# OBSIDIAN CIRCULATION: NEW DISTRIBUTION ZONES FOR THE ARGENTINEAN NORTHWEST

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The results reported in this work are part of research seeking a better understanding of the cultural development and social relations carried out by prehispanic peoples who inhabited the western and eastern sides of the Cumbres Calchaquíes-Sierras del Aconquija (Tucumán-Argentina) mountain range. There are two goals in the search for characteristic features in the subject: 1) Source determination by XRF of nine obsidian samples from different archaeological sites on both slopes of Cumbres Calchaquíes (Tucumán) and 2) Analyzing obsidian distribution range taking into account the findings of the first goal and comparing them with the database for other sites of the Argentinean Northwest (NOA) (Yacobaccio et al. 2002; Yacobaccio et al. 2004; Escola 2007).

The research context for the analyzed obsidian samples involves the study of prehispanic occupation on the western and eastern slopes of the Cumbres Calchaquíes of Tucumán (26º and 27º South and 66º30' West) during the Late-Formative interval (*ca.* 2200-550 BP). Since archaeological information for this zone is scarce, this survey is the first step towards a systematic investigation of obsidian circulation in the cultural process and the socio-economic relations between this and other areas.

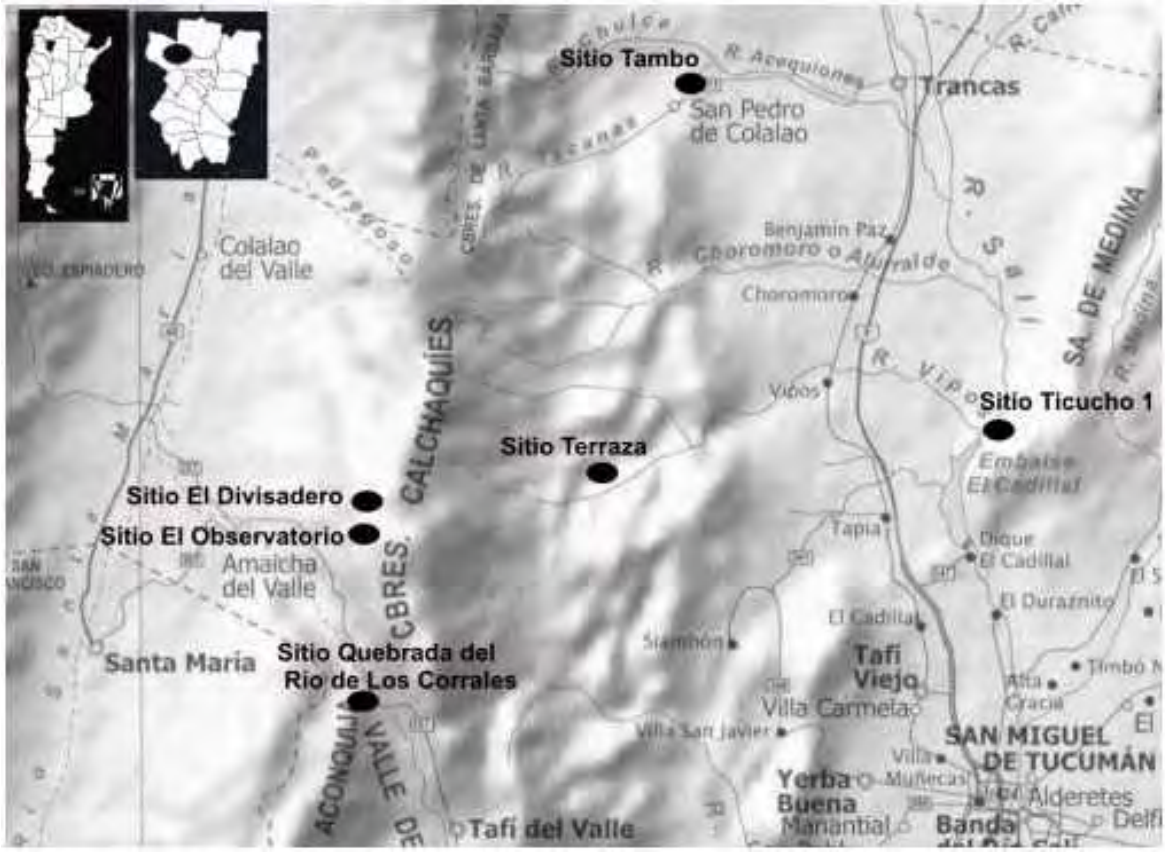


Figure 1. Location map of analyzed sites.

