DEPLETION-ENRICHMENT OF LITHOSPHERIC MANTLE AND MANTLE PLUME REGIME: EVIDENCE FROM DEEP-SEATED XENOLITHS IN THE VITIM AND UDOKAN VOLCANIC FIELDS (TRANSBAIKALIA, RUSSIA)

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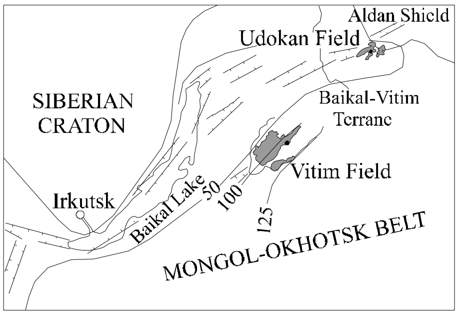
Formation of the Vitim (VF) and Udokan (UF) volcanic fields (15–0 Ma) is explained by Late Cenozoic extension in the north-eastern Baikal Rift System (BRS) caused by a tectonic collision. At the same time volcanism of VF was accompanied by plume activity on the periphery of BRS. Mantle xenoliths and host alkaline basalts of VF and UF reflect ancient mantle heterogeneity and different tectonic and plume regimes. VF is located on the lithosphere slope of BRS (Fig.1) near the boundary of anomalous mantle. Lithosphere thickness in VF ranges from 125 km in the south-east to 50 in the north-west (Zorin, 1990). UF is located at the junction of the BRS rift structure and the Aldan shield of the Siberian Craton with the ancient depleted mantle.



Mantle xenoliths from Miocene basalts in VF are defined by fertile, primitive, and strongly enriched hydrous vein-metasomatized garnet and spinel peridotites. Differentiation of the melts, and melt/mantle interaction restricted the formation of megacryst-, "green" pyroxenite-, and reactional-series of xenoliths (Ashchepkov et al., 1996; Litasov et al., 1997). Interaction of hot basaltic magma and lherzolite resulted in formation of orthopyroxene–garnet–ilmenite–phlogopite rims and Ti, Al, Na and LREE enrichment of lherzolites. The rate of element concentration change increases with the increasing vein thickness. The U-shape of the REE patterns and trace-element modeling of lherzolites (Ashchepkov et al., 1997) suggest the influence of a fluid (reduced, with high H_2O-activity) causing a pervasive porous melt flow through the lherzolite prior to the magma intrusion. Mantle xenoliths from Quaternary basanites are formed by fertile, enriched and depleted equigranular lherzolites, and depleted Cr-spinel harzburgites. Equigranular types correspond to percolation of two kinds of melts (fluids). One caused formation of ferriferous lherzolites and the other ultra-depleted, but high-Ti lherzolites. "Black" and "green" vein systems are less developed. The Quaternary xenoliths reflect a weaker plume reactivation after the Miocene eruption. Quaternary basalts have some higher $^{87}Sr/^{86}Sr$ and lower ε_{Nd} compared to Miocene basalts. Both correspond to an OIB-like source.

New data on the Udokan xenoliths suggest a refractory mantle under UF. We assume the existence of a depleted anhydrous subcratonic mantle beneath the central part of UF related to the Phanerozoic Baikal–Vitim terrane (Fig. 1). Low extent of enrichment processes is illustrated by only rare spinel websterite veins and modal cpx–sp addition to lherzolites. Numerous unequilibrated dunite veins in refractory lherzolites are interpreted as recrystallized residue marking the percolation of oxidized anhydrous fluids (Kelemen et al., 1995). Mantle xenoliths beneath the northern part of UF, belonging to the Proterozoic Aldan shield, represent partially melted spinel lherzolites with abundant glass-bearing melt pockets. Xenoliths represent the uppermost mantle material and indicate the melt delay near the crust–mantle boundary. This agrees with the trace element and isotopic data on UF volcanics (Rasskazov et al., 1997) which show a deep asthenospheric source with OIB characteristics for the central UF and a mixture of OIB and lower crust material for the northern UF.

The present model implies that the Vitim plume magmatism resulted from the Mongolian (South Baikal) plume at the 400 km boundary. Such implication is supported by global seismic tomography data (Fukao, 1994). In the Udokan plateau, the magmatism resulted from intra-lithospheric heating and reactivation of the Aldan shield and BRS weakened junction zone (Rasskazov et al., 1997) without feeding by a deep plume source.

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