

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

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18 **Abstract**

19 A new method for the radiogenic isotope (U-Th-Pa-Ra), Sr, Nd, Hf) analysis of the
20 soluble and insoluble components found within ice cores is presented. Melting
21 experiments with rock standards in the presence of EDTA indicate that carbonates, as
22 well as silicates, can be buffered sufficiently to negate dissolution. The use of EDTA
23 allows adsorbing species, such as Th and Hf, to remain in solution during melting thus
24 fully separating the dust (insoluble) and sea salt (soluble) components of the ice after
25 filtration. A new elemental separation scheme for low sample masses, less than 5 mg
26 solid material, utilizes 4 primary ion exchange columns and two “clean-up” columns
27 to fully isolate U, Th, Pa, Ra, Sr, Nd, and Hf while maintaining high yields. Elution
28 schemes measured for USGS rock standards and a Chinese loess are presented to
29 provide a comparison for variable matrix compositions. Mass spectrometer techniques
30 were modified to measure small aliquots of the standards, equivalent to the amounts
31 found in ice core samples, 10ng and less. A MC-ICPMS was employed for the
32 measurement of U, Th, Pa, Ra, and Hf; results of the experiments show that with ion
33 yields up to 1%, rock standards have errors for $^{234}\text{U}/^{238}\text{U}$ of 1%, $^{230}\text{Th}/^{232}\text{Th}$ of 1.5%,
34 [^{228}Ra] of 9%, and $^{176}\text{Hf}/^{177}\text{Hf}$ of 100ppm. MC-TIMS measurements of Sr and Nd
35 show similar errors for small sample sizes: $^{87}\text{Sr}/^{86}\text{Sr}$ of 50ppm and $^{143}\text{Nd}/^{144}\text{Nd}$ of
36 80ppm. This new analytical method increases the number of possible tracers measured
37 from a single sample, reducing separation times and sample consumption, as well as
38 providing a radiometric clock to the suite of tracers.

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