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The Aconcahua obsidian source and its relation to south central Andean exchange systems

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Obsidian is a highly prized raw material used for the production of prehistoric tool types throughout the world. Because of its predicable fracturing characteristics and its amazing sharpness, artifacts made from obsidian are often transported over long distances. Conveniently, individual obsidian sources and the artifacts derived from them can be identified by specific chemical fingerprints making obsidian analysis one of the best analytical tools for defining prehistoric exchange networks.

History of research

In 1977 Richard Burger and Frank Asaro published an obsidian study using x ray fluorescence and instrumental neutron activation or INA, identifying several obsidian source types in the central and south central Andes. Their work included 251 obsidian samples from16 Titicaca basin sites and demonstrated that three obsidian types were used in the region. They labeled the main two types the Cuzco Type and the Titicaca Basin Type, and the third, a rare type they called Tumuku. In their study, different source types were found at preceramic sites, suggesting that traffic in obsidian occured at least as early as this broadly defined period.

Karen Chavez (1980), actually the first to use the INA technique on Peruvian obsidian, provides a more definite chronology for Titicaca basin obsidian use. Her work at Marcavalle, Pikicallapata

and Qaluyu documented Early Horizon obsidian exchange of the Cuzco and Titicaca basin types between the Cuzco and northern Titicaca region. Her data show that Titicaca basin type obsidian was in use at Qaluyu by as early as 1400 BC and at Pikicallapata by as early as 1200 BC. Similarly, the Cuzco type was found at Qaluyu by 1200 BC, showing that at least by this time an exchange system linked the two regions.

In 1994 Michael Glascock and Martin Giesso concluded an INA analysis of 87 obsidain artifacts from Tiwanaku and sites in its hinterland, including Chiripa. Their study shows that 10 separate obsidian source types were in use at sites in the Tiwanaku core area, five of these were rare types and that the Titicaca Basin Type was the most common. Obsidian samples submitted from Chiripa in their study were predominately from Middle Horizon contexts and all were of the Titicaca basin type. Given Tiwanku's size and the extent of its influence it's not suprising that heartland sites contain a relatively high number of obsidian source types or that obsidian came to them from as far as 800km away.

Two years ago Sarah Brooks (Brooks and Glascock 1996) presented a paper here showing that the source of the Titicaca basin type obsidian was located in the in the Colca river valley. She named the source Cotayayi, which will hereafter be referred to as the Colca source. Based on obsidian hydration dates from worked material found at the quarry a tentative date of 10,000BC. was assigned for its initial use. Although the site is the source of the majority of obsidian at Titicaca basin sites, she found no evidence that it was directly controlled by foreign groups.

The above mention studies demonstrate that many obsidian types were in circulation in the and South Central Andes and although many sources have not been located, the existence of long distance exchange systems have been confirmed. Although information concerning obsidian source identification and distribution is rapidly progressing, a fundamental question addressed here is at what point in prehistory were obsidian exchange systems in place and what role did obsidian play in the evolving economies of south Central Andean peoples.

Aconcahua Source

While engaged in my dissertation research, I was able to collect an obsidian source within the Titicaca basin, one initially spotted by a group of geologists gold prospecting throughout the region. At the time, I thought that given the source's proximity to Tumuku it was a likely candidate for being the Rare Tumuku type defined by Burger and Asaro.

The Aconcahua source is located on an extinct volcano with the same name approximately 22 km southwest of Mazo Cruz (figure 1). At an altitude of 5000 m.a.sl. obsidian can be seen here eroding out of a saddle covering an area of about one hectare, with nodules extending downslope. Because of the difficulty of reaching the source and its remote location I was unable to conduct a detailed survey of the area. There are therefore, no archaeological sites known at this time associated with the source area. However, worked nodules were collected on the hill slopes of the site which suggested an initial indication that the source was used prehistorically.

The Data

Eleven source samples and 63 obsidian artifacts from archaeological sites within and bordering the Titicaca basin were submitted for INA analysis at the University of Missouri. Mark Aldenderfer contributed 6 artifacts from Asana (figure 1), located in the upper Osmore valley 37 from Quelcatani (figure 1), sitauted near the Aconcahua source and 4 surface samples from his Rio Ilave survey project. Aldenderfer's material is derived from well dated excavation levels ranging in time from the Early to Late Archaic at Asana and from the Middle Archaic through the Late Horizon at Quelcatani. Chip Stanish supplied 2 artifacts from Formative period contexts at TumaTumani (figure 1), and three surface artifacts from the Island of the Sun (Figure 1). Lee Steadman provided 4 samples from Camata (Figure 1), excavated from Late Archaic through Formative Period levels. Six samples from the Late Intermediate period site of Cutimbo (Figure 1), were included from my excavations of domestic structures there.

