High-pressure behavior and phase transitions of thaumasite

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Thaumasite, $Ca_3Si(OH)_6(CO_3)(SO_4)·12H_2O$, is a rare mineral with a hexagonal structure based on cylindrical columns of $[Ca_3Si(OH)_6(H_2O)_{12}]^{4+}$ running parallel to the *c* axis, among which the SO_4^{2-} and the CO_3^{2-} groups are hosted. Thaumasite is unique because i) is the only known mineral stable at ambient *P–T* conditions that possesses silicon hexa-coordinated by hydroxyls; ii) is an indicator of sulphate attack in concretes (deterioration due to thaumasite formation especially occurs at subzero *T*). The thermal behavior of thaumasite has been investigated at *LT* and *HT* [1-3], and it was found that the thaumasite structure collapsed because of a severe dehydration above 417 K [3]. At all events, reports on the *HP* response of the thaumasite structure are lacking.

In this work, the *HP* evolution of the thaumasite structure was investigated using synchrotron XRPD, up to 19.5 GPa. Although during the Rietveld refinements no symmetry changes have been observed, the unit-cell decreasing with *P* is characterized by two strong discontinuities in the 1.38–3.53 GPa and 7.40–15.02 GPa *P*-ranges, respectively. Hence, three distinct compression regimes can be defined, with the thaumasite structure that retains the same $P6_3$ space group. These isosymmetric transitions occur with an increasing of the unit-cell parameters, revealing that the thaumasite structure becomes stiffer after each discontinuity. Comparing the *LT* and *HT* data from literature [1-3] with those collected under *HP* conditions, it is interesting to underline that the variation of the axial ratio *a*/*c* as a function of the normalized cell volume V/V_0 describes an ideal inverse relationship [4].

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Trace element composition in a migmatite-granite complex (NW Portugal