The region is a transitional zone between ecologically well differentiated environments: the dry and arid Santa María Valley, the pastures of the Tafí Valley to the west, and the eastern jungle slopes of the Cumbres Calchaquíes to the east in a barely 40 km wide meridian strip. The ample altitude range (between 400 and 5000 masl) allows for a remarkable study of vertical biotic zoning.

The archaeological sites where the samples were found are "Terraza", "Tambo" and "Ticucho 1" (Figure 1) on the eastern slope of the Cumbres Calchaquíes (Tucumán).

During the Formative (*ca.* 2200-1200 BP), which includes "Terraza" and "Tambo", the use of space was characterized by the occupation of hills and river terraces. Prehispanic groups that lived in small, semi-sedentary settlements in the foothills were hunter-gatherers with a complementary agriculture (Caria 2004, 2007). "Terraza" (Vipos) consists of five little defined, semicircular stone structures scattered on the surface of a river terrace. Some grey, polished, not ordinary ceramic potsherds were recovered along with other types of fragments. A sling stone was found among the lithic material apart from the obsidian. "Tambo" (San Pedro de Colalao) may be defined as a burial site on a glacis without surface structures and with ceramic materials characteristic of the Candelaria tradition in its Molleyaco phase (*ca.* 1500 AP) (Caria 2004).

Later, during the Late period (1200-550 BP) that comprises "Ticucho 1", this site was influenced by entities of higher socio-political complexity. They came from the western slope (Santa María Valley), nd its occupants adapted spatially to the environmental characteristics, thus generating distinctive sites that were somewhat different from the typical ones of the Santa María Valley. "Ticucho 1" is on a glacis and it consists of circular stone structures five meters in diameter and a large quantity of grinding tools (mortars and "conanas"). A clearly defined occupation layer was found at a depth of 70 cm within one of the structures. It consisted of faunal, ceramic, and lithic (quartz, quartzite, obsidian and basalt flakes) materials. It was dated at 1020±35 BP (NSRL-12171) (Caria 2004).

The samples from the western slope of the Cumbres Calchaquíes are from "El Divisadero" and "El Observatorio" and those from the northern end of the Aconquija mountain range are from Quebrada del Río Los Corrales (Figure 1). In these areas, Formative occupations are masked by the reoccupation of large sites of semi-urban characteristics and by satellite settlements with differentiated functions typical of the Late period, which would make localization of the former occupations difficult (Gómez Augier 2005; Gómez Augier and Collantes 2006). However, some sites have been placed more recently that may be assigned to the Formative period. They show a spatial pattern of compound and separate circular structures associated with farming land.

"El Divisadero" (Ampimpa) occupies an ample section of the middle and apical portion of a wide alluvial fan at the western piedmont of the Cumbres Calchaquíes. Numerous groups of aggregate circular stone structures ("daisy pattern" type), small rock mounds and associated areas of cultivation platforms make up the main settling pattern; there are also some isolated circular structures of megalithic characteristics and menhir-like vertical stones. Some petroglyphs were detected in peripheral areas to the site. Ceramic materials corresponding to the Condor Huasi Polícromo, Ciénaga Gris Grabado and Aguada Pintado were recovered on the surface and in probing excavations. Lithic material includes flakes and artifacts of basalt, obsidian, quartz and pink quartzite. The architectural designs and ceramic and lithic materials found would identify this site as belonging to the Formative period (2200-1200 BP). The discovery of some structures and materials, however, suggest a possible occupation that would also encompass the Late period (Gómez Augier and Caria 2008).

