



HT-induced processes in monoclinic and orthorhombic amphiboles and their effects on thermodynamic models

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Rock-forming minerals with complex structure and crystal-chemistry have a complex behaviour under increasing T and P. The most relevant phenomena observed are: expansion of the unit cell (often anisotropic), cation disordering among sites with equal or different coordination, phase transitions, deprotonation or dehydration processes. All these processes significantly affect both the molar volume and the thermoelasticity of the studied phase.

Amphiboles are an important family of rock-forming minerals with a really intricate crystal-chemistry. They are known to store markers of petrological processes, and thus HT study of amphiboles under controlled conditions are also useful to check our present knowledge (derived based on crystal-chemical and petrological observations) and to provide further and more detailed petrogenetic information. Moreover, HT studies of amphiboles should provide precious information on phase stability, molar volumes and crystal-chemical markers to be used in thermodynamic modelling in upper-mantle geological contexts, as well as on the condition of water release and thus on the water budget in the Earth mantle.

We have accumulated in the latest two years good quality data on the HT (RT to 1000 K) behaviour of a number of monoclinic calcic amphiboles with significant Al contents and variable Fe²⁺/Mg ratio (pargasite, hastingsite and kaersutite) which are of relevance to upper mantle processes. More recently, we have been working on orthorhombic amphiboles (anthophyllite and gedrite), the second of which is also of interest for understanding mineral behaviour in "cold" subduction zones.

For each composition, we have recorded quantitative information on thermoelastic behaviour and on the structural effects and atomistic-level mechanisms of cation disordering and deprotonation processes. The observed changes in the unit-cell (and thus molar) volume are often inverse but never complementary. We will comment on the differences observed, and will relate them to changes in composition (especially of the A, B and C cations) and symmetry (in this case, the different ways of piling up I-beams along the c direction which affect the local environment of the B cations, and the existence of two symmetry-independent double-chains of tetrahedra), with the aim to provide more precise tools to interpret amphibole behaviour in HT petrogenetic environments.