European Mineralogical Conference
Vol. 1, EMC2012-165, 2012
European Mineralogical Conference 2012

Relationship between metasomatism and metamorphism during the Sveconorwegian tectonothermal event in South Norway

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Widespread metasomatism affected the 100 km long and 25 km wide Proterozoic Bamble and Modum-Kongsberg Sectors, South Norway, resulting in chemical and mineralogical transformation of wide segments of continental crust. In the Kragerø region, scapolitisation and albitisation is associated with veining, breccia zones and over pervasively metasomatised areas > 1 km2. At Ødegården verk, the transformation of gabbro to scapolite metagabbro and albitite follow fluid fronts were H_2O-, CO_2- and Cl-bearing phases formed at the expense of the primary volatile-free minerals. During an incipient amphibolitisation stage the primary mafic minerals were replaced by hastingsite, followed by edenitic and pargasitic Ca-amphibole. Magnetite was dissolved, while rutile formed by breakdown of ilmenite. Plagioclase was replaced by Cl-rich scapolite (Me19-42) reflecting Cl-saturation while K- and Mg-saturation produced phlogopite, enstatite, sapphirine and rare corundum. The high modal contents of chlorapatite in the scapolite metagabbro imply infiltration of P. The albitite consist dominantly of albite (Ab95-98) with varying, generally small, amounts of chlorite, calcite, rutile, epidote, pumpellyite and prehnite. Scapolitization and albitization caused a strong depletion in Fe which led to high Mg# of the Fe-Mg-bearing phases. In addition, infiltration of K, Mg, and Na is evident from the mineral replacement reactions and bulk geochemical data.
The Bamble sector of South Norway has been reported as a classical high-grade metamorphic terrain. Detailed petrographic investigations over fluid fronts illustrate a continuity of the metasomatic rocks to the host metamorphic rocks, including an evolution of hastingsite (Mg#=0.33) in amphibolite to edenite with the characteristically high Mg#=0.87 in scapolite metagabbro. The described mineral assemblage, including enstatite, sapphirine and marialitic scapolite, indicates conditions of scapolitisation at ~600-700°C, consistent with the upper amphibolite facies metamorphism dominating the Kragerø region. The veining formed by metasomatism grades into the regional banding which is typically described as created by the Sveconorwegian orogenic event. We regard the metasomatism as an important mineral- and rock-forming process and speculate on its role on the rheology of the crust.