A new procedure for separating and measuring radiogenic isotopes (U, Th, Pa, Ra, Sr, Nd, Hf) in ice cores.

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Abstract

A new method for the radiogenic isotope (U-Th-Pa-Ra), Sr, Nd, Hf) analysis of the soluble and insoluble components found within ice cores is presented. Melting experiments with rock standards in the presence of EDTA indicate that carbonates, as well as silicates, can be buffered sufficiently to negate dissolution. The use of EDTA allows adsorbing species, such as Th and Hf, to remain in solution during melting thus fully separating the dust (insoluble) and sea salt (soluble) components of the ice after filtration. A new elemental separation scheme for low sample masses, less than 5 mg solid material, utilizes 4 primary ion exchange columns and two "clean-up" columns to fully isolate U, Th, Pa, Ra, Sr, Nd, and Hf while maintaining high yields. Elution schemes measured for USGS rock standards and a Chinese loess are presented to provide a comparison for variable matrix compositions. Mass spectrometer techniques were modified to measure small aliquots of the standards, equivalent to the amounts found in ice core samples, 10ng and less. A MC-ICPMS was employed for the measurement of U, Th, Pa, Ra, and Hf; results of the experiments show that with ion yields up to 1%, rock standards have errors for $^{234}U/^{238}U$ of 1%, $^{230}Th/^{232}Th$ of 1.5%, [^{228}Ra] of 9%, and $^{176}Hf/^{177}Hf$ of 100ppm. MC-TIMS measurements of Sr and Nd show similar errors for small sample sizes: $^{87}Sr/^{86}Sr$ of 50ppm and $^{143}Nd/^{144}Nd$ of 80ppm.This new analytical method increases the number of possible tracers measured from a single sample, reducing separation times and sample consumption, as well as providing a radiometric clock to the suite of tracers.