MANTLE XENOLITHS FROM THE QUATERNARY PALI-AIKE VOLCANIC FIELD OF SOUTHERNMOST SOUTH AMERICA: IMPLICATIONS FOR THE ACCRETION OF PHANEROZOIC CONTINENTAL LITHOSPHERE.

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The Quaternary alkali basalts of the Pali-Aike volcanic field occur within the region of southernmost Patagonia that has been interpreted as Phanerozoic accretionary continental lithosphere (de Wit, 1977; Ramos, 1988; Stern et al., 1989 and 1990). The ultramafic xenoliths they contain are thus samples of mantle significantly younger, and perhaps formed by different processes, than the cratonic Archean and early Proterozoic mantle sampled by kimberlites. The presence of garnet-bearing peridotites amoung the Pali-Aike ultramafic xenoliths provides a rare window to the deeper portions of this accretionary subcontinental mantle lithosphere.

Important petrochemical features of the Pali-Aike xenoliths include:

(1) A significant proportion (>15%) of the Pali-Aike xenoliths are fertile, Fe-rich, coarse-grained garnet-lherzolites (modal garnet + clinopyroxene >20%), although infertile Mg-rich harzburgites are the dominant type amoung the Pali-Aike xenoliths as in many other alkali basalt and kimberlite xenolith suites. Mineral geothermometry and geobarometry suggest that while the upper part (30-60 km depth) of the subcontinental mantle lithosphere below Pali-Aike is composed almost exclusively of infertile Mg-rich harzburgite (Figure 1), the deeper portion (>60 km depth) consists dominantly of fertile garnet-lherzolite. This implies a significant chemical and density gradient within the mantle section represented by the xenoliths.

(2) Mineral geothermometry and geobarometry indicate that temperatures of the lithosphere approach the basalt solidus (>1150^{o}C) at 80 km depth (Figure 1). This suggests a relatively thin lithosphere below Pali-Aike, perhaps thinned and heated by the back-arc processes that produced the Pali-Aike basalts (Douglas et al., 1987; Stern et al., 1990).

(3) Fertile garnet-lherzolites have isotopic composition that fall within the mantle array defined by oceanic basalts, with the isotopic composition of some xenoliths approaching that of mid-ocean ridge basalts (ϵ_{Nd} >+7 and ϵ_{Sr} <-30). No radiogeneic phases (ϵ_{Nd} <0 or ϵ_{Sr} >0), formed by ancient enrichment events such as are well documented within many kimberlite xenolith suites, have been observed within the Pali-Aike xenoliths.

(4) Some xenoliths have light-rare-earth-element depletion, with high Sm/Nd ratios (normalized Sm/Nd >>1). However, in general Sm/Nd ratios do not correlate with ϵ_{Nd}, suggesting non-modal metasomatism has affected many of the Pali-Aike xenoliths as has been demonstrated for many other xenoliths suites. Modal metasomatism, consisting of

phlogopite ± amphibole viens, is also a prominant feature within some of the Pali-Aike garnet-lherzolites. The Nd-isotopic composition of these viens are similar to those of

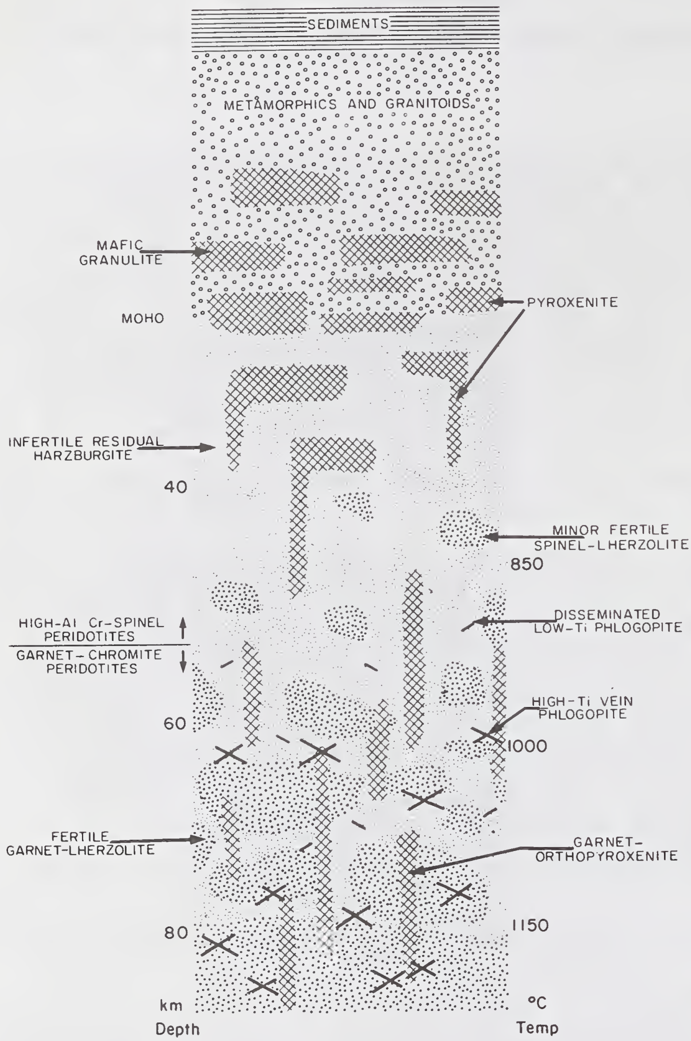

Figure 1. Schematic cross section through the portion of the continental lithosphere of southernmost South America represented by the xenoliths in the Pali-Aike basalts.

the Pali-Aike basalts, and given the high Rb/Sr of the veins, the small difference in their Sr-isotopic composition with the host basalts can be accounted for by an age correction of less than 1 m.y. Thus these modal metasomatic features are interpreted as being caused by intrusion into the lithosphere of melts and/or fluids genetically related to the host Pali-Aike alkali basalts.

The Phanerozoic accretionary subcontinental mantle lithosphere below southernmost South America, as represented by the Pali-Aike xenoliths, is distinct in many obvious ways compared to the Archean and early Proterozoic subcontinental lithosphere represented by xenolith suites within kimberlites: it is thinner, its geothermal gradient is higher, it lacks signifant quantities of eclogite as well as diamonds or other phases formed by ancient lithospheric enrichment events, and most significantly it is chemically and density stratified over a relatively short vertical distance of a few tens of kilometers such that the deeper portion consists of fertile Fe-rich lherzolites which occur, but are uncommon, within the kimberlite suite of coarse grained, undeformed peridotite xenoliths.

The inferred vertical chemical zonation of the subcontinental mantle lithosphere represented by the Pali-Aike xenoliths, with infertile Mg-rich harzburgites grading downward into fertile Fe-rich lherzolites, is similar to the vertical chemical zonation expected for oceanic lithosphere formed by melt extraction below a mid-oceanic spreading center. Also, the isotopic and trace-element composition of some xenoliths approach what would be expected for MORB-source mantle. Accordingly the subcontinental mantle lithosphere below Pali-Aike is interpreted to have formed by tectonic capture, during the early Paleozoic, of a segment of what previously had been oceanic lithosphere formed at a late-Proterozoic mid-ocean spreading center. Lithospheric underplating and non-modal metasomatism within this subcontinental lithosphere may have occurred in association with subsequent tectonic events such as the opening of the South Atlantic during the Mesozoic or the subduction of the Chile Rise in the Cenozoic, but the most recent phase of modal metasomatism is associated with the generation of the Pali-Aike host basalts which has caused heating and thinning of the subcontinental mantle.

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