Investigating Cultural Heterogeneity in San Pedro de Atacama, Northern Chile, Through Biogeochemistry and Bioarchaeology

Kelly J. Knudson[1]* and Christina Torres-Rouff[2]

[1]*Center for Bioarchaeological Research, School of Human Evolution and Social Change, Arizona State University, Tempe, AZ 85287*
[2]*Department of Anthropology, The Colorado College, Colorado Springs, CO 80903*

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ABSTRACT Individuals living in the San Pedro de Atacama oases and the neighboring upper Loa River Valley of northern Chile experienced the collapse of an influential foreign polity, environmental decline, and the appearance of a culturally distinct group during the Late Intermediate Period (ca. AD 1,100–1,400). We investigate cultural heterogeneity at the Loa site of Caspana through analyses of strontium and oxygen isotopes, cranial modification styles, and mortuary behavior, integrating biological aspects of identity, particularly geographic origins, with cultural aspects of identity manifested in body modification and mortuary behavior. We test the hypothesis that the Caspana population (n = 66) represents a migrant group, as supported by archeological and ethnographic evidence, rather than a culturally distinct local group. For Caspana archeological human tooth enamel, mean $^{87}Sr/^{86}Sr = 0.70771 \pm 0.00038$ (1σ, n = 30) and mean $\delta^{18}O_{c(V\text{-}PDB)} = -3.9 \pm 0.6‰$ (1σ, n = 16); these isotopic data suggest that only one individual lived outside the region. Material culture suggests that the individuals buried at Caspana shared some cultural affinity with the San Pedro oases while maintaining distinct cultural traditions. Finally, cranial modification data show high frequencies of head shaping [92.4% (n = 61/65)] and an overwhelming preference for annular modification [75.4% (n = 46/61)], contrasting sharply with practices in the San Pedro area. Based on multiple lines of evidence, we argue that, rather than representing a group of *altiplano* migrants, the Caspana population existed in the region for some time. However, cranial modification styles and mortuary behavior that are markedly distinct from patterns in surrounding areas raise the possibility of cultural heterogeneity and cultural fissioning. Am J Phys Anthropol 138:473–485, 2009. ©2008 Wiley-Liss, Inc.

The Late Intermediate Period (ca. AD 1,100–1,400) was a time of dramatic cultural restructuring in the Andes. In addition to enduring the collapse of an influential foreign polity and environmental decline, individuals living in the Atacama Desert of northern Chile witnessed the appearance of a culturally distinct group in the upper Loa River Valley (Castro et al., 1984; Berenguer and Dauelsberg, 1989; Schiappacasse et al., 1989). Here, we investigate cultural heterogeneity in the upper Loa site of Caspana and the neighboring San Pedro de Atacama oases through analyses of strontium and oxygen isotope values in archeological human remains, cranial modification styles, and mortuary behavior (see Fig. 1). Our research, the first to explore these questions through human skeletal remains, is focused on determining the origins of the group buried at Caspana by integrating biological aspects of identity, in the form of geographic origins, with those constructed elements of cultural identity manifest in body modification and the material record of burial ritual. Was the Caspana population a migrant group, as hypothesized through archeological and ethnographic evidence, or a culturally distinct local group?

We situate our investigation in theories concerning migration, diasporas, and social boundary construction. We provide a brief description of the uses of biogeochemistry and bioarchaeology to investigate cultural heterogeneity, describe the archeological context and then introduce our materials and methods. Strontium and oxygen isotope data from Caspana are presented to explore the relationship of its occupants to those of neighboring sites in the San Pedro de Atacama oases and investigate their relationship to cultural signifiers of identity, including cranial modification styles and mortuary behavior. We conclude with a discussion of cultural heterogeneity in northern Chile during the Late Intermediate Period.

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*Correspondence to: Kelly J. Knudson, Center for Bioarchaeological Research, School of Human Evolution and Social Change, Arizona State University, PO Box 872402, Tempe, AZ 85287, USA. E-mail: kelly.knudson@asu.edu

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Fig. 1. Map of the San Pedro de Atacama oasis and the neighboring Loa River Valley of northern Chile with sites discussed in the text.

MIGRATIONS, DIASPORAS, AND THE CREATION OF SOCIAL BOUNDARIES

Theoretical frameworks focused on migration, diasporas, and the creation of social boundaries can inform our investigations of group dynamics in northern Chile. While migration was de-emphasized in processual and postprocessual archeological frameworks, a resurgence of research on migration has emphasized its role in culture change (e.g. Anthony, 1992; Burmeister, 2000). Much of this research relies on techniques to identify migration and the use of multiple lines of evidence to recognize ethnic enclaves (e.g. Price et al., 2000; Spence, 2005).

Like ethnic enclaves, diaspora groups are expatriate communities that share (1) dispersal from an original center, (2) a collective memory or myth about this homeland, and (3) ethnic group consciousness (Safran, 1991; Clifford, 1994). Owen (2005, p 49) has defined the material correlates of diasporic populations as follows:

> 1) the material culture of the homeland...bioarchaeological evidence that shows that users of the intrusive material culture were immigrants ... or descendents of immigrants; 2) iconography and/or ritual practices that referred to the homeland persisted for a long period; and 3) the peripheral populations maintained a visible, identity-marking material culture in contrast to surrounding groups.

Owen's (2005) and Goldstein's (2005) research on Tiwanaku diasporic colonies provide examples of these communities and their unique group identities. Goldstein (2005) states that Tiwanaku's refugee populations produced new social identities reflecting both the original homeland and new place of residence. Since Caspana dates to this post-Tiwanaku era, it may reflect a refugee population relocating during the stressful post-Tiwanaku collapse, and would, therefore, exhibit clear *altiplano* ties distinct from surrounding groups.

In groups that do not represent distinct ethnic or biological populations, the creation of social boundaries can represent cultural distinctions. However, these fluid boundaries reflect changes in the nature of the relationship between groups over time, and can lead to population fissioning. While frequently inferred as a result of increasing population density, Bandy (2004, p 322, 324) notes that, "in conditions of relatively low population density and relatively egalitarian social organization, conflict can be resolved by splitting the local group," and argues that new settlements are evidence for splitting. Therefore, fissioning resulting from conflicts or resource stress could produce population movement and the creation and presentation of differing social identities. Social boundary construction may clarify the relationship between Caspana and San Pedro de Atacama if the Caspana population was not *altiplano*-derived, but rather its members were distinguishing themselves from a local origin through cranial modification styles, material culture, and mortuary behavior.

CULTURAL HETEROGENEITY THROUGH BIOGEOCHEMISTRY, CRANIAL MODIFICATION, AND MORTUARY BEHAVIOR

Given the complexities of identifying biological and cultural affinities in past populations, we use multiple lines of evidence to examine cultural heterogeneity in San Pedro de Atacama and the upper Loa River Valley. Specifically, we use strontium and oxygen isotope analyses to determine residential mobility and geographic origin; cranial modification styles and mortuary behavior indicate complementary aspects of cultural affinity. We briefly introduce these approaches below.

