Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37775

Connecting *in vitro* heavy metal fluid-biomineral partitioning to evaluate chronic heavy metal exposure of humans: Application to samples from the ancient Maya Civilization

SATISH C. B. MYNENI

Princeton University

Evaluation of chronic exposure of humans to heavy metal contaminants has been a challenge. While blood chemical analysis is very useful, it can only provide information on the toxic metal exposure at short time scales. While cellular damage, and vital organ functional tests are often used in toxicological studies, such information can only provide indirect information.

To evaluate how well osteological samples can be used to predict human chronic exposure to heavy metals, our team conducted *in vitro* studies on As, Pb and Zn partitioning from simulated body fluids (SBF) into precipitating carbonated-hydroxyapatite (CHAp). To induce coprecipitation of CHAp with heavy metals, the solution chemical conditions were set in such a way that they are at the saturation state of CHAp. Using heavy metal partition coefficients from SBF to CHAp, and heavy metal speciation (XANES spectroscopy for As), we attempted to assess the chronic exposure of humans to these elements.

Our studies show that As partitioning constants can be derived for As coprecipitating with CHAp in SBF at all examined As concentrations relevant to the natural systems. As(V) also preferentially partitioned when compared to As(III), and the substituted As(III) in CHAp was in the form of As(V). However, similar partitioning equations could not be developed for Pb in the concentration range examined, and this is because of near total uptake and substitution of Pb in CHAp. Both elements were taken up by CHAp at concentrations below these metal precipitates suggesting that ionic substitution in CHAp is the primary mechanism for the metal uptake.

Using this information, we examined the possible exposure of ancient Maya Civilization to As. We used As found in the osteological remains of different mammals, including humans, and our lab-derived As partitioning curves (from SBF to CHAp) to evaluate the possible levels of As in blood. Considering the relatively short half-life of As in modern humans, and As partitioning from diet into blood, we predicted that all examined mammals were exposed to elevated levels of As. Results from this investigation, and the applications of this study to modern human As exposure will be presented.