^{142}Nd isotope constraints on the evolution of the Hadean Earth

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We have measured ^{142}Nd/^{144}Nd ratios in terrestrial rocks using the new generation TIMS TRITON T1 to investigate whether ^{146}Sm-^{142}Nd systematics ($T_{1/2}$ = 103 Ma) can provide precise age constraints on the differentiation of the Hadean Earth. Our repeated measurements of the AMES Nd standard gives an external reproductibility of 5 ppm (2σ) allowing confident resolution of ^{142}Nd anomalies as small as 10 ppm. Present-day MORBs, and Hawaiian lavas from the Koolau series show no ^{142}Nd anomaly relative the Allende meteorite and the Nd AMES standard. Our measurements of 7 metasediment samples from Isua yielded well-resolved ^{142}Nd anomalies averaging 15 ± 4 ppm (Caro et al. in press). This suggests that the Sm/Nd in the Earth's mantle has been fractionated very early after terrestrial accretion. However, in 3.7-3.8 Ga old felsic rocks and basalts from Isua, no detectable ^{142}Nd anomalies are present, indicating that the anomalies were not widespread and must have been erased within 700 Ma.

The short half-life of the parent nuclide ^{146}Sm precludes the production of anomalies for ages younger than 4.2-4.3 Ga, given the range in Sm/Nd in terrestrial material. Thus, ^{142}Nd isotope systematics provides a unique tracer to investigate mantle mixing compared with other isotope tracers such as ^{143}Nd-^{144}Nd where the production of anomalies can occur all along Earth history. We have used a simple parameterization of mixing time as a function of strain rate (Olson et al. 1984) and related the strain rate to the Rayleigh number. By taking a Rayleigh number an order of magnitude larger for the Hadean Earth, we find that the mixing time is a factor of three shorter, which would mean that the small initial anomalies (50 ppm at most) produced during an early differentiation of the Earth could be more easily rehomogenized between 4.5 and 3.8 Ga.

References

G. Caro, B. Bourdon, J.-L. Birck and S. Moorbath Nature (in press).

P. Olson, D.A. Yuen and D. Balsiger (1984) J. Geophys. Res. **89**, 425-436.

Heavy metal distribution in rock, sediments and groundwater from Mineral de Pozos mining area, Central-North Mexico: First geochemical base line map in Mexico

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Mexico has a history of more than 500 years of extensive mining operations. However, there is an incomplete inventory of heavy metal distribution on the surface and near-surface environment. This work presents the first Geochemical Baseline Maps for the distribution of heavy metals in a mineralised zone. Silver and gold mineralization on quartz-rich epithermal veins was first discovered in the 1600´s in the Mineral de Pozos area, north-central Mexico. Exploitation at the district is estimated at 1,200,000 tons of material with average grades of 1.35 kg/ton Ag, and 8.5 g/ton. Concentration of Cr, Co and Ni in rocks, sediments and mine tailings are below their average concentration in the earth's crust. But concentration of Cu, Zn, As, Cd and Pb in rock, sediments and tailings are above their averages in the earth's crust. Concentration of As and Pb in groundwater (As = 0.011 to 0.090 mg/l; and Pb = 0.025 to 0.035) are generally above the WHO standard for drinking water. Experimental leaching results indicate that potential for leaching As is relatively low (leachates average less than 0.050 mg/l). Lead concentration in the leaching experiments ranges from 0.001 to 0.180 mg/l (average of 0.010 mg/l). These results suggest that As and Pb concentrations in groundwater may be mostly derived from natural sources and weathering processes in the area rather than derived from mine waste material. We present Geochemical Baselines Maps for the distribution of these metals in rock, sediments and groundwater from the area. The same methodology will be used is being used in other zones of Mexico.