Biogeochemistry and residential mobility

The two most common methods used to identify archeological human residential mobility measure strontium and oxygen isotope ratios in dental and skeletal elements that formed at different times in an individual's lifetime (e.g., Price et al., 2000; Montgomery et al., 2005). Briefly, strontium substitutes for calcium in the hydroxyapatite in dental and skeletal elements during development (Turekian and Kulp, 1956). Since strontium isotope ratios do not fractionate appreciably, the strontium isotope ratios measured in human enamel and bone reflect the strontium isotope ratios in the food and water consumed; when predominantly local strontium sources are consumed, these strontium isotope values in the human body reflect the biologically available strontium in the geologic region or regions in which an individual lived during enamel or bone formation (see overview in Bentley, 2006).

While strontium isotope signatures in a given ecosystem can reflect the strontium isotope signatures in the underlying bedrock (Faure, 1986), oxygen isotope signatures in meteoric water ($\delta^{18}O_{mw}$) vary according to environmental factors including humidity, elevation, temperature, and latitude (e.g., Craig, 1961a). When body temperature is constant, the oxygen isotope values in hydroxyapatite carbonate ($\delta^{18}O_c$) and phosphate ($\delta^{18}O_p$) reflect the oxygen isotope values in body water, which largely reflect the oxygen isotope values in consumed water sources (Longinelli, 1984; Luz et al., 1984). Many scholars have used oxygen isotope signatures in archeological human enamel and bone to identify residential mobility (e.g., White et al., 2004; Prowse et al., 2007). Both techniques are particularly applicable to the situation considered here.

Finally, carbon isotope signatures ($\delta^{13}C$) reflect paleodiet rather than geographic origin. Because plants utilize carbon according to C_4, C_3, or CAM photosynthetic pathways, different carbon isotope signatures correspond to different plant types (see overviews in Schoeninger and Moore, 1992; Katzenberg, 2000; Lee-Thorp and Sponheimer, 2006; Tykot, 2006). Here, we use $\delta^{13}C_{apatite}$ in tooth enamel to examine childhood diet and the weaning process to better understand the variability in our enamel oxygen isotope signatures, which are affected by ^{18}O enrichment in breast milk, as will be discussed below (e.g. Herring et al., 1998; Wright and Schwarcz, 1998, 1999).

Cranial modification and mortuary behavior

Cranial vault modification and mortuary practices can elucidate the cultural construction of group identity. Ethnicity "has a membership which defines itself, and is identified by others, as constituting a category distinguishable from other categories of the same order," (Barth, 1969, p 11). This implies that group identity is a cultural construction in constant interaction with that of other groups and that cultural differences are strengthened in these interactions (Barth, 1969). Goldstein (2005, p 33) notes for diaspora populations that this "might be marked by distinctions in practice and activities, and thus by stylistic and practice-based ethnic distinctions as well as spatial segregation from other communities." These differences are manifest in cultural practices such as cranial vault modification, which in the Andes appears closely tied to group identity (Blom, 2005; Torres-Rouff, 2007). Similarly, mortuary behavior reflects the values of the living and can reveal aspects of social behavior and group identity (Binford, 1971; Tainter, 1978). Examination of these cultural signifiers allows us to consider the presentation of a group identity independently of biological signatures of identity.

Cultural heterogeneity during the Late Intermediate Period

Through the integration of these perspectives, we hope to elucidate the nature of the culturally constructed differences between the upper Loa River Valley and San Pedro de Atacama populations and explore the possibility of migration or social boundary formation. During the Late Intermediate Period in San Pedro de Atacama, formerly disparate populations consolidated, possibly seeking defensive positioning and safety; settlement pattern changes indicate substantial population aggregations and the construction of fortified sites (Mostny, 1949; Schiappacasse et al., 1989; Llagostera and Costa-Junqueira, 1999). A strong drought coincided with these developments (Ortloff and Kolata, 1993; Erickson, 1999) and likely caused resource stress in the already environmentally marginal societies of the Atacama (Berenguer, 2004). Socially and politically, the collapse of the influential Tiwanaku polity and the concomitant loss of the Middle Horizon's characteristic affluence (ca. AD 500–1,100) resulted in cultural restructuring in much of the Andes (Parsons and Hastings, 1988; Conlee et al., 2004).

Although the earlier Middle Horizon appears relatively homogeneous, archeologists hypothesize that the Late Intermediate Period was a time of cultural heterogeneity resulting from migrations, possibly from the *altiplano*, after Tiwanaku's fall and the concurrent environmental stress (Uribe Rodríguez et al., 2004). Atacameños likely inhabited San Pedro de Atacama, while a foreign group may have occupied the Loa River Valley (see Fig. 1). Archeological and ethnographic evidence, including the construction of *altiplano*-style stone burial towers (*chullpas*), some nonlocal ceramic types, and the presence of Quechua and Aymara speakers, suggests an *altiplano* origin for the Loa River Valley population (Castro et al., 1984). However, it is unclear if upper Loa River Valley sites such as Caspana represent foreign enclaves in the Late Intermediate Period (see Fig. 2). To explore this, we examine geographic origin through biogeochemistry, while analyses of cranial modification patterns and mortuary behavior allow us to explore the presentation of cultural identity.

ISOTOPE SIGNATURES IN THE SOUTH CENTRAL ANDES

Andean geologic and environmental variability enables us to use strontium and oxygen isotope analyses to test the hypothesis that the individuals buried at Caspana were first-generation migrants from the *altiplano*. The upper Loa River Valley, where Caspana is, and the San Pedro de Atacama oases are located in a geologic zone composed predominantly of late Cenozoic volcanic rocks such as andesites (e.g. O'Callaghan and Francis, 1986; Rogers and Hawkesworth, 1989). In the San Pedro de Atacama region, exposed bedrock samples exhibit mean $^{87}Sr/^{86}Sr = 0.70646 \pm 0.00020$ (1σ, $n = 8$) (Rogers and Hawkesworth, 1989) and andesites from the San Pedro and San Pablo volcanoes have mean $^{87}Sr/^{86}Sr = 0.70653 \pm 0.00036$ (1σ, $n = 16$) (Francis et al., 1977). In contrast, the strontium isotope ratios in the Bolivian *altiplano* and the Lake Titicaca Basin are much higher, where mean $^{87}Sr/^{86}Sr = 0.70834 \pm 0.00013$ (1σ, $n = 3$) in Lake Titicaca surface water (Grove et al., 2003). This reflects the Paleozoic andesites, sandstones, red mudstones, and alluvial deposits (e.g. Argollo et al., 1996). Finally, to determine the biologically available strontium isotope signatures in the Lake Titicaca Basin and the San Pedro de Atacama region (see Price et al., 2002; Evans and Tatham, 2004), K.J. Knudson examined the strontium isotope ratios in modern and archeological small mammals who consumed strontium from local sources (Table 1) (Knudson et al., 2005; Knudson and Price, 2007). These data correspond well with the geologic data from the region, and demonstrate the differences in strontium isotope signatures in the study region, particularly in the San Pedro de Atacama oasis and the neighboring *altiplano*.

