

Decrease in water activity due to fluid absent partial melting monitored with water content in biotite in the Western Adamello contact aureole (Italy)

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The fluorine and chlorine exchange on the hydroxyl site in micas is used to monitor changes in fluid composition (Munoz 1984). Most studies assume that the OH-site does not contain vacancies, since the vast majority of studies use analytical techniques that does not allow to directly measure the OH- content of the mica. Nevertheless, studies have shown that significant amounts of O₂- are present, and its concentration increases with temperature and titanium content. This feature was interpreted as the consequence of a Ti-oxygen exchange in amphibolite and granulite facies rocks (Dyar et al. 1993, Cesare et al. 2008). Here, we present OH, F, Cl data for biotite from contact aureoles from biotite-schist to partially molten sillimanite-cordierite schists.

OH-F-Cl content of biotites were analyzed using Secondary Ion Mass Spectrometry (SIMS), and major elements were analyzed by EMP. Samples were collected in the mid-crustal Western Adamello contact aureole (Italian Alps, Floess and Baumgartner, 2013). For that purpose we used biotite standards with water content constrained by Thermal Conversion Elemental Analyzer (TC/EA) see Bauer and Vennemann 2014, at a level of precision of 0.1-0.2 wt% (2SD). SIMS measurements typically have a precision of 0.1wt% (2SD), corresponding to the homogeneity of the internal standard at the SwissSIMS laboratory.

OH- content decreases in samples with increasing peak temperature and Ti content (Ti range for biotites of 0.15-0.42 p.f.u for all samples). Nevertheless, within each individual sample, OH- is not a function of Ti. Ti variations are about 0.4 p.f.u., which is ten times the analytical uncertainty of the EMP analysis (0.004 p.f.u., 1SD). Water content is constant within analytical precision for each sample. The mean of OH- measurements is 3.41 p.f.u. in biotite and garnet grade samples, whereas those of samples in the partially molten zone have values of 3.27 p.f.u. We do not see any correlation with XMg or F and Cl. Hence, we interpret the concentration of OH- to be influenced by water activity within the rocks, and temperature.

Our results confirm that oxy-biotite is a non-negligible component, but in the case of prograde metamorphism we do not interpret this as the consequence of a Ti-oxygen exchange only, but also as the consequence of a decrease in water activity due to partial melting.

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