A TURQUOISE ARTIFACT FROM TEOTIHUACAN

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July, 1999
Turquoise artifacts appeared sporadically in Mesoamerica as early as the Formative period (Merry de Morales 1987:100, Figure 8.4; Weigand 1989:43). Most occurrences, however, postdate the collapse of Teotihuacan. In the Late Classic and Postclassic periods increasing quantities are found, often in the form of elaborate mosaics, in a wide variety of contexts in central, west and northwest Mexico. Neutron activation analysis has determined that much of this turquoise derives from sources in the southwestern United States (Weigand et al. 1977; Harbottle and Weigand 1992; Weigand and Harbottle 1993).

Teotihuacan played a major role in Mesoamerica during the Terminal Formative and Early-Middle Classic periods. It was the dominant power in central Mexico from about the time of Christ to its collapse at about A.D. 650 (Millon 1988, 1992; Cowgill 1996). Throughout this period goods flowed into Teotihuacan from many parts of the Mesoamerican world. Despite this widespread economic interaction, only two pieces of turquoise have been recovered in the city. In the following pages, the context and implications of one of these finds will be examined.

The Enclave

Tlailotlacan, the "Oaxaca Barrio" of Teotihuacan, consists of about a dozen apartment compounds near the west edge of the city (Millon 1973:41-42). The enclave was founded about A.D. 200 by Zapotec immigrants who arrived there from the Valley of Oaxaca, and who then maintained a version of Zapotec culture in the area until the collapse of Teotihuacan at about A.D. 650 (Spence 1989, 1992; Rattray 1987, 1993).

As part of their effort to avoid assimilation, the Tlailotlacanos maintained a primarily Zapotec mortuary program (Spence and Gamboa 1995). A central feature of this program was the use of Zapotec-style tombs. Each apartment compound had one such tomb in use at any one time. The senior couple of the apartment compound, and perhaps a few of their closest adult relatives, would be interred in the tomb as they died. This would entail repeated entries into the tomb, to deposit newly dead individuals and perhaps to perform ceremonies over earlier decedents. At some point, often in conjunction with extensive architectural remodelling of the apartment compound, the tomb in use would be closed and a new one built elsewhere in the structure. At that time, some of the goods and skeletal elements in the earlier tomb would be removed, though whether they were then reinterred in the new tomb or disposed of elsewhere is not known.

Site 6:N1W6, here designated TL6, was excavated in 1987 and 1989 (Millon et al. 1973:70; Spence 1989, 1990, 1992). Four tombs, each associated with a different stage in the occupation of the apartment compound, were discovered. One of these, the East Tomb, was located in a platform on the east side of the principal patio of the structure (Spence
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Its construction and use date to the Early Xolalpan phase, ca. A.D. 350-450.

The East Tomb

The tomb had been cut into the platform. Its floor was formed by the naturally occurring thin layer of hard soil that covers the tepetate bedrock in this part of Teotihuacan. The faces of the cut were coated with a mud mortar preparation, into which were set the stones of the tomb walls. The inner faces of the stones were squared, but no further facing of mud mortar, concrete, or plaster was applied to the interior tomb walls. These walls survived to a height of about a meter, very near the original height of the tomb. However, modern plowing has removed the upper levels of the platform, and probably the uppermost part of the tomb itself.

The tomb consists of a chamber, 195 cm long (east-west) by 125 cm wide, with a separate stepped entry at its west end (Spence 1989:Figure 3; 1992:Figures 1, 4). No roofing materials were identified in the chamber area, suggesting that the roof was constructed of perishable material, perhaps a movable wood cover of some sort. However, some concrete slabs resting on the fill in the entry indicate a more substantial cover there. Modern destruction makes it unclear whether the entry started from the platform surface or from the patio banquette.

The tomb and entry were fully excavated. The fill was a soft, grey, sandy clay soil with some stones. It appears to have been deliberately placed in the tomb, to seal it after its period of use was over. This fill is riddled with the burrows of groundhogs, ubiquitous at the site. The excavation was by trowel, and all soil was then passed through a fine screen.

A considerable quantity of poorly preserved human bone was found in the chamber. Although these bones were concentrated largely on or near the chamber floor, a number of fragments were also scattered throughout the fill, apparently as a result of the extensive groundhog activity. At least two individuals, an adult male and an adult of undetermined sex, are represented. None of the bones were in articulation; indeed, they were scattered widely across the chamber floor. Although groundhog activity was probably responsible for some of this disarticulation, it was clearly too thorough to be due to that alone. The activities of the tomb caretakers must have played a major role, as they entered the tomb to deposit new burials or perform rituals.