While the number of baseline samples for strontium isotope analysis in the South Central Andes is growing,

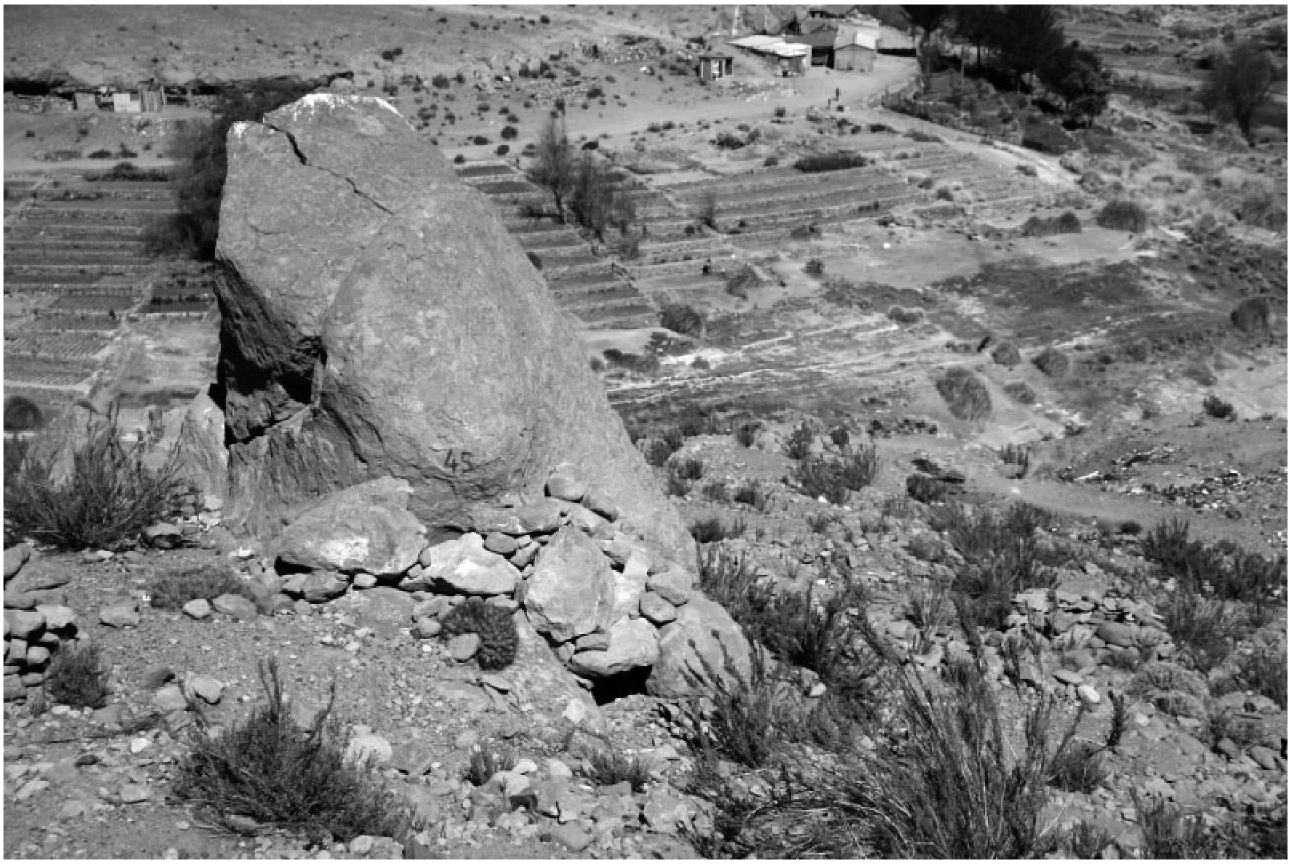

Fig. 2. Photograph of tomb 45 at Caspana demonstrating characteristic mortuary placement beneath large stones (Photograph by Jason Krantz).

this region has not seen as many mobility studies utilizing light stable isotopes (e.g., Tomczak, 2003; Knudson and Price, 2007). However, there are differences in elevation, precipitation, temperature, and amounts of glacial ice in the *altiplano* and the hyper-arid and lower-altitude San Pedro de Atacama region (e.g., Messerli et al., 1993; Wolfe et al., 2001; Núñez et al., 2002). Precipitation in the *altiplano* city of La Paz, Bolivia, exhibited $\delta^{18}O_{mw\ (V\text{-}SMOW)} = -13.3$ to -10.8‰ between 1996 and 2001 and oxygen isotope values in Lake Titicaca Basin surface water were $\delta^{18}O_{mw\ (V\text{-}SMOW)} = -17.6$ to -12.6‰ (IAEA/WMO, 2006). We hypothesize that $\delta^{18}O_{mw\ (V\text{-}SMOW)}$ will be higher in San Pedro de Atacama and the Loa River Valley (Wolfe et al., 2001). For example, precipitation in the Andes of northern Argentina exhibits $\delta^{18}O_{mw\ (V\text{-}SMOW)} = -3.5$ to -6.9‰ in 1981–1982 in Cerro Ancasti (IAEA/WMO, 2006). Current evidence suggests that the paleoclimate in the Lake Titicaca Basin, southern *altiplano*, and the San Pedro de Atacama region during the Late Intermediate Period was not significantly different than current conditions (Messerli et al., 1993; Núñez et al., 2002), with the exception of a major *altiplano* drought at the end of the Middle Horizon and beginning of the Late Intermediate Period (Thompson et al., 1985; Ortloff and Kolata, 1993; Binford et al., 1997). Since the *altiplano* currently receives ~200 mm of rainfall per year while the San Pedro de Atacama region receives less than 20 mm of precipitation per year (Núñez et al., 2002), we hypothesize that differences in oxygen isotope signatures between the two regions will be apparent even in the face of an *altiplano* drought.

Finally, using isotopic signatures in archeological tooth enamel and bone to elucidate residential mobility is only successful when the retention of biogenic isotopic values can be demonstrated. Numerous studies have demonstrated the resistance of archeological enamel to diagenetic contamination (e.g. Budd et al., 2000; Hoppe et al., 2003; Lee-Thorp and Sponheimer, 2003). Mechanical cleaning can minimize diagenetic contamination, which can also be monitored (e.g. Lambert et al., 1991). In the arid San Pedro de Atacama region, where some individuals are naturally mummified and there is excellent preservation of organic materials, previous studies have demonstrated biogenic isotopic values in both human enamel and bone (Knudson, 2007; Knudson and Price, 2007).