Source material was irradiated with the both abbreviated method, which measures seven chemical elements and the long form, which measures 27 elements. The long treatment revealed that the Aconcahua material represents a new obsidian source different from other known compositional groups in central and south central Andes (Figure 2 and see Figure 10). However as Figure 3 demonstrates, several elements defining the Aconcahua a source overlap with both the Andahuaylas A and B types as well as the Cuzco type. This similarity of compositional elements made it difficult to differentiate between the several source types when only the short irradiation form was used (Figure 4).

For this reason, 12 artifacts needed the long treatment. Of these, four turned out to be Colca obsidian and two were from the Aconcahua source. One artifact, KF007 (see Figure 5) was different from all other known obsidian types. Two of the remaining five artifacts proved to be the Alca type. Three artifacts are similar in all but two element counts to the Alca Type suggesting to Glascock that they may be from a source nearby it. Importantly, Glascock compared the chemical signature of these three artifacts to the rare Tumuku obsidian type and found them to be one and the same and has designated them the possible Alca-2 type. In general however, as Figure 6 shows, the overwhelming majority of the archaeological samples proved to be from the Colca canyon source.

Our analysis is important however, because unlike previous works it provides a basis for evaluating the movement of obsidian both through space and depth of time (Figure 7). Although Asana was probably occupied as early as 8000BC, the first Colca obsidian there dates to ca. 6900BC. At Quelcatani, the earliest dated obsidian, significantly, is from the our unknown source dating to 5200BC. Colca obsidian appears at Quelcatani by 3600BC, substantially later than at Asana. Given its proximity to Quelcatani, it is curious that the Aconcowa source appears relatively late in the sequence. Also, the source is represented by only two archaelogical artifacts, both from Quelcatani, one appearing at 400BC and the other at 0 AD. The possible Alca-2 type was in use at Quelcatani by ca.1000BC, two hundred years later than the Alca type shows up at Qaluyu to the northeast. The surface obsidian from the Ilave survey zones was also from the Colca source and is associated with Late Archaic and Early Formative period sites. On the lake, Colca obsidian came from

preceramic levels dating between 1750-1200BC at Camata and substantially later in time, probably between 200BC and 400AD at TumaTumani. At present, we have no absolute dates for early obsidian use from the Island of the Sun. Of the three pieces submited two were from the Colca source.

These data show that, in addition to being the most prevalent, the Colca valley obsidian was also the earliest material used. Although the Aconcahua source is geographically closer to all the study sites , it as well as the other represented types all occur in much smaller frequencies and date to later periods. There are several possible explanations for this: 1) the local Aconcahua source was discovered relatively late; 2) the Aconcahua material was not good quality; 3) Colca obsidian was of superior quality or 4) having Colca obsidian was part of economic behavior that valued trading for exotic obsidian rather than using locally available material.

Based on our obsidan analysis and absolute dates we propose three possible early obsidian exchange networks for the south central Andes (Figure 8). The first is a coastal network where obsidian was moved through indirect access mechanisms including down line trade, exchange and barter. This network has obsidian originating at the Colca source moving down the Rio Colca to and along the coast and up various western valleys an d into the Titicaca basin. The second or Sierra route, has Colca obsidian traveling along the Colca southward and moving through the Rio Tambo and Corlaque river systems to near Lago Viscacha and from there west to the coast and eastward through the Rio Ilave drainage to the lake. We also suggest a third, or Altiplano route, one that leaves the Colca and heads straight to the Altiplano. Given the dates associated with

the occurance of the Colca obsidian at the study sites (Figure 9), we favor the coastal route as comprising the earliest obsidian exchange network in the region. However, the existence of other lines of movement, including the Sierra route, cannot be ruled out. The fact that the earliest dated obsidian at Quelcatani is from an unknown source and that the Colca material appears there much later than it does at Asana suggests that obsidan may have reached the site via other routes.

Based on the geographical proximity of the Colca source and the dates of its distribution to northern basin sites it is likely that an Altiplano route developed sometime during the Formative Period. This supposition is supported by Kidder's observation that obsidian was abundant at Pucara, perhaps enhancing its position as an important exchange nexus. However, an important observation must be added here, obsidian at the majority of western lakeside Formative period sites is rare, occurring in the form projectile points, might be explained partly because the importance of hunting was declining or, if warfare was occurring, as is suggested by iconographic images of trophy heads on pottery and sculpture from Pucara, obsidian use may have been reserved for elites and/or associated with ritualistic behavior.

In contrast, Formative occupation levels, at least at Quelcatani, show a marked increase in obsidian point production and associated debitage, much more than would have been required for hunting alone. Increased obsidian point production in the interior region may have been the result of expanded trade with finished points going to lakeside sites, the result of status competition between accumulators, or the result of an increase in warfare associated with territorial

conflicts between more closely packed groups. Although as yet unclear, it appears that obsidian played an important role in the evolving economies of Titicaca basin groups through time.

