Geophysical Research Abstracts
Vol. 13, EGU2011-13128, 2011
EGU General Assembly 2011

The Development and Application of Cryogenic Laser Ablation ICP-MS (CLA-ICP-MS) for Trace Elemental Analysis of Biological Tissues

Thomas Darrah (1), M. Ellen Campbell (1,2), Dario Tedesco (3,4), Matthew Horton (2), Robyn Hannigan (1,2)

(1) Environmental Earth and Ocean Sciences, University of Massachusetts Boston, Boston, United States (thomas.darrah@umb.edu), (2) GeoMed Analytical LLC, Boston, MA USA, (3) United Nation Operational Project Services, Goma, Goma, DRC, Goma, DRC, 81100, Italy, (4) Department of Environmental Science, 2nd University of Naples, IT, Via Vivaldi 43, Caserta Italia, 81100, Italy

ICP-MS and laser ablation ICP-MS (LA-ICP-MS) are well established techniques for the analysis of trace elements in geological and environmental samples. LA-ICP-MS is commonly used in geological applications to determine the spatial distribution and concentrations of elements in small sampling intervals (as low as 10 microns). Analysis of hard biological tissue samples (e.g. wood for tree rings, bones, shells, otoliths) has been performed by LA-ICP-MS to varying extents. However, to determine elemental concentrations in the majority of biological samples, which are soft and water-rich, samples are typically digested into solutions, obfuscating spatial variations in metal concentrations. In many cases, spatial distribution can reveal highly pertinent information, specifically in forensic or biological tissues that experience spatially variable chemical alteration over time. We report the development of a cryogenic laser ablation cell (GeoMed Analytical, Boston USA) capable of freezing tissue samples, such that soft samples are solidified and laser ablation can be utilized. The cell is temperature programmable and capable of maintaining a sample at any temperature between -30C and room temperature throughout prolonged analysis. We couple this new cryogenic technology with a high performance laser ablation cell (High Performance Ablation Technologies, PA, USA) to maximize ablation sensitivity and resolution for elemental concentrations in many biological tissues.

To demonstrate the utility of cryogenic laser ablation ICP-MS (CLA-ICP-MS), we present data obtained from human hair samples donated by individuals who recently participated in a geological expedition to Mt. Nyiragongo. Mt. Nyiragongo is an extremely active volcano (present lava lake) along the border of the D.R.C. and Rwanda in the western branch of the East African Rift, which emits lava with exceedingly metal-rich (e.g. REEs, HFSEs, etc) aerosol contents. Because hair grows in a linear fashion, a metal concentration “time series” can be produced to evaluate metal exposure prior to, during, and following time spent within the volcanic crater. The use of high performance CLA-ICP-MS technology allowed us to ablate and analyze along the length of the hair without unintended destruction of the sample and with far improved spatial resolution, enabling directly evaluation of the changes in metal incorporation into the human body resulting from exposure to metal-rich aerosols from Nyiragongo volcano.