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CASE REPORT

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The Identification of a Human Skull Recovered from an eBay Sale

ABSTRACT: A human skull seized by the State of Louisiana from an eBay sale is analyzed. Bioarchaeological analyses of age-at-death, sex, and population affinity suggest the individual represented by the skull was a middle-aged Native American female. The presence of intentional cranial modification independently supports the population affinity assessment while confounding the metric analyses. However, no further specificity as to population affinity could be inferred using existing methods and comparative databases. Sedimentological and palynological analyses were attempted to redress this impasse. The presence of fine-grained charcoal, abundant fungal remains, and small angular quartz grains suggestive of burial in loess, as well as the lack of pollen, pteridophyte spores, and microscopic algae, suggest a likely upland burial location from somewhere in the lower Mississippi Valley. The sedimentological and palynological analyses, while not conclusive, show promise for use in future affiliation analyses of human remains recovered during the course of forensic investigations. The results are reviewed within the broader context of the legal debate over the repatriation of human remains.

KEYWORDS: forensic science, craniometrics, NAGPRA, sedimentology, palynology, eBay, law enforcement

In a 2000 article, Murad and Murad (1) stressed the necessity of maintaining ready collections of human skeletal remains for the functioning of the field of forensic anthropology. The authors argued that the use of curated human skeletal remains of all cultural and biological affiliations for the purposes of providing a ready resource for use in forensic identification is an essential component of carrying out the Native American Graves Protection and Repatriation Act (NAGPRA). Indeed, this assists in serving the humanitarian purposes to which the American Board of Forensic Anthropology is committed.

This paper reports the results of bioarchaeological and sedimentological analyses on a human skull seized from an eBay auction sale. The case report further illustrates the importance of continued research on all affiliations of human skeletal remains and how traditional and unique research was employed in efforts to identify a Native American skull recovered from a forensic setting. In addition, this case report discusses possible alternatives—namely palynological and sedimentological analyses—to the use of comparative skeletal collections in order to learn more about unprovenienced, unaffiliated skeletal remains in a post-NAGPRA environment.

Background

In January 2007, the Louisiana Division of Archaeology (Division) was alerted by the National Park Service (NPS) of the sale of a suspect human skull identified in an eBay auction from a seller located in Lake Charles, Louisiana (Fig. 1). The Division contacted the Louisiana Department of Justice (LDOJ) for assistance in investigating this possible violation of state and federal law.

The posted images allowed several basic observations pertinent to NAGPRA, the foremost of which was the presence of soil in the orbits and nasal cavity and the general appearance and surface coloration suggesting that the skull had been previously interred. There was no information in the posted auction listing to suggest that the skull was of Native American origin, thus calling into question the applicability of NAGPRA. Once recovered, the skull was assigned the LDOJ case number 33–238.

Early in the investigation process, the Division and LDOJ participated in discussions with all of the federally recognized Native American tribes in Louisiana in order to keep them apprised of the matter in the event that skull 33–238 was determined to be of Native American origin. The tribes were thankful for the proactive work of the Division and LDOJ and supported further nondestructive analysis of skull 33–238 in an attempt to identify affiliation, if possible.

Further information and several Native American artifacts were gathered from the seller by an LDOJ investigator, with assistance from the Division. The seller was cooperative, offering a search of his home and other properties for other materials of interest to the Division. The skull and the artifacts had come from an estate recently acquired by the seller. As it turned out, the estate, known as the Pohler Estate, was not unknown to the Division. Roy Pohler was a well-known antiquities collector during the early and middle twentieth century. At some point in the 1980s, he donated a substantial portion of his collections to the State of Louisiana. The artifacts contained in this collection derived from numerous countries around the world, and Pohler had little or no documentation regarding their origin. With this knowledge in mind, LDOJ realized that it was not a *sine qua non* that the recovered skull had been removed from a Louisiana burial ground. LDOJ partnered with Arizona State University to accomplish a nondestructive bioarchaeological analysis of the skull in an effort to determine, as reliably as possible, the identity of the remains that were sold on eBay. As the

