

EXPERIMENTAL HIGH P-T CONSTRAINTS ON THE PARTIAL MELTING OF FLUID-BEARING PERIDOTITE: IMPLICATIONS FOR PARTIAL MELTING AND CRITICAL BEHAVIOR IN HYDROUS MANT

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Financial support by RFBR, grant N 00-05-64741

Herald of the Earth Sciences Department RAS, № 1(20)'2002

URL: http://www.scgis.ru/russian/cp1251/h_dgggms/1-2002/informbul-1.htm#magm-2.engl

The peridotite-sulfide (PS) system has been studied using a solid-media apparatus with using of a double Pt-peridotite capsule method. The experiments were completed at 15-40 kbar, 1250-1400°C, in the presence of H₂O or H₂O+CO₂ fluid. The experimental charges were prepared by packing of the basalt and sulfide powder mixture together with the fluid component into a peridotite capsule; this capsule was then placed into a Pt capsule, which was closed by welding. The bulk H₂O content was controlled by adding basalt as either anhydrous powder with H₂O or as H₂O-bearing basaltic glass powder. H₂O-CO₂ binary fluid mixtures were generated from oxalic acid dehydrate; this method allows chemical exchange between the coexisting phases in the mineral assemblage of peridotite, silicate, sulfide melt and fluid.

In the PS-H₂O-CO₂ system, partial melting of the peridotite occurred for the entire range of P and T studied. For the PS-H₂O system, partial melting occurred over a pressure range 15-25 kbar. The peridotite capsule not destroyed in the course of the experiment, although it reacted with the silicate and sulfide melts until equilibrium was achieved. The charges after the experimental runs consist of peridotite capsule and homogeneous silicate glasses containing sulfide globules. The peridotite capsule easily differs from the glass. The composition of the fluid-bearing partial melts, saturated by sulfide and peridotite mineral assemblages (Ol+Opx at pressure range 15-25 kbar and Opx+Cpx at P=40 kbar in the presence of H₂O +CO₂) corresponded to high-MgO basalt (10-22 wt.% MgO), and depend on P, T, and fluid composition. Sulphur solubility in fluid-bearing silicate melts increase with T, decreases with P, and increases from dry silicate melt, through H₂O + CO₂ - bearing melt, to hydrous silicate melt. Partition coefficients for Ni between Ol and silicate melt vary from 5-9, D opx/l varies from 2-3, sulfide and silicate melt Dmsl/l vary from 220-270.

Very different results were obtained in the systems PS+H₂O at P=40 kbar and T=1350-1400°C. The peridotite capsule was destroyed during the experiment, and the silicate melts did not quench to a glass. The material, produced by these experiments is an amorphous powder, consisting of a micron sized crystalline phases, silicate and metallic spheres. Electron microprobe analyses of several of the experimentally produced phases, (Ol, Opx, silicates of Ca, Al, Fe-Al spinel), silicate spheres (from Al-Q to Q compositions) and Fe-Ni metallic globules indicate significant heterogeneity of the quenched products. Very unusual compositional substitution in experimental charges at this condition appears to indicate the presence unusual critical phenomena. P-T conditions for these experiments corresponding may correspond to those found in: (1) hot spots overlain by lithospheric mantle; and (2) mantle wedge material above a subducting slab of oceanic crust. This means, that, for example, in the mantle wedge above a subducting slab, where aqueous fluid are released in large amounts by slab dehydration at >120 km depth on the range 1350-1400°C, there would be no phase boundary between vapours and melt and no solidus where melting began.