**CHEMISTRY AND MINERALOGY OF EARTH’S MANTLE**

**Ca-Al-silicate inclusions in natural moissanite (SiC)**

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**ABSTRACT**

Hundred-micrometer-sized calcium-aluminum-silicates (CAS) inclusions occur in moissanite-4H, moissanite-15R, and moissanite-6H from Turkey. These inclusions commonly consist of tabular exsolution lamellae of two different minerals. By combined electron microprobe and Raman spectroscopy analysis, at least eight different, essentially Mg- and Fe-free Ca-Al-silicate or Al-silicate phases have been discerned. The most common phase is dmisteinbergite, a hexagonal modification of CaAlSi3O8, occurring in association with lamellae of Ca4(AlSi)3O14 or Ca3(AlSi)2O13 compositions. All three phases contain significant amounts of BaO (up to 2 mol% of celsian component in dmisteinbergite), SrO, SO3, and light rare earth elements (LREE). In particular, Ca3(AlSi)2O13 contains up to 2.1 wt% of LREE, 3.9 wt% of F, and significant traces of Cl, while it is also associated to osbornite (TiN). Pure gheleinite, CaAlSiO4, and three additional compositions, namely CaAl4-xSi6+xO14, Ca1-x(AlSi)3+xO6, and Ca3(AlSi)2O14 have been found, either occurring as single grains or forming exsolution lamellae. They also contain significant amounts of BaO, SrO, SO3, and LREE. One last intriguing phase is composed in average of 65.9 wt% SiO2, 17.4% Al2O3, 3.0% alkalis, 6.0% BaO, 2.0% CaO+MgO, 0.9% ZrO2, and up to 0.5% LREE. Dmisteinbergite and gheleinite show Raman peaks in very good agreement with literature data. Ca4(AlSi)3O14 shows main Raman modes at 416 and 1009 cm–1, Ca3(AlSi)2O13 at 531 and 1579 cm–1 while Ca3(AlSi)2O14 has a strong peak at 553 cm–1. CaAl4-xSi6+xO14 shows a weak Raman pattern, while Ca3(AlSi)2O14 has no detectable Raman modes. Since the association moissanite-CAS is thermodynamically not stable at ambient pressure and moissanite crystals hosting the CAS phases have δ13C values typical of deep-mantle origin, we interpret the CAS inclusions as partially retrogressed HP minerals. Striking analogies exist between observed CAS compositions and experimentally obtained HP-HT mineralogy. For instance, Ca4(AlSi)3O14 contains up to 25 mol% of Al2O3, which is considered as the upper limit of alumina solubility in Ca-perovskite. The study confirms that CAS phases are an important mantle depository for large ion lithophile elements (LILE) and LREE.

**Keywords:** Moissanite, dmisteinbergite, gheleinite, unknown CAS mineral, Raman spectra, mineral composition

**INTRODUCTION**

The natural occurrence of moissanite, natural α-silicon carbide, under terrestrial conditions was vigorously debated until the end of the 1980s. Milton and Vitaliano (1984) critically but correctly proposed a series of six independent criteria to discern natural moissanite occurrences from synthetic SiC contamination. Extensive field researches in the last three decades fulfilled most of these criteria. The first one concerned the finding of moissanite as inclusion in other minerals. In fact, moissanite crystals were reported included in diamonds and carbonados from kimberlites and lamproites from many continental cratons in Russia (Yakutia; Marshintsev 1990), China (Fuxian; Leung 1990), Japan (Yakutia; Shiryaev et al. 2011), while abundant silicon and...

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