In conclusion:

1) We have shown that the antiquity of south central Andean obsidian exchange networks extends much farther back in time than was previously demonstrated.

2) The Anconcahua source, though it must be designated a rare type, has been added to the number of known obsidian sources in the region, as well as another rare type whose location remains to be found. Also, we have shown that the Tumuku rare type defined by Burger likely originated in the same area as the Alca source.

3) Our data support a model of an early obsidian exchange system originating in the Colca valley linking it to the Osmore drainage and the western Titicaca basin. Through time, other obsidian trade routes may have developed including an Altiplano route which may emerged sometime in the Formative Period.

4) We suggest that during the Formative Period, obsidian use may be very different at sites near the lake than it is at sites located in the interior region.

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Important archaeological sites mentioned in text

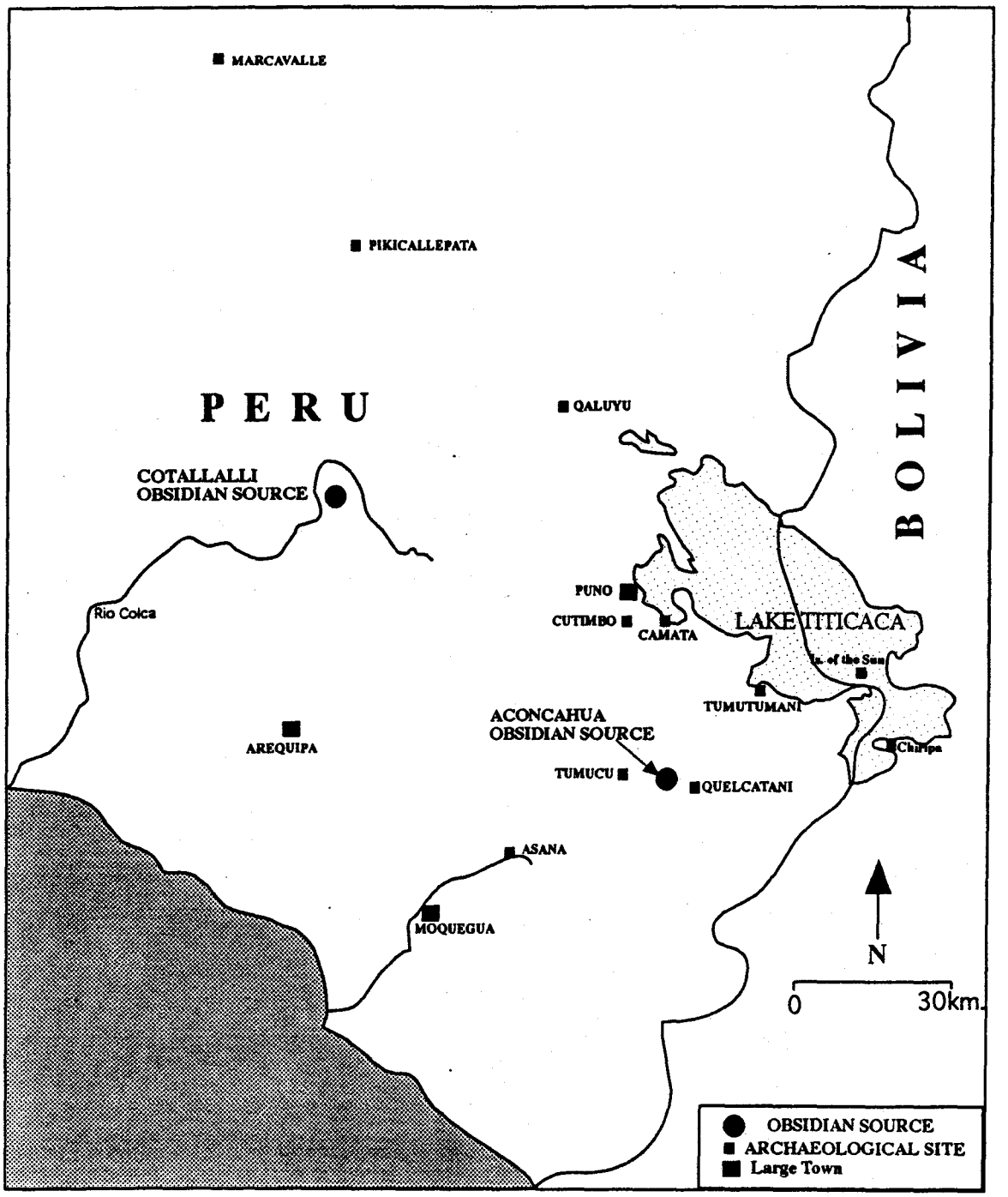
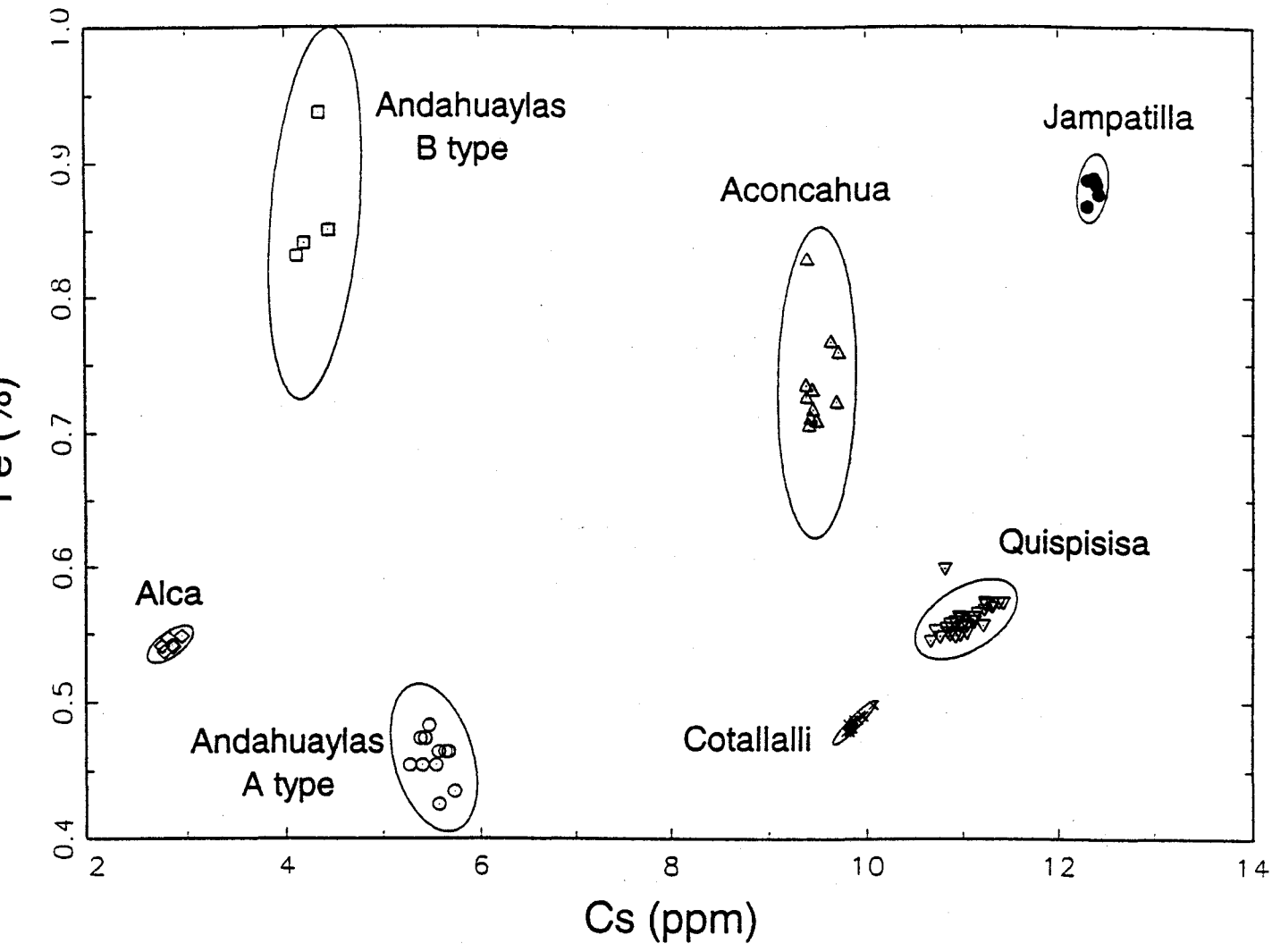