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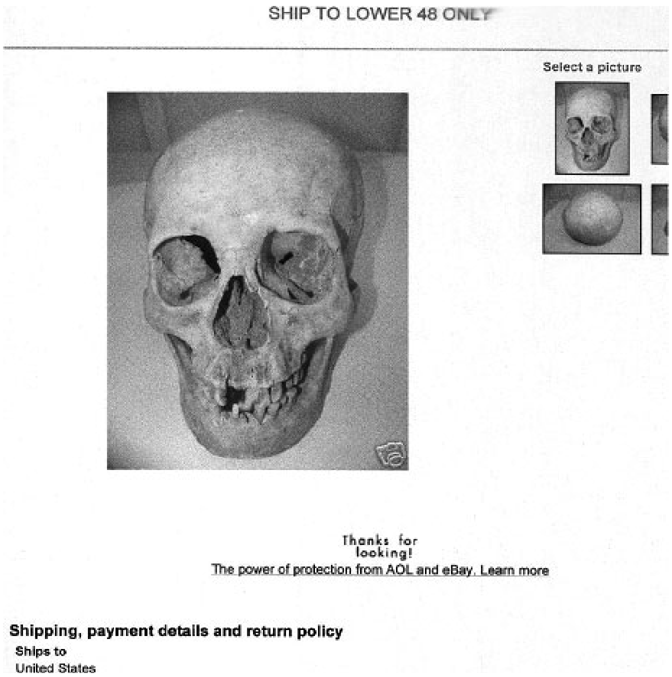

FIG. 1—*Screen capture of the auction of skull 33–238 from the eBay website.*

bioarchaeological analyses proved to be less helpful than hoped in identifying the potential affiliation of the subject human remains, LDOJ further partnered with Georgia Southern University to accomplish analyses of the soil recovered from various orifices in the skull.

Because of the cooperative nature of the seller and what appeared to be his honest lack of knowledge of the prohibition against selling such remains, LDOJ decided not to pursue criminal charges. Following that decision, the matter became a moral desire to identify, as best as could be done, the person whose remains were recovered.

The Relevant Laws and eBay Policies

Both the State of Louisiana (State) and the federal government have promulgated laws to regulate the treatment of certain human remains. Only those portions of the relevant laws that apply to the sale of human remains are considered here. The federal law, known as the NAGPRA (2), provides for both civil and criminal penalties for desecrating Native American graves and for buying, selling, or trading those remains. The Louisiana Unmarked Human Burial Sites Preservation Act (3) provides considerably more protection for human burials and remains than does NAGPRA. The State law also provides criminal and civil penalties for the unauthorized disturbance of Native American remains. However, this law goes even further than does NAGPRA by extending analogous protections to all unmarked human burials (4). Regardless of affiliation, in most cases, the sale of human remains that had once been buried, under Louisiana law, is prohibited.

In addition to these laws, eBay has its own policies regarding the sale of human remains. eBay's Prohibited and Restricted Items Policy on Human Remains states that "humans, the human body, or any human body parts are not permitted on eBay. Items that contain human hair (such as lockets) as well as skulls and skeletons that are used for medical purposes may be listed on eBay. eBay does not permit the sale of Native American skulls, bones or other Native American-grave-related items, as the sale of such items may violate federal law" (5).

FIG. 2—*Frontal and profile views of skull 33–238.*

Bioarchaeological Analysis

Description

The remains recovered from the eBay sale consisted of a fragmented but essentially complete human cranium, including the mandible (a skull) (Fig. 2). A majority of the dentition was present and observable, although many individual teeth were not *in situ* due to the fragmentation of the maxilla. No postcranial remains were present.

