Lithic Analysis of Coyote Canyon Mammoth Site Sediments

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INTRODUCTION

Mammoth-sized bones were first discovered at the Coyote Canyon Mammoth Site, near Kennewick, Washington, in 1999. After confirmation that multiple skeletal elements of a mammoth were still in place there in 2008, the Coyote Canyon Mammoth Site was secured for research and education. A team of volunteers began formal excavation of the site in 2010.

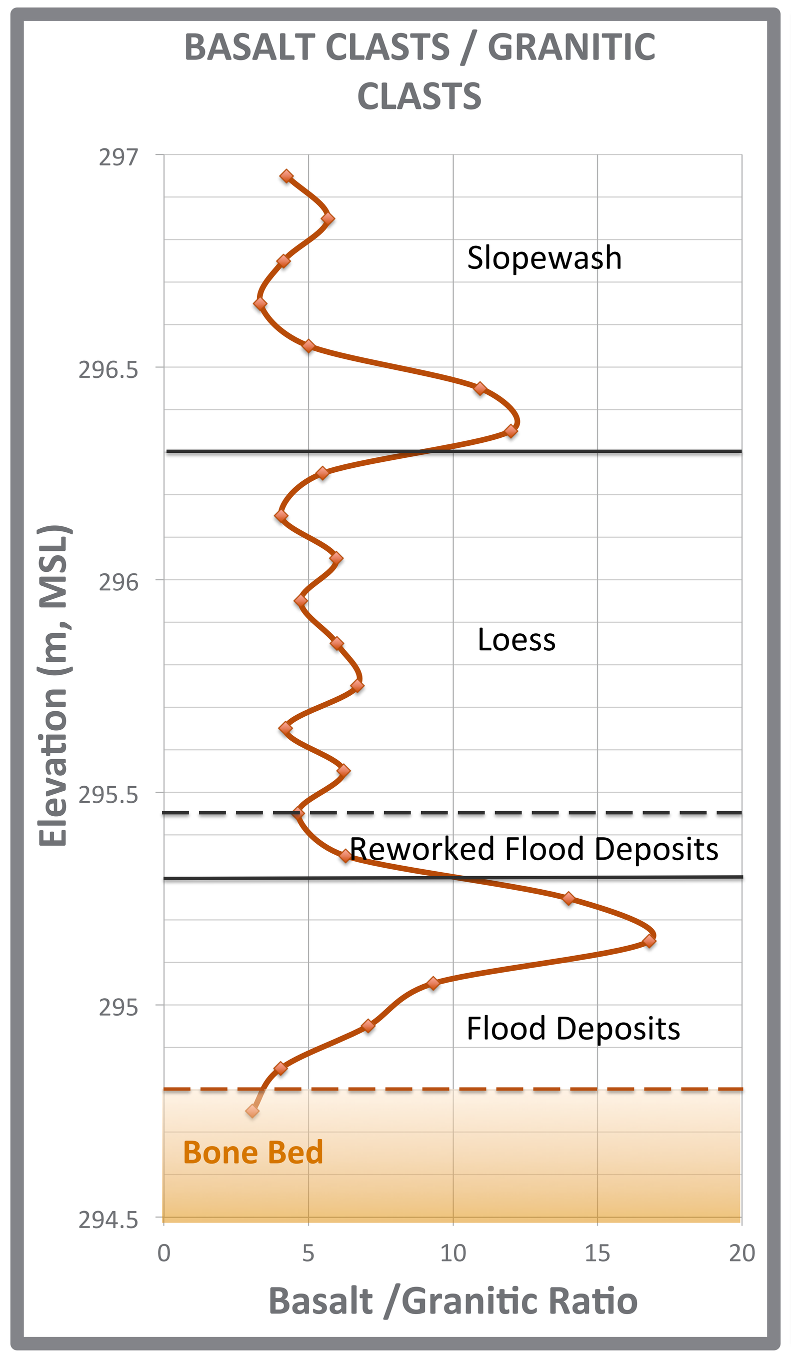
Initial findings suggest that the skeletal remains are located within fine-grained Ice Age flood deposits, which are overlain by reworked flood deposits and eolian sediments (loess), and those in turn overlain by slopewash. We hypothesized that the Ice Age flood deposits should have a higher percentage of granitic and other felsic (rich in light-colored silicate minerals) sand grains from sources near the origin of the floods, whereas locally derived deposits should have a higher basalt content due to the abundance of basalt bedrock and absence of local felsic bedrock.