fig. 1


Andahuaylas
B type
Jampatilla
Aconcahua
Quispisisa
Alca
Andahuaylas
A type
Cotallalli
1.0
0.9
0.8
0.7
0.6
0.5
0.4
2
4
6
8
10
12
14
Cs (ppm)

g. 2

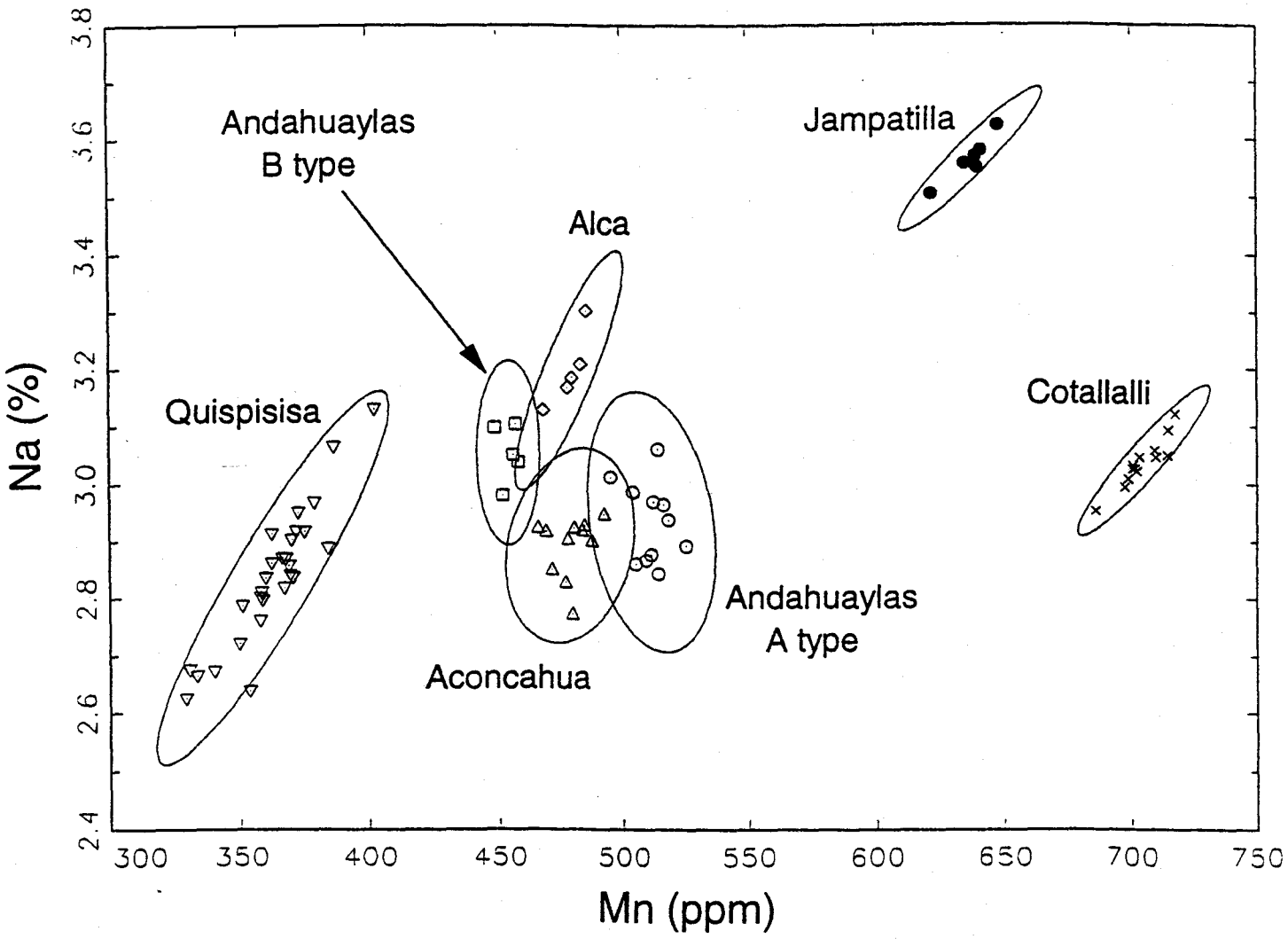

Andahuaylas
B type
Alca
Jampatilla
Quispisisa
Cotallalli
Andahuaylas
A type
Aconcahua
Na (%)
Mn (ppm)
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
300
350
400
450
500
550
600
650
700
750

