Geophysical Research Abstracts
Vol. 12, EGU2010-11723, 2010
EGU General Assembly 2010

The influence of deformation on zircon and the effect on their isotope system: a case study from the polymetamorphic Lindås Nappe, SW-Norway

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Zircon (ZrSiO4) is considered to be chemically robust under the range of conditions present in the earth's crust. Nevertheless, element mobility in zircon can occur, most importantly Pb-loss related to alteration, leaching by fluids and recrystallization. A recent discussion concerns the role of crystal-plastic deformation and microstructures in zircons and their effect on zircon geochemistry.

In this study we have investigated different gabbroic-anorthositic samples from the Lindås Nappe in the Bergen Arcs, an arcuate structure composed of Caledonian thrust sheets. Although the samples stem from the same nappe und should therefore reveal the same geological history, major differences within the isotope system and therefore the measured ages can be observed. This is due to the diverse imprints of various geological mechanisms on the zircons and their isotopic compositions. This consideration can be used to deduce the polymetamorphic history of the Lindås Nappe by choosing samples variously affected by the different events. Zircons from the dominating anorthosite in the nappe give the oldest age of around 970 Ma, regarded to date the intrusive event. They also clearly reveal the HT Sveconorwegian event at 930 Ma, whereas they are less affected by the younger Caledonian event. The metamorphic age of the HP Caledonian event (425 Ma) is constrained by recrystallized zircons in a fluid driven shear zone within the surrounding anorthosites. Within this 2 cm wide shear zone zircons are exceptionally abundant, and are remarkable in terms of size of up to half a mm, the small amount of U and evidence of internal deformation. Extensive Caledonian Pb loss is linked to this deformation. Recrystallization seems to have happened during the Caledonian event since the recrystallized, smaller grains, located mainly in the pressure shadow of the older ones, yield Caledonian ages. Fluid driven mineral reactions and related volume changes are regarded to be the trigger for deforming the zircons.