

Partial melting of mantle metasomatized ultrabasites under the Avachinsky volcano of Kamchatka

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In this work, a hydrodynamic model of heat and mass transfer in a permeable fissured-porous region above the magmatic foci was constructed to study the partial melting of mantle metasomatized ultrabasites. The mathematical model is constructed in approximation of a multi-tank flow reactor based on a statistical analysis of the structural-mineralogical characteristics and composition of metasomatized ultrabasites from xenoliths of andesiorbasalts of the Avachinsky volcano, using the data on the composition of the fluid phase and temperature of formation of mineral associations. The study of dynamics of zonality of equilibrium non-isothermal infiltration metasomatism makes it possible to evaluate the physical-chemical and thermodynamic conditions of observed metasomatic changes in the primary composition of harzburgites in the spinel abyssal facies in the temperature range of 600-1150°C. In such rocks, two forms of magmatic fluids were established: 1) local (up to 1-5 vol.%) melting of spinel in association with orthopyroxene and formation of compound veins in open cracks (1-5 cm wide) with clinopyroxene + amphibole composition, crystallizing in the range of 1100-1200°C; 2) drusy filling of the open cracks with clinopyroxene or amphibole (as well as plagioclase, magnetite, bubbly acid glass). These minerals contain normal melt inclusions that homogenize in the specified temperature range. The temperatures corresponding to homogenization of normal melt inclusions in spinel are around 1160°. Since no zones of convective melting or melt – rock interaction were found in the studied rocks, the first type of local melting can be explained by decompression melting. The decompression mechanism of melting is possible at convective heating of mantle rocks in the process of seismogenic volumetric pressure reduction, when the temperatures exceed slightly the solidus temperature of highly fluidized ultrabasites. The second variant of open crack filling with clinopyroxene or amphibole crystals is similar to the processes of sublimation and recrystallization of basic rocks when magmatic fluids affect fractured ultrabasites. The possibility of such a mechanism was investigated at the facility in the Institute of Nuclear Physics of the Siberian Branch of the Russian Academy of Sciences, which generates high-density electron beams and makes it possible to obtain boiling ultrabasic and basic liquids and condensates of magmatic gas on the surface of harzburgite or artificial metal and glass screens. Thus, under the volcanoes in the depth range above 60 km there is a seismogenic area of development of the mixed fluid-magmatic systems, where the processes of infiltration metasomatism, partial decompression melting and formation of veins occur. The work was financially supported by the Russian Foundation for Basic Research, Grants No. 16-29-15131, 16-01-00729.