



Short Communication

Coesite in metasediments from the Muzhaerte valley, southwestern Tianshan

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The sediments, including calcareous, siliciclastic and volcanoclastic, usually occupy >90% in volume of an accretionary complex and thus, if involved in subduction zones, their maximum return depths (i.e., peak pressures) are fundamental to unravel the geodynamic processes during the convergence of plates [1]. As a unique example of accreted complex returned from sub-arc depths (>90 km) worldwide, the metamorphic belt of southwestern Tianshan, NW China has been focused on and hotly discussed in the last two decades [2–5]. Coesite is considered to be diagnostic of the maximum return depths for silica-saturated rocks, the lack of which in some samples often aroused disputation regarding the return depths among the researchers [6,7]. Up to now, there have been abundant reports of coesite-bearing metasediments in the Akeyazi area (Fig. 1) and their occurrences in adjacent regions are still unclear, although ultrahigh-pressure (UHP) conditions have been claimed based on phase relations of carbonate minerals for a pelitic schist from the Muzhaerte valley, ca. 30 km west of the Akeyazi coesite localities [9]. In this study, we carefully examined two metasedimentary samples (albite schist and quartz-rich eclogitic rock) from the Muzhaerte metaophiolitic complex and identified very small coesite grains in porphyroblastic garnet.

The studied albite schist (M162-17), interleaved with quartzite, calcschist and marble, is representative of the Muzhaerte HP metasediments. It is strongly foliated, with steep dipping and the striking parallel to the South Central Tianshan Suture (SCTS). The uniform schistosity is defined by white mica and amphibole as well as subparallel quartz bands. The schist sample is dominated by albite (55%, modal proportion) and quartz (24%), with subordinate greenish to bluish amphibole (5%, mostly pseudomorphosed by chlorite and albite), epidote (2%), calcite (2%), white mica (8%) and garnet (4%, partially replaced by calcite and chlorite along fractures). Garnet is rare but exhibits large euhedral crystal, with inclusions of quartz and rutile. The eclogitic rock (M162-23) is

dominated by omphacite (38%), garnet (25%), quartz (20%), epidote (7%), white mica (6%), glaucophane (3%) and calcite (1%), probably derived from andesitic volcanoclastic rock. Omphacite is fibrous to prismatic and is locally intergrown with quartz. Garnet is euhedral with abundant inclusions of epidote, rutile and quartz. Although monomineralic quartz and strain-free polygonal quartz aggregates in porphyroblastic garnet are common, the quartz aggregates with palisade or mosaic texture typical of coesite pseudomorph are rarely observed.

Coesite is identified not by optical microscopy, but by micro-Raman spectroscopy at Peking University, since all of the coesite inclusions observed are monomineralic, not surrounded by quartz and thus cannot be well distinguished from quartz under transmitted light. The coesite inclusions are 10–20 μm in diameter, with or without surrounding micro-cracks in host garnet (Fig. 2a and b). The coesite grains are so small that some of them are not exposed on the surface (Fig. 2b). They all have pronounced Raman bands diagnostic of coesite (e.g., 523, 428 and 271 cm^{-1} ; Fig. 2c and d). An upshift of the main coesite Raman band (521 cm^{-1} under ambient conditions) to ca. 523 cm^{-1} indicates an overpressure retained in coesite inclusions due to decompressional expansion. The characteristic 464 cm^{-1} band of quartz with or without a shift is weak or negligible (Fig. 2c and d), which implies very weak coesite-quartz transformation consistent with the general absence of radial cracks in host garnet. This may suggest that when coesite inclusions are smaller, the coesite-quartz transformation could be inhibited more effectively by rigid host minerals.

This study concludes that the metasedimentary matrix enclosing variably retrograded mafic-ultramafic boudins in the Muzhaerte area has returned from great depths comparable to the eastern Habutengu-Kebuerte UHP unit (HKU) in the Akeyazi area [5]. However, its spatial distribution and geological connection with the HKU are still unknown. The rocks in both areas show a block-in-matrix structure, whereas blocky serpentinites of variable sizes are all exposed in Muzhaerte (Fig. 1), constituting a metaophiolitic complex distinct from the HKU. In terms of structural

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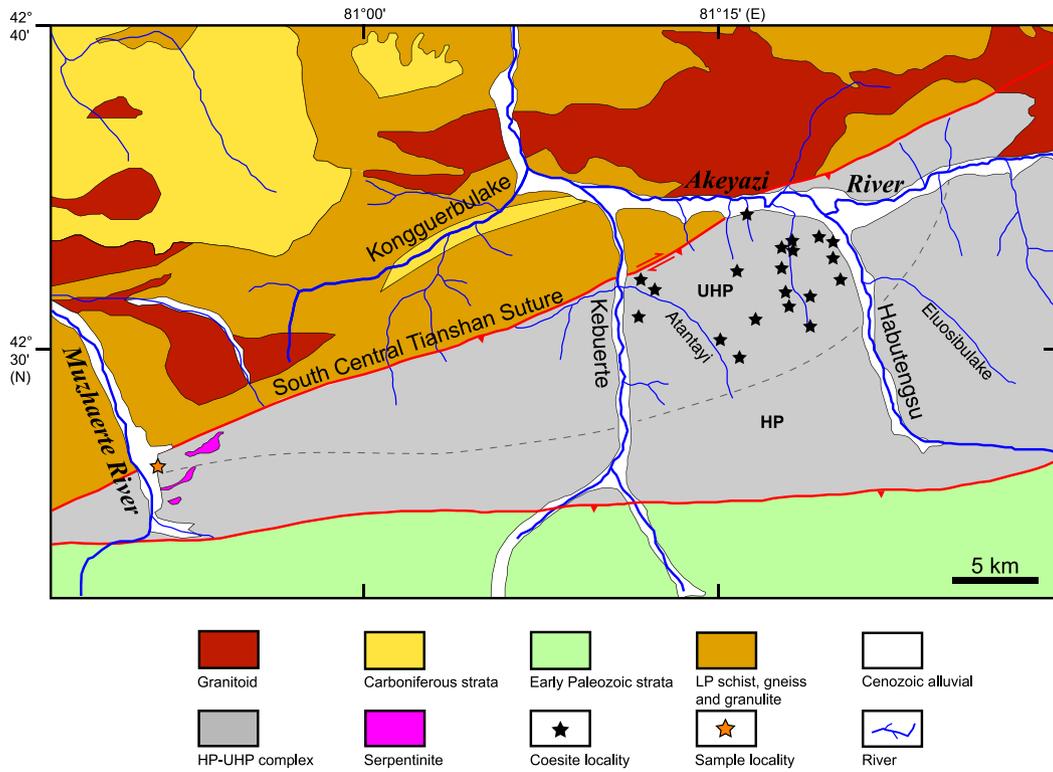


