



## Multi-stage barites in partially melted UHP eclogite: implications for fluid/melt activities during deep continental subduction in the Sulu orogenic belt

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Barite ( $\text{BaSO}_4$ ) is well-known from deep-sea sedimentary environments but has received less attention to its presence in high-grade metamorphic rocks. Recently, barite in ultrahigh pressure (UHP) eclogite has drawn increasing attention from geologists, especially in the Dabie-Sulu orogen, since it is an important indicator for high-salinity fluid events, thus aiding in further understanding HP-UHP fluid / melt evolution. However, its formation time and mechanism in UHP eclogite are still controversial, with three representative viewpoints: (1) Liu et al. (2000) found barite-anhydrite-coesite inclusions in zircon and interpreted them to have formed by UHP metamorphic fluids; (2) Zeng et al. (2007) recognized isolated barite within K-feldspar (Kfs) and Quartz (Qz) surrounded by radial cracks in omphacite, and interpreted Kfs+Qz to be reaction products of potassium-rich fluid/melt and coesite, with the barite formed by prograde metamorphic fluids; (3) Gao et al. (2012) and Chen et al. (2014) found barite-bearing Multiphase Solid (MS) inclusions within garnet and omphacite and assumed that the barite formed by phengite breakdown possibly caused by eclogite partial melting during exhumation, though no direct evidence were proposed. The controversy above is mainly due to the lack of direct formation evidence and absence of a clear link with the metamorphic evolution of UHP eclogite along the subduction-exhumation path. We report detailed petrological and micro-structural analyses revealing four types of barites clearly linked with (1) the prograde, (2) earlier stage of partial melting and (3) later stage of crystallization differentiation, as well as (4) high-grade amphibolite-facies retrogression of a deeply subducted and partially melted intergranular coesite-bearing eclogite from Yangkou Bay, Sulu Orogen. Round barite inclusions (type-I) within UHP-stage garnet and omphacite are formed by internally buffered fluids from mineral dehydration during prograde metamorphism. Zr-in-rutile thermometry shows their formation temperature to be 586-664 °C at 1.5-2.5 GPa. Barite-bearing MS inclusions with Ba-bearing K-feldspar (type-II) connected by Kfs+Pl+Bt veinlets of in-situ phengite breakdown and thin barite veinlets along grain boundaries (type-III) are products of phengite breakdown and induced fluid flow during exhumation. These barites have witnessed the gradational separation process of melt/ fluid from miscibility on/above the second critical endpoint during UHP metamorphism, to immiscibility along the exhumation path of the subducted slab. Associated reactions from pyrite to hematite and goethite with the type-III barite ring surrounding the pyrite provide evidence for a local high oxygen fugacity environment during eclogite partial melting and subsequent melt/fluid crystallization processes. Moreover, large grain barite aggregations (type-IV) modified by amphibole+albite symplectite are most likely formed by release of molecular and hydroxyl water from anhydrous minerals of eclogite during high-grade amphibolite-facies retrogression. The growth of multi-stage barites in UHP eclogite further advances our understanding of fluid/melt transfer, crystallization processes along the subduction-exhumation path of the partially melted eclogite, broadening our knowledge of melt/fluid evolution within subduction-collision zones worldwide.

### REFERENCES

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