Fig. 3

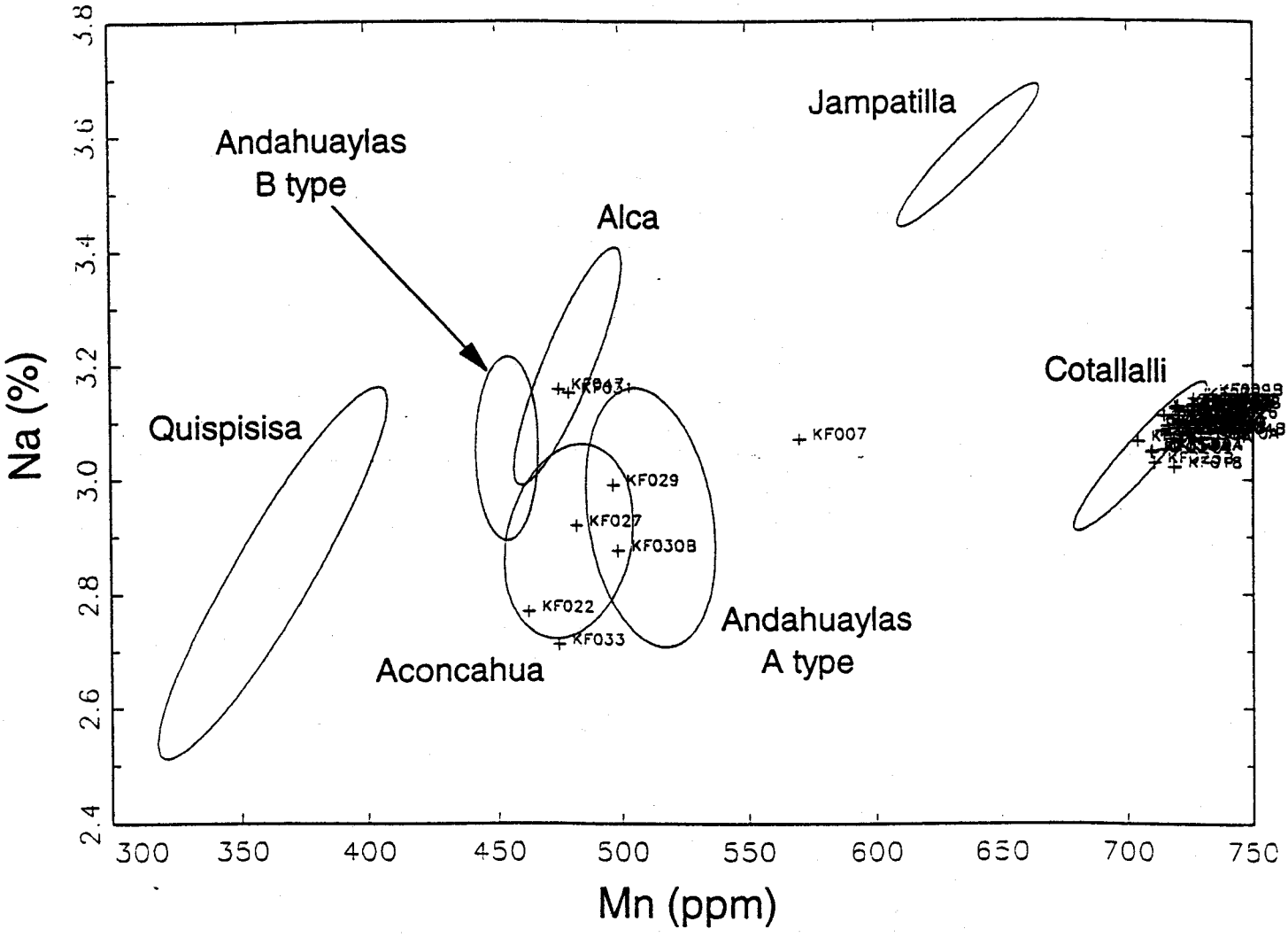
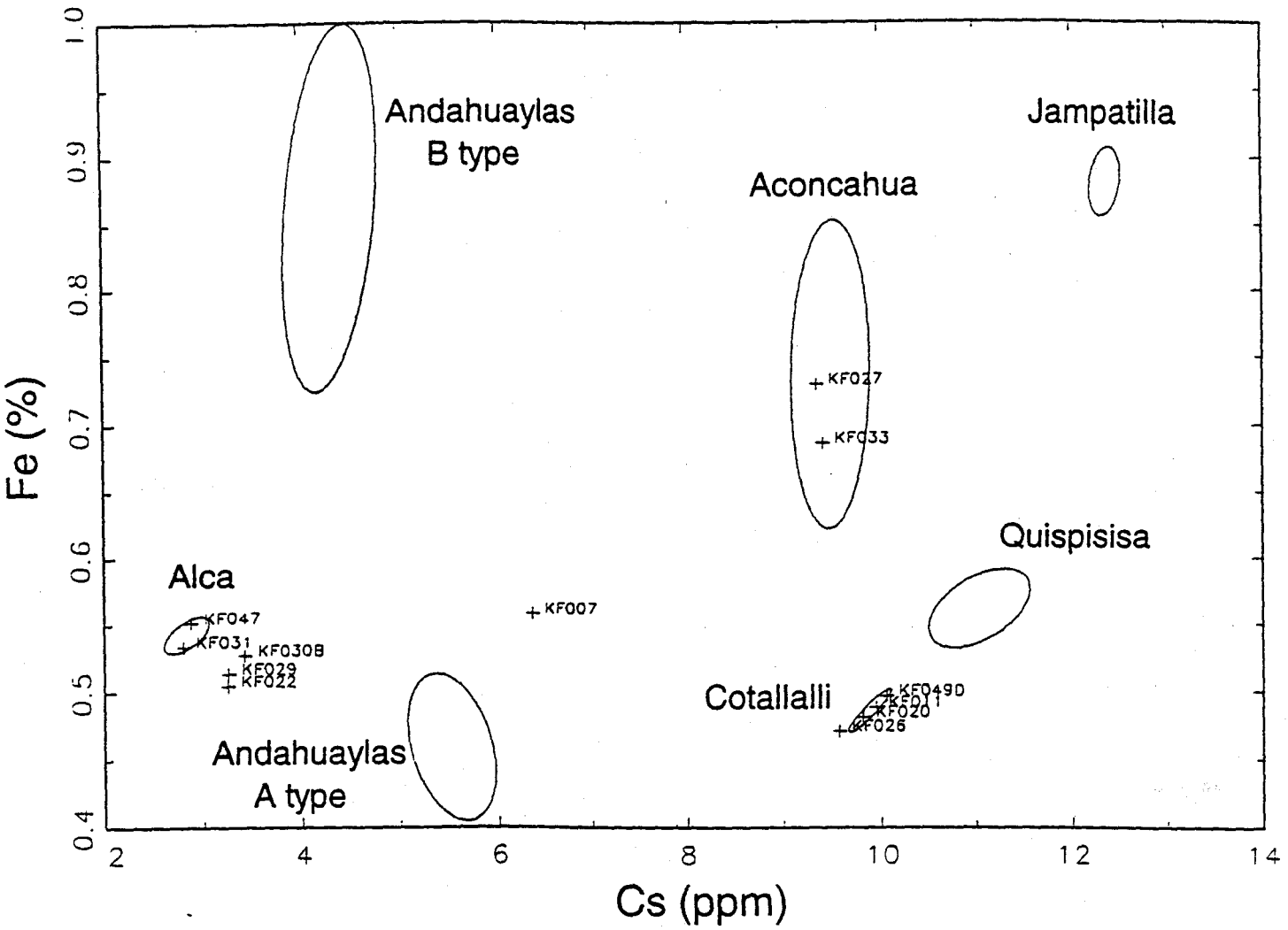