"El Observatorio" site (Ampimpa) is strategically placed on a position of visual control towards the Santa María Valley at 2600 masl. Geomorphologically it covers an erosion glacis and mass remotion accumulation surfaces adjacent to a spring and natural pastures. Semicircular, rectangular and poligonal structures of different sizes were surveyed as well as retaining walls and leveling structures. Among the materials found on the surface and in excavations there is a clear predominance of Santamariano style ceramics (Santamariano Negro over Blanco-Famabalasto Negro Grabado) that would assign this site to the Late period (*ca.* 1000-600 BP). Abundant faunal material was found that belonged to domestic and wild camelids. This feature suggested the site may

have been used as a space for camelid management, probably as a place for breeding and grazing subordinate to a population of higher importance (Gómez Augier 2005)

The site "Quebrada del Río de Los Corrales" is in Abra del Infiernillo at 3200 masl. This is a tectonic sinking zone within the northern section of the Aconquija range. Morphologically, it constitutes the northern limit of Valle de Tafí which lies on a North-South position and is limited in the South by the peaks of Ñuñorco Chico (2900 masl) and Ñuñorco Grande (3200 masl). There are three kinds of structures: 1) living enclosures (sample PAT 102 comes from it), 2) animal pens and 3) farming platforms. A cave was also found and studied where there were 14 mortars carved on the stone floor at the entrance (Caria et al. 2006; 2007).

The beginning of prehispanic occupation in "Quebrada del Río de Los Corrales" takes place *ca.* 2300 years BP according to radiocarbon dating of a *poaceae* sample that was part of a straw bed from "Cueva de Los Corrales 1" (CC1). The dating corresponding to Layer 2 (3rd extraction, C3A microsection) read 2060±200 BP (UGA-01616) (Oliszewski 2007 y Caria et al. 2007). Additionally, following Berberián and Nielsen (1988), if the presence of circular/subcircular living enclosures is taken into account, prehispanic occupation may be tentatively placed between *ca.* 2300 and 1200 years BP. Also, ceramic material collected at the site may be assigned to the styles known as Tafi and Ciénaga that belong to a time range between *ca.* 2100 and 1200 BP. Hence, until absolute dates are associated to agricultural structures, we consider that the beginnings of occupation for this area occurred *ca.* 2300-2100 BP**.** We do not know, in the light of current knowledge, when the living enclosures were abandoned. However, architectural characteristics and surface ceramics material, date occupation until *ca.* 1200 years BP.

**Background**

In 1990, new investigations aimed at localizing and characterizing obsidian sources and determining the provenance of archaeological samples in the Argentinean Northwest were carried out. Since then, ten obsidian sources have been identified and described (Yacobaccio et al. 2002): Ona-Las Cuevas, Cueros de Purulla, Chascón and Valle Ancho (Catamarca, Argentina), Quirón, Alto Tocomar and Ramadas (Salta, Argentina); Caldera Vilama 1 and 2 (Jujuy, Argentina) and Zapaleri or Laguna Blanca (Altiplano de Lípez, Bolivia). At the same time, eleven additional sources called Unknown Sources A, B, C, D, E, F, G, H, I, J, K and M were identified (Yacobaccio et al. 2002). Recent studies have found the location of Unknown Source B which we now know as Laguna Cavi (Escola and Hocsman 2007; Escola et al. 2007).

The geographic distribution of the different obsidian sources has two main distribution spheres. The first sphere is controlled by the Zapaleri source in the septentrional section of the Argentinean Northwest, and the second sphere is dominated by Ona-Las Cuevas source in the southern region (Yacobaccio et al. 2004). The latter has a distribution range of 340 km and it is the one this work will address. The Ona-Las Cuevas source is in Antofagasta de la Sierra (Catamarca, Southern Puna), 80-90 km away from the town of the same name. The obsidian from this source reached archaeological sites in Southern Puna, Valle del Cajón, western Aconquija slopes, Valle de Santa María and Valle de Lerma and Quebrada del Toro to the north between 2200 and 550 BP (Yacobaccio et al. 2002).