Fig. 1. Geological map of western segment of the HP–UHP metamorphic belt of southwestern Tianshan (after Ref. [8]) showing sample locality. Coesite localities in the Akeyazi area are from Refs. [4,5], including several new findings. Inferred boundary of the HP and UHP units is indicated by dashed line.

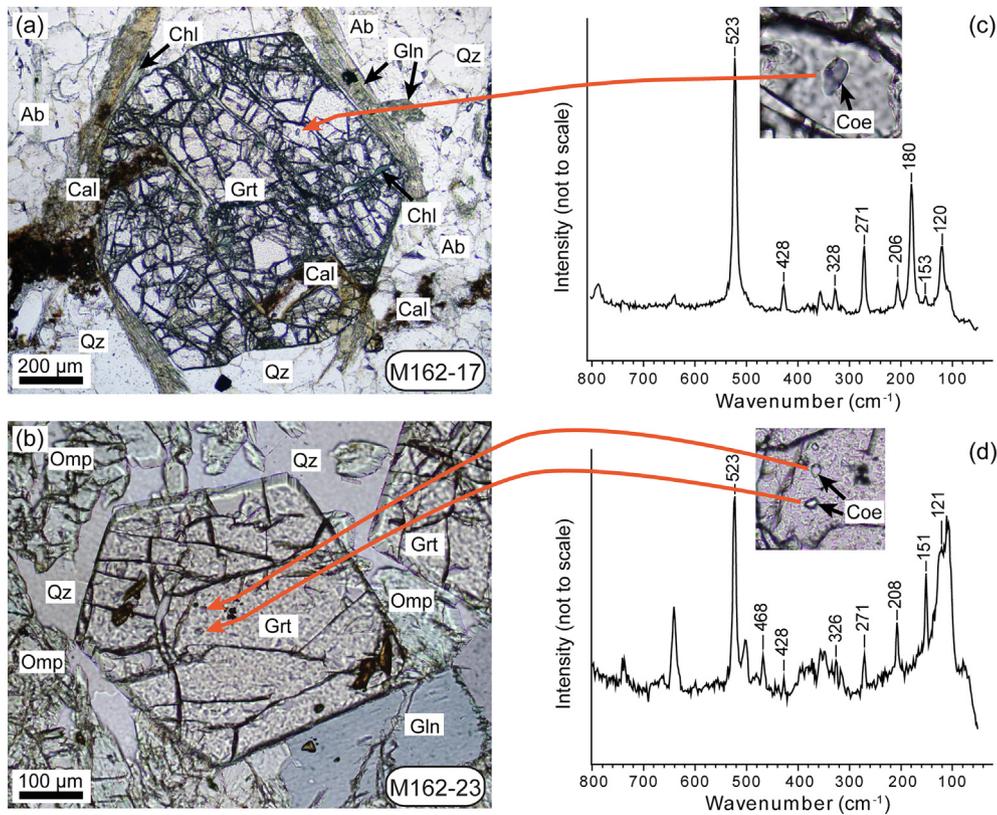


Fig. 2. Plane-polarized light photomicrographs (a, b) and Raman spectra (c, d) of minute coesite inclusions in garnet from the Muzhaerte valley. (a, c) Schist sample M162-17. Euhedral garnet and prismatic glaucophane are altered by chlorite, albite and calcite. (b, d) Quartz-rich eclogitic rock sample M162-23. Note that only strong bands of coesite and quartz are labelled. In contrast to M162-17, the two coesite grains in M162-23 are not exposed on the surface, only visible in a defocused mode (see inset in d). Ab, albite; Cal, calcite; Chl, chlorite; Coe, coesite; Grt, garnet; Gln, glaucophane; Omp, omphacite; Qz, quartz.

geology, the Muzhaerte UHP metasediments have a uniform attitude with steep dipping, clearly sheared by strike-slip faulting along the SCTS [10]. However, the HKU equivalents have varying dipping directions [4], with some uniformly showing NEE striking trends close to the SCTS. Therefore it is possible that the Muzhaerte UHP rocks have experienced a tectono-metamorphic history different from that of the HKU. Detailed P - T - t paths and structural and geochemical studies are awaited to elucidate the potentially contrasting geodynamic processes recorded by the Muzhaerte and HKU rocks.

Conflict of interest

The authors declare that they have no conflict of interest.

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