MATERIALS

The Caspana cemetery, located on the Salado River, a Loa River tributary, was excavated in the 1950s (Le Paige, 1956). The Caspana collection, housed at the Museo Arqueológico R.P. Gustavo Le Paige in San Pedro de Atacama, consists of 66 well-preserved crania analyzed by C. Torres-Rouff (Table 2). As a result of earlier collection strategies, no postcranial remains were available for study. K.J. Knudson collected samples for biogeochemical research using a sampling strategy designed to reflect the age and sex composition of the cemetery

TABLE 1. Strontium isotope data for archeological and modern fauna samples from the study regions

Region (site)	Laboratory number	Specimen number	Material	Corrected $^{87}Sr/^{86}Sr^{a,b}$
San Pedro de Atacama (Quitor)	F1635	QT6-0018	*Akodon* sp. (archeological, bone)	0.707659[a]
San Pedro de Atacama (Quitor)	F1636	QT6-0033	*Canis familiaris* (archeological, bone)	0.707762[a]
San Pedro de Atacama (San Pedro de Atacama)	F1714	SPA-0001	*Cavia porcellus* (modern, bone)	0.707511[a]
Southern *Altiplano* (Potosi)	F2778	POT-0001	*Cavia porcellus* (modern, bone)	0.713233[a]
Southern *Altiplano* (Potosi)	F2779	POT-0002	*Cavia porcellus* (modern, bone)	0.720503[a]
Titicaca Basin [Desaguadero Valley (Khonkho Wankane)]	ACL-0252	KW-U7.19N2	*Galea musteloides* (archeological, bone)	0.70872
Titicaca Basin [Desaguadero Valley (Khonkho Wankane)]	ACL-0254	KW-U7.11N4	*Galea musteloides* (archeological, bone)	0.70877
Titicaca Basin [Desaguadero Valley (Khonkho Wankane)]	ACL-0255	KW-5407	*Ctenomys leucodon* (archeological, bone)	0.70877
Titicaca Basin [Desaguadero Valley (Khonkho Wankane)]	ACL-0256	KW-5259	*Ctenomys leucodon* (archeological, bone)	0.70918
Titicaca Basin [Desaguadero Valley (Khonkho Wankane)]	ACL-0257	KW-5259	*Ctenomys leucodon* (archeological, bone)	0.70894
Titicaca Basin [Katari Valley (Lukurmata)]	F1025	LKM-002A	*Cavia porcellus* (modern, bone)	0.710561[a]
Titicaca Basin [Taraco Peninsula (Chiripa)]	F1024	CHIR-001A	*Cavia porcellus* (modern, bone)	0.709291[a]
Titicaca Basin [Taraco Peninsula (Chiripa)]	F1235	CHIR-002A	*Cavia porcellus* (modern, bone)	0.70936
Titicaca Basin [Tiwanaku Valley (Achuta)]	F1717	TIW-006A	*Cavia porcellus* (modern, bone)	0.709304[a]
Titicaca Basin [Tiwanaku Valley (Achuta)]	F1912	TIW-005A	*Cavia porcellus* (modern, bone)	0.709877[a]
Titicaca Basin [Tiwanaku Valley (Achuta)]	F1916	TIW-006B	*Cavia porcellus* (modern, bone)	0.70936
Titicaca Basin [Tiwanaku Valley (Tiwanaku)]	F1026	TIW-001A	*Cavia porcellus* (modern, bone)	0.709562[a]
Titicaca Basin [Tiwanaku Valley (Tiwanaku)]	F1718	TIW-0007	*Cavia porcellus* (modern, bone)	0.709545[a]
Titicaca Basin [Tiwanaku Valley (Yanarico)]	F1715	TIW-003A	*Cavia porcellus* (modern, bone)	0.709545[a]
Titicaca Basin [Tiwanaku Valley (Yanarico)]	F1913	TIW-003B	*Cavia porcellus* (modern, bone)	0.71016
Titicaca Basin [Tiwanaku Valley (Yanarico)]	F1914	TIW-004A	*Cavia porcellus* (modern, bone)	0.70969

[a] Strontium isotope analysis of these samples were performed by P.D. Fullagar at the University of North Carolina at Chapel Hill and published previously (Knudson and Price, 2007; Knudson et al., 2005); all others were analyzed by K.J. Knudson and G. Gordon at Arizona State University.

[b] In San Pedro de Atacama, mean $^{87}Sr/^{86}Sr = 0.70764 \pm 0.00013$ (1σ, $n = 3$) for archeological and modern fauna. In the Lake Titicaca Basin, mean strontium isotope data from modern and archeological fauna is available from the following areas: Tiwanaku Valley [mean $^{87}Sr/^{86}Sr = 0.70963 \pm 0.00028$ (1σ, $n = 8$)], Desaguadero (Machaca) Valley [mean $^{87}Sr/^{86}Sr = 0.70888 \pm 0.00019$ (1σ, $n = 5$)], Katari Valley ($^{87}Sr/^{86}Sr = 0.710561$, $n = 1$), and Taraco Peninsula ($^{87}Sr/^{86}Sr = 0.709291$–$0.70936$, $n = 2$) (Knudson and Price, 2007).

TABLE 2. The skeletal sample from Caspana, Chile[a]

	Juvenile	Young adult	Middle adult	Old adult	Adult	Total
Female	0	9	7	6	0	22
Probable female	0	2	2	4	1	9
Indeterminate	5	0	0	0	2	7
Probable male	0	1	9	3	0	13
Male	0	3	9	3	0	15

[a] Age was based on analyses of cranial suture closure and dental wear and individuals were grouped into the following large age categories: juvenile (0–18 years), young adult (18–30 years), middle adult (30–40 years), old adult (40 or more years), and adult when no specific age group could be determined. Sex was determined based on the sexually dimorphic features of the skull.

TABLE 3. Bioarcheological data for archeological human remains from Caspana, Chile, included in isotopic analyses

Site	Specimen number	Feature number	Burial number	Age[a]	Sex[a]	Cranial modification[b]
Caspana	CAS-0006	11645	6	YA	F	Unmodified
Caspana	CAS-0013	11649	13	18–20 years	F	Annular oblique
Caspana	CAS-0015	11613	15	YA	M	Annular erect
Caspana	CAS-0020	11642	20	18–20 years	F	Annular oblique
Caspana	CAS-0021	11651	21	MA	M	Annular oblique
Caspana	CAS-0022	11618	22	YA	PF	Tabular oblique
Caspana	CAS-0024	12111	24	YA	M	Annular erect
Caspana	CAS-0026	11604	26	MA	F	Tabular erect
Caspana	CAS-0027	11605	27	YA	F	Tabular oblique
Caspana	CAS-0031	11636	31	OA	F	Annular oblique
Caspana	CAS-0032	11637	32	MA	F	Annular oblique
Caspana	CAS-0033	10999	33	8 years	I	Annular erect
Caspana	CAS-0035	11621	35	MA	F	Annular oblique
Caspana	CAS-0042	11635	42	YA	PF	Tabular oblique
Caspana	CAS-0047	11609	47	YA	F	Tabular oblique
Caspana	CAS-0050	11633	50	YA	PM	Annular oblique
Caspana	CAS-0056	11630	56	MA	M	Annular oblique
Caspana	CAS-0058	11619	58	12 years	I	Annular oblique
Caspana	CAS-0063	12096	63	MA	M	Annular erect
Caspana	CAS-0069	11648	69	YA	F	Annular erect
Caspana	CAS-S/N(11606)	11606	NA	MA	PM	Unmodified

[a] Age and sex estimates were determined by C. Torres-Rouff. Abbreviations are as follows: YA = young adult, MA = middle adult, OA = old adult, F = female, M = male, I = indeterminate sex, PF = possible female, PM = possible male.
[b] Cranial modification was analyzed by C. Torres-Rouff, whose methods are described in the text.

(Table 3). Notably, enamel was collected from multiple dental elements in each individual to examine dietary and mobility patterns throughout an individual's lifetime; strontium samples were prioritized when there was not enough enamel for both strontium and oxygen isotope analysis (Table 4).

