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# 'To and fro' the southern Andean highlands (Argentina and Chile): Archaeometric insights on geographic vectors of mobility

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ABSTRACT

The Andes mountain range is one key physiographic feature of South America with the potential to have acted as a barrier and corridor for human societies. The goal of this paper is to assess from where and how were the highlands utilized during the last 2000 years, which is a key period witnessing the development of productive economies and changes in the organization of mobility. We develop a regional case study focused on the highland wetland Laguna del Diamante (3300 masl), which is a highly productive ecosystem only accessible during summer. This case is based on a multidisciplinary approach combining: a) geochemical characterization of obsidian sources located in the highlands and artifacts; b) isotopic approach to ranges of paleomobility of individuals by means of $^{87}Sr/^{86}Sr$; and c) stylistic study of ceramic assemblages.

The two main obsidian types from the highlands have restricted and decaying spatial distribution, suggesting that these archaeological distributions track part of human circuits of mobility instead of indirect transport acquisition. Their archaeological distribution is heavily skewed towards the western Andean slope. We present strontium isotope values for four teeth and bone samples from two individuals recovered in the area, which are interpreted in reference to a preliminary baseline of biologically available strontium. We infer that these individuals had ranges of paleomobility systematically connecting the western slope with the highlands. The analysis of the ceramic assemblages shows that most of the diagnostic sherds can be assigned to styles that have distributional cores in the Central Valley of Chile up until the time of Inca presence, while only a minimum portion of the sample can be assigned to distributional cores on the eastern slope. By integrating the patterns in the transport of obsidian and ceramic artifacts and the paleomobility of individuals, we find support for the existence of dominant access to the highlands from the western Andean slope. A GIS-based analysis of the seasonality of precipitation shows that the western slope presents more pronounced and drier summer months, providing a context that contributes to explain these patterns. These results contradict previous interpretations suggesting that the archaeological record from the highlands is more directly tied to human groups inhabiting the eastern lowlands during most of the year. Beyond the geographic debate, this issue has an impact on the subsistence organization of the incoming groups, on the socio-economic role of the highlands, and on the demographic contexts leading to trajectories of economic intensification in both Andean slopes. This research contributes to build a framework for comparative research on human use of highland environments.

## 1. Introduction and goals

The Andes mountain range is one of the key physiographic features of South America, extending 7500 km along the western margin of the continent, from 10° N in Colombia to 53° S in Tierra del Fuego Island (Clapperton, 1993). In this paper we focus in a segment of the southern Andes (Argentina and Chile, 34°S), with mean altitudes above 3000 masl. At this latitude, the Andes constitute a topographic wall

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to atmospheric circulation, establishing contrasting patterns in the amount of precipitation and the structure of phytogeographical communities on both slopes (Garreaud et al., 2009). From the perspective of human biogeography, the high altitudes combined with macro-regional climate patterns (Garreaud et al., 2009) allow access to the Andean highlands basically during the summer season, whether for intermountain mobility, hunting and/or herding activities in highly productive summer ecosystems, lithic provisioning, flow of information, and exchange of material goods. This formidable geologic structure has the potential to have variably acted as a barrier and corridor for human societies through time.

The patterns of human use of the Andes have been a central topic in the archaeology of western South America for decades (Aldenderfer, 1998; Capriles et al., 2016; Durán et al., 2006; Lagiglia, 1997; Murra, 1972; Neme, 2016; Rademaker et al., 2014). In this context, the general goal of this paper is to *assess from where and how were the highlands utilized during the last 2000 years*, which is a key period witnessing the development of productive economies, the introduction of ceramic technology, and significant changes in the organization of mobility (Gil et al., 2015; Sanhueza and Falabella, 2010).

While the highlands may have been likely accessed and occupied from different areas in both slopes, dominant geographic vectors of access may emerge under specific conditions. Considering the existence of striking biogeographic and socio-demographic differences between both Andean slopes, the issue of the spatial source(s) of human groups occupying the highlands becomes significant. In this context, we will assess the existence of dominant geographic vectors of access to the highlands (Cortegoso et al., 2016). We develop a regional case focused on the Laguna del Diamante area, which is a wetland located at 3300 masl with a key position in intermountain mobility paths (Mendoza Province, Argentina, Fig. 1). We articulate three lines of research: a) Geochemical characterization of obsidian sources and artifacts focusing on two chemical types identified in Laguna del Diamante (Durán et al., 2012); b) Isotopic approach to ranges of paleomobility of individuals recovered at the only mortuary site (LD-S13) recorded in this highland locality; and c) Stylistic composition of ceramic assemblages and their likely place of provenience. Each of these archaeological proxies sheds light on different levels of the complex social webs of trans-Andean interaction. If utilized in combination, these proxies provide a robust strategy of wide methodological value.

