Trace element distribution amongst minerals of the Allalin Gabbro

J.A. MILLER AND K.V. SMIT

Department of Geology, Stellenbosch University, South Africa ; karenvenasmit@gmail.com; jmiller@sun.ac.za

The Allalin Gabbro, which forms part of the Zermatt-Saas ophiolite, contains both relicts of the original igneous mineralogy and high-pressure metamorphic assemblages. Incomplete recrystallisation of mineral assemblages has therefore allowed the preservation of different metamorphic stages and reaction paths associated with the gabbro to eclogite transition that have been well documented by numerous previous studies. This knowledge base provides an ideal framework within which to investigate the redistribution of trace elements during the gabbro to eclogite transition.

In this study, the trace element content of differrent minerals or mineral sites was determined via laser ablation ICP-MS from four gabbro samples that represent a sequence of variably re-equilibrated and metamorphosed ocean floor gabbros. The most coherent trace element patterns occur in gabbros with igneous relicts, although the trace element patterns for olivine are erratic owing to very low trace element concentrations. Garnet, which develops as a coronitic phase on olivine and its pseudomorphs, displays an unusally flat trace element pattern with a pronounced positive Eu-anomaly most probably inherited from plagioclase. Ex-plagioclase sites, now consisting of finely intergrown jadeitic pyroxene and zoisite, also have positive Eu-anomalies as does metamorphic enstatite that is intergrown with magnetite on igneous olivine. In comparison, trace element patterns in garnet from gabbros that preserve retrogressed high-pressure metamorphic mineral assemblages have no Eu-anomaly and are strongly enriched in the HREE's with no apparent zoning from core to rim. Omphacite is LREE enriched in retrogressed gabbros but the trace element content of the pyroxenes is in general negatively related to the jadeitic content. Hydrous minerals such as talc, amphibole and chloritoid all exhibit erratic trace element patterns in part due to low trace element concentrations (sample/chondrite <1).

The trace element composition of high-pressure metamorphic minerals in the Allalin Gabbro is strongly controlled by the trace element composition of the precursor igneous mineralogy. Garnet only obtains typical trace element patterns (HREE enrichment and high Y contents) in response to deformation affecting retrogressed samples, and is related to decreasing pyrope content. Given that deformation is linked to exhumation it seems likely that trace element contents of high-pressure minerals are relatively immobile during static prograde metamorphic changes. Significant trace element redistrubution in different mineral sites only occurs in response to exhumation induced deformation and not fluid liberation during progressive dehydration in subduction zone environments.