of enrichment to permit extraction of light REE enriched lavas at moderate degrees of melting.

Fragments of "veined mantle" have been analysed for REE, Nd and Sr isotopes. Co-existing kaersutite and diopside give an "age" of 169 ± 21 MA (1σ) (MSWD = 0.63) with an $(^{143}Nd/^{144}Nd)_I$ = 0.51287. Clinopyroxenes separated from five petrographically distinct peridotites exhibit an extreme range in $^{143}Nd/^{144}Nd$ = 0.512983 - 0.512603 and $^{87}Sr/^{86}Sr$ = 0.70272 - 0.704697, that overlaps the "mantle array". If the linear arrays on trace element and isotope diagrams represent "mixing lines" then we can define the enriched (E) and depleted (D) components in the mantle. First, the kaersutite veined Type I lherzolites from Geronimo and Dish Hill comprise a MORB residue (D) and an enriched component identical to Basin and Range lavas. Clearly kaersutite veins represent frozen conduits of basanitic magma. Second the anhydrous Type I and Type II lherzolites at Geronimo and San Carlos comprise a MORB residue (D) and an enriched component with $\Sigma_{Nd} \approx 0$. Mantle below the southwestern U.S.A. has experienced a multi-stage history comprising a major widespread depletion event (> 1 b.y.) and enrichment events caused by migration and infiltration of LIL element rich fluids. (Σ_{Nd} = 0 to 8.)

E14
MANTLE HETEROGENEITY: ISOTOPIC AND TRACE ELEMENT EVIDENCE FROM NUNIVAK ISLAND ALASKA

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A diverse suite of ultramafic and mafic nodules occurs in Quaternary basanites on Nunivak Island (166°W, 60°N), including granuloblastic-equant (GE), coarse-equant (CE), and coarse-tabular (CT) lherzolites, amphibole-pyroxenites, and pyroxene granulites. GE nodules have La/Yb ratios less than chondrites, and clinopyroxenes from these nodules have $^{87}Sr/^{86}Sr$ (0.70203-0.70264) and $^{143}Nd/^{144}Nd$ (0.51321-0.51330) ratios similar to those of oceanic-ridge basalts. We interpret these nodules to be petrogenetically related to oceanic-ridge basalts however, very low bulk rock K contents (9-17 ppm) complicate simple models. The CT and CE peridotites, some of which contain hydrous minerals, all have La/Yb ratios greater than chondrites, and have high concentrations of K (80-1065 ppm), Rb (0.058-2.83 ppm), Ba (3.7-42 ppm), and Sr (11-82 ppm) relative to the GE nodules (0.01-0.11 ppm Rb, 0.56-0.83 ppm Ba, 12-16 ppm Sr). These CE and CT nodules are similar to metasomatized peridotites from other localities. Isotopic data indicate that some of the amphibole-bearing peridotites ($^{87}Sr/^{86}Sr$= 0.70289-0.70313; clinopyroxene $^{143}Nd/^{144}Nd$ = 0.51309) are petrogenetically related to the amphibole-pyroxenites ($^{87}Sr/^{86}Sr$=0.70288-0.70297; 2 whole rocks $^{143}Nd/^{144}Nd$ = 0.51310). These pyroxenites have trace element characteristics consistent with an origin as crystal accumulates. We infer that this example of metasomatism is the result of the infiltration of a H-C-O-rich fluid and/or residual silicate melt which originated in the pyroxenites. Based on consideration of isotopic data, we concur with Menzies and Murthy (1980) that the metasomatism occurred recently, and that it is petrogenetically related to the basaltic volcanism on Nunivak. Metamorphic textures in the pyroxenites preclude a direct relationship with the host basalts.

E15
METASOMATISM AND CHEMICAL HETEROGENEITY IN THE SUB-CONTINENTAL MANTLE: Sr and Nd ISOTOPIC ANALYSIS OF APATITE RICH XENOLITHS AND ALKALINE MAGMAS FROM EASTERN AUSTRALIA

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Cenozoic volcanic rocks from E. Australia are relatively uncontaminated (viz. high Mg values, high Ni, Cr, Co and Sc) and offer a unique opportunity to study mantle isotopic heterogeneities. Most of the magmas in the S. Highlands province are geochemically distinct and reached the surface as isolated flows of limited volume. Consequently the considerable range in $^{87}Sr/^{86}Sr$ = 0.70289 - 0.70444 and $^{143}Nd/^{144}Nd$ = 0.512965 - 0.512611 (13 rocks) can best be reconciled by melt extraction from a geochemically and mineralogically inhomogeneous mantle. Trace element and isotopic analyses of Al-augite series xenoliths reveal the following: (1) Apatite-rich pyroxenites have a narrow $^{143}Nd/^{144}Nd$ = 0.51257 - 0.51266 and $^{87}Sr/^{86}Sr$ = 0.70368 - 0.70397, similar to that of the host dike rocks (i.e. $^{143}Nd/^{144}Nd$ = 0.512611 - 0.512663 and $^{87}Sr/^{86}Sr$ = 0.70405 - 0.70414). (2) Whole rock pyroxenites have slightly higher $^{87}Sr/^{86}Sr$ ratios than constituent minerals perhaps due to the presence of mica. (3) Minerals separated from the xenoliths (viz. apatite, amph. and cpx.) exhibit an extremely narrow range in $^{87}Sr/^{86}Sr$ = 0.703543 - 0.703665 and a wide range in $^{143}Nd/^{144}Nd$ = 0.51252 - 0.51276, with the exception of spinel which has a higher $^{87}Sr/^{86}Sr$ = 0.704139. The minerals and whole rocks plot to the left of the mantle array. (4) Co-existing spinel, apatite and clinopyroxene exhibit a narrow range in Sm/Nd that does not permit accurate dating of pyroxenite formation (≈500 m.y.). The pyroxenites are believed to represent the products of infiltration and crystallisation of a kimberlitic liquid into the mantle. The mantle heterogeneities produced by such metasomatism may be widespread in the Southern Highlands and may explain the diverse nature of the volcanic rocks.

E16
Nd ISOTOPIC DISEQUILIBRIUM IN GARNET PERIDOTITES FROM THE BULTFONTEIN KIMBERLITE AND IMPLICATIONS FOR MANTLE METASOMATIC COMPONENT ADDITION

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The Sm-Nd and Rb-Sr isotopic systematics of garnet, diopside and phlogopite from coarse granular peridotite xenoliths in the southern African Bultfontein kimberlite pipe indicate addition of a mantle metasomatic component. $^{147}Sm/^{144}Nd$ and $^{143}Nd/^{144}Nd$ ratios of garnet, diopside and phlogopite (major REE carrier phases), corrected back to the time of kimberlite emplacement (90 m.y.), are negatively correlated precluding conventional Nd isochron relationships and requiring exotic component addition without reequilibration. On a Nd-Sr correlation diagram these phases lie on an extension of the mantle array defined by mantle derived volcanics, at lower Nd and higher Sr isotopic ratios, as pre-