Skull 33–238 exhibited soil staining and was not bleached or professionally prepared. The degree and intensity of staining was consistent with sub-surface burial, although it is not possible to estimate the duration of interment. That the individual was buried in the ground is confirmed by the presence of soil in many foramina, and it was this initial observation that prompted the intervention of the LDOJ.

The cranial vault demonstrates tabular intentional cranial modification centered posteriorly near bregma and anteriorly near the frontal boss (6). The presence of cranial modification suggests a Native American population affinity. There were numerous pathological conditions in the dentition including four abscesses (RM^1, LP^2, LM^2, RM_2 – all buccal perforations), likely sequellae to carious destruction of the tooth crown, as well as caries in four of 20 remaining teeth (RM^1, RI^2, LP^2, RM_2). The molar caries were large and affected over 50% of the occlusal surface. The dentition was also heavily worn and all crown surfaces were significantly affected by dental attrition (for example LM^1 was scored a 32 after Buikstra and Ubelaker [6]). The severity of attrition is not consistent with a modern, twentieth-century diet and also suggests a premodern temporal affiliation.

Age-at-Death

The spheno-occiptial synchondrosis was completely fused, suggesting an adult age-at-death (6). The severity of dental attrition on observable teeth suggests a more advanced adult age. Cranial suture closure corroborates the age-at-death observed on the dentition. The suture scores, using the methods suggested in Buikstra and Ubelaker (6), correspond with a Vault Score of S3, indicating a mean age-at-death of 38 years with a range of variation of 27–44 years. The Lateral-Anterior Score was S3 indicating a mean age-at-death of 40 years with a range of variation of 27–51 years. Therefore, available data, although limited, suggest the individual was a middle-aged adult.

Sex Assessment

The sex of the individual represented by skull 33–238 was evaluated using the Buikstra and Ubelaker (6) scoring system. Of the five traits in this scoring system, the only feature that marginally suggests a male sex is the thickness of the supraborbital margin (left = 3, right = 4). The remaining features either present a neutral morphology (nuchal crest = 3) or probable female morphologies: mastoid processes (left = 2, right = 2), glabella projection = 2, and mental eminence = 1–2. These data suggest a probable female sex assessment, an inference bolstered by consideration of other cranial morphological markers of sex (7,8). The skull is extremely gracile with well-developed parietal and frontal bosses, the temporal bones and maxillae are diminutive and lightly built, the zygomatics are small, the root of the zygoma does not extend beyond the external auditory meatus, and the temporal and masseteric muscle markings are weakly developed. The overall size and architecture of the skull suggests a female sex assessment.

A sex estimate was also derived from metric comparison of the size and shape of skull 33–238 with samples of known sex, a common procedure in forensic anthropology based on discriminant function analysis (e.g., [9]). For this case, cranial dimensions were compared to known sex males and females in the Forensic Data Bank (10,11). Analysis was performed using the cranial discriminant function analysis program FORDISC 2.0 (12). Sex assessment was based on only those measurements deemed least potentially affected by antero-posterior cranial vault deformation, an approach not without limitations (13–24).

Comparison of skull 33–238 to known sex samples for 14 measurements capturing aspects of cranial breadth and facial height and breadth (ZYB, AUB, UFHT, WFB, UFBR, NLH, NLB, OBB, OBH, EKB, DKB, FOL, FOB, MDH) supported the female sex assessment based on cranioscopic observations. The training sample produced an accuracy of 86.5% and the skull was classified into the female sample with a posterior probability of 0.979. Although much more similar to the females in the Forensic Data Bank, the low typicality probability (0.016) indicates that skull 33–238 is not particularly well represented by the composition of the training sample in the Forensic Data Bank. This is to be expected considering the presumed differences in antiquity between target and source populations and the well-documented secular changes in cranial dimensions through time (10,25–28). Comparison of the measurements for 33–238 with the sample means for the Forensic Data Bank males and females indicates the size of the skull in this case is not atypically small (Table 1). In fact, for eight of 14 measurements 33–238 is larger than the female means in the Forensic Data Bank. The low typicality probability, therefore, likely reflects cranial shape differences that result from the fact that the target population is not included in the Forensic Data Bank.

