Tracking Hadean processes in modern basalts

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Some modern ocean island basalts preserve variations in 182W/184W, 129Xe/130Xe and 3He/4He ratios retained from early Hadean processes. No such variations in 142Nd/144Nd have been resolved previously in modern rocks, even though small fractionations (e.g., 5%) in Sm/Nd ratios during the first 70 Ma of Earth's history should result in measureable (c.10 ppm) offsets in 142Nd/144Nd ratios.

We analysed 142Nd in basalts from Samoa and Hawaii characterized by negative correlations between 182W/184W and 3He/4He ratios. Analytical precision was maximized by replicate dissolutions and analyses, by long TIMS measurement that provided dynamic ratios ratios for all Nd isotopes except 150Nd, and by chemical purification that ensured high Nd recovery and minimized isobaric interferences. Averages of replicates of all 7 samples had 142Nd/144Nd within 2s of the JNdi standard (±4.2 ppm). Ratios for five of these samples were within 2SE of JNdi (±1.2 ppm). One sample each from Samoa and Hawaii had 142Nd/144Nd ratios 3 ppm higher than JNdi and outside its 2SE. Small (c. 3 ppm) variations are resolved among samples from Samoa.

Variations in 142Nd/144Nd should track ancient silicate melting and crystallization. The new Nd results suggest the remnants of Hadean silicate processing are sparsely sampled by Hawaii and Samoa sources. Lack of correlation of Nd with W or He isotope compositions suggests variation in these three isotope systems result from different processes.

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