

Chlorine content in biotite as tracer of fluid-rock interaction during contact metamorphism

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Fluid-rock interaction plays an important role in mass and heat transport during contact metamorphism. Here we present high precision Secondary ion mass spectrometry (SIMS) analyses of Cl-OH exchange in biotite from the Western Adamello contact aureole (Italian Alps). Application of this knowledge has been tested to the metapelites of the Torres del Paine contact aureole (Chile) that experienced fluid flow.

The Western Adamello contact aureole is mainly composed of polymetamorphic metapelites. They experienced partial retrogression after the Variscan metamorphism, prior to Tertiary contact metamorphism. The Cl content in biotite from 5 samples from different metamorphic grades have been determined using the SIMS with a precision of 5 ppm (1SD). Matrix biotites and biotites included in andalusite have the same composition. Hence the biotite retained its prograde/peak Cl composition. The Cl content for different samples ranges between 0.1-0.6wt%, without any trend related to metamorphic grade (biotite-cordierite zone to partial melting after muscovite breakdown). The Cl content does not show any correlation with X_{Mg} , Al^{IV} or Ti, showing the absence of crystallographic control on Cl content at these low concentration values. We conclude that low Cl content in biotite represent the initial Cl availability when biotite crystalize and is mainly controled by the bulk rock Cl content. This composition can only be changed if biotite recrystallizes during later metamorphic reaction, in equilibrium with a fluid with a completely different salinity.

The Torres del Paine contact aureole is composed of Cretaceous turbidites, metamorphosed at 750bar. The Cl content in metamorphic biotites have constant values (0.01-0.06wt%) except for biotite from few samples close to the intrusion that exhibit high Cl content (0.15-0.2wt%). Textural evidences of coarsening during muscovite breakdown reaction of these samples allow us to conclude that biotite recrystallizes at higher temperature, due to fluid flow triggered by crystallisation of the granites, leading to the exsolution of igneous fluid of higher salinity.