METHODS

Strontium, oxygen, and carbon isotope analyses

Enamel samples were prepared in the Archeological Chemistry Laboratory (ACL) at Arizona State University (ASU) using established procedures (e.g. Knudson and Price, 2007). Enamel was collected using a Dremel Mini-Mite equipped with a carbide burr from the buccal or lingual portion of the tooth crown. Strontium isotope ratios were obtained at the Isotope Geochemistry Laboratory at the University of North Carolina at Chapel Hill (UNC) by P.D. Fullagar and at the W.M. Keck Foundation Laboratory for Environmental Biogeochemistry at ASU by K.J. Knudson and G. Gordon. Strontium was separated from the sample matrix with EiChrom SrSpec resin (50–100 μm in diameter). At UNC, strontium isotopes were measured on a VG Sector 54 thermal ionization mass spectrometer (TIMS). Accuracy and precision are demonstrated by recent analyses of international standard SRM-987, where $^{87}Sr/^{86}Sr = 0.710260 \pm 0.000010$ (2σ, $n = 20$), compared to $^{87}Sr/^{86}Sr = 0.710263 \pm 0.000016$ (2σ) (Stein et al., 1997). At ASU, strontium isotopes were measured on a Neptune multi-collector inductively coupled plasma mass spectrometer (MC-ICP-MS), where SRM-987 exhibited $^{87}Sr/^{86}Sr = 0.710265 \pm 0.000010$ (2σ, $n = 25$).

Carbon and oxygen isotope samples of enamel hydroxyapatite carbonate ($\delta^{13}C_c$, $\delta^{18}O_c$) were prepared in the ACL using established procedures (Koch et al., 1997). Enamel samples were treated with a 2% NaOCl (bleach) solution for 24 h followed by treatment with 0.1 M CH_3COOH (acetic acid) for 24 h. Carbon and oxygen isotope data were obtained at the W.M. Keck Foundation Laboratory for Environmental Biogeochemistry at ASU by H. Williams under the direction of K.J. Knudson and S. Klonowski using a Thermo-Finnigan DeltaPlus isotope ratio mass spectrometer (IRMS) with a GasBench interface. Replicates of NBS-19 resulted in a reproducibility of ±0.2‰ for $\delta^{18}O$ and ±0.3‰ for $\delta^{13}C$, where $\delta^{18}O_c$ and $\delta^{13}C_c$ are reported relative to the V-PDB (Vienna PeeDee belemnite) carbonate standard and are expressed in per mil (‰) using the following standard formula: $\delta^{18}O = \{[(^{18}O/^{16}O_{sample})/(^{18}O/^{16}O_{standard})] - 1\} \times 1{,}000$ (Craig, 1961b; Coplen, 1994). When necessary, the following conversion equations were used to convert $\delta^{18}O_{VPDB}$ to $\delta^{18}O_{V\text{-}SMOW}$ and $\delta^{18}O_{dw}$ values:

TABLE 4. Biogeochemical data for archeological human remains from Caspana, Chile

Site	Laboratory number	Specimen number	Feature number	Dental element[a]	Corrected $^{87}Sr/^{86}Sr$	$\delta^{18}O_{c\ (V\text{-}PDB)}$	$\delta^{13}C_{c\ (V\text{-}PDB)}$
Caspana	ACL-0082	CAS-0006	11645	URC1	0.707614[b]	NA	NA
Caspana	ACL-0083	CAS-0006	11645	URM2	0.707597[b]	NA	NA
Caspana	ACL-0084	CAS-0013	11649	URM2	0.707678[b]	NA	NA
Caspana	ACL-0085	CAS-0013	11649	URM3	0.707629[b]	−4.9	−6.0
Caspana	ACL-0086	CAS-0015	11613	URM1	0.707701[b]	−3.3	−7.2
Caspana	ACL-0087	CAS-0015	11613	URM2	0.707722[b]	NA	NA
Caspana	ACL-0088	CAS-0020	11642	URM3	0.707589[b]	NA	NA
Caspana	ACL-0089	CAS-0021	11651	URM3	0.707696[b]	−4.5	−6.6
Caspana	ACL-0091	CAS-0022	11618	URM3	0.707740[b]	NA	NA
Caspana	ACL-0092	CAS-0024	12111	URP1	0.707698[b]	NA	NA
Caspana	ACL-0093	CAS-0024	12111	URM3	0.707706[b]	NA	NA
Caspana	ACL-0094	CAS-0026	11604	URM2	0.70706	NA	NA
Caspana	ACL-0095	CAS-0027	11605	URP2	0.70767	NA	NA
Caspana	ACL-0097	CAS-0027	11605	URM3	0.70964	−4.6	−5.7
Caspana	ACL-0098	CAS-0031	11636	URM1	0.70769	−3.3	−9.6
Caspana	ACL-0099	CAS-0032	11637	URM2	0.70762	−4.1	−9.3
Caspana	ACL-0100	CAS-0032	11637	URM3	0.70750	−4.7	−8.4
Caspana	ACL-0101	CAS-0033	10999	ULM1	0.70769	−3.4	−6.5
Caspana	ACL-0102	CAS-0035	11621	URM2	0.70759	−3.7	−4.3
Caspana	ACL-0103	CAS-0042	11635	URP2	0.70770	−4.6	−5.6
Caspana	ACL-0104	CAS-0042	11635	URM1	0.70767	−3.5	−5.9
Caspana	ACL-0105	CAS-0047	11609	URM3	0.70770	−3.3	−7.0
Caspana	ACL-0106	CAS-0050	11633	ULM3	0.70764	NA	NA
Caspana	ACL-0107	CAS-0056	11630	LRP1	0.70768	−3.6	−6.3
Caspana	ACL-0108	CAS-0056	11630	LLM2	0.70768	NA	NA
Caspana	ACL-0109	CAS-0058	11619	ulm1	0.70770	NA	NA
Caspana	ACL-0110	CAS-0063	12096	LLM2	0.70770	NA	NA
Caspana	ACL-0111	CAS-0069	11648	URC1	0.70767	−2.9	−6.4
Caspana	ACL-0112	CAS-0069	11648	URM2	0.70767	−3.5	−5.6
Caspana	ACL-0113	CAS-S/N(11606)	11606	ULM2	0.70768	−4.1	−6.6

[a] Dental elements collected by K.J. Knudson are abbreviated as follows: ULM2 = upper left second molar, URC1 = upper right first canine, ulm1 = deciduous upper left first molar.
[b] Strontium isotope analysis of these samples were performed by P.D. Fullagar at the University of North Carolina at Chapel Hill; all others were analyzed by K.J. Knudson and G. Gordon at Arizona State University.

$$\delta^{18}O_{V\text{-}SMOW} = (1.03091 \times (\delta^{18}O_{VPDB})) + 30.91 \text{ (Coplen et al., 1983)}$$

$$\delta^{18}O_{VPDB} = (0.97002 \times \delta^{18}O_{V-SMOW}) - 29.98 \text{ (Coplen et al., 1983)}$$

$$\delta^{18}O_{c(V\text{-}SMOW)} = (8.5 + (\delta^{18}O_p))/0.98 \text{ (Iacumin et al., 1996)}$$

$$\delta^{18}O_{p(V\text{-}SMOW)} = (0.78 \times (\delta^{18}O_{dw})) + 22.70 \text{ (Luz et al., 1984) (see also } \delta^{18}O_{p(V\text{-}SMOW)} = (0.64 \times (\delta^{18}O_{dw)}) + 22.37 \text{ (Longinelli, 1984))}$$

