Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09686, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09686
EGU General Assembly 2008

Oriented growth of garnet by topotactic reactions in high-pressure, mafic garnet granulite during dehydration melting of hornblende-gabbronorite

J. A. Padrón-Navarta, C. J. Garrido, A. Sánchez-Navas

Departamento de Mineralogía y Petrología, Universidad de Granada, Facultad de Ciencias, 18002 Granada, Spain (padron@ugr.es/ Phone: + 34 958 243358)

We present a microsctructural EBSD-SEM study of garnet growth in high-pressure, mafic garnet granulites formed by dehydration melting of hornblende-gabbronorite protoliths in the Jijal complex (Kohistan paleo-island arc complex, N. Pakistan). The composite samples preserve a sharp transition along with the low-pressure, precursor protolith is replaced by garnet along mm-sized reaction front. A precursor magmatic foliation in the gabbronorite is defined by mafic-rich layering with an associated magmatic lineation defined by the shape preferred orientation (SPO) of mafic clusters composed of orthopyroxene (Opx), clinopyroxene (Cpx), amphibole (Amp) and oxides. The shape of the reaction front is convoluted and oblique to the magmatic layering. Pole figures of Opx, Amp and, to a lesser extent Cpx obtained by EBSD, show a strong lattice preferred orientation (LPO) that is intimately related to the magmatic foliation and lineation observed in the precursor hornblende-gabbronorite. Their LPO are characterized by an alignment of their c-axes, which are contained within the foliation plane. Garnet aggregates also display a strong LPO showing a maximum density distribution resembling that of a single-crystal of garnet with one of their [111] directions normal to the thin section. Two of the four [111] directions of garnet are within the magmatic foliation plane with a density maximum subparallel to the magmatic lineation of the precursor. The implied crystallographic relationship $[111]_{Grt}$ // $\mathbf{c}_{Opx,Cpx,Amp}$was also deduced with TEM observations.

The sharp discontinuous modal and compositional variations observed at the reaction

front attest for the role of kinetic inhibition of earlier prograde, solid-state reactions predicted by equilibrium phase diagrams. The P-T field for the equilibration of Jijal garnet granulites establishes that the reaction affinities of c. 5-10 kJmol^{-1} for the grt-in reaction and 0-5 kJmol^{-1} for the opx-out reaction.

Once amphibole was consumed in the reaction, the strong orientational relationship between mafic phases reagents allowed the growth of garnet with the same orientation over a pyroxene subtract, eventually sintering into single-crystal garnets. We show that in the absence of deformation, the orientation of mafic precursor phases conditioned the nucleation site and the orientated growth of garnet due to mechanisms involving topotaxial transformation reactions and homepitaxial growth of garnet. As a consequence, the orientation and texture of precursor phases fully determined the nucleation sites and the orientation of garnet during the formation of high-pressure, mafic garnet-granulite after low-pressure mafic protoliths.