There are also some minor sources along with Ona-Las Cuevas, but only two are of interest for the purpose of this work: Cueros de Purulla and Laguna Cavi (previously known as Unknown B). Use of Cueros de Purulla occurred at the same time as Ona-Las Cuevas and it supplyied obsidian to different sites in the Catamarca Puna reaching as far as Valle del Cajón. Cueros de Purulla is 60-70 km southeast of Antofagasta de la Sierra, Catamarca (Yacobaccio et al. 2004). Laguna Cavi is located south-southwest of Volcán Galán, Antofagasta de la Sierra, 36 km away from Antofagasta de la Sierra. Like Cueros de Purulla, use of obsidian from Laguna Cavu was active at the same time as Ona-Las Cuevas, but obsidian from Laguna Cavi was distributed over a larger area than Cueros de Purulla. In fact, utilization of obsidian from Laguna Cavi has been detected at archaeological sites in the Catamarca Puna, the western slopes of the Aconquija range, Valle del Cajón, Valle de Santa María and Valle Calchaquí (Yacobaccio et al. 2002; Escola et al. 2007).

## Analytical Procedures

Analysis of the artifacts in this study was performed using an *ElvaX* desktop energy-dispersive x-ray fluorescence (ED-XRF) spectrometer. The spectrometer consists of an X-ray generator, and X-ray detector, and a multi-channel analyzer (MCA). The detector is an electronically-cooled, solid-state Si-pin-diode with an area or 30 $mm^2$ and a resolution of 180 eV at 5.9 keV (at a count rate of 1000 counts per second). The X-ray tube is an aircooled, tungsten anode with a 140 micron beryllium end-window. The analyses were performed with an operating voltage 35 KV with a tube current of 45 microamps and a counting time of 400 seconds. Concentrations were calculated in parts per million using a regression program based on the quadratic regression model established from a series of obsidian reference samples previously characterized by neutron activation analysis (NAA) and XRF. The elements measured were K, Ti, Mn, Fe, Zn, Ga, Rb, Sr, Y, Zr, and Nb. All analyses of obsidian artifacts using this instrument were performed non-destructively.

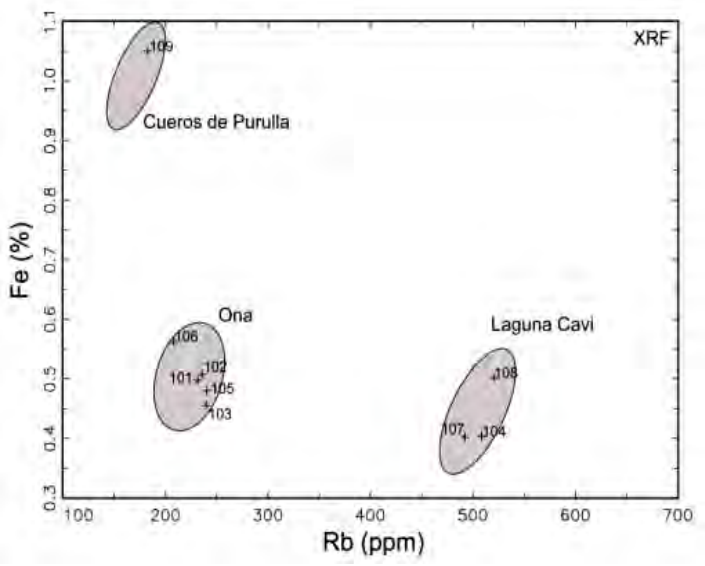


Figure 2. Bivariate plot of Fe and Rb.

## Results

Analysis of the nine samples by XRF showed the following results as summarized in Table 1, Table 2 and Figure 2.