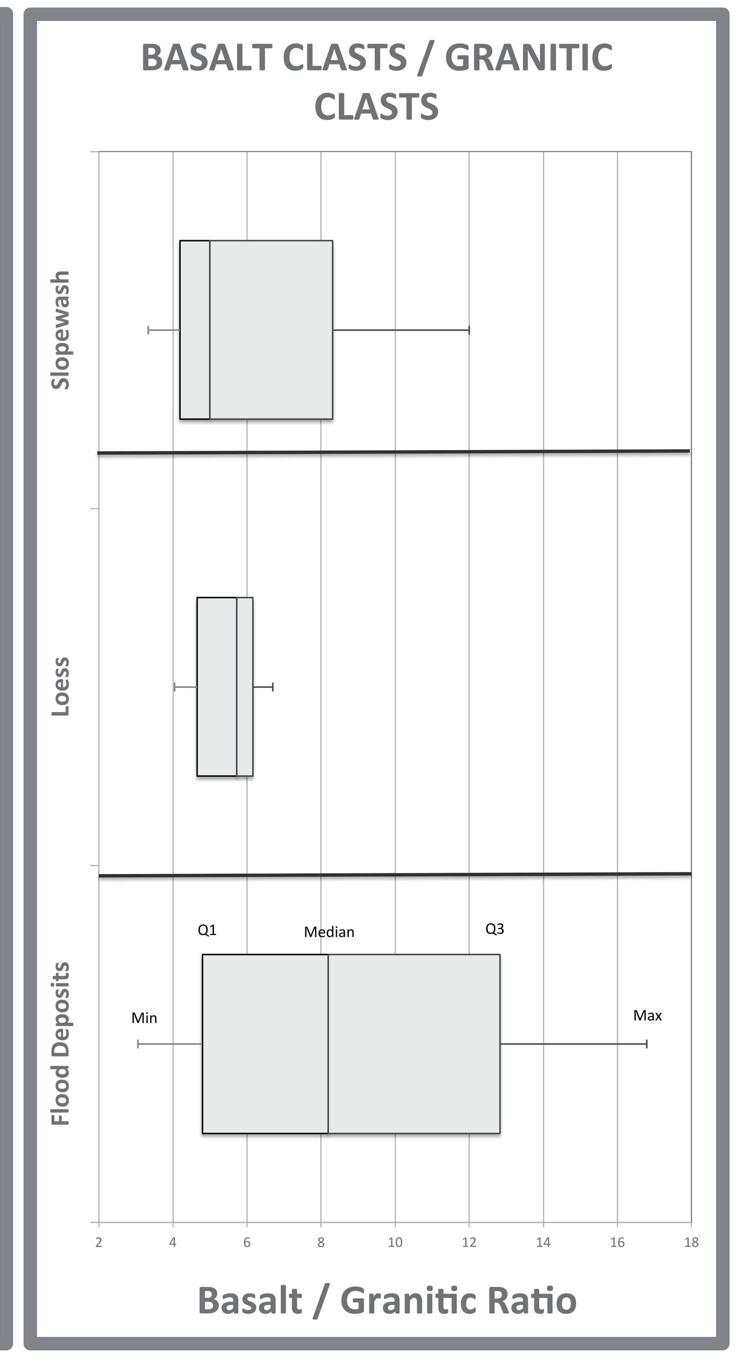
The research presented here was conducted to test this hypothesis by using point-counting methodology to quantify the lithic (rock fragment) composition of very coarse sand grains within each of the stratigraphic units and to examine the usefulness of sand-grain composition in reconstructing the geologic history of the Coyote Canyon Mammoth Site.

METHODS

Lithic point-counting methods used in this research are similar to those used by Hobbs (1998) and Meyer (1986) to determine the 1-2 mm sand-grain composition of glacial sediments in Minnesota, where sand-grain composition data are routinely used to help reconstruct the glacial history.

Sediments representing 23 depth discrete levels overlying the mammoth bone bed were selected for lithic point-count analysis. These sediments had been previously recovered from excavation unit 2 (XU2) in 10-cm-thick layers, wet screened (washed) to remove all material smaller than 1 mm, air dried, and bagged. For this study, each sample was then hand sieved to recover the 1-2 mm (very coarse sand) fraction for point-counting. The 1-2 mm sand fraction was selected because, according to Hobbs (1998), "finer fractions are increasingly dominated by quartz, offering less potential for contrast between units." A 2-gram aliquot yielding 345-512 grains was extracted, using a sample splitter and the cone-and quarter method, as described by Schumacher, Shines, Burtin & Papp (1990). Each aliquot of 1-2 mm sand grains was then separated into seven different lithic groups (basaltic, caliche, granitic, light-colored translucent, light-colored opaque, organics, and other) based on their visual appearance under a low-power binocular microscope (e.g. 3.5x magnification). Each group of similar sand grains was then counted by hand and recorded on a data sheet.





RESULTS

The majority of very coarse sand grains (clasts) are composed of basalt, representing 46 to 76% of the grains. Pedogenic caliche clasts make up 3.5 to 31%, while granitics (4 to 18%) and other felsic (light colored) clasts (0 to 12.7%) make up the remainder of the lithic (rock) fragments. The data are highly variable with depth, probably due in part to the subjective nature of the visual identification of sand gains. However, some data (such as the ratio between the number of basaltic clasts and the number of granitic clasts) suggest lithologic changes that correlate well with previously interpreted stratigraphic contacts (Guettinger et al. 2010 ; Last et al. 2012).

