The search for global variations in ^{142}Nd isotopic compositions of Eoarchean rocks

V. BENNETT[1]*, A. BRANDON[2], A. NUTMAN[3], Y. WAN[3] AND L. BLACK[4]

[1]Research School of Earth Sciences, The Australian National University (*correspondence: vickie.bennett@anu.edu.au)
[2]NASA Johnson Space Center, Houston, TX, USA
[3]Chinese Academy of Geological Sciences, Beijing, China
[4]Geoscience Australia, Canberra, Australia

Excesses in ^{142}Nd of up to 20 ppm compared with modern terrestrial compositions and up to 40 ppm compared with chondritic meteorites are now known to be pervasive in >3.6 Ga rocks from southwest Greenland (e.g. [1-5]). These compositions establish that at least parts of the Earth's mantle experienced significant Sm/Nd fractionation at >4.5 Ga, while ^{146}Sm (half-life=103myr) was still actively decaying. The first reported measurements however, of coeval, similarly juvenile granitic rocks (3.73 Ga tonalites) from a second extensive Eoarchean terrane, the Narryer Geniss complex, Western Australia showed no significant ^{142}Nd excess [5] relative to modern mantle. These results raise the questions of what was the original extent of early formed, highly depleted (high Sm/Nd) mantle and what were the timescales of re-mixing of this mantle in the Hadean-early Archean?

To pursue these questions we have measured precise ^{142}Nd/^{144}Nd isotopic compostions of rocks from two additional Eoarchean terranes, the Anshan Province China, and Enderby Land, Antarctica. ^{142}Nd compositions were measured on the NASA-JSC Triton using a multidynamic collection scheme [5] yielding an external precision of ±4 ppm (2SD) for this analytical period. The samples include ca. 3.88 Ga granulite facies orthogneisses and paragneisses from Mt. Sones, Antarctica [6] and ca. 3.8 meta-quartz diorites and trondhjemites from the Anshan province [7]. The new ^{142}Nd data confirms the existence of global chemical heterogenity in the Eoarchean mantle. We interpret these results to reflect early, widespread mantle differentiation, unrelated to crust formation, followed by destruction of some high Sm/Nd, high ^{142}Nd mantle domains by remixing with enriched, or undepleted, mantle prior to 3.8 Ga.

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Organic decontamination of sampling devices for life-detection studies

L.G. BENNING[1], J.L. EIGENBRODE[2,3], J. MAULE[2,6], N. WAINWRIGHT[4], A. STEELE[2], H.E.F. AMUNDSEN[5] AND AMASE 2005 AND 2006 TEAMS[1,2,3,5]

[1]Earth and Biosphere Institute, School of Earth and Environment, University of Leeds, UK (*correspondence: liane@see.leeds.ac.uk)
[2]NASA Goddard Space Flight Center, Greenbelt, MD, USA
[3]Geophysical Laboratory, Carnegie Institution of Washington, Washington DC, USA
[4]Charles River Laboratories, Inc., Charleston, SC, USA
[5]Earth and Planetary Exploration, Oslo, Norway
[6]NASA Marshall Space Flight Center, Huntsville, AL, USA

Sampling and storage devices used for life-detection and habitability investigations in extremophile environments on Earth, Mars and elsewhere require stringent cleaning and decontamination protocols to organic levels consistent with null values. Although various protocols have been proposed for laboratory cleaning of flight hardware, few null-level protocols are available for in-field deployment. Here we present a novel seven-step, multi-reagent cleaning and decontamination protocol which was used for field tests in an extreme environment during two seasons of the Arctic Mars Analog Svalbard Expeditions to Norway. Two sampling devices: (a) an ice-corer and (b) on a rover-guided scoop were repeatedly deployed for ice or sediment sampling and in-field testing and analyses were carried out. The effectiveness of the new protocol was validated *in situ* by quantifying the metabolic activity via APT, and by analyzing the lipopolysacchride (LPS) levels via high-sensitivity endotoxin assays. Finally, the field results were complemented by laboratory-based molecular quantifications of organic compounds via gas chromatography-mass spectrometry. The results showed that the combination and step-wise application of disinfectants to remove all inorganic and organic compounds via oxidation and solvation were highly effective at removing all surface-bound cellular remnants and all organic traces to levels necessary for molecular organic- and life-detection studies. The validation of this seven-step protocol provides a high confidence level for future analogue investigations in extreme environments and this protocol can be applied to other sampling devices used for future astrobiology missions.