Both skeletons were incomplete, though poor preservation makes it difficult to say how much or precisely what is missing from each. Cranial and facial elements are underrepresented, suggesting that they had been removed from the tomb before it was sealed. One left tibia had four parallel cutmarks across its medial surface, possibly made during one of the later entries into the tomb.

Offering materials were also scattered on the floor and through the overlying fill. Mica and marine shell, represented only by small fragments, were common, and a small nodule of cinnabar was found. There was also one unused prismatic obsidian blade on the tomb floor, and a dog mandible in the lowest part of the fill. Two highly polished beads were recovered, both of the same fine green jade. One, a cylindrical bead, was on the tomb floor beside the lower right canine of the male. The other, a rounded quadrilobate form, was
in the fill about fourteen centimeters above the floor. To judge by other finds at the site, these beads had originally been placed in the mouths of the two corpses.

Also on the tomb floor were sherds of a Teotihuacan bowl. The vessel is small and dark brown, with a low polish. The base is flat, the walls slightly flaring. The sherds form only about one quarter of the bowl.

Further offerings were found in the stepped entry. Resting partially on the steps and partially on the soil that was used to fill and seal the tomb were ten miniature vessels in pairs (two copas, two vases, two jars, and four ollas). Intermingled among these were the broken mouth segment of a Teotihuacan censer mask, an ornament of cut marine shell, mica fragments, more sherds of the bowl from the floor of the tomb chamber (to make up another quarter of the vessel), and several elements from the disarticulated and incomplete skeleton of an elderly male. Slightly apart from these but also in the entry rested, upside down, a tripod vase of copa ware. On one of the steps was a complete obsidian prismatic blade.

The precise origin of this entry set of material is not clear. At least some of it is from the chamber, as shown by the bowl segments that fit together. However, no other fragments of the censer mask were found in either the chamber or the entry. The elderly male of the entry is a different individual from the two identified in the chamber; dental attrition shows that the entry male is older.

It is possible that the entry material represents the last burial, and its associated offering, to have been placed in the chamber. As the latest burial, the skeleton would have been extended with the bones still in articular position. It, and the offering, would have been relatively easy to identify and collect. If some postcranial bones had been left behind in the chamber, as the incompleteness of the entry skeleton indicates, they would be difficult to distinguish from those of the other two individuals because of the poor preservation in the tomb. By this scenario, there may have been three individuals with their associated offerings in the chamber, the latest being gathered and redeposited in the entry when the tomb was sealed.

THE TURQUOISE ARTIFACT

The Context

Unfortunately, the turquoise artifact was not noticed while still in situ. Rather, it was identified later, during examination of the material recovered from the screening of the fill excavated from the southwest corner of the tomb chamber. The fill level in which the turquoise rested extended from 76 cm to 50 cm above the tomb floor. Also recovered from this particular zone were a fragment of a human femur, five Teotihuacan sherds, and one piece of obsidian. The sherds and obsidian were undoubtedly just refuse, accidental inclusions in the soil used to fill and seal the tomb, but the femur fragment offers supporting evidence that the turquoise artifact was part of an offering displaced from the tomb floor by rodent activity.

The larger fill stratum from which the turquoise was recovered produced a total of 86
sherds, four of which are Aztec. These latter are from undecorated utilitarian vessels, jars and a comal. They raise the possibility that the turquoise artifact may have been a later Aztec-period intrusion into this layer. Although no Aztec architecture or burials survive in the immediate vicinity, remnants have been found in other parts of the enclave (Rattray 1993:21; Quintanilla 1993). However, the Aztec material recovered to date in this area suggests a community of simple farmers, with nothing to indicate high status (Quintanilla 1993). Turquoise would not normally be expected in this sort of social context.

The turquoise artifact is a light blue-green, a broad oval in outline, and 7 mm in maximum diameter by 2 mm thick. Its weight is 169.2 mg. The "outer" face, the one apparently meant to be viewed, is slightly convex and has a high polish. The edges were formed by chipping, with some subsequent smoothing. The inner face is also polished, but flat. It is only 5 mm in diameter, because the chipped edges are bevelled toward the inner surface.

