9, 2012). S obsidian is a crystal-free peralkaline rhyolite, and artifacts composed of this material have been observed from 40°50′ to 45°20′S and from the eastern rim of the Andes to the Atlantic coast with ages no older than 2700 cal BP (e.g., Favier Dubois et al., 2009; Gómez Otero and Stern, 2005; Stern, 2017; Stern et al., 2000, 2013). T/SN is a crystal-free peralkaline rhyolitic obsidian with a similar distribution as that of S, except for its southernmost occurrence at 44°30′S (Stern, 2017;