

Pargasite at extreme conditions: a comprehensive *P-T* study

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Pargasite is a Ca-amphibole associated to medium- or high-pressure/high-temperature conditions. The occurrence of hydroxyl groups into the amphibole's structure has proved to be a significant agent in the water cycle within the upper mantle (*e.g.*, Gill 1981). In order to better understand the water cycle in the upper and potentially lower mantle, it is of critical importance to determine the stability of all hydrous minerals subducted into the mantle. However, despite their geological importance, only a few *in situ* high-pressure (*HP*) and high-temperature (*HT*) studies have been performed in order to describe the *P-T* stability fields, the thermo-elastic behaviour and the *P*- or *T*-induced deformation mechanisms of amphiboles at the atomic scale. The compressibility of tremolite, pargasite and glaucophane were investigated by Comodi et al. (1991) on the basis of *in situ* single-crystal X-ray diffraction experiments with a diamond anvil cell (DAC) up about 4 GPa. However, as pointed out in Welch et al. (2007), there is a need to extend the compressibility measurement to *P* higher than 10 GPa, in order to improve the accuracy of the refined isothermal bulk modulus values and their *P*-derivatives. Furthermore, to the best of our knowledge, no simultaneous *in situ P-T* studies have been conducted on amphiboles so far. This lack of knowledge prevents a detailed description of the behaviour of amphiboles that are stable at *HP-HT* conditions and consequently it is still difficult to assess their petrological implications. In this light, we have selected crystals of pargasite from the peridotite of the "phlogopite peridotite unit" of the Finero mafic-ultramafic complex (Ivrea-Verbano Formation, Italy) (Cowthorn, 1975), in order to describe: *a*) the *HP* elastic behaviour of this amphibole and its deformation mechanisms at the atomic scale up to 20 GPa, by single-crystal synchrotron X-ray diffraction with a diamond anvil cell, *b*) its *HT* behaviour, along with its potential de-hydroxylation, by *in situ* X-ray synchrotron powder diffraction using a hot air blower device (up to 823 K), and *c*) its phase stability field at simultaneous *HP-HT* conditions, by single-crystal synchrotron X-ray diffraction with a resistive-heated diamond anvil cell ($P_{\max} = 16.5$ GPa, $T_{\max} = 1200$ K). The thermal and compressional behaviour of pargasite are now fully described within the *P*- and *T*-range investigated and the petrological implications of our experimental findings are discussed.

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