American Mineralogist, Volume 87, pages 454–461, 2002

Coesite exsolution from supersilicic titanite in UHP marble from the Kokchetav Massif, northern Kazakhstan

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ABSTRACT

Coesite exsolved from supersilicic titanite was discovered in an impure calcite marble at Kumdy-kol in the Kokchetav UHP (ultrahigh-pressure) metamorphic terrane, northern Kazakhstan. This impure marble consists mainly of calcite, K-feldspar, diopside, and symplectites of diopside + zoisite, with minor amount of titanite, phengite, and garnet. No diamond was found in the marble. Coesite and quartz, which have needle or platy shapes measuring about 20–60 μm in length, occur as major exsolved phases in the cores and mantles of titanite crystals with minor calcite and apatite. The strongest Raman band for the coesite needles and plates was confirmed at about 524 cm^{-1} with a weak band at about 271 cm^{-1}. To estimate the initial composition of the titanite before coesite exsolution, exsolved phases were reintegrated by measuring their area fractions on digital images. The highest excess Si in titanite was thus determined to be 0.145 atoms per formula unit (apfu). This composition requires a pressure higher than 6 GPa on the basis of phase relations in the system $CaTiSiO_5$–$CaSi_2O_5$. This pressure is consistent with other evidence of high pressure in the same marble, such as 1.4–1.8 wt% K_2O and over 1000 ppm H_2O in diopside. Supersilicic titanite and coesite exsolution also indicate that SiO_2 exsolution occurred in the coesite stability field during exhumation of the UHP metamorphic unit.