GEOCHEMICAL MODELLING OF MAGMA GENERATION IN PASSIVE AND ACTIVE MANTLE PLUMES

I. D. RYABCHIKOV

Institute for Geology of Ore Deposits, Russian Academy of Sciences, Moscow 109017, Russia

Modelling of N-MORB generation has been performed using PARMEL and COMAGMAT computer programs. Primary magma composition was calculated as mixture of individual melt fractions arising during decompressional dynamic melting of peridotitic material. This composition has been further modified by fractional crystallization until MgO content of derivative melt reaches the value of average N-MORB. This modelling requires larger contribution from the deeper parts of the melting volume. Separation of the most incompatible elements (U and Th) during this process becomes possible due to the participation of a small fraction of volatile-rich melt coming from the garnet lherzolite zone situated much deeper than the main part of the melting volume.

The estimated parameters governing dynamic processes of magma generation permitted to evaluate abundances in N-MORB and OIB sources for a number of incompatible elements. Their primitive mantle normalized values exhibit the same features as were discovered by Hofmann (1988) by comparison of oceanic and continental crusts.

The initial pressure for the beginning of melting during N-MORB generation (26 kbar) is very close to the intersection of garnet-in boundary with the solidus of dry fertile lherzolite. Before the beginning of melting at 26 kbar the starting peridotite contains ca. 3.5 % of garnet according to calculations by PARMEL, and it completely disappears during the first kilobar of decompressive partial melting.

The temperature and pressure at which rising material intersects dry solidus of fertile peridotite in our model permits to estimate the potential temperature of these plumes at close to 1350 ^{o}C. This is close to the position of the average mantle adiabate in recent publications (e.g., White & McKenzie, 1995), and therefore, our calculations support the model of passive plumes for the generation of MORBs.

By contrast, estimated parameters for the beginning of melting during the generation of intraplate magmas (Hawaii, East Greeland, using magma composition in melt inclusions) require significantly deeper levels in the mantle (initial pressure close to 37 kbar) and temperatures ca. 150 ^{o}C higher than average mantle adiabate.

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