



Rare earth element and Sm-Nd isotopic redistribution in accessory minerals during lower crust recycling (Bergen Arc, Norway)

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In the Bergen Arc (Norway), the mineralogy, composition and Sm-Nd dating of REE-rich accessory minerals were obtained in samples of the anorthosite-mangerite-gabbronorite-chernockite series that have experienced early metamorphic crystallisation under granulite facies conditions at the Grenvillian (around 930 Ma) and minor to complete retrogression under eclogite and/or amphibolite conditions at the Caledonian (390-430 Ma). In the granulite sample, apatite contains significant REE content. Early (pre-Caledonian) fluid/rock interaction causes the replacement of one early magmatic generation of REE-rich apatite, found as relics armoured in ilmenite-hematite, by secondary apatite with less REE that are redistributed in monazite needles inclusions and REE-rich epidote rim. In the Caledonian retrogressed samples, reaction extent depends mainly on the external fluid availability. In amphibolitized sample, REE are strongly redistributed in a corona of epidote group mineral that surrounds apatite. The in-situ Sm-Nd isotope data for epidote-group minerals and titanite confirms that these two minerals crystallized and equilibrated isotopically during the fluid-assisted Caledonian metamorphism. In eclogitized samples, apatite has the lowest REE and REE are redistributed in the main eclogite assemblage (mainly zoisite). Remarkably, the REE composition of apatite inclusions in ilmenite-hematite indicates that it remained unchanged during the granulite equilibration and later amphibolite/eclogite retrogression and that it is a good indicator of early magmatic crystallisation conditions.