The ^{226}Ra chronology and magma residence time of young lavas from Loihi Seamount, Hawaii

A.J. PIETRUSZKA[1], E.H. HAURI[2], R.W. CARLSON[2] AND M.O. GARICA[3]

[1]Department of Geological Sciences, San Diego State University, 5500 Campanile Dr., San Diego, CA 92182-1020 (apietruszka@geology.sdsu.edu)

[2]Department of Terrestrial Magnetism, Carnegie Institution of Washington, 5241 Broad Branch Rd., N.W., Washington, DC 20015, USA (hauri@dtm.ciw.edu; carlson@dtm.ciw.edu)

[3]Department of Geology and Geophysics, University of Hawaii, Honolulu, HI 96822, USA (garcia@soest.hawaii.edu)

We report measurements of ^{226}Ra-^{230}Th disequilibria in a suite of young lavas collected from the summit platform and south rift zone of Loihi Seamount using the *Alvin, Pisces V,* and *Shinkai 6500* submersibles. These data are used to decipher the residence time of magma at Loihi and the relative post-eruptive ages of the samples. All analyses were preformed on fresh, hand-picked glasses using high-precision plasma ionization mass spectrometry. The samples display a relatively large range in the amount of excess ^{226}Ra (~0-13%). Most of this variation probably reflects the decay of ^{226}Ra after these melts were extracted from the mantle. Model ages calculated from the ^{226}Ra-^{230}Th disequilibria imply a ~200-12,000 yr range in the time since melt extraction (T_{ME}). Most of the T_{ME} variations are thought to reflect the post-eruptive decay of ^{226}Ra, and thus, may be used as proxies for the relative eruption ages of the lavas. The eastern-central portion of Loihi's summit appears to be one of the least active areas of this volcano, whereas the southern portion of the summit may be one of the most active areas. Tholeiitic lavas from the wall of the East Pit at Loihi's summit accumulated over a period of ~1200 yr. Residence time analysis of the fluctuations in the Th/Yb ratios of these lavas suggest that they were derived from a magma chamber with a residence time of ~530 yr, which is much longer than estimates for historical Kilauea Volcano using similar techniques (~30-180 yr). Assuming a magma supply rate of ~0.0058 km^3/yr for Loihi's recent eruptive history (based on estimates of the age and volume of this volcano), these lavas may have tapped a chamber containing ~3 km^3 of magma. This is larger than might be expected for a pre-shield Hawaiian volcano, but is remarkably similar to the estimated volume of magma within Kilauea's summit reservoir (~2-3 km^3).

Comparison of Th, Pb, Nd and Sr isotopes in oceanic basalts: Implications for mantle heterogeneity and magma genesis

K.W.W. SIMS AND S.R. HART

Dept Of Geology and Geophysics, Woods Hole Oceanographic Instituition, Woods Hole, MA, 02543

In principle, comparison of ^{230}Th/^{232}Th, ^{238}U/^{232}Th and ^{230}Th/^{238}U with longer-lived radiogenic isotopes can provide first-order insight into the nature of the mantle source, and the styles of melt generation and magma transport. Despite several studies comparing Th isotopes with longer-lived radiogenic isotopes in oceanic basalts, only one of the four end member mantle components defining the mantle tetrahedron, DMM, is well represented. For the other three end member mantle components (HIMU, EM1 and EM2), there are no high precision measurements of Th isotopes for representative samples. Because of this lack of high quality Th isotopic data for the other three of the end member mantle components (HIMU, EM1 and EM2), the form and relative significance of the relationships between U-Th systematics and the other longer isotopic systems like Sm-Nd, Rb-Sr and U-Pb are not yet well defined.

Here we present new U-Th disequilibria data for a suite of young basaltic samples from the Samoan Islands representing the EM2 end member mantle component. These data are then compared with the MORB and OIB database for which U-series disequilibria and longer-lived radiogenic isotopes of Sr, Nd, and Pb have been measured by mass spectrometric methods. This data compilation shows that: 1) ^{230}Th/^{232}Th and ^{238}U/^{232}Th are correlated with ^{87}Sr/^{86}Sr and ^{143}Nd/^{144}Nd; 2) these correlations can, to a first-order, be approximated by two-component mixing; and 3) the functional form of these relationships are hyperbolic rather than linear, as has been previously suggested. The relationships of ^{230}Th/^{232}Th and ^{238}U/^{232}Th with Pb isotopic composition are more complex and require multiple source components. Using a maximum likelihood non-linear inversion method we show that the correlations of ^{230}Th/^{232}Th with ^{87}Sr/^{86}Sr and ^{143}Nd/^{144}Nd are better defined than the correlations of ^{238}U/^{232}Th with ^{87}Sr/^{86}Sr and ^{143}Nd/^{144}Nd, suggesting that ^{230}Th/^{232}Th is a better estimate of the U/Th source ratio and that net elemental fractionation of U from Th plays an important role in establishing a basalts (^{230}Th/^{238}U) disequilibria. In addition we show that the extent and variability in (^{230}Th/^{238}U) decreases as a function of source enrichment.