Population Affinity

Although dental morphological data are useful for population affinity assessment, the extent of dental attrition precluded observation of these data. Therefore, population affinity was assessed using craniometric analysis. Skull 33–238 was compared to the Forensic Data Bank (11) and to the Howells data bank (29, 30). The former contains data from 275 African American, 79 Native American, and 466 European or European-American individuals (11). The Howells data bank contains data from over 5,000 individuals with a global distribution, although heavily emphasizing the Pacific rim (29,30). Because of the confidence that skull 33–238 was that of a female, craniometric comparisons were restricted to females within each database, thus reducing the functional sample sizes. Only variables least directly affected by intentional cranial modification were included (ZYB, AUB, UFHT, WFB, UFBR, NLH, NLB, OBB, OBH, EKB, DKB, FOL, FOB, MDH).

Based on these 14 measurements, individuals in the Forensic Data Bank training sample were correctly allocated to their respective source populations at a rate of 94.5% (Table 2), confirming the confidence in these results. Skull 33–238 was allocated into the Amerind female population with a posterior probability of 0.659, double that of any other comparative population. The typicality probability was low, however, at 0.09. This indicates a lack of statistically significant difference. Skull 33–238 was also not significantly different from the African female sample in the Forensic Data Bank. Comparison with female samples from the broader Howells data bank produced similar results. As expected, as the number of comparative samples increased the classification rate for the training sample decreased; only 47.3% of crania were correctly reclassified based on these 14 measurements. Skull 33–238 was most closely affiliated with the Arikara sample with a fairly high posterior probability (0.681). The typicality probability was 0.263 (Table 3) indicating a stronger fit with Plains populations from the colonial period than with near modern southwestern U.S. Native

TABLE 1—*Cranial measurements for 33–238 and Forensic Data Bank (FDB) males and females.*

	33–238	FDB-males (n = 122)	FDB-females (n = 85)
ZYB	127	130.74	121.75
AUB	124	122.95	115.86
UFHT	72	72.24	67.09
WFB	90	97.26	93.35
UFBR	99	106.21	100.80
NLH	49	52.03	48.51
NLB	28	24.71	23.46
OBB	38	40.75	38.66
OBH	36	33.72	33.69
EKB	93	98.93	94.06
DKB	18	22.42	21.08
FOL	36	36.91	35.12
FOB	31	30.30	29.06
MDH	24	32.56	28.00

TABLE 2—*Results of comparison of 33–238 to Forensic Data Bank females.*

Group	Total Number	Classified Into: European	African	Amerind	% Corr
Training sample					
European	48	46	1	1	95.8%
African	37	3	34	0	91.9%
Amerind	25	1	0	24	86.0%
Total	110		Correct = 104		94.5%

Group Classified Into	Distance	Posterior Probability	Typicality Probability
Multi-group Classification			
European	35.2	0.001	0.001
African	22.8	0.340	0.063
Amerind*	21.5	0.659	0.090

*Indicates group into which skull 33–238 was allocated.

TABLE 3—*Results of comparison of 33–238 to Howells data bank.*

Multi-group Classification			
Group Classified Into	Distance	Posterior Probability	Typicality Probability
Ainu	24.0	0.006	0.020
Andaman	42.6	0.000	0.000
Arikara*	14.6	0.681	0.263
Atayal	23.0	0.010	0.028
Australia	36.2	0.000	0.000
Berg	26.5	0.002	0.009
Buriat	17.6	0.152	0.128
Bushman	43.4	0.000	0.000
Dogon	35.4	0.000	0.000
Easter Island	31.5	0.000	0.002
Egypt	32.8	0.000	0.001
Guam	23.5	0.008	0.024
Hainan	21.3	0.024	0.046
Mokapu	22.5	0.013	0.032
Moriori	24.8	0.004	0.016
N. Japan	23.4	0.008	0.025
S. Japan	21.2	0.026	0.048
Tasmania	32.2	0.000	0.001
Teita	39.1	0.000	0.004
Tolai	29.1	0.000	0.004
Zalavar	29.4	0.000	0.003
Zulu	29.9	0.000	0.003

*Indicates group into which skull 33–238 was allocated.