The form indicates that the piece was not intended to be an element in a mosaic construction. One possibility is that it was an inlay of some sort, though no trace of an adhesive survives. Perhaps it represented an eye in an effigy made largely of some perishable material like wood. Another possibility is that, like the two jade beads, it had originally been placed in the mouth of one of the three corpses in the chamber (assuming that the elderly male from the entry had initially been placed in the chamber).

Sample Identification

To analyze both the turquoise specimen (designated TQA111) and the many samples of mined and artifact turquoise that go to make up the Brookhaven National Laboratory Database, neutron activation analysis was employed. In the analysis of mining samples, where turquoise is generally found as veins in matrix, samples of the clean turquoise were drilled out of the matrix using drill-bits of solid tungsten carbide. In this way a reasonable separation between turquoise and matrix was accomplished. Archaeological artifacts were generally analyzed whole, and in such cases, where possible, examples with little or no matrix were chosen. It was noted that this is the same choice usually made by the lapidary in earlier times.

The actual procedures have been published (Weigand et al. 1977), but may be described briefly as follows. Powder samples of about 40 mg were sealed into hyper-pure quartz tubes and irradiated, along with standards, in the Brookhaven Medical Research Reactor (BMRR) or the High Flux Beam Reactor (HFBR). Artifacts were individually wrapped in very pure aluminum foil. Two bombardments were usually made; the first of these was for a minute and served to activate the elements copper, arsenic, manganese, sodium and potassium to the point where their respective radionuclidic forms could be determined through gamma-ray spectroscopy. After about a week there was a second bombardment of twenty minutes if the HFBR was used, or two to four hours if the BMRR was used. In this "long" bombardment the elements barium, lanthanum, scandium, rubidium, cesium, europium, hafnium, thorium, chromium, iron, antimony, calcium, gold, silver and zinc were usually measurable. On occasion ytterbium and samarium were also determined. Owing to the great variability of chemical composition of natural turquoise, not all elements
were determinable in all samples. However, in such cases a provision of the software for multivariate analysis could be invoked that permitted missing-data samples to be included in the clustering or provenance assignment calculations. For standardization, samples of six U.S.G.S. rock standards (Flanagan 1969, 1973) were included with the bombarded turquoise specimens; after 1976 these bombardments were calibrated by means of a secondary "in-house" standard called "Ohio Red Clay", which had itself been extensively cross-compared with the six U.S.G.S. rock standards.

Arsenic and copper were standardized by special locally-prepared standards. After bombardment and an appropriate "cooling" period samples, artifacts and standards were gamma-ray counted with a Germanium detector of ca. 35% efficiency and 1.8 keV (at 1173 keV) resolution. Gamma-ray spectra were processed by standard methods, resulting in a chemical compositional "profile" that could be entered in our turquoise compositional database.

Multivariate Analysis

Our approach to the problem of pattern-matching the compositional profile of the Teotihuacan specimen (TQA111) with possible targets in the database was essentially the same used in archaeological ceramic analysis. We define an n-dimensional Euclidean hyperspace, where n is the number of elements employed in the multivariate analysis, each coordinate representing the log concentration of a particular element oxide in the turquoise. A single point in this hyperspace represents the complete log-transformed analytical data of a particular sample, and one searches the database for other matching specimens by simply calculating the "Mean Euclidean Distance" (Weigand et al. 1977) between that point and every other point in the hyperspace. We find that most turquoise mining areas are characterized by a cluster of samples having relatively short distances from one another, that is to say, they form a "cloud" of points in hyperspace.

When this Euclidean analysis or "search" was applied to specimen TQA111 using the eight elements Na, K, Ba, Eu, Th, Fe, Cu and As, a number of interesting targets surfaced in the database at short Euclidean distances. For example, there were several turquoise mosaic fragments found in an area called "Las Cuevas" in Jalisco, Mexico (Tombs 32, 43, and 91). An especially close match was a mosaic fragment from a slope near Tomb 27. Other artifacts included one from the "Ranchos" complex at Ixtlan del Rio, Nayarit, and a number from the site of El Vesuvio, Zacatecas. Mining target specimens included material from the important Cerrillos (New Mexico) and Royston (Nevada) turquoise mining areas.

Although these Euclidean searches produced a number of interesting matches in chemical composition, they do not in themselves permit a very reliable provenance assignment for the specimen in question, TQA111. Fortunately, there is a much more powerful technique called the "Mahalanobis search", which we regularly employ in provenance research based on the characteristics of chemical compositional profiles. The Mahalanobis search is based on two software programs developed at Brookhaven National Laboratory by E. V. Sayre, called "ADCORR" and "ADSEARCH". This software begins by calculating the variance-covariance matrix and the characteristic vectors of a compositional group, for example turquoise found at the Royston, Nevada or the Leadville, Colorado mine.
The program handles missing data in a very innovative way, substituting for a missing datum that value that leads to the least increase in Mahalanobis distance.