Jampatilla
Andahuaylas
B type
Alca
Cotallalli
Quispisisa
KF007
KF029
KF027
KF0308
KF022
KF033
Andahuaylas
A type
Aconcahua
Na (%)
Mn (ppm)
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
300
350
400
450
500
550
600
650
700
750

Fig. 4


Andahuaylas
B type
Jampatilla
Aconcahua
KF027
KF033
Quispisisa
Alca
KF047
KF031
KF030B
KF029
KF022
KF007
Cotallalli
KF049D
KF021
KF020
KF026
Andahuaylas
A type
Fe (%)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
2
4
6
8
10
12
14
Cs (ppm)

Sample ID	Site	Source	Date	
KF 001	Asana	**Cotallalli**	**ca. 6900 BC**	•
KF 002	Asana	Cotallalli	6300-6000 BC	
KF 003	Asana	Cotallalli	ca. 6800 BC	
KF 004A	Asana	Cotallalli	4500 BC	
KF 004B	Asana	Cotallalli	4500 BC	
KF 005	Asana	Cotallalli	6300-6000 BC	
KF 006	Asana	Cotallalli	6300-6000 BC	
KF 007	Quelcatani	**Unknown**	**5200 BC**	•
KF 008	Quelcatani	Cotallalli	3620 BC	
KF 009A	Quelcatani	Cotallalli	1700-1600 BC	
KF 009B	Quelcatani	Cotallalli	1700-1600 BC	
KF 009C	Quelcatani	Cotallalli	1700-1600 BC	
KF 010A	Quelcatani	Cotallalli	1700-1600 BC	
KF 010B	Quelcatani	Cotallalli	1700-1600 BC	
KF 011	Quelcatani	Cotallalli	1700-1600 BC	
KF 012	Quelcatani	Cotallalli	1000 BC	
KF 013	Quelcatani	Cotallalli	1000 BC	
KF 014	Quelcatani	Cotallalli	1000 BC	
KF 015A	Quelcatani	Cotallalli	900 BC	
KF 015B	Quelcatani	Cotallalli	900 BC	
KF 016	Quelcatani	Cotallalli	900 BC	
KF 017	Quelcatani	Cotallalli	900 BC	
KF 018	Quelcatani	Cotallalli	600 BC	
KF 019	Quelcatani	Cotallalli	600 BC	
KF 020	Quelcatani	Cotallalli	ca. 400 BC	
KF 021A	Quelcatani	Cotallalli	ca. 400 BC	
KF 021B	Quelcatani	Cotallalli	ca. 400 BC	
KF 022	Quelcatani	**Possible Alca 2**	**ca. 400 BC**	•
KF 023	Quelcatani	Cotallalli	ca. 300 BC	
KF 024	Quelcatani	Cotallalli	ca. 300 BC	
KF 025A	Quelcatani	Cotallalli	ca. 300 BC	
KF 025B	Quelcatani	Cotallalli	ca. 300 BC	
KF 026	Quelcatani	Cotallalli	ca. 0 AD	
KF 027	Quelcatani	**Aconcahua**	**ca. 0 AD**	•
KF 029	Quelcatani	**Possible Alca 2**	**ca. 1000 BC**	•
KF 030A	Quelcatani	Cotallalli	ca. 1000 BC	
KF 030B	Quelcatani	**Possible Alca 2**	**ca. 1000 BC**	•
KF 031	Quelcatani	**Alca**	**620 BC**	•
KF 032	Quelcatani	Cotallalli	620 BC	
KF 033	Quelcatani	**Aconcahua**	**400 BC**	•
KF 034	Quelcatani	Cotallalli	400 BC	
KF 035	Quelcatani	Cotallalli	400 BC	
KF 036	Ilave Survey	Cotallalli	L. Arch/E. Form	
KF 037	Ilave Survey	Cotallalli	L. Arch/E. Form	
KF 038	Ilave Survey	Cotallalli	L. Arch/E. Form	
KF 039	Ilave Survey	Cotallalli	Middle Archaic	
KF 040	Camata	**Cotallalli**	**1750-1200 BC**	•
KF 041	Camata	Cotallalli	1200-1050 BC	
KF 042	Camata	Cotallalli	1050-850 BC	
KF 043	Camata	Cotallalli	850-650 BC	
KF 044	TumaTumani	Cotallalli	200 BC-AD 400 ?	
KF 045	TumaTumani	Cotallalli	surface	
KF 046	Is. of the Sun	Cotallalli	surface	
KF 047	Is. of the Sun	**Alca**	surface	•
KF 048	Is. of the Sun	Cotallalli	surface	
KF 049A	Cutimbo	Cotallalli	LIP	
KF 049B	Cutimbo	Cotallalli	LIP	
KF 049C	Cutimbo	Cotallalli	LIP	
KF 049D	Cutimbo	Cotallalli	LIP	
KF 050A	Cutimbo	Cotallalli	LIP	
KF 050B	Cutimbo	Cotallalli	LIP	