Statistical analysis by stratigraphic group indicate that the median basalt-to-granitic ratio of the flood deposits is greater than that of the loess (including reworked flood deposits) and slopewash. However, it also appears to be decreasing with depth.

Lithic Percentage of Very Coarse Sand Grains

Lithic Group	Minimum	Average	Maximum
Basalt	46.3%	61.7%	76.0%
$CaCO_3$	3.5%	13.6%	31.1%
Granite	4.4%	10.9%	17.6%
Light Opaque	0.4%	1.8%	4.2%
Light Translucent	0.0%	2.4%	12.7%
Organic	0.0%	0.8%	3.8%
Other	2.1%	9.3%	17.7%

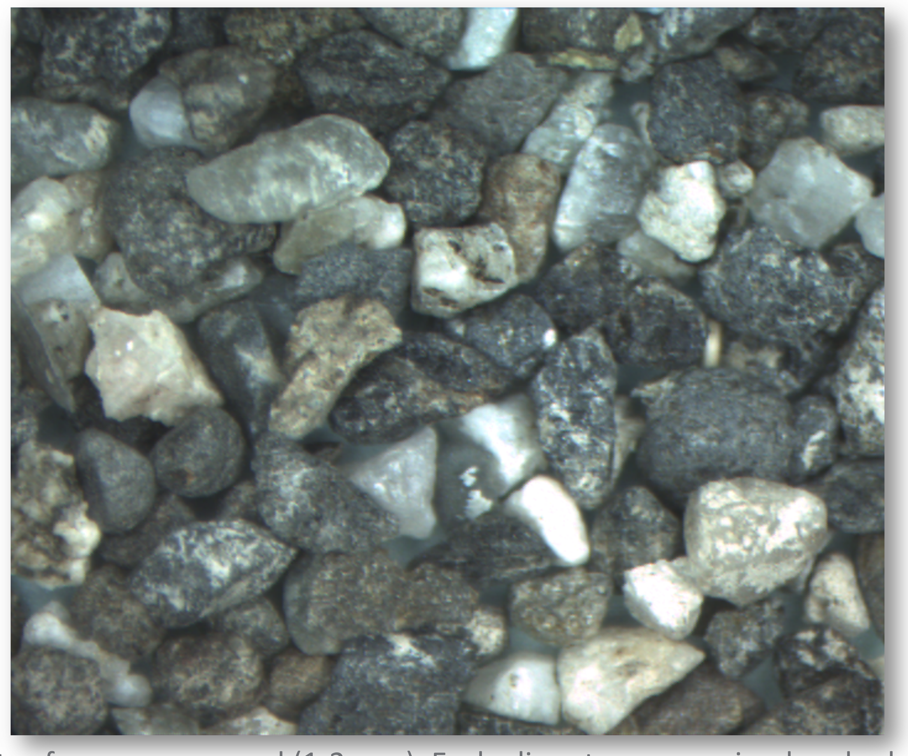
DISCUSSION

Our results suggest there is at least a weak relationship between the lithic composition (e.g. basalt-to-granitic ratio) of the very coarse sand fraction and the major stratigraphic units overlying the mammoth bone bed. While these data appear to contradict our apriori hypothesis that the Ice Age flood deposits would have a lower ratio of basalt-to-granitic sand grains, this ratio also appears to be decreasing with depth, and may in fact become lower than the other locally derived strata. The data also suggest that with a large sample size it may be possible to statistically differentiate the samples into distinct stratigraphic units (e.g. differentiate old fine-grained slackwater flood deposits from younger flood deposits or fine-grained loess deposits), and thus help to reconstruct the geologic history of the site.

The number of samples used in this study was small (only 23 total samples) and there was a fairly high degree of variability found within the stratigraphic layers (particularly the Ice Age flood deposits and slopewash). Additionally, identification and sorting of the large numbers of sand grains is subjective in nature, and the samples are dominated by the large numbers of basalt grains. Additional studies should be conducted to improve the sample size of lithic data, improve consistency in identification and classification of the lithic fragments, and perhaps incorporate less subjective data such as elemental (e.g. X-Ray Fluorescence) analyses.

Despite the limitations of this study, the results do suggest that these types of analyses could improve our understanding of the geologic events recorded at the site and their role in the death of the Coyote Canyon Mammoth.

A low power binocular microscope was used to identify and sort the very coarse sand grains.



Washed samples were cone-and-quartered to produce 2-gm aliquots of very coarse sand (1-2 mm). Each aliquot was examined under low-power magnification and the sand grains separate into seven groups and each grain counted.

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