## B106 A Comparison of Sampling Techniques of Surface and Bulk Dental Enamel for Analysis With Inductively Coupled Plasma/Mass Spectrometry (ICP/MS)

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**Learning Overview:** The goal of this presentation is to address the efficacy of using laser ablation to sample dental enamel compared to previous methods used for surface and bulk enamel for the purpose of geolocation.

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by examining different procedures for sampling surface and bulk dental enamel for geolocation, which in turn can aid in the identification of unidentified remains in the state of Virginia.

There is a need in the forensic community for novel pathways through which to identify unidentified remains when other methods have failed. If the region where the individual lived could be identified, this could aid in potentially connecting the remains to a missing person's report from that region. In a previous study, it was shown that the trace isotopes in surface enamel are distinctly different from the bulk enamel in human teeth. This allows for more specific information about where the individual most recently lived, due to the demineralization and remineralization cycles of the outer enamel, and where they lived in their formative years from the bulk enamel that is formed first and not changed over time. Ultimately, the trace isotopic signatures can be collected from both surface and bulk enamel to develop a database of known signatures from known regions in Virginia, aiding in the identification of approximately 165 sets of unidentified remains currently in the Offices of the Chief Medical Examiner. The purpose of this project is to compare the previously established method of sampling both surface and bulk enamel for isotope analysis using ICP/MS and using laser ablation coupled with ICP/MS for more precise targeting.

To compare sampling techniques, each sample was first chemically etched using a nitric acid etching solution following procedures from the previous study and the resulting solution was diluted and analyzed using ICP/MS for $^{24,25,26}$Mg, $^{50,52,53}$Cr, $^{56}$Fe, $^{58,60,61,62}$Ni, $^{64,66,67,68,70}$Zn, $^{74,76,77,78,80,82}$Se, $^{84,86,87,88}$Sr, $^{130,132,134,135,136,137,138}$Ba, and $^{204,206,207,208}$Pb. Each sample was then cut using a double-bladed diamond saw to remove a small section of the tooth from an area that was not chemically etched. The section was then sampled using laser ablation at the surface of the tooth, 100µm from the surface and 200µm from the surface three times for each sample. The samples were then analyzed using ICP/MS for the same isotopes as the etched surface samples. Finally, the bulk enamel was extracted from each sample by first breaking it with a hammer and then manually removing pieces of enamel that were then crushed into a powder using a mortar and pestle. A small quantity of the powder was then chemically digested and the resulting solution was diluted and analyzed for the same isotopes of the etched surface sample.

Preliminary discriminant function analysis indicates that samples can be classified by region, which is consistent with findings from the previous study. Additionally, preliminary comparisons of samples collected at 0, 100, and 200µm indicate that trace isotopes at 100 and 200µm from the surface are very similar, whereas the trace isotopes at 0µm appear to be discernable from those at 100 and 200µm. This allows for data collected at 100 or 200µm to be treated as equivalent to bulk enamel for direct comparison between the two collection methods. Further statistical analyses will compare the data from the samples obtained using chemical etching and manual extraction to the samples obtained using laser ablation, allowing for comparison of the efficacy of sampling techniques.

**Geolocation, Isotope Analysis, Human Identification**



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