GRANITIC ROCKS AND METASEDIMENTS IN ARCHEAN CRUST, RAINY LAKE AREA, ONTARIO: ND ISOTOPE EVIDENCE FOR MANTLE-LIKE SM/ND SOURCES, S.B. Shirey and G.N. Hanson, Earth and Space Sciences, SUNY, Stony Brook, NY 11794

Granitoids, felsic volcanic rocks and clastic metasediments are typical rocks in Archean granite-greenstone belts that could have formed from pre-existing continental crust. Understanding the petrogenesis of such rocks is important to assess the relative roles of new crust formation or old crust recycling in the formation of granite-greenstone belts.

The Rainy Lake area, Ontario, is a 35 by 10 km fault-bounded, granite greenstone terrane located between the Wabigoon metavolcanic-plutonic superbelt and the Quetico gneiss-metasediment superbelt of the Superior Province. Its structure and composition are similar to the granite-greenstone belts which surround the large oval complexes of polycyclic granite and granite gneiss in the Wabigoon superbelt.

The stratigraphic and strucutral interpretations (1,2,3,4,5,6) of rocks in the area yield the following sequence (oldest to youngest): interbedded basalts and rhyolites, graywackes, gabbros to anorthosites, tonalites, syenodiorites and granodiorites. The early supracrustal units display recumbant, near-isoclinal folds and metamorphism into the amphibolite grade has affected all but the granodiorites. U-Pb isotope ratios on zircons and sphene (7,8,9) from all the rocks except the basalts and gabbros fall about a chord with an upper intercept of 2670 ± 30 My, representing a mean age for the belt.

The major element chemistry of the rocks (Fig. 1) and REE chemistry (Fig. 2) are diverse, suggesting each group of rocks was probably derived by a separate process. For example, two types of mantle sources, one strongly light REE enriched and the other only slightly light REE enriched are implied by the REE distribution in the basalts and syenodiorites. The low heavy REE content of the graywackes suggests the existence of a heavy REE depleted crustal material that was sampled during erosion and deposition. The high heavy REE content of the rhyolites rules out the basalt as a precursor for any reasonable extent of melting or fractional crystallization. Sampling of different source areas by melting or erosion would be expected to yield rocks with a variety of Nd isotope initial ratios that would be a function of the age of each source and its time-integrated Sm/Nd.

$^{143}Nd/^{144}Nd$ from the suite of granitoids, rhyolites and metasediments fit within error about a line whose slope corresponds to a mean age of 2670 My with the exception of two samples (Fig. 3). This suggests metamorphic recrystallization of the rocks has not strongly affected the Sm-Nd system on the scale of whole-rock samples at a time much later than the formation of the belt. Because the relative ages of each rock group is well known from field relations, a relative model initial $^{143}Nd/^{144}Nd$ can be calculated for each of the rocks and plotted on its growth curve in epsilon Nd versus time (Fig. 4).

ND ISOTOPES IN GRANITIC ROCKS

84

Shirey, S.B. and G.N. Hanson

Nd isotope ratios on mafic-ultramafic volcanic rocks (10,11,12) suggest the worldwide Archean mantle at 2700 My had a composition that ranged from +4.0 to -2.5 epsilon Nd units. Early in the development of the Rainy Lake belt, the mantle beneath it must have had a range in composition capable of yielding the basalts, gabbros and anorthosites presently exposed. Nd isotope data on these rock types (13,14) suggest the local mantle had a restricted range of -0.1 to +1.9 epsilon Nd units (Fig. 4). Nd isotope growth curves for metasediments, rhyolites and granitoids project through the values for the local mantle within error and show an identical range of 2 epsilon units at 2700 My. The source areas for these rocks could contain significantly older ultramafic-mafic rocks with Sm/Nd similar to CHUR. This possibilty can not be resolved with Nd isotope data. However the data do rule out the possibility that the granitoids were derived by melting of significantly older rocks with Sm/Nd ratios similar to typical continental crust. One likely possibilty is that the rocks in the Rainy Lake area had a short-lived history in the crust and the precursors to these rocks ultimately removed from the mantle shortly before the formation of the belt.

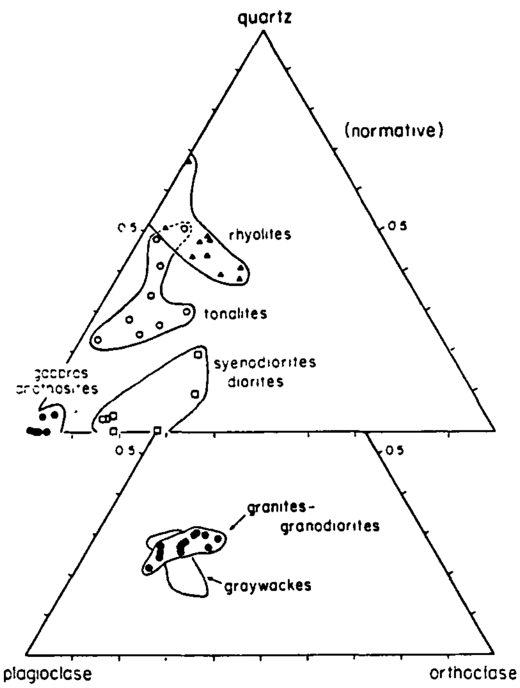

Figure 1.