## 2. Environmental setting and archaeological background

### 2.1. Environmental setting

The macro-region of study extends from the Pacific coast in Chile to the central western Argentinean lowlands, including a segment of the Andes mountain range of Argentina and Chile (34°S) with mean altitudes above 3000 masl and a width of ca. 150 km. The interaction of the westerly storm-tracks with the Andes results in an orographic rain-shadow effect that produces a strong west-east decrease in precipitation (Garreaud et al., 2009). Rainfall decreases with altitude on both sides of the Andes and vegetation distribution follows this gradient (Abraham et al., 2009; Muñoz-Schick et al., 2000).

The highlands are characterized by large amounts of precipitation occurring mostly in winter and by the presence of localized wetlands with high quality summer pastures that attract wild camelids and bird communities seasonally. This is the case of the Laguna del Diamante (Fig. 2), which forms a part of an annual migratory round of modern guanaco (*Lama guanicoe*) populations (Puig et al., 2011). Very dry summer seasons characterize the Pacific-dominated western slope, while summer precipitation is largely confined to the eastern flanks of the Andes, produced by moisture of Atlantic source (Hoke et al., 2013). While there is marked interannual variability in the snowpack in the highlands (Masiokas et al., 2012), the nivometric records for Laguna del Diamante indicate a mean winter cover of 453 mm for the period 1956–2014 (Pronóstico de Escurrimientos, 2015).

### 2.2. Archaeological background

The region witnessed a number of key historical processes beginning with the initial human colonization during the Pleistocene-Holocene

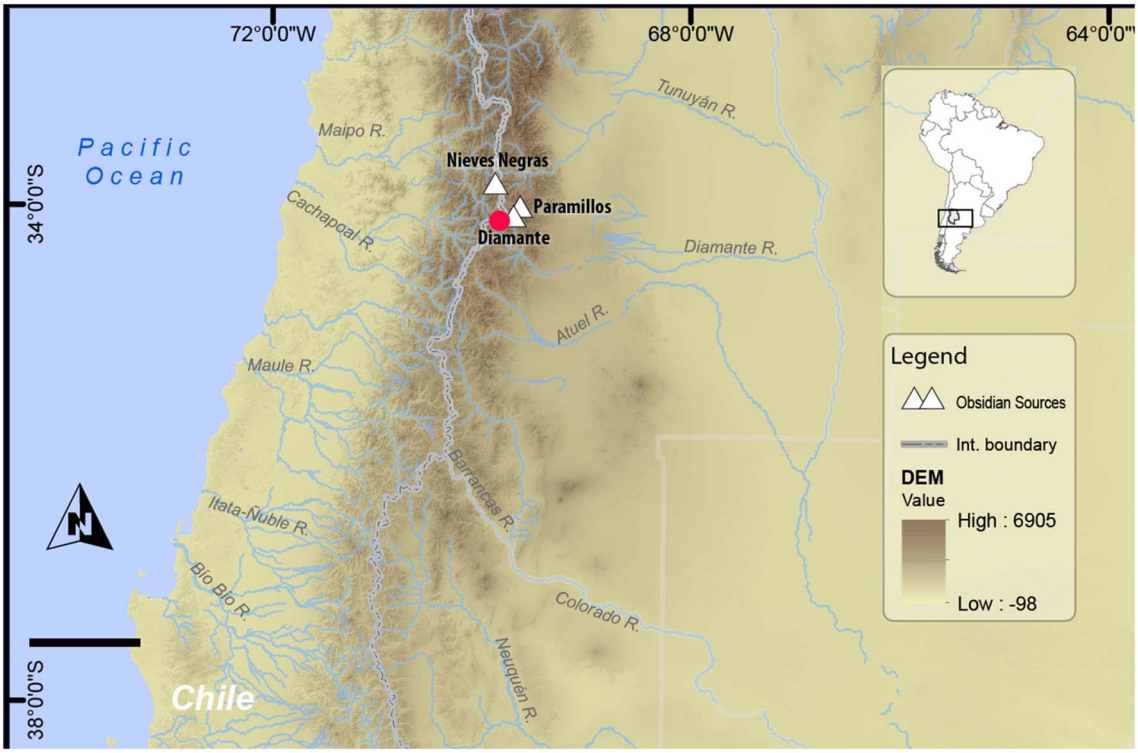


**Fig. 1.** Laguna del Diamante study area (obsidian sources shown).