Analyses of cranial modification and mortuary behavior

Demographic data were collected following standard protocols (Tables 2 and 3) (Buikstra and Ubelaker, 1994). Cranial modification style was recorded using the broad classification system of Dembo and Imbelloni (1938) and subsequent researchers in the Andes (Tables 3 and 4) (e.g., Munizaga, 1969; Cocilovo and Zavattieri, 1994). Each skull was examined visually for the presence and type of deliberate cranial shaping. Since vault modification relies on the visibility of this social signifier, skulls lacking clear signs of alteration were scored as unmodified. Annular and tabular types were observed, each with an erect and an oblique variant. Annular forms involve the tight binding of the head with fabric bands and create a marked circumferential constriction and an elongated head shape. The more directed pressure of a tabular form results from boards or stiff pads on the anterior and posterior of the skull. This appears as a flattening from front to back with expansion of the parietal region. In both cases, the erect and oblique variants differ in the angle of pressure placed on the back of the skull. This classification system focuses on the visible features of the shaped head as opposed to the nuances visible only in skeletal remains; so, it is particularly appropriate for investigations of identity.

Data on the mortuary context were derived from field notes and cemetery descriptions (Le Paige, 1956). In particular, information on the specifics of tomb construction and structure were considered. Additionally, the goods found with the burials were analyzed; specifically, the type, material, and number of objects in each grave was studied. We focus here on the presence of nonlocal goods in the tombs in addition to the quantity and distribution of these mortuary accompaniments. These data allow for comparison to mortuary practices elsewhere in the Atacama as well as to those in the *altiplano*.

RESULTS

Strontium, oxygen, and carbon isotope data

The Caspana archeological human enamel values have values in the range of $^{87}Sr/^{86}Sr$ = 0.70706–0.70964

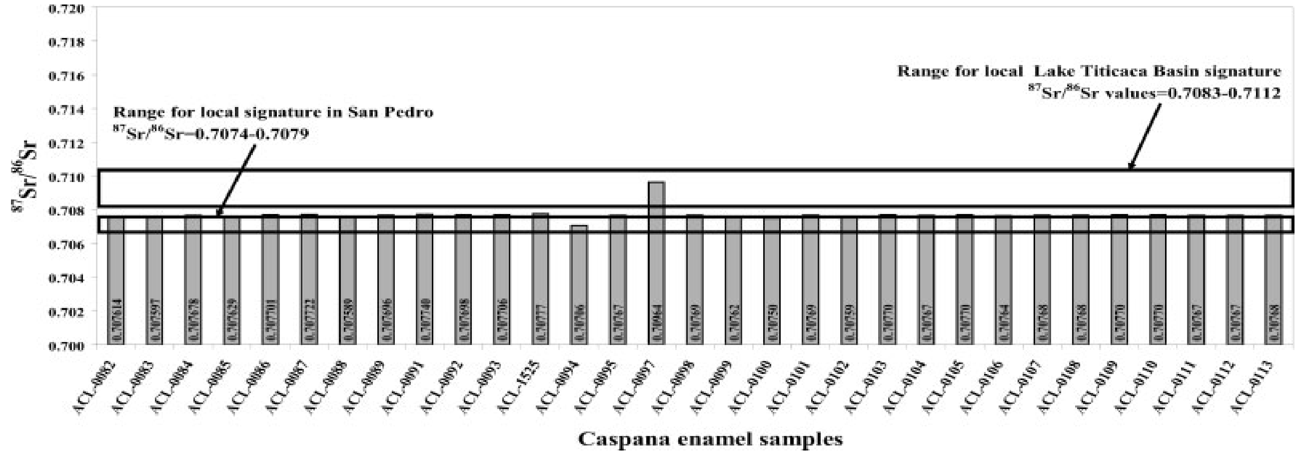

Fig. 3. Strontium isotope data from archeological human tooth enamel from Caspana.

TABLE 5. Cranial vault modification at Caspana, Chile

	Unmodified	Annular erect	Annular oblique	Tabular erect	Tabular oblique
Female[a]	2/21 (9.5%)	3/21 (14.3%)	12/21 (57.1%)	1/21 (4.8%)	3/21 (14.3%)
Probable female	0/9 (0.0%)	5/9 (55.6%)	1/9 (11.1%)	1/9 (11.1%)	2/9 (22.2%)
Indeterminate	0/7 (0.0%)	4/7 (57.1%)	3/7 (42.9%)	0/7 (0.0%)	0/7 (0.0%)
Probable male	1/13 (7.7%)	5/13 (38.5%)	6/13 (46.2%)	0/13 (0.0%)	1/13 (7.7%)
Male	1/15 (6.7%)	7/15 (46.7%)	7/15 (46.7%)	0/15 (0.0%)	0/15 (0.0%)

[a] One female cranium was too fragmented to determine the presence of vault modification (Caspana, Tomb 61, Catalog no. 11616).

(Table 4, Fig. 3), with a mean of $^{87}Sr/^{86}Sr = 0.70771 \pm 0.00038$ (1σ, $n = 30$). The removal of one outlier [ACL-0097, CAS-0027 ($^{87}Sr/^{86}Sr = 0.70964$)] demonstrates that the majority of the individuals sampled exhibit homogeneous strontium isotope ratios, with mean $^{87}Sr/^{86}Sr = 0.70765 \pm 0.00012$ (1σ, $n = 29$). Oxygen isotope data from Caspana are similarly homogeneous, and mean $\delta^{18}O_{c(V\text{-}PDB)} = -3.9 \pm 0.6‰$ (1σ, $n = 16$) (Table 4). Finally, carbon isotope data from Caspana exhibit mean $\delta^{13}C_{c(V\text{-}PDB)} = -6.7 \pm 1.4‰$ (1σ, $n = 16$) (Table 4). Our interpretations of these data will be detailed in the subsequent discussion section.

Cranial modification data

The skeletal sample from Caspana includes 66 crania (Table 2). The presence of cranial vault modification is 92.4% ($n = 61/65$) with no statistically significant difference in the presence of modification between the sexes ($\chi^2 = 0.005$; $df = 1$; $P = 0.943$) (Table 5). Forty-six of the 61 modified individuals had their head shaped in an annular style (Table 5). There is a significant difference between the sexes in type of modification ($\chi^2 = 4.780$; $df = 1$; $P = 0.029$), with only one male showing a tabular form as compared to seven females. Males were more evenly distributed between the annular erect and oblique variants (12 and 13 individuals, respectively) than females (8 and 13 individuals, respectively); however, there was no significant difference ($\chi^2 = 5.400$; $df = 3$; $P = 0.145$).

Mortuary data

Like others in the upper Loa River Valley, Caspana tombs are found under very large stones that mark communal graves including between 3 and 30 burials that may denote kin groupings (see Fig. 2). The Caspana collection derives from eight tombs. It is possible that individuals were added to the graves over time (Le Paige, 1956; Castro et al., 1984), although the skeletal remains were complete and articulated when excavated suggesting that if this occurred it was not a disturbance to those individuals already in the grave. Some communal graves at other upper Loa sites are accompanied by *chullpas* that appear to have had ritual and elite mortuary functions (Berenguer et al., 1982; Castro et al., 1984). To date, no such structures have been found at Caspana, although the arrangements of stones on the graves may suggest a similar ideology. Given the prevalence of *chullpas* in the area, their absence at Caspana may reflect a gap in the archeological record or the reuse of *chullpa* stones in the construction of the modern town of Caspana (Le Paige, 1956).

