Recycled Carbonate-Rich Sediments in the Hawaiian Plume: Evidence from Mahukona Seamount

Shichun Huang and Munir Humayun (National High Magnetic Laboratory; Geological Sciences, FSU)

Introduction

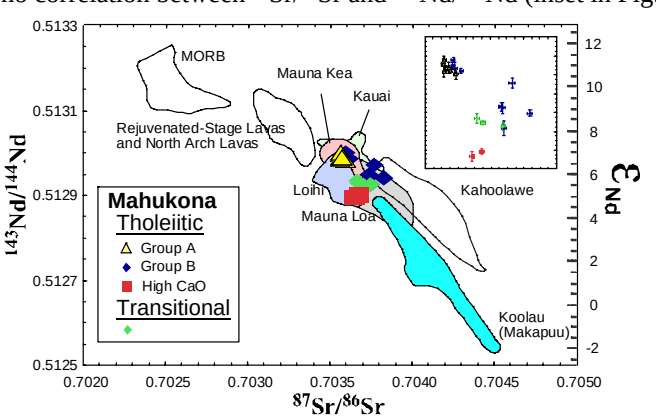
Material from the surface of the Earth can be returned to the deep mantle through subduction zones, and the subducted material may be re-sampled via plume-related volcanism [1] in the global plate tectonic cycle. Lavas from Hawaii, the most active plume-related volcanism on Earth, exhibit considerable heterogeneity in radiogenic isotopes (Sr-Nd-Hf-Pb), as well as in their major and trace element abundances. Some of these geochemical features are attributed to recycled oceanic crust, including sediments [e.g., 2, 3]. Here we report major and trace element concentrations, and Sr-Nd-Hf-Pb isotopic compositions for shield lavas from Mahukona Seamount, Hawaii. Using these data, we identify a recycled carbonate-rich sedimentary source component in the Mahukona lavas.

Experimental

Isotopic compositions of Mahukona lavas were determined on the Finnigan MAT 262 TIMS ($^{87}Sr/^{86}Sr$) and ThermoFinnigan *Neptune* MC-ICP-MS ($^{143}Nd/^{144}Nd$), at the Plasma Analytical facility, NHMFL.

Results and Discussion

In general Hawaiian shield lavas form a negative trend on a $^{87}Sr/^{86}Sr$ *vs.* $^{143}Nd/^{144}Nd$ plot (Fig. 1a). But Mahukona lavas show no correlation between $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ (inset in Fig. 1a). In contrast, within Mahukona lavas, $^{143}Nd/^{144}Nd$ is highly



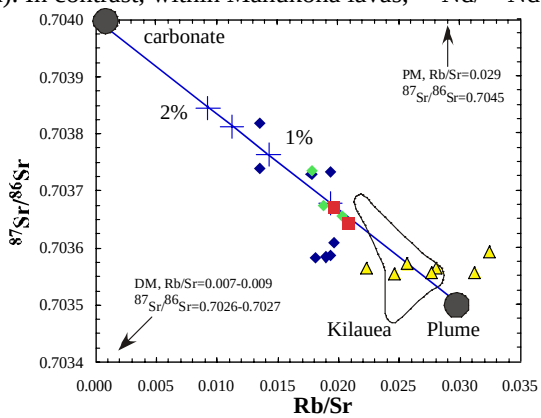


Figure 1a (left). $^{87}Sr/^{86}Sr$ vs $^{143}Nd/^{144}Nd$ in Mahuknoa lavas. Fields for other Hawaiian shields, Hawaiian rejuvenated stage lavas and MORB are shown for comparison. **Figure 2b (right).** Rb/Sr vs $^{87}Sr/^{86}Sr$ in Mahukona lavas.

correlated with Hf and Pb isotopic ratios [4]. Therefore, $^{87}Sr/^{86}Sr$ is decoupled from Nd-Hf-Pb isotopic systems. Surprisingly, Mahukona lavas exhibit $^{87}Sr/^{86}Sr$ that is negatively correlated with Rb/Sr (Fig. 1b), the parent-daughter ratio of the beta-decay of ^{87}Rb to ^{87}Sr, implying that a source component characterized with high $^{87}Sr/^{86}Sr$ (>0.704) and low Rb/Sr (<0.015) was sampled by Mahukona lavas. This component cannot be generated via internal processes in the mantle, because high $^{87}Sr/^{86}Sr$ requires high Rb/Sr. Since ancient (~2 billion year old) carbonate-rich sediments have high $^{87}Sr/^{86}Sr$ (inherited from seawater) and low Rb/Sr, we propose recycled ancient carbonate-rich sediment as a component in the Mahukona source.

Conclusions

We provide the first strong evidence for ancient carbonate-rich sediments entrained in the mantle plume.

References

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