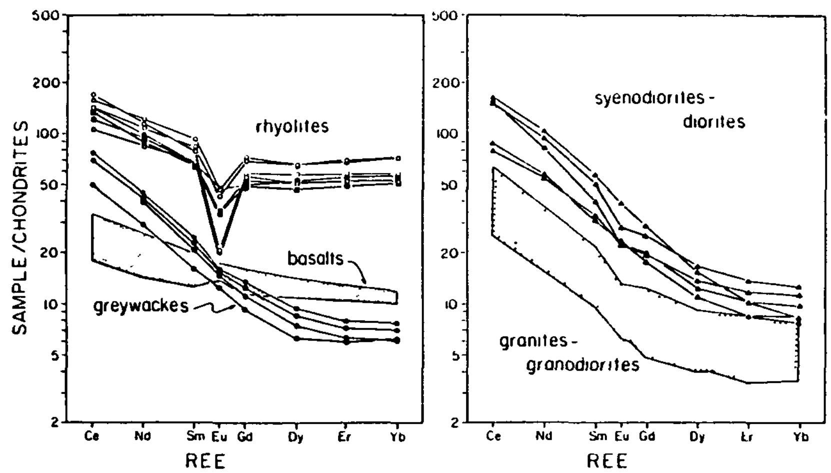

Figure 2.

Shirey, S.B. and G.N. Hanson

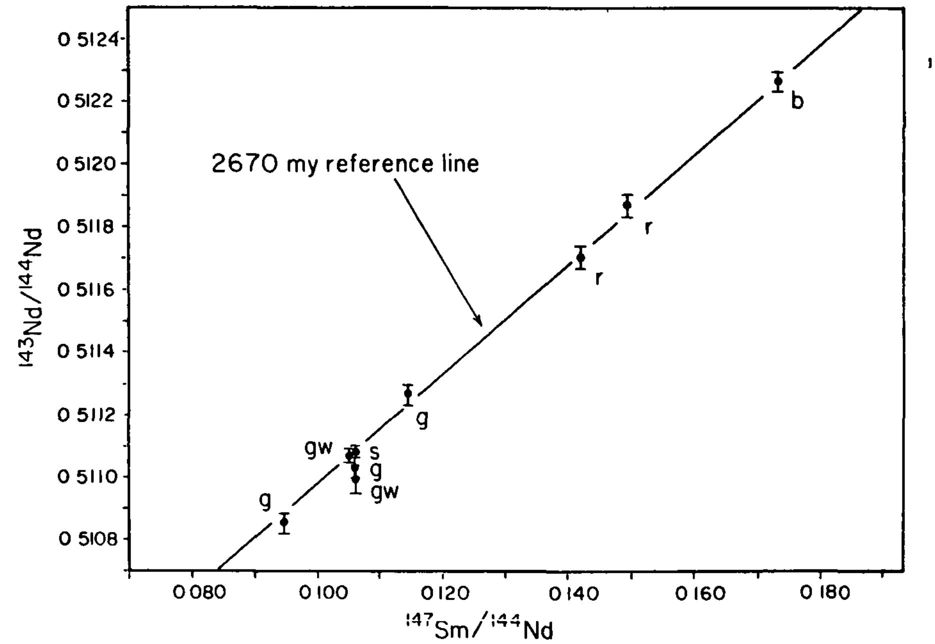

Figure 3.

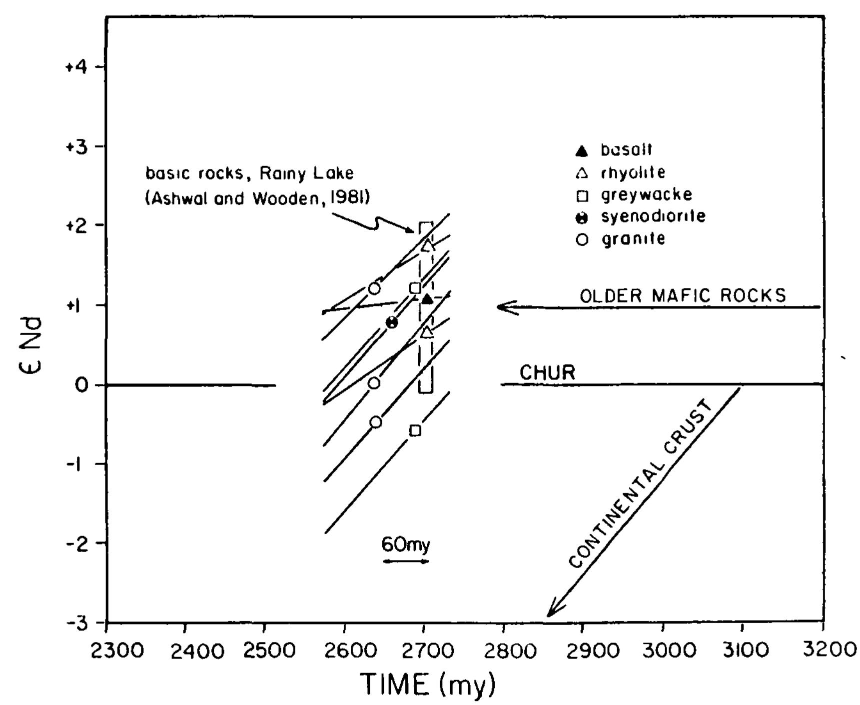

Figure 4.

Shirey, S.B. and G.N. Hanson

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