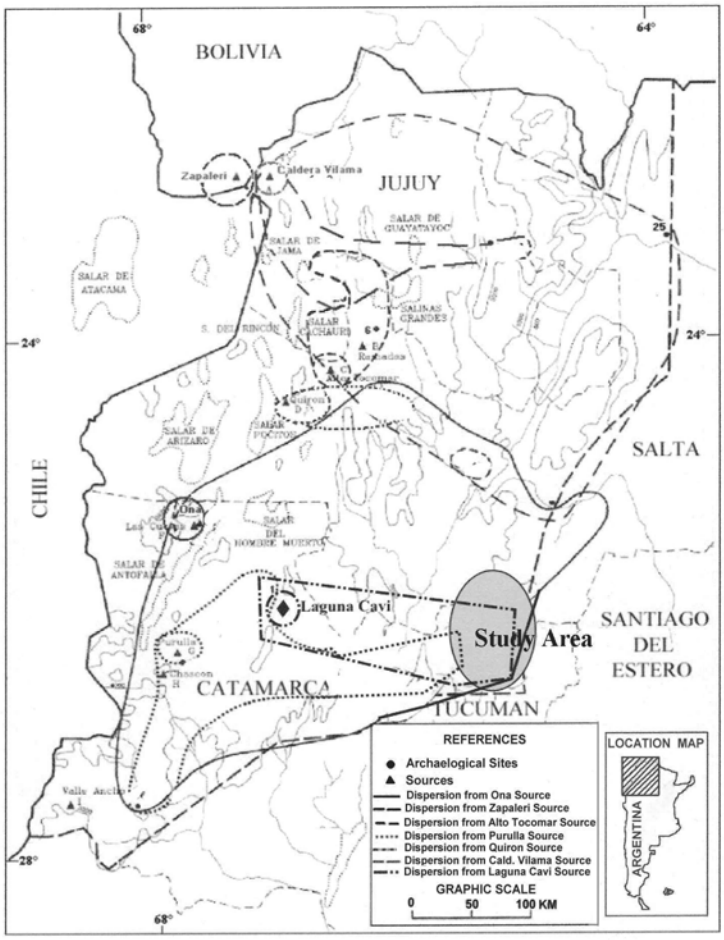


Figure 3. Obsidian distribution map (modified from Yacobaccio et al. 2004).

## Conclusions

Based on the results obtained and the goals set forth, we may conclude that:

1) The original sources of the obsidian samples in archaeological sites on both slopes of the Cumbres Calchaquíes (Tucumán) belong to Ona-Las Cuevas, Laguna Cavi and Cueros de Purulla, all in the Catamarca Puna. Thus, this section of the Cumbres Calchaquíes was a constituent participant in the trade between Punean prehispanic groups and those of the eastern high valleys. In this sense, it is interesting to point out that recent XRF tests of the site El Médano (Belén, Catamarca) have detected artifacts from the sources previously mentioned in the archaeological record. This is remarkable because this strategically located site on prehispanic trade routes between the Puna and the eastern valleys has been identified as a caravan camp (Escola et al. 2007).

Table 1. Detail of analyzed samples and source identification

| Site name | Sample origin | Sample number | Chronology | Sample description | Obsidian source identification |
|---|---|---|---|---|---|
| Ticucho 1 (Ticucho) | Structure 1 – Layer 2 | PAT 101 | 1020±35 AP (NSRL-12171) | Arrow tip | Ona |
| Quebrada del Río de Los Corrales (El Infiernillo) | Surface collection | PAT 102 | Formative | Flake | Ona |
| Tambo (San Pedro de Colalao) | Surface collection | PAT 103 | Formative | Flake | Ona |
| Tambo (San Pedro de Colalao) | Surface collection | PAT 104 | Formative | Flake | Laguna Cavi |
| Terraza (Vipos) | Surface collection | PAT 105 | Formative | Flake | Ona |
| El Observatorio (Ampimpa) | Probing Excavation II-Level 4 | PAT 106 | Late | Flake | Ona |
| El Observatorio (Ampimpa) | Probing Excavation IV-Level 2 | PAT 107 | Late | Flake | Laguna Cavi |
| El Divisadero (Ampimpa) | On-ground collection | PAT 108 | Formative-Late | Flake | Laguna Cavi |
| El Divisadero (Ampimpa) | Structure 1-Probing Excavation 1-Level 1 | PAT 109 | Formative-Late | Arrow tip | Cueros de Purulla |