The procedure leads to a calculation of the distance between the sample in question and the centroid of the group, taking into account all the inter-elemental correlations; this is the Mahalanobis distance, and can be interpreted in terms of the probability of membership of the sample in a normally distributed group having those correlational characteristics. Hotelling's T-squared is used to adjust the probability to account for the limited size of the core group, and as before, log concentrations are used.

We have assembled a number of core groups representing many of the turquoise sources of the American Southwest and Mexico that were exploited at different cultural periods (Harbottle and Weigand 1992), and were able to apply them in the calculation of Mahalanobis distances and probabilities of group membership of the single specimen TQA111.

Results

Of the different mines and mining areas tested, only two give a calculated probability of group membership of TQA111 greater than 1%, and they are Royston and Cerrillos. Mining areas for which there is essentially no probability that they were the source of TQA111 include Morenci, Crescent mines, Azure and New Azure, Tulloch, Leadville, Tyrone, Fox No. 5, and Darling Darlene. Two compositional subgroups from the Royston mine gave probabilities of group membership of 6.4% and 1.5%, while the overall Cerrillos group gave a probability of 97.7% for group membership of TQA111. A subgroup of Cerrillos which we have designated "Cerrillos 3" gave a probability of group membership of 84%, while another subgroup representing Mt. Chalchihuitl gave a probability of 62.3%. However, the authors feel that limited sampling and compositional variability do not permit us to attach too much significance to these subgroup probabilities.

It is interesting that this same Mahalanobis distance calculation, when applied to the group of artifacts (mostly mosaic fragments) found at Las Cuevas, Jalisco suggested that many of them also had their mining origins at Cerrillos. The same was true of a number of the artifacts found at El Vesuvio, Zacatecas. However, these two locales represent, respectively, Postclassic and Late Classic occupations, postdating Teotihuacan.

CONCLUSIONS

The TQA111 specimen is one of only two turquoise items found to date in Teotihuacan. The other is a small piece of debitage from Frente 3 in the La Ventilla area, where evidence of lapidary workshops was found during excavations conducted by Sergio Gómez (personal communication, Sergio Gómez, 1999; Cabrera 1996:29). The piece has been identified as turquoise by a geologist, but its particular source region is unknown. Excavations in two other lapidary workshops in the city, TE18 and 33:S3W1, have produced
no turquoise, though a variety of other semi-precious stones and exotic materials have been identified (Turner 1992:99; Widmer 1991). No turquoise has been recovered in the extensive Teotihuacan Mapping Project surface collections (Turner 1992:99). The turquoise mosaic on a Teotihuacan-style mask from Guerrero may be a Postclassic period addition to the Middle Classic period mask (Millon 1988:161).

It has been suggested that Teotihuacan was the ultimate destination of much of the turquoise passing through Chalchihuites culture centers like Alta Vista (Kelley 1980:54-55; Harbottle and Weigand 1992:80). However, to date no definite imports from the Chalchihuites culture have been identified in Teotihuacan, nor have any Teotihuacan products been found in Chalchihuites sites. Also, it seems that much of the Chalchihuites turquoise processing postdates the collapse of Teotihuacan, the date of which has recently been pushed back to about A.D.650, although lesser amounts of turquoise were present in the Chalchihuites region, Guerrero, and perhaps Michoacán during the Middle Classic period (Cowgill 1996; Harbottle and Weigand 1992:80). Exploitation of the Cerrillos source area also largely postdates Teotihuacan (Mathien 1998). Finally, the recovery to date of only two small pieces of the material in Teotihuacan is not encouraging. It is possible that more lie concealed in burials of the highest elite, very few of which have been excavated in Teotihuacan (Harbottle and Weigand 1992:80). However, it is unlikely that large quantities of turquoise will be found in such contexts; luxury goods in Teotihuacan tended to be distributed rather widely across the social spectrum, with few or no materials confined to elite contexts (Sempowski 1992:52; 1994). Certainly Tlailotlacan displays no evidence of wealth or high status.

