

Supersilicic clinopyroxene and silica exsolution in UHPM eclogite and pelitic gneiss from the Kokchetav massif, Kazakhstan

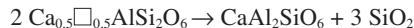
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ABSTRACT

Abundant exsolved quartz rods occur in matrix clinopyroxene of eclogite from the Kokchetav massif, Kazakhstan. These rocks are diamond-grade, ultrahigh-pressure (UHP) metamorphic rocks that recrystallized at $P > 6$ GPa and $T > 1000$ °C. Zircon is an excellent container, which effectively protects peak UHP metamorphic phases from retrogression. Therefore, to ascertain the pre-exsolution composition of the clinopyroxene, we analyzed clinopyroxene inclusions in zircon of the eclogite and a diamond-bearing biotite gneiss. Clinopyroxene in zircon has an excess of $\text{Fe}^{3+} + \text{VIAl}$ over $\text{IVAl} + \text{Na} + \text{K}$, and calculated cation totals significantly less than 4.0 per six O atoms. The stoichiometry of these pyroxenes can be reconciled if the Ca-Eskola end-member ($\text{Ca}_{0.5}\square_{0.5}\text{AlSi}_2\text{O}_6$) is considered. The zircon-hosted clinopyroxene in the eclogite contains up to 9.6 mol% of the Ca-Eskola component, and in the biotite gneiss up to 18.2 mol%, whereas the matrix clinopyroxene contains much less (1.3 mol%, on average). Recalculation of the composition of the matrix clinopyroxene prior to exsolution of quartz rods yields 6.8 mol% Ca-Eskola component, which is consistent with the composition of the clinopyroxene inclusions in zircon. We conclude that the Ca-Eskola component in the peak metamorphic clinopyroxenes broke down by a retrograde reaction:



resulting in exsolution of the quartz rods in the matrix clinopyroxene.

Subducted crustal and supracrustal rocks form the Ca-Eskola clinopyroxene at high pressures and temperatures. The vacancy-containing clinopyroxene may have an important bearing on the physico-chemical properties of the subducted slab at upper mantle depth.