Americans. Skull 33–238 was also not significantly different from Buriat females (central China), Peruvian females, Santa Cruz (California) Native American females, and South Japanese females. The Arikara allocation is also fairly robust to the exclusion of specific variables. For example, MDH, FOL, and FOB were removed from the analysis because these measurements are either difficult to measure (MDH) or poor discriminators of population affinity (FOL, FOB). The allocation did not change (Arikara posterior probability – 0.610, typicality probability = 0.163). Furthermore, ZYB and AUB were removed from the analyses because these variables may be more affected by vault modification than the remaining variables which are all located in the facial region. Once again, the resulting allocation did not change (Arikara posterior probability – 0.275, typicality probability = 0.126).

The relatively low typicality probabilities, even for samples with the largest posterior probabilities, is to be expected. The Amerind sample in the Forensic Data Bank consists of modern Native Americans from the southwestern United States that may not be representative of prehistoric or premodern Native Americans from the southeastern United States. The same can also be said of the Plains Arikara as well as other populations in the Howells data bank. Currently, the age (antiquity) of the specimen is unknown and this further confounds craniometric analysis, as does the presence of vault modification, despite attempts to mitigate the effects by using craniometric variables least affected by this cultural practice. Nonetheless, caution is warranted and these results should be interpreted appropriately.

Palynological and Sedimentological Analyses

In an effort to further ascertain the origin of the skull, several grams of sediment were removed from the sinuses and auditory meati. The samples consisted of pale yellowish brown (10 YR 6/2) clay/silt with minute bone fragments and several cockroach egg case fragments.

A portion of the sediment sample was placed in a beaker with distilled water to allow it to moisten and disperse. After 2 days, the dispersed sediment was sieved through a common tea strainer (~30 mesh) to remove skull fragments and other coarse particles. The finer fraction was collected in a beaker and swirled and decanted repeatedly until a fine suspended fraction and a coarser settled fraction could be separated from one another.

The fine, suspended material was decanted into a test tube and subsequently treated with 10% hydrochloric acid (HCl) (to remove carbonates), and 52% hydrofluoric acid (HF) (to remove silicates). The reaction to HCl was unremarkable, but the sediment reacted violently to the HF. This kind of reaction is common among samples from the Atlantic Coastal Plain that contain a great deal of fine-grained mineral matter, including the clay mineral kaolinite. The sample residues contained no pollen, pteridophyte spores, or microscopic algae. A standard palynological analysis was, therefore, not possible. The residue did, however, contain an abundance of very fine-grained charcoal and abundant fungal remains, including spores of several types as well as hyphae.

Charcoal can be used to infer the effect of fires, but unless particularly distinctive charred particles are seen (the epidermis of grasses, for example) little can be inferred from its presence. Similarly, while some fungal spores and sporangia have proven to be of great value biostratigraphically or environmentally (e.g., [31–33]) none of the more distinctive types were seen on the slides from this sample. The abundance of both charcoal and fungal debris, and the nature of the inorganic fraction of the sample sediment can be used, in concert, to draw some inferences concerning the probable location of burial of skull 33–238.

The residue, even after treatment with HF, remained full of very fine inorganic sediment that tended to pack itself in the bottom of the sample tubes. This is atypical, and suggests highly angular granules that would spontaneously "lock" themselves together. There was, at the same time, a great deal of very fine organic matter that remained in suspension, much more than had been expected from such a small sample. The amount of floating, probable submicron debris in a sample is highly variable, and is certainly dependent upon the amount of colloidal parent-material present in a particular sample. The very fine material in the subject sample might have been due to the presence of organic (skeletal) source materials.