In fact, it may be the unique situation of Tlailotlacan that led to the presence of turquoise there. The enclave was occupied by people who had a form of Zapotec culture, and relied on that identity to maintain a widespread trade network (Spence 1992). One segment of this network involved a number of communities in the Tula region that exploited the region’s limestone deposits to supply Teotihuacan with lime (Matos Moctezuma 1976:11; Sanders et al. 1979:126-127; Díaz 1980; Crespo and Mastache 1981). This special link to the north may have given Tlailotlacan traders peripheral access to the limited quantities of Cerrillos turquoise entering Mesoamerica at that time.

It is some 1800 km as the crow flies from the Cerrillos source area to Teotihuacan. It is difficult to say just how specimen TQA111 might have covered this distance. We have a reasonable picture of the routes and way stations involved in the turquoise exchange systems of the Postclassic periods (Harbottle and Weigand 1992:84). At the time of Teotihuacan’s peak, however, the quantities of turquoise circulating in Mesoamerica were much smaller, and the networks through which the material moved may have been less firmly established. Even the Tlailotlacanos, with their connections to the north, may have had only haphazard access to turquoise. Some sites to the north, like the La Negreta site of southern Queretaro, do have Teotihuacan materials (Brambila and Velasco 1988:297). However, their access to Teotihuacan goods, and in return Teotihuacan’s access to northern goods, may have been sporadic and indirect, mediated through a shifting network of intervening communities.

There is another possibility. Recent excavations in site 19:N1W5, just 160 meters east of the eastern border of Tlailotlacan, have produced ceramics and figurines in Michoacán styles and a shaft tomb (Cabrera 1998; Gómez 1999). There is a good possibility that
immigrants from Michoacán occupied the site. Also, turquoise is said to have been recovered at Loma de Santa María in Michoacán, a site with talud-tablero architecture and Teotihuacan-related ceramics (Manzanilla 1988; Trejo de la Rosa 1979). It is possible, then, that turquoise artifact TQA111 reached Tlailotlacan through this connection. Although no turquoise has been found in site 19:N1W5, there was a Zapotec-style tomb there like those of Tlailotlacan.

In sum, the presence of only two small pieces of turquoise in Teotihuacan, in rather different contexts, does not suggest any sort of regular access to or importation of turquoise. We might assume, given the interest of Teotihuacanos in acquiring blue-green stones, that had turquoise been available to them, they would happily have accepted it. The two isolated incidences in which it does occur may thus be nothing more than historical oddities, chance acquisitions through a fluid and unpredictable trade network. Only time and further work will tell.

Acknowledgements. The excavation of Tlailotlacan apartment compound TL6 was funded by the Social Sciences and Humanities Research Council of Canada. The authors thank Tom Charlton for identifying the Aztec ceramics from the East Tomb, and Sergio Gómez for information on the turquoise discovered during his excavation of La Ventilla Frente 3. We are also grateful to the Instituto Nacional de Antropología e Historia of Mexico for permission to analyze turquoise specimen TQA111 and to conduct the excavations that led to its recovery. Research at Brookhaven National Laboratory is supported by the U.S. Department of Energy under Contract DE-AC02-98CH10886.

REFERENCES CITED

Brambila, R., and M. Velasco

Cabrera, R.

Cowgill, G. L.

Crespo, A. M., and A. G. Mastache
Nacional Autónoma de México, Mexico.

Díaz, C.

Flanagan, F.


Gómez, S.
1999  Nuevos Datos sobre Relación entre Teotihuacán y el Occidente de México. Paper presented at the Primera Mesa Redonda de Teotihuacan, Centro de Estudios Teotihuacanos, Mexico.

Harbottle, G., and P. C. Weigand

Kelley, J. C.

Manzanilla, R.

Mathien, F.

Matos Moctezuma, E.

Merry de Morales, M.

Millon, R.


Millon, R., R. Drewitt, and G. L. Cowgill

Quintanilla, P.

Rattray, E.


Sanders, W. T., J. R. Parsons, and R. Santley

Sempowski, M.


Spence, M. W.


Spence, M. W., and L. Gamboa

Trejo de la Rosa, L.

Turner, M.

Weigand, P. C.
1989 Architecture and Settlement Patterns Within the Mesoamerican Formative Tradition. In El Preclásico o Formativo. Avances y Perspectivas, edited by
M. Carmona Macías, pp.39-64. Instituto Nacional de Antropología e Historia, Mexico.

Weigand, P. C., and G. Harbottle

Weigand, P. C., G. Harbottle, and E. V. Sayre

Widmer, R.