Fig. 6

Sample ID	Site	Source	Date
KF 001	Asana	Cotallalli	ca. 6900 BC
KF 007	Quelcatani	Unknown	5200 BC
KF 008	Quelcatani	Cotallalli	3620 BC
KF 040	Camata	Cotallalli	1750-1200 BC
KF 044	TumaTumani	Cotallalli	200 BC-AD 400 ?
KF 029	Quelcatani	Possible Alca 2	ca. 1000 BC
KF 030B	Quelcatani	Possible Alca 2	ca. 1000 BC
KF 022	Quelcatani	Possible Alca 2	ca. 400 BC
KF 031	Quelcatani	Alca	620 BC
KF 047	Is. of the Sun	Alca	surface
KF 033	Quelcatani	Aconcahua	400 BC
KF 027	Quelcatani	Aconcahua	ca. 0 AD

Important dates for obsidian use

Fig. 7

Possible obsidian exchange routes



Fig. 6

Important dates and distribution of obsidian types



fig. 9

Descriptive statistics for the obsidian source at Aconcahua, Peru.

Type of statistics: Arithmetic

Element	Mean	St. Dev.	% St. Dev.	No. Obs.	Minimum	Maximum
BA	944.409	12.818	1.357	11	927.300	969.400
LA	44.367	0.378	0.853	11	43.964	45.130
LU	0.254	0.008	3.036	11	0.242	0.264
ND	28.831	1.498	5.197	11	26.244	30.996
SM	3.942	0.043	1.098	11	3.868	4.032
U	9.675	1.585	16.379	11	8.091	12.682
YB	1.111	0.038	3.427	11	1.060	1.174
CE	78.740	1.177	1.495	11	76.788	80.507
CO	0.605	0.080	13.189	11	0.530	0.780
CS	9.497	0.125	1.318	11	9.386	9.713
EU	0.641	0.009	1.478	11	0.626	0.658
FE	7376.945	359.663	4.876	11	7057.800	8285.600
HF	4.565	0.175	3.837	11	4.383	4.882
RB	191.130	14.468	7.570	11	182.740	233.870
SB	0.985	0.022	2.269	11	0.953	1.017
SC	1.895	0.045	2.385	11	1.837	1.999
SR	157.501	17.295	10.981	11	124.100	185.950
TA	1.142	0.018	1.533	11	1.120	1.170
TB	0.295	0.029	9.870	11	0.269	0.361
TH	27.899	0.370	1.327	11	27.491	28.603
ZN	45.454	1.734	3.816	11	42.540	47.750
ZR	196.791	10.421	5.296	11	179.050	219.110
CL	1063.282	61.265	5.762	11	960.900	1147.300
DY	1.982	0.299	15.075	11	1.532	2.531
K	41211.009	3043.238	7.385	11	37540.800	48610.000
MN	478.697	8.183	1.709	11	465.390	492.560
NA	28916.827	530.409	1.834	11	27719.200	29475.000

ANIDs of specimens included:

AP001 AP002 AP003 AP004 AP005 AP006 AP007 AP008
AP009 AP010 AP011

Tbl. 1A