Sm-Nd SYSTEMATICS IN SOME MANTLE-DERIVED MINERALS AND THEIR IMPLICATION FOR BASALT EVOLUTION; A. R. Basu and M. Tatsumoto, U.S. Geological Survey, Denver, Colorado 80225

Recent studies (1) have shown that the average continental crust has distinctly lower $^{143}Nd/^{144}Nd$ and Sm/Nd ratios than the upper mantle. The low Sm/Nd ratios in these continental rocks are believed to have resulted from REE fractionation during crust-mantle evolution. To this date all measurements of Nd-isotopic composition have been on rocks derived indirectly from the upper mantle-such as midocean ridge tholeiites and alkali olivine basalt. In order to better understand the Sm-Nd systematics during crust-mantle evolution, we have undertaken a study involving measurements of Sm, Nd contents and the Nd-isotopic composition in some direct samples of the upper mantle. The present study reports some preliminary results.

Of the possible upper mantle minerals, clinopyroxene, garnet and amphibole are the most likely reservoirs of the REE in the mantle. The Sm, Nd contents and the $^{143}Nd/^{144}Nd$ ratios in three of these minerals, "directly" derived from the upper mantle are given in table 1. Sample B-33 is a coarse granular garnet lherzolite xenolith in the kimberlite pipe of Bultfontein in South Africa. The time of emplacement of this pipe is 90 m.y. (2). The rock is relatively unaltered and it was possible to handpick under a binocular microscope clear, unaltered grains of garnet and clinopyroxene. Application of pyroxene geothermometry and geobarometry (3-4) suggests temperature and pressure of equilibration of 1000°C and 50 kb, respectively, for this xenolith. In other words, this rock is a representative sample at a 150 km depth of the subcontinental mantle beneath South Africa 90 million years ago.

The amphibole sample (H-13) is a single megacryst found in association with similar amphibole bearing peridotite xenoliths in alkali basalt from Dish Hill, California. The age of eruption of host basalt is Plio-Pleistocene.

The data in table 1 show that the Sm/Nd ratio is lowest in the clinopyroxene, intermediate in the amphibole and highest in the garnet. However, the $^{143}Nd/^{144}Nd$ ratios in these minerals are not directly correlated with their Sm/Nd ratios, suggesting complex, heterogeneous behavior. Although the present $^{143}Nd/^{144}Nd$ ratios in the coexisting pyroxene and garnet are identical within experimental uncertainties, the initial $^{143}Nd/^{144}Nd$ ratios in the garnet must have been lower, of the order of 0.5121, 90 million years ago at the time of pipe emplacement.

The $^{143}Nd/^{144}Nd$ ratios of the minerals, reported in table 1, support the generally accepted notion that the upper mantle is heterogeneous. The amphibole has high $^{143}Nd/^{144}Nd$ ratios similar to midocean ridge tholeiites (MORB)(5) supporting the proposal of Basu and Murthy (6) that these amphiboles play a significant role in the genesis of MORB. On the other hand, the lower $^{143}Nd/^{144}Nd$ ratios of the garnet lherzolite are compatible with the derivation of alkalic basalts from this rock.

Sm-Nd SYSTEMATICS IN MANTLE-DERIVED MINERALS

Basu, A. R. and Tatsumoto, M.

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Table - 1

Sample	Mineral	Sm (ppm)	Nd (ppm)	$^{147}Sm/^{144}Nd$	$^{143}Nd/^{144}Nd$*
B-33 Granular Garnet Lherzolite from Bultfontein Kimberlite pipe, South Africa	Diopside	2.283	21.032	0.066	0.512235±30
	Garnet	1.711	4.657	0.222	0.512201±32
H-13 Kaersutite inclusion in alkali basalt, from Dish Hill, California	Kaersutite (amphibole)	4.479	15.664	0.173	0.513088±30

*Ratios were normaled to $^{150}Nd/^{144}Nd = 0.236433$. Uncertainties correspond to the last figure and are 2σ mean. Uncertainties in measuring the concentrations are estimated to be less than 0.1%.