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Low-pressure and low-temperature K-bearing kosmochloric diopside from the Osayama serpentinite mélange, SW Japan

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ABSTRACT

Kosmochloric diopside with high K content up to 0.56 wt% (0.026 K atom per formula unit) was discovered from the Osayama serpentinite mélange in the Chugoku Mountains, SW Japan. K-bearing clinopyroxene fills microcracks (5–150 μm in wide) together with uvarovite within albite vein of a tremolite rock. Compositions of analyzed clinopyroxene consist mainly of kosmochlor + augite (92–98 mol%; $Ko_{19\text{-}38}Aug_{56\text{-}76}$) components and minor amounts of jadeite (0–6 mol%), aegirine (0–5 mol%), Ca-Tschermak (0–3 mol%), and K-kosmochlor (0–2 mol%). Although the K content in clinopyroxene is also variable and heterogeneous even in a single vein, clinopyroxene with higher K content occurs in Ko-rich part. Higher magnification secondary electron images confirmed that exsolution and inclusion are essentially absent in the analyzed clinopyroxenes. The good negative correlation between Cr + Na + K and Ca + Mg + Fe^{2+} indicates the Cr incorporation into the octahedral site. Furthermore, K correlates with Na and Cr, indicating a simultaneous enrichment of K for Na and Cr during pyroxene growth. Textual relations, and parageneses and compositions of minerals suggest that the K-Cpx precipitated together with uvarovite in brittle microcracks directly from a Ca- and Cr-rich hydrothermal fluid at approximately $P < 0.3$ GPa and $T < 400$ °C. Although it has been experimentally concluded that only ultrahigh-P (>4 GPa) environment permits to host relatively large K^+ cation into the clinopyroxene structure, our finding indicates that the incorporation of K into the kosmochlor–diopside series solid solution with at least 0.2 Cr cation p.f.u. is possible even at low P conditions.