Despite the communal nature of the graves, the Caspana burials had relatively few artifacts. Those artifacts that were found included two ceramics, approximately a dozen pyro-engraved gourds, a few shells, and textile fragments (Le Paige, 1956). Two snuff trays were found among the graves considered here and display iconography frequently seen in the upper Loa River Valley yet less common outside that area (Torres and Repke, 2006). The gourds found at Caspana are pyro-engraved with animal and geometric forms in the style of the Atacama

TABLE 6. Cranial vault modification in San Pedro de Atacama, Chile

	Unmodified	Annular erect	Annular oblique	Tabular erect	Tabular oblique
Coyo 3	14/33 (42.4%)	0/33 (0.0%)	0/33 (0.0%)	17/33 (51.5%)	1/33 (3.0%)
Yaye 1–4	70/144 (48.6%)	1/144 (0.7%)	7/144 (4.9%)	42/144 (29.2%)	24/144 (16.7%)
Quitor 6 Tardío	10/21 (47.6%)	0/21 (0.0%)	0/21 (0.0%)	4/21 (19.0%)	7/21 (33.3%)

region as well as that of neighboring groups. Ceramics are also of local and Atacameño style. Caspana graves contain few items for personal adornment. The remainder of the mortuary assemblage consists of domestic items and a substantial number of weaving implements. Finally, there is no clear evidence of mortuary objects from the *altiplano*.

DISCUSSION: CULTURAL HETEROGENEITY IN SAN PEDRO DE ATACAMA

Geographic origins at Caspana

Importantly, the strontium and oxygen sources in the diet most likely represent local sources rather than non-local imports. The high-calcium, and high-strontium, foods in the diet likely derive from terrestrial plants and water sources, while oxygen isotopes at Caspana derive from the Loa River, which carries precipitation from higher altitudes. Finally, there is no evidence for the consumption of large quantities of marine foods in the archeozoological record; this is also supported by the majority of the strontium isotope values, which do not exhibit a marine signature of $^{87}Sr/^{86}Sr = 0.7092$ (Veizer, 1989). Since strontium isotope values do not likely derive from the consumption of non-local strontium sources, the strontium isotope data present a population where most of the individuals buried at Caspana lived in the region during enamel formation. Mean Caspana enamel values of $^{87}Sr/^{86}Sr = 0.70765 \pm 0.00012$ (1σ, $n = 29$) are similar to that of modern fauna from the region, which exhibit mean $^{87}Sr/^{86}Sr = 0.70764 \pm 0.00013$ (1σ, $n = 3$) (see Fig. 3). Defining the local range as the mean of the modern faunal values plus and minus two standard deviations, 28 individuals fall within the San Pedro de Atacama area local range ($^{87}Sr/^{86}Sr = 0.7074–0.7079$) and one individual is just below this value [ACL-0094, CAS-0026 ($^{87}Sr/^{86}Sr = 0.70706$)].

Interestingly, there is one clear outlier in this population [ACL-0097, CAS-0027 ($^{87}Sr/^{86}Sr = 0.70964$)] (see Fig. 3). This strontium isotope ratio is consistent with the consumption of large amounts of strontium from marine products, since seawater exhibits $^{87}Sr/^{86}Sr = 0.7092$ (Veizer, 1989), or with an origin in the high-altitude *altiplano* to the north and east. This outlier exhibits a strontium isotope ratio most similar to faunal and human values in the southern Lake Titicaca Basin, such as the Tiwanaku Valley [faunal mean $^{87}Sr/^{86}Sr = 0.70963 \pm 0.00028$ (1σ, $n = 8$)] (Knudson and Price, 2007), although we note that this strontium isotope ratio could also be consistent with the consumption of strontium from a variety of different geologic zones.

Oxygen isotope values also imply that most individuals sampled from Caspana lived there during the first few years of life. For third molars, which are presumably not affected by ^{18}O enrichment in breast milk because they form after weaning between approximately ages 15 and 20 years, oxygen isotope values are higher than precipitation values in the Lake Titicaca Basin, and again point to a local origin for these five individuals [ACL-0085, CAS-0013 ($\delta^{18}O_{dw(V\text{-}SMOW)} = -8.7‰$), ACL-0089, CAS-0021 ($\delta^{18}O_{dw(V\text{-}SMOW)} = -8.0‰$), ACL-0097, CAS-0027 ($\delta^{18}O_{dw(V\text{-}SMOW)} = -8.2‰$), ACL-0100, CAS-0032 ($\delta^{18}O_{dw(V\text{-}SMOW)} = -8.4‰$), ACL-0105, CAS-0047 ($\delta^{18}O_{dw(V\text{-}SMOW)} = -6.1‰$)]. Enamel samples that formed before and during the weaning process are expected to be enriched in ^{18}O, since human breast milk is enriched relative to imbibed water (Roberts et al., 1988). This trend is visible in three enamel pairs from three individuals (Table 4); for example, in CAS-0032, the second molar oxygen isotope value is heavier or less depleted than the third molar oxygen isotope value from the same individual (Table 4). However, this enrichment is not large enough to identify local individuals as first-generation migrants.

Carbon isotope values can be used to better understand the oxygen isotope values and the weaning process, as well as paleodiet at Caspana. The Caspana enamel carbon isotopic signatures reflect a mix of predominantly C_4 with smaller amounts of C_3 carbon sources (Table 4). A comparison of enamel samples that formed at different times in one individual's life shows that the enamel samples that formed after weaning are heavier isotopically and exhibit higher $\delta^{13}C_{c(VPDB)}$ values, and can be used to understand the incorporation of foods during the weaning process. For example, in tooth enamel that formed at different times in individuals CAS-0032 and CAS-0069, the enamel series demonstrates the addition of C_4 foods such as maize with smaller amounts of C_3 foods. While the carbon isotope data from Caspana could also be consistent with the addition of marine products in the diet, the archeozoological data from this inland region and the previously discussed strontium isotope data from Caspana do not point to the consumption of large amounts of marine food. However, this hypothesis could be tested in the future with analyses of carbon and nitrogen isotopes in bone collagen.

Therefore, the isotopic data imply that the majority of the individuals buried at Caspana were not first-generation *altiplano* migrants. This does not fit models of an ethnic enclave of first-generation migrants, although it may reflect a diasporic community inhabited by individuals whose ancestors migrated into the area, or a community of predominantly local inhabitants. To explore possible migration and cultural fissioning in the region, we turn to the signifiers of cultural identity seen in cranial modification and mortuary data.