2) The distribution sphere of the southern section the Argentine Northwest related to the source Ona-Las Cuevas, is now spread in its southernmost portion to the low lands of Tucumán (Figure 3). Thus, the western piedmont of the Cumbres Calchaquíes (sites "El Observatorio" and "El Divisadero"), the north end of the Sierras del Aconquija (site "Quebrada del Río de los Corrales"), the eastern piedmont of the Cumbres Calchaquíes (sites "Tambo" and "Terraza") and the Valley of Trancas ("Ticucho 1"), all in Tucumán, are included in this distribution zone.

Use of obsidian from Cueros de Purulla, stretched from the Catamarca Puna to the Valle del Cajón (Yacobaccio et al. 2002) and eastward into the western piedmont of Cumbres Calchaquíes (site "Divisadero"). The same may be said of the source at Laguna Cavi, including in this case a distribution that covers the eastern (site "Tambo") and western (sites "Divisadero" and "El Observatorio") piedmonts of the Cumbres Calchaquíes.

Likewise, it is interesting to observe some tendencies in this survey. Fifty-six percent of the artifacts belong to the source Ona-Las Cuevas, thus keeping the predominance already observed in previous studies of the meridional section of the Argentinean Northwest (Yacobaccio et al. 2002, Yacobaccio et al. 2004). Additionally, a parallel utilization of Ona-Las Cuevas and Laguna Cavi can be observed in two of the sites ("Tambo" and "El Observatorio") while the same may be noticed in the site "Divisadero" where there is a parallel use of the minor sources at Cueros de Purulla and Laguna Cavi. However, a larger survey should be carried out at other sites in order to reach more definite conclusions.

The most remarkable finding from this first investigation is the inclusion of the eastern low lands in the distribution zone for obsidian from the Catamarca Puna.

***Aknowledgments.*** Analyses were supported by the Project, 26/G333 Tucumán State University Research Council (CIUNT).

Table 2. Chemical elementary concentrations for the samples analyzed

| Samples | *K* | *Ti* | *Mn* | *Fe* | *Zn* | *Ga* | *Rb* | *Sr* | *Y* | *Zr* | *Nb* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PAT101 | 38418.8 | 805.2 | 391.2 | 4973 | 28.8 | 18.7 | 231.5 | 141.6 | 23.5 | 85.4 | 14.2 |
| PAT102 | 42512 | 847.8 | 374 | 5076.8 | 19.9 | 22.3 | 235.8 | 151.3 | 23.7 | 105.8 | 15.9 |
| PAT103 | 40261.9 | 740.4 | 376.7 | 4548.2 | 22.1 | 20.7 | 239.6 | 130.6 | 21.6 | 84.2 | 14.6 |
| PAT104 | 34893.2 | 247.1 | 809.2 | 4035.3 | 56.2 | 17.6 | 508.4 | 12.6 | 62.3 | 38.3 | 56.7 |
| PAT105 | 39736.4 | 781.1 | 354.9 | 4800.5 | 26.4 | 19.8 | 240.5 | 138.4 | 24.3 | 84 | 17.4 |
| PAT106 | 39408.2 | 939.8 | 373.4 | 5615 | 35.9 | 18.5 | 208.1 | 200.6 | 42.1 | 100.7 | 18.4 |
| PAT107 | 28047.3 | 211.6 | 785.8 | 4018.3 | 33.9 | 21.8 | 492 | 3.3 | 44 | 90.6 | 22.5 |
| PAT108 | 38960.8 | 310.6 | 831.7 | 5017.1 | 41.6 | 34.9 | 520.9 | 8.8 | 50.8 | 110.8 | 33.2 |
| PAT109 | 41587.5 | 1737.4 | 574.8 | 10499.9 | 52.8 | 10.9 | 182.6 | 334.8 | 81.8 | 181.2 | 22.2 |

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