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SPECIAL COLLECTION: ADVANCES IN ULTRAHIGH-PRESSURE METAMORPHISM

Multi-stage barite crystallization in partially melted UHP eclogite from the Sulu belt, China

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Abstract

Barite inclusions in rock-forming and accessory minerals and in multiphase solid inclusions (MSI) in ultrahigh pressure (UHP) eclogites have been controversially interpreted to record the presence of high-salinity oxidizing fluids[1] close to the peak of metamorphism. A detailed petrographic and microstructural study of barite in partially melted UHP eclogite from Yangkou, in the central Sulu belt of China demonstrates that barite precipitation is a multi-stage process. The different generations of barite provide insight into the evolution of fluid systems as *P-T* conditions evolved through the late prograde stage of subduction to the peak of UHP metamorphism and subsequently during exhumation. Five microstructural types of barite are recognized in this study. Type I barite (variable high to low Sr/Ba) occurs as equant primary inclusions with rutile in garnet and omphacite within coesite-bearing eclogite. Zr-in-rutile thermometry on the primary inclusions of rutile yields $T = 658–699$ °C at $P = 2.5–4.5$ GPa. Thus, barite inclusions were likely precipitated from an internally buffered fluid during the late prograde evolution. Type II barite (low Sr/Ba) occurs in MSI located toward the rims of garnet and omphacite. Since peak pressure was above the second critical endpoint for basaltic compositions, the MSI are inferred to represent aliquots of a silica-rich supercritical fluid trapped during the late prograde evolution close to the metamorphic peak. Type III barite (low Sr/Ba) occurs in pseudomorphs after phengite inclusions in garnet. The replacement phase assemblage formed during exhumation, by in situ melting of phengite. Type IV barite (low Sr/Ba) forms coarse-grained patches associated with sub-solidus replacement of omphacite by hornblende and albite symplectites along grain boundaries. Type V barite (low Sr/Ba) occurs as grain-boundary veinlets, intergranular grains, and closed rings around pyrite that is partly replaced by hematite and goethite. We interpret the types IV and V barite to have precipitated from an internally generated grain-boundary aqueous fluid, which is expected to be a response to H_2O exsolving from garnet and omphacite during low-pressure amphibolite facies conditions. Therefore, barite precipitated during the late prograde subduction and the retrograde exhumation of UHP eclogite yields information about the mobility of Ba, Sr, and S during the metamorphic evolution.

Keywords: Barite, multiphase solid inclusions, supercritical fluid, partial melting, melt/fluid immiscibility, UHP eclogite, Sulu belt, Invited Centennial article