Cranial modification and cultural identity at Caspana

The Caspana cranial modification data were compared to data from the contemporary San Pedro de Atacama cemeteries of Coyo 3, Yaye 1-4, and Quitor 6 Tardío (Table 6) (Torres-Rouff, 2007). There is no significant difference in the frequency of modification between sites (χ^2 = 2.349; df = 2; P = 0.309) or in modification style (χ^2 = 2.181; df = 4; P = 0.703), although tabular forms are more common (Table 6). The dominant presence of tabular modification in these cemeteries parallels the pattern seen over many centuries in San Pedro cemeteries (Munizaga, 1969; Cocilovo and Costa-Junqueira, 2001). Tabular erect modification predominates at Coyo 3 and Yaye, while tabular oblique forms are more common at Quitor 6, although this could be a manifestation of the small sample size (Table 6). Annular forms are clearly in the minority (4.5%). The consistency of the Late Intermediate Period results with the patterns seen throughout the occupation of the San Pedro oases reflects stability and ethnic continuity in this sample, making it ideal for comparison to Caspana (Torres-Rouff, 2007).

The results from Caspana in presence of modification paint a markedly different picture than those seen in the San Pedro oases. In contrast to the San Pedro cemeteries, a much higher portion of the individuals from Caspana have their heads modified (93.8%, 61/65; Fisher's exact $P \leq 0.0001$) (Tables 5 and 6). Moreover, in addition to the overwhelming presence of vault modification, the homogeneity of the practice is quite pronounced. Fifty-three of the 61 modified individuals at Caspana (86.9%) display annular forms, split nearly evenly between the erect (n = 24) and oblique (n = 29) variants. This is significantly different from the San Pedro sites as a whole, as well as individually (Fisher's exact $P \leq 0.0001$; χ^2 = 120.218, df = 3, $P \leq 0.0001$; respectively). Tabular forms are uncommon, with the erect variant appearing in only two females and the oblique variant in five females and one male at Caspana. It is interesting to note that of the eight individuals with tabular modification, only one is a male, perhaps providing evidence for a practice of female exogamy similar to that proposed for the San Pedro oases (Costa Junqueira and Llagostera, 1994). If these patterns, in part, resulted from exogamy, it is possible that these females were from other villages along the Loa or elsewhere in the Atacama.

Interestingly, when the Caspana data are compared to those from cemeteries in the *altiplano*, they are also distinct. Blom's (2005) analysis of cranial modification, at sites in the Katari and Tiwanaku Valleys of Bolivia, shows a population with patterns that are evocative of those seen at Caspana. In the Katari and Tiwanaku valleys, Blom (2005) finds that the overwhelming majority of individuals had a modified cranium (87/108; 80.6%). Nevertheless, the practice was not as dominant as at Caspana (61/65; 93.8%) and as such is still significantly different (Fisher's exact P = 0.0239). When type of modification is explored, we also see a preference for the use of annular modification in the *altiplano* (46/66; Blom, 2005). Again, this presents a trend that, while similar to the patterns at Caspana (53/61; 86.9%), is still significantly different (Fisher's exact P = 0.0311).

The individual with an outlier strontium ratio [ACL-0097, CAS-0027 ($^{87}Sr/^{86}Sr$ = 0.70964)] at Caspana is a young adult female with tabular oblique modification. The strontium evidence suggests that she spent early childhood in the area before spending time in a region or regions with a higher strontium isotope signature during third molar enamel formation and then ultimately returned to the Caspana area before burial. This is of particular interest since she would have been in the local area when her head was being shaped in this less common form. Nevertheless, like the strontium values, the tabular cranial modification sets her apart from much of her burial population.

The Caspana population used cranial vault modification more consistently and homogenously than the San Pedro inhabitants. While more similar to the *altiplano*, the use of head shaping at Caspana is also different from the patterns seen there. It is evident that these diverse populations employed the cultural practice of head shaping in distinct ways. This fits with the notion of a diasporic community, which "might be marked by distinctions in practice and activities, and thus by stylistic and practice-based ethnic distinctions" (Goldstein, 2005, p 33). Similarly, a fissioned group would likely make efforts to differentiate itself in these highly visible ways (Bandy, 2004). Here, cranial vault modification is an effective tool for stressing group coherence or heterogeneity between different groups.

Mortuary behavior and cultural identity at Caspana

Mortuary behavior, including both the structure of tombs and the style of the burials within them, illuminates other differences and similarities between Caspana and the surrounding region. The communal graves with large stones and clear markers that typify Caspana burials are quite different from those in San Pedro de Atacama. In San Pedro, graves are typically individual pit burials that are occasionally marked with a wooden pole however have no other structure associated with them (Llagostera, 2004). Communal burials are quite rare in the rest of the Atacama (Latcham, 1938), and do not appear in the upper Loa River Valley until the Late Intermediate Period. Earlier burials there resemble the San Pedro pattern (Castro et al., 1984). As such, the construction of the cemetery itself is decidedly different from the regional pattern.

Conversely, the material culture at Caspana and the contemporary San Pedro de Atacama cemeteries is quite similar, and includes objects for dress, economic, and subsistence items. Ceramic assemblages in both areas are predominantly local San Pedro styles with a scattering of foreign objects from throughout the southern Andes (Le Paige, 1956; Costa Junqueira, 1988; Costa Junqueira and Llagostera, 1994). Most of the differences in material culture are likely related to diversity in subsistence strategies. The Caspana graves are notable for their lack of hunting equipment; there are very few axes or bows and arrows, objects that are prevalent in the San Pedro oases. The snuff trays from Caspana do not display iconography that reflects outside influence in the Loa Region. The only object of potentially foreign origin is a pyro-engraved gourd with designs resembling those from northwest Argentina (Le Paige, 1956). Finally, the Caspana graves contain fewer items of adornment or personal goods than those in the San Pedro area. Nevertheless, the material culture illuminates general areas of similarity between the groups.

CONCLUSION

In this paper, we have demonstrated the ability of appropriately contextualized isotopic data to contribute to the elucidation of the complex relationships between biological and cultural identity in the past. Based on strontium and oxygen isotope analyses of archeological human enamel from Caspana, the mortuary population was predominately local, with the exception of one individual. Importantly, the Caspana population does not appear to consist of first-generation migrants from the *altiplano*, as had been hypothesized based on archeological and ethnographic data. In addition, the information presented here indicates that burial patterns were quite distinct between the inhabitants of Caspana and San Pedro. Therefore, it would seem that while these populations shared material culture, distinctions are most visible in the ideological or social realm represented through mortuary practice and body modification. Moreover, some of the differences are stressed in the style of burial. Burials in the San Pedro oases, which are typically single people and accompanied by mortuary goods including items of personal adornment, convey a sense of individuality that is not seen in large communal burials like those of Caspana. Together with the homogeneity seen in cranial shaping, this may suggest that the people of Caspana had a different way of conceptualizing the individual.

While our isotope and mortuary artifact data reveal a predominantly local population, this is in contrast to the data from examination of cranial modification and burial patterns. Interestingly, these cultural practices suggest a group that differentiated itself from the surrounding populations. Clearly, in this context, there is no simplistic relationship between biological and cultural identity. We argue that rather than representing a group of *altiplano* migrants, as has been hypothesized in the archeological literature, this population from Caspana had existed in the region for some time and shared material culture styles with the neighboring San Pedro oases. However, a close analysis of our data suggests cultural heterogeneity and possibly cultural fissioning in this population. This boundary maintenance is reflective of the significant changes in the social environment during the Late Intermediate Period.

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