Correlation between $^{148}Nd/^{144}Nd$ and $^{150}Nd/^{144}Nd$ ratios and the issue of ^{142}Nd anomalies in early Archean rocks

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A major ambiguity remains in ascertaining whether the silicate portion of the Earth underwent differentiation during the Hadean. This issue can be addressed by utilizing possible fractionations of lithophile extinct nuclides and their daughters and specifically, the ^{146}Sm-^{142}Nd system ($t_{1/2}$ = 103 Ma). However, the relatively short half-life of ^{146}Sm, the low initial $^{146}Sm/^{144}Sm$ ratio (= 0.008), and the low degree of fractionation of Sm over Nd observed on Earth, indicate that even if differentiated reservoirs were produced between 4.5 and 4.3 Ga on Earth, they would show small effects in ^{142}Nd of the order of a few tens of ppm.

Several searches of ^{142}Nd effects in early Archean rocks have given conflicting or ambiguous results. Recent attempts using a new generation of TIMS (Triton, ThermoFinnigan) have again yielded apparently conflicting results: Caro et al. (2003) find that all rocks from 3.7-3.8 Ga Isua supracrustals, West Greenland give 15 ppm excesses in $^{142}Nd/^{144}Nd$ ratio over Ames Nd std. In contrast, Papanastassiou et al. (2003) find that an Isua felsic gneiss contains no ^{142}Nd excess over Caltech nNd-β standard. Whereas it is possible to imagine early Archean rocks with variable ^{142}Nd anomalies, there appears to be a critical issue of the manner in which the two sets of data were reduced to obtain the final results. Papanastassiou et al. (2003) used the exponential law and measured $^{146}Nd/^{142}Nd$ ratios to normalize their data for mass dependent isotope fractionation. Caro et al. (2003) first used the exponential law and measured $^{146}Nd/^{144}Nd$ ratios to normalize their data. They then removed residual correlations between $^{142}Nd/^{144}Nd$ and $^{150}Nd/^{144}Nd$ by subsequently re-normalizing their data using the latter ratio. Papanastassiou et al. (2003) found that normalized $^{148}Nd/^{144}Nd$ and $^{150}Nd/^{144}Nd$ ratios display correlated shifts and inferred them to be ion optical artifacts. This raises the intriguing possibility that second order corrections using $^{150}Nd/^{144}Nd$ ratios could potentially introduce anomalies where there are none. In order to investigate this possibility we measured 10 ppm, 20 ppm, 30 ppm, and 57 ppm gravitationally standards enriched in ^{142}Nd interleaved with Caltech nNd-β. We find that while residual correlations exist between normalized $^{142}Nd/^{144}Nd$ and $^{150}Nd/^{144}Nd$ ratios within individual measurements the data show no systematic deviations when the normalized raw data from enriched and normal standards are plotted together. Moreover, there are no correlations between the averages of normalized $^{142}Nd/^{144}Nd$ and $^{150}Nd/^{144}Nd$ ratios. It is evident that +30 ppm ^{142}Nd anomalies can be resolved using the canonical exponential normalization and extreme care needs to be taken when using second-order normalization.

Prospecting For Metallic Minerals on the SeaFloor

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Prospecting for metallic minerals on the seafloor requires knowledge of mineral deposits and models of their formation of geophysical and chemical exploration methods, and of data evaluation and interpretation methods .Exploration for marine manganese nodules and the massive sulphides on the spreading centres on the oceanic ridges have been discussed. free fall grab is the most recommended method for nodule prospecting whereas underwater TV surveys and pneumatic grab with TV device is the most suitable method for surveys for massive sulphides on the mid-oceanic spreading and conveying centres. How does one find marine mineral resources? Economically important deposits are almost always concentrated in small areas, because many factors must have combined favourably to produce an area of enrichment. The idea that “it is usually easier to locate a mine by chance than to predict one” is no longer to be accepted.

References

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