harzburgite) of a mantle source rock with REE abundances equal to twice chondrites. Apparently, at the time of melting some peridotites contained spinel and others contained garnet.

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RARE EARTH ELEMENT DISTRIBUTIONS IN NEPHELINE SYENITES, HALIBURTON-BANCROFT AREA, ONTARIO

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Using instrumental neutron activation techniques we have analyzed a suite of nepheline-bearing rocks from the Haliburton-Bancroft area for rare earths and other trace elements, including Sc, Co, Cr, Rb, Ba, La, Ce, Nd, Sm, Eu, Tb, Yb, Lu, Hf and Th. Igneous-textured hypersolvus nepheline syenites from Monmouth Township and Trooper Lake have low REE abundances ($La_{E.F.}$=6-16, $Yb_{E.F.}$=3-8, and $La/Yb_{E.F.}$=2-3). REE abundances in composite samples of nepheline pegmatites are similar to hypersolvus nepheline syenites. Three composite samples of nepheline biotite gneisses, which probably formed from meta-sedimentary rocks by metasomatism (nephelinization), are significantly higher in total REE contents ($La_{E.F.}$=46-51, $Yb_{E.F.}$=10-12). Their REE patterns resemble Precambrian shales and graywackes. Nepheline syenitic gneisses and granitic gneisses from Tory Hill have steep-sloped patterns and are remarkably higher in REE contents than a perthite syenite from the same area. Formation of nepheline rocks in this area may have involved 1) accumulation of a sedimentary sequence, 2) metamorphism and intrusion of nepheline syenitic magma that formed igneous nepheline syenites and pegmatites, and 3) metasomatism that converted meta-sediments into nepheline gneisses. Our results suggest that metasomatic processes probably have not appreciably changed REE patterns of parent rocks.

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PETROGENESIS OF THE HONOLULU VOLCANIC SERIES: CONSTRAINTS BASED ON TRACE ELEMENT DATA

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The Honolulu Volcanic series consists of alkalic basalts (2 to >20% normative nepheline) with high Mg/Mg+Fe and abundant mantle xenoliths; thus, these basalts represent magmas that experienced little low level fractionation. Consistent with this deduction are the high Cr (323-575 ppm), Ni (200-390 ppm) and Co (60-72 ppm) contents which vary directly with MgO (10.7-13.5 wt.%). Ratios of K/Rb (323-518), K/Ba (9.1-22) and K/Sr (range 6-12) imply a mantle source lacking amphibole and with little or no phlogopite. Abundances of incompatible elements such as light REE, P_2O_5 and Th are strongly correlated indicating that these elements are not retained by residual phases. The strongly fractionated REE patterns require derivation from a garnet bearing source. If the source has homogeneous REE abundances, the factor of 4 variations in LREE (19-86 ppm La) reflects large variations in degree of melting. Nd isotopic data for a HVS nephelinite (DePaolo and Wasserburg, 1976) infer a time-averaged source relatively depleted in LREE. Using 3 X chondritic abundances for heavy REE and the Nd isotopic data we estimate that Ce in the mantle source is 1.4 X chondrites. Derivation of HVS basalts from such a source by simple partial melting requires <1% melting. Alternative models include recent LREE enrichment or zone refining.

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LESSER ANTILLES ISLAND ARC: RARE EARTH VARIATIONS

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A general view of rare earth element (REE) geochemistry in the Lesser Antilles Island Arc now appears possible, following the completion of an exploratory survey of volcanic rocks from more than 30 eruptive centers or episodes on 14 islands. Flat to light RE enriched RE fractionation patterns of the types reported associated with alkalic, calc-alkalic, and island arc tholeiitic rock suites of the Western Pacific have all been found in this survey, but light RE enrichment does not vary systematically along the arc. This survey shows no obvious RE difference between the volcanic arc and older Limestone Caribbees, nor is lateral zonation of light RE enrichment apparent within quaternary rocks of the volcanic arc. However, the RE geochemistry of the islands is clearly distinct from that of the light RE depleted greenstones dredged from the Desirade Fault Scarp on the Atlantic flank of the arc edifice, and from rocks of Jurassic-dated La Desirade Island. As a whole, RE constraints permit derivation of some Lesser Antillean andesites from associated basalts by simple shallow fractional crystallization. In contrast, others may be related by different degrees of partial melting, involving garnet as a relict phase, or derived from separate sources, but RE fractionation models are non-unique.

