Associations of Aragonite, Magnesite, and Dolomite in Eclogites from the Jæren Nappe, SW Norway

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Published ultrahigh pressure (UHP) experimental data imply that equilibrium assemblages of aragonite and magnesite form during breakdown of dolomite at pressures higher than 5 GPa. As a consequence, such carbonates often are used as indicators for UHP conditions in eclogite facies rocks. Eclogites from the Jæren nappe, SW Norway, contain carbonate aggregates that consist of aragonite, magnesite, dolomite, and calcite. Application of the grt-cpx-phe-ky-coe/qtz geothermobarometer provided P-T conditions of 2.8 GPa and 670 °C. Zr-in-rutile thermometry yielded a temperature of 681 ± 30 °C. These conditions constrain peak eclogite facies deformation and metamorphism. Typical UHP indicators (e.g., coesite, diamond) have not been recognized in the studied rocks.

Aragonite and magnesite exhibit disequilibrium textures, which imply that the phases have not formed from dolomite breakdown. The various carbonate phases are separated by a reaction front at which magnesite is replaced by aragonite. The replacement occurred by a dissolution reprecipitation mechanism, triggered and mediated by a metasomatic fluid. Using a combination of temperature estimates, textural observations, and kinetic considerations this replacement process can be related to high pressure conditions. The retrograde replacement of aragonite by calcite was remarkably inefficient. Considering kinetics of the aragonite to calcite transition, fast exhumation cannot be the only factor accounting for aragonite preservation in the studied rocks. Other important factors may be high confining pressure maintained by magnesite, limited fluid availability or suppression of the apparently fluid-mediated pseudomorphism by removal of fluids from the system.

The aragonite and magnesite association provides important insights into the kinetics and mechanisms of carbonate phase transformations during HP metamorphism of subducted carbonate bearing rocks and illustrates the key role of fluids. This study also shows that special caution is warranted in the interpretation of aragonite and magnesite association in eclogite facies rocks. Elsewhere the observation of such phases has been used as evidence for UHP conditions. However, for the Garborg rocks we can clearly show that such an interpretation would be inaccurate. Ignoring the difference between coexistence and equilibrium may lead to petrological misinterpretation with extreme consequences for the geodynamic reconstruction of eclogite-bearing terranes.

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