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Mineral replacement and element mobility during scapolitisation and albitisation of metagabbro from the Bamble sector, SE-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 the chemical and mineralogical transformation of wide segments of continental crust. Scapolitisation was associated with veining, and was followed by albitisation, transforming metagabbros pervasively over large areas. The transformation of gabbro to scapolite metagabbro is observed as a fluid front replacing the primary magmatic mineral assemblage in three stages: During an incipient amphibolitisation stage the primary mafic minerals were replaced by anthophyllite or hastingsite, followed by pargasitic and edenitic Ca-amphibole. Magnetite was dissolved, while rutile formed by the breakdown of ilmenite. Plagioclase was replaced by Cl-rich scapolite (Me_{19-42}) reflecting Cl-saturation while K- and Mg-saturation produced phlogopite, enstatite, sapphirine and rare corundum. The high modal contents of chlorapatite and tourmaline in the scapolite-metagabbro imply infiltration of B and P. The albitites consist dominantly of albite (Ab_{95-98}) with varying, generally small, amounts of chlorite, calcite, rutile, epidote and pumpellyite. Constant volume isocon plots were constructed for sample sets of increasingly altered samples crossing fluid fronts. The results imply that metagabbro undergoing scapolitisation is strongly depleted in Fe_2O_3, progressively depleted in Al_2O_3 and undergo an increase in MgO and Na_2O and a smaller increase in SiO_2. Albititsation shows the same extensive depletion in Fe_2O_3, in addition to depletion in TiO_2, MgO and CaO, while Na_2O, Al_2O_3 and SiO_2 increase.
The above described mineral replacement reactions and chemical evolution document element mobilization. Fluids played an active role in these reactions, forming H_2O-, CO_2- and Cl-bearing phases at the expense of the primary volatile-free minerals. To summarize, scapolitisation caused infiltration of K, Mg, Na, B and P, and albitisation infiltration of Na. Characteristically, the metasomatism shows a strong depletion in Fe which led to higher Mg# of the Fe-Mg-bearing phases. We regard the metasomatism as an important mineral- and rock-forming process, and speculate about its role in the formation of the Fe-ores and Mg-Al-rich lithologies such as orthoamphibole-cordierite schist and sillimanite-nodular gneisses in the Bamble and Modum-Kongsberg Sectors.