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SPECIAL COLLECTION: NEW ADVANCES IN SUBDUCTION ZONE MAGMA GENESIS

Experimental formation of pyroxenite veins by reactions between olivine and Si, Al, Ca, Na, and Cl-rich fluids at 800 °C and 800 MPa: Implications for fluid metasomatism in the mantle wedge

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Abstract

Fluids buffered by a plagioclase matrix are experimentally reacted with olivine megacrysts at 800 °C and 800 MPa (piston-cylinder press, CaF_2 assembly) to form secondary veins of orthopyroxene ± clinopyroxene in the olivine. Fluids utilized were varied in both amount (0–2 wt%) and salinity (0–8 M NaCl). Assuming equilibrium with the plagioclase matrix, they are presumed enriched in Si, Al, Ca, Na, and Cl and are thereby similar in composition to slab-derived fluids. The experiments provide controlled, multi-component analogs of Si-metasomatism in the mantle wedge above subduction zones. The veins are dominated by orthopyroxene with minor clinopyroxene and form complex interconnected networks along fractures in the olivine. The reaction is rate limited by interfacial process of dissolution and precipitation. Porosity is developed throughout the veins and along sub-grain boundaries in the olivine megacrysts. These veins strongly resemble the textures observed in secondary metasomatic orthopyroxene veins widely reported in upper mantle xenoliths within arc magmas. A review of literature data on natural samples and experiments suggests that orthopyroxene ± clinopyroxene veins primarily form between 750–950 °C and over a large pressure range from 0.8–3.4 GPa. The abundance and composition of these metasomatic veins may vary as a function of pressure, variances in the fluid-rock partition coefficients, and/or by modification of the metasomatic fluid during the reaction.

Keywords: Experimental petrology, metasomatism, fluid, orthopyroxene veins