The sample proved to be full of very fine, highly angular silt, composed mostly of quartz. The untreated particles were very angular with low sphericity. Furthermore, the size range was 62–125 microns, or 3.0–4.0 phi. Given that most of the grains appeared to be quartz (one prismatic crystal of zircon was observed in a cursory scan), such a description could easily describe a loess.

According to Pye (34), as cited in Markewich et al. (35), loess is "composed chiefly of quartz, feldspar, mica, clay minerals and carbonate grains...The origin of the silt particles in loess is attributed primarily to glacial grinding and secondarily to salt weathering and eolian abrasion" (p.23). The Northern Great Plains and entire Mississippi Valley are full of loess sheets, so this type of sediment is neither rare nor unusual, but it does exist in significant amounts, mostly in the mid-continent. This is discussed in Markewich et al. (35), who observed and described five separate loess sheets in the Middle Mississippi Valley. One of the deposits that Markewich et al. (36) discussed was from the Loosahatchie River in southwestern Tennessee. Wood from the Loosahatchie site was dated at 11,200 ± years BP. A small sediment sample from a bank-side outcrop of alluvial sediment from the Loosahatchie site was observed under the microscope and it proved to be indistinguishable from the skull 33–238 sediment. That does not mean the skull came from Tennessee, but it does mean that the sediment within which the person was buried is probably loess. Rich (in Markewich et al. [35]) further describes sediment recovered from Phillips Bayou, near Helena, Arkansas, a unit that is assignable to the Roxana Silt (28,980 ± 800 years BP). In his description of the Phillips Bayou sample, Rich notes that the sample "contained much HF-insoluble mineral material, most notably prismatic crystals of a mineral with a high refractive index and brilliant birefringence tentatively identified as zircon" (p.155). The Phillips Bayou sample was, thus, in a palynological and sedimentological sense, quite like the skull 33–238 sample.

In an effort to firmly associate the skull 33–238 sediment with loess, two additional samples of loess were observed under a microscope. A sample of loess from the bluffs at Vicksburg, Mississippi, was observed, as was a sample from a mammoth burial site on the campus of Principia College, Elsah, Illinois; the mammoth site sample came from a depth of 1.8 m, so the depth of the burial was comparable to what one might expect for many human burials. There is a striking similarity in mineral grain shape and composition among the three samples, though no zircon was visible in the mammoth sample. The significance of the zircon itself is that it is derived from rocks of igneous origin, such as volcanic ash. While zircons from the Carrizo Plain (see below) could have been derived from any of a number of volcanic sites in California and neighboring states, the zircons from the skull 33–238 might well have originated in one of several ash beds (e.g., the Pearlette Ash; [37]) that are known from the Mississippi River Basin.

In addition to the silt, there is a large amount of very fine angular charcoal, as previously mentioned. In fact, a qualitative analysis suggests that charcoal is the dominant organic component. The charcoal is so abundant and fine-grained that it seems that it must have been wind-blown. It could have been swept off burned uplands and accumulated with the silt. Very similar associations are seen in sediments from Soda Lake, in the Carrizo Plain of southern California that are currently being analyzed (38). There, we know that wind deposition in the plain is the dominant type of sediment movement, and southern California has a well-known and complex fire-dependent flora. The sediment size in the Plain is much smaller than with the sample from 33–238 because of the deposition of clays in Soda Lake, but periodically in core sequences from the lake silt particles are encountered (sometimes with abundant zircon), and there is always an abundance of tiny, angular charcoal particles. Short of having something large enough to identify, such as pieces of charred epidermis, little more can be inferred from observed charcoal except that it probably has similar origins to that of the Carrizo charcoal—it was likely blown from adjacent fire-prone uplands, most probably shrub- or grasslands.

