

Redox melting and composition of near liquidus melts of C-O-H- bearing peridotite

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Three types of experiments were performed at pressures up to 8 GPa to elucidate the near solidus melting of C-O-H bearing peridotite. The first were near liquidus studies of average Group 1A kimberlite + 20 % CO₂ (added as magnesite) in graphite lined Pt-capsules which yielded olivine+orthopyroxene at 3 GPa, orthopyroxene+garnet+magnesite at 5-6 GPa and coesite+garnet+magnesite+diamond at 8 GPa. Thus, a Group 1A average kimberlite is too rich in SiO₂ to be a near-solidus melt in carbonated peridotite at pressures higher than 6 GPa. A second set of experiments with garnet peridotite within olivine lined Pt capsules at 6-8 GPa and 1300-1500°C was originally designed to extend the experimental data set for the Al-in-opx barometer to higher pressures. Though, nominally, no C-O-H fluid was added carbonatitic to kimberlitic melts originated in each of the experiments. The melt was always concentrated in interstices between the Pt- and the olivine capsule. Fe-loss to the Pt-capsule did not occur. The residuum in the center of the olivine capsule always consisted of olivine, orthopyroxene and garnet and of magnesite at the lower experimental temperatures. At 1300°C, the concentration of SiO₂ in the melt decreases from 15 wt % at 6 GPa to 2 wt % at 8 GPa. These data suggest that the 1300°C isotherm intersects the solidus of a C-O-H-bearing peridotite at about 8 GPa. Under such conditions, the weight CaO/MgO ratio in melt is about 1.2 and the melt contains about 0.15 wt % Al₂O₃ and 8 wt % Na₂O. A third set experiments contained either 10 % magnesite, calcite or graphite together with garnet peridotite within the olivine capsule. Time studies showed that at the beginning of the runs reduction of carbonate to graphite occurred and no melt originated. From 5 hour run times onwards magnesite reappeared and carbonatitic to kimberlitic melts occurred between the Pt- and the olivine capsules. In runs with 20 hours graphite was oxidized to magnesite. The partial melting behaviour must be the result of originally reducing conditions in the capsule which change to more oxidizing conditions through the loss of Fe from olivine to Pt. Melts with intermediate kimberlite-carbonatite compositions can thus be widespread in the deep upper mantle and are very mobile.