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# Precipitates of α-cristobalite and silicate glass in UHP clinopyroxene from a Bohemian Massif eclogite

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## ABSTRACT

Low-pressure metastable nanoscale crystals of α-cristobalite have been observed epitaxially exsolved in cores of UHP clinopyroxene from the Bohemian Massif, Czech Republic. SAED patterns and HRTEM images detail the close structural relationship between host clinopyroxene and α-cristobalite precipitate: $[001]_{Di} \parallel [010]\alpha$, $(010)_{Di} \sim\parallel (101)\alpha$. TEM results indicate that α-cristobalite exsolved from host clinopyroxene. Non-crystalline Al-bearing silicate phases, also exsolved from UHP clinopyroxene, possesses Al/Si ratios close to eutectic compositions in the system $NaAlSi_3O_8$-$SiO_2$-$H_2O$ system. The presence of glass exsolution suggests a high-temperature formation environment and presence of water. The α-cristobalite formed in a localized low-pressure, micro-environment formed through exsolution of vacancies and excess silica from the host pyroxene lattice. This micro-environment may be a result of negative density changes due to excess lower density silica exsolving from higher density pyroxene during an exsolution process that involved no localized volume change. Interface-controlled exsolution via lattice matching at the diopside/cristobalite interface, and stability changes and melting point depression due to nanoscale size effects contributed to the formation and persistence of this metastable phase. Amphibole in association with α-cristobalite and some non-crystalline silicate phases may be a clue to localized water quantities; silica exsolution with amphibole may have formed below the eutectic temperature and at a later stage than non-crystalline silicate phases without amphibole. Silica rods in Nové Dvory clinopyroxenes were previously thought to be quartz; however, our investigation reveals various low-pressure, high-temperature, and/or metastable phases greatly affected by the presence of vacancy and OH in clinopyroxenes. The results will help us better understand OH in the UHP pyroxene and even water release in the mantle.

**Keywords:** UHP, diopside, silicate glass, cristobalite, TEM, vacancy, OH, eclogite; Isotopes, Minerals, and Petrology: Honoring John Valley