**An atom-trap method for analyzing 41Ca/Ca**

**in bones and rocks at the 10-16 level**

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Calcium is a major element in the biosphere and lithosphere. Its rare isotope 41Ca, with a half-life of 99 thousand years and isotopic abundances in the range of 10-16 – 10-15, can trace environmental processes at an age scale beyond the reach of 14C. Accelerator Mass Spectrometry (AMS) has been used to measure 41Ca/Ca down to the 10-15 level in natural samples, where it was limited by isobar interferences. We present an Atom Trap Trace Analysis (ATTA) method for 41Ca/Ca analysis, realizing a precision of 10% at the level of 10-16 with samples of bones, rocks and seawater, and achieving a detection limit at the 10-17 level, well below the distribution of natural abundances. This table-top method is poised for studies of calcium-containing samples of Middle- and Late-Pleistocene in geoscience and archeology.

ATTA is also used to analyze the environmental radioactive isotopes 85Kr, 39Ar, and 81Kr. In collaboration with earth scientists, we are dating groundwater and mapping its flow in major aquifers around the world, and dating old ice from the deep ice cores of Antarctica, Greenland, and the Tibetan Plateau. For an update on this worldwide effort, please google “ATTA Primer”.