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Nd IN ISLAND ARC AND CONTINENTAL VOLCANIC ROCKS

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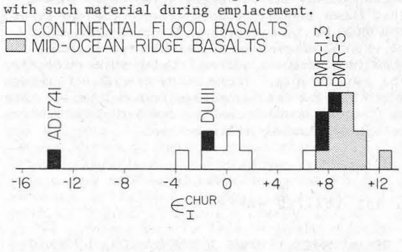
Measurements of initial $^{143}Nd/^{144}Nd$ (expressed as ε_I^{CHUR}) and $^{87}Sr/^{86}Sr$ were made on an andesite (BMR-1) and two dacites (BMR-3,5) from the New Britain volcanic arc to compare them with oceanic basalts and continental volcanics, and to evaluate models of the genesis of island arc magmas and their role in the growth of continental crust. In addition, continental ultrapotassic volcanics have been measured to determine if they are derived from a special magma source.

The island arc samples have ε_I^{CHUR} similar to mid-ocean ridge and oceanic island basalts and clearly different from most continental flood basalts (Figure). If these samples are representative, then island arc magmas must be derived not from a primary, chondritic-REE reservoir (CHUR) as are the continents, but from a light-REE depleted (high Sm/Nd) reservoir.

A ugandite (DU 111, 5%K_2O) from the E. African Rift appears to be derived from a reservoir similar to that which produces continental flood basalts. A wyomingite (AD 1741,10%K_2O) from the Leucite Hills has ε_I^{CHUR} drastically different from all other young volcanic rocks. This rock must be derived from ancient (>1 AE), low Sm/Nd material, perhaps ancient crust or ancient alkali basaltic material, or was highly contaminated with such material during emplacement.



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DERIVATION OF CONTINENTAL VOLCANICS FROM ENRICHED AND DEPLETED MANTLE: ND-ISOTOPE EVIDENCE.

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From the correlation between $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ in oceanic basalts (EPSL 34, 13) the bulk Earth (BE) Rb/Sr ratio is estimated at 0.032 if $[Sm/Nd]_{BE}$ is chondritic. Most oceanic basalts are derived from sources which have been depleted relative to the bulk Earth.
Recent volcanics from Roccamonfina, Italy have $^{87}Sr/^{86}Sr$ ratios upto 0.7100, and $^{143}Nd/^{144}Nd$ ratios considerably lower than $[^{143}Nd/^{144}Nd]_{BE}$ (=0.5126), indicating derivation from a source with a time-integrated light REE enrichment.
In contrast tholeiites from Etna, Sicily have $^{87}Sr/^{86}Sr$ ratios ranging from 0.70314 to 0.70337 which inversely correlate with $^{143}Nd/^{144}Nd$ ratios similar to Iceland-Reykjanes Ridge basalts (EPSL 34, 13) and have been derived from a source with a time-integrated light REE depletion.
However the REE abundances and Sm/Nd ratios of the Etna tholeiites cannot be modelled by melting of a source with Sm/Nd greater than chondrites, and enrichment of the source region in light REE prior to the melting event is indicated.

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ND- AND SR-ISOTOPE COMPOSITIONS OF ALTERED OCEANIC CRUST AND ISLAND ARC THOLEIITES.

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Dredged and drilled oceanic basalts which show evidence of submarine alteration, in general, have higher $^{87}Sr/^{86}Sr$ ratios (upto 0.708 in this study) than fresh basalts. $^{143}Nd/^{144}Nd$ ratios (normalized to 146/144=0.7219) measured on a number of altered submarine basalts show a small range between 0.5130 and 0.5132. These observations are consistent with the much higher ($>10^5$) concentrations of Sr than Nd in seawater. The Nd- and Sr-isotope relationships in altered oceanic crust potentially provide an important tracer for the identification of magmas derived from subducted oceanic crust. Nd- and Sr-isotopes have been measured in a suite of island-arc tholeiites from the South Sandwich Islands and dredged tholeiites from the Scotia Sea. Nd-isotope compositions of South Sandwich Islands basalts range from 0.51295 to 0.51315 and the Scotia Sea basalts average 0.51305, all within the range of mid-ocean ridge tholeiites. $^{87}Sr/^{86}Sr$ ratios of the Scotia Sea basalts are similar to mantle-derived unaltered mid-ocean ridge basalts (0.7030-0.7032). The South Sandwich Islands basalts are in the range 0.7038 to 0.7040, suggesting that these are at least in part derived from altered oceanic crust.

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Sm-Nd CONSTRAINTS ON THE EVOLUTION OF OCEANIC ROCKS

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Oceanic ridge tholeiites are thought to inherit their LIL depleted characteristics and chondrite normalized light REE depletion from mantle sources that have undergone previous differentiation events. Constraints on mantle REE evolution are being developed through investigation of the Sm-