No pollen or pteridophyte spores were observed in the skull 33–238 residue. This is probably consistent with the wind-sorting phenomenon and what was probably a xeric (dry) environment. The abundant fungal remains are an anomaly. As Traverse (39) notes "fungal spores are abundant in sediments in which organic matter (such as wood fragments, cuticles, and other tissue pieces) abound, presumably as a reflection of saprophytic fungi at work" (p.306). There is no evidence for the presence of a food supply for the fungi, assuming the food supply did not develop on the remains of the body; we presume that the fungi accumulated with the charcoal and the rest of the sedimentary particles as part of the wind-blown sedimentary load.

The provenience of skull 33–238 can only be estimated because of the lack of sufficient data to narrow the site to a small area. The complete lack of pollen and pteridophyte spores means that no estimation of the nature of the vegetation and climate at the time and location of burial can be made. However, the general characteristics of the sediment suggest that the person was buried in a loess deposit. The lack of palynomorphs, aside from fungal debris, the abundance and small size of the charcoal particles, and the mineralogical composition of the sediment do suggest, however, that skull 33–238 was interred in sediments that had accumulated in a xeric, fire-prone terrestrial environment that supported little in the way of higher plant life. Such sediments are common in the eolian loess deposits of the Middle Mississippi Valley, and it seems most likely that that is where skull 33–238 was buried.

Conclusion

Murad and Murad (1) reported a successful identification of a human skull and the reuniting of that skull with the remainder of its body in a California cemetery. Unfortunately, we cannot report such successful results. As noted above, we were able to ascertain that skull 33–238 was likely a middle-aged Native American female, but little else. Instead of reuniting skull 33–238 with its body, the State of Louisiana was able to provide some amount of comfort to the Louisiana Native community by demonstrating, through its enforcement actions and nondestructive analyses, that it takes seriously the charges of NAGPRA and the Louisiana Unmarked Burial Sites Protection Act. Skull 33–238, along with other Native American remains, will be reinterred, per the tribes' request, in a keepsafe cemetery maintained by the State of Louisiana.

The inability to identify with more certainty whether a current cultural group is affiliated with skull 33–238 underscores the need for further data collection from Native American remains in the United States. Currently, only three Native American samples are included in the Howells data set: postcontact Arikara, South Dakota; pre- to postcontact Santa Cruz California, and precontact Peru, supplemented by 79 individuals in the Forensic Data Bank (11,29,30) primarily from the Southwest. Inuit data are also included in the Howells data bank. Nonetheless, given the range of variability in Native American crania, particularly through time, such a comparative framework is not sufficient for consulting in NAGPRA cases involving the looting and illegal sale of Native American (including Pacific Islander) skulls from hundreds or perhaps thousands of tribal groups spread over several millennia. Brues (40) advocated using a local rather than racial approach to craniometric affinity assessment which counters some of the elements of typological essentialism in forensic practice. To this end, FORDISC version 3 does allow for the incorporation of local data into the comparative database. However, this belies a more serious issue with forensic consultations between law enforcement agencies and biological anthropologists. Raw craniometric data are infrequently published and not widely available through online sources. The lack of such a comprehensive database means that future researchers will be faced with frustrating and inconclusive analyses. Numerous authors have commented on the harms to science caused by NAGPRA with respect to the continued study of Native American remains (e.g., [41]). The illicit sale of human remains shows no signs of abating (42–46) and law enforcement agencies must have an effective way of establishing population affinity, notwithstanding the debates about this practice in the academic literature (47–55).

In addition, however, this case report does demonstrate the unique potential for at least geographic identification of human remains recovered from illicit sales through nondestructive sediment analyses. Although the sediment sample recovered from skull 33–238 did not contain enough diagnostic material to pin down a specific geographic area, the potential that was demonstrated through this study provides another nondestructive approach to answering questions of affiliation that should be considered in future cases.

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