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An experimental study on mantle wedge peridotite metasomatism by supercritical fluid

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Supercritical fluid (SCF) has been demonstrated to be an excellent potential metasomatic agent in the subduction zone process, yet no prior research has investigated the metasomatism of mantle wedge peridotite (PERD) by SCF. To explore the mechanism and products characteristics of metasomatism of mantle wedge peridotite by SCF, we conducted reaction experiments of typical mantle wedge peridotite (spinel lherzolite, KLB-1) with SCF formed by oceanic sediment (represented by Global Subducting Sediment, GLOSS)-water system under the condition of the subarc mantle (3 GPa, 1200 °C) in piston cylinder apparatus. As the mass ratio of SCF to PERD increased from 1:10 to 2:1 in experiments, the composition of residual liquid, relocated to the top of the capsule, changed from basaltic hydrous melt to high magnesian andesite SCF. Concomitantly, the metasomatized lithology changed from hornblende-bearing lherzolite to harzburgite and then to dunite. The major element composition of SCF metasomatic orthopyroxene and clinopyroxene was notably different from the equivalents metasomatized by aqueous fluids or silicate melts in previous experimental studies, expecially in that the SiO_2 and MgO of orthopyroxene was significantly elevated by SCF metasomatism. In some runs doped with trace elements, olivine was significantly enriched in MREE, HREE, and HFSE, whereas orthopyroxene was enriched in REE, HFSE, and LILE, except Zr. These preliminary results indicate that SCF metasomatism could produce geochemical charactersitics (in terms of both major and trace elements) distinct from those of the metasomatic products by aqueous fluids or silicate melts.