

## **High-grade fluid/rock interactions in metapelites: theoretical and observed phase relations and the behavior of accessory phosphate phases in the Kottavattam charnockites (S-India)**

Tropper, Peter; Strasser, Marlen; Hasler, Thomas

Institute of Mineralogy and Petrography, University of Innsbruck, Innrain 52, A-6020 Innsbruck, Austria.

Charnockitization is a fluid-driven process that takes place in rocks from the lower crust. During this process an externally-derived fluid interacts with the rocks and mineralogical and textural transformations occur within the rocks. The most important feature is the breakdown of water-bearing minerals like hornblende and biotite to pyroxenes due to the influx of low  $a(\text{H}_2\text{O})$  fluids. In the course of this Bachelor Thesis, the in-situ charnockitisation in felsic granulite samples from Kottavattam, S-India was investigated using polarizing microscopy, micro-X-ray fluorescence and electron probe microanalysis. Typical textures associated with charnockitisation such as the replacement of biotite by orthopyroxene (now replaced by chlorite/smectite), the formation of myrmekites and monazite exsolutions in apatite could be identified. The observed phase relations are compared to thermodynamic calculations using the program Domino-Theriak (de Capitani & Petrakakis, 2010). In this investigation six samples of a charnockite rock sample (Opx-bearing granulite) from India (Kottavattam) were investigated. The XRD and XRF investigations show that the feldspar content increases sharply from Kotta-1 (unaltered) to Kotta-6 (charnockite). Quartz, biotite and garnet contents decrease from samples Kotta-1 to Kotta-6. Responsible for these changes in mineral composition are two mineral reactions: Garnet + Quartz = Plagioclase + Orthopyroxene (CFASH) and Biotite + Quartz = K-Feldspar + Orthopyroxene +  $\text{H}_2\text{O}$  (KFASH). Apatites with inclusions of monazite were observed. The inclusions show two patterns. Monazite and/or xenotime inclusions without discernible orientation within the apatite and those, which occur along cracks within the crystal. Overall, two generations of monazite and 3 generations of apatite formed. In the first stage, apatite is depleted in (Y + REE) and the first generation of monazite randomly orientated within apatite. Contemporaneous a second generation of apatite forms depleted in (Y + REE). In stage II another generation of monazites and/or xenotime formed along cracks due to solubility and recrystallization of apatite. Apatite along these surfaces is also (Y + REE) depleted hence forming the 3<sup>rd</sup> apatite generation. Calculations using Domino-Theriak show that the mineral assemblage garnet, 2 feldspars, biotite, magnetite and quartz is preserved in samples Kotta-1 to Kotta-4. In the calculations of samples Kotta-5 and Kotta-6, orthopyroxene forms. However, the samples are retrogradely altered to such an extent that their bulk composition probably no longer corresponds to the initial bulk composition. Similar to the XRD analysis the calculations show that for samples Kotta-1 through Kotta-6 biotite and garnet contents decrease and feldspar contents increase with increasing charnockitization. In the calculated pseudosections the lowered  $a(\text{H}_2\text{O})$  necessary to stabilize orthopyroxene is 0.75 in sample Kotta-1. In samples Kotta-2 through Kotta-4,  $a(\text{H}_2\text{O})$  ranges from 0.05 to 0.1. In samples Kotta-5 and Kotta-6, the initial chemistry has already changed so that only orthopyroxene is stable instead of biotite. Overall,  $a(\text{H}_2\text{O})$  varies strongly between the samples between 0.7 and 0.05 which could be due to local differences in fluid composition. The data obtained agree very well with the studies of Raith & Srikantappa (1993) on the same rocks.