A geothermal gradient of the upper mantle beneath Jeju-do, Korea: evidence from mantle xenoliths

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Ultramafic xenoliths found in alkali basalts from Jeju-do, Korea are mostly spinel lherzolites composed of olivine, orthopyroxene, clinopyroxene and spinel. A subordinate amount of spinel harzburgites and pyroxenites are also found. Temperatures for these xenoliths were estimated from the compositions of coexisting pyroxenes (Wood & Banno 1973; Wells 1977; Bertrand & Mercier 1985; Brey & Köhler 1990), the Al-solubility in orthopyroxene coexisting with olivine and spinel (Sachtleben & Seck 1981; Webb & Wood 1986), and from Fe/Mg partitioning between olivine and spinel (Ballhaus *et al.* 1991). Temperature estimates from the thermometers by Wells (1977) and Brey and Köhler (1990) are compatible. Average equilibrium temperatures by these two methods for spinel peridotites range from 890 to 1030°C. Pressures for spinel peridotites were estimated from the geobarometer by Köhler and Brey (1991) derived from the equilibrium Ca content of olivine coexisting with clinopyroxene, and fall within the range of 12.9 to 26.3 kbar. The combination of the thermometer by Brey and Köhler (1990) and the geobarometer by Köhler and Brey (1991) yields P-T estimates for Jeju-do spinel peridotites that fall in experimentally determined spinel lherzolite field in CFMASCr system (O'Neill 1981). These P-T data sets have been used to construct the Quaternary Jeju-do geotherm, which is significantly different from the conventional conductive geotherm. The xenolith-derived geotherm has a higher T gradient at low P (13 kbar) than at high P, which may be due to perturbation of the conductive heat flow by magma underplating or overplating at the crust-mantle boundary. Temperature estimates and statistics on the xenoliths indicate that the crust/mantle boundary in Jeju-do lies at about 11 kbar (~39 km). Spinel-lherzolite is inferred as a main constituent rock of the uppermost lithospheric mantle beneath Jeju-do. Pyroxenites were intercalated in peridotites in similar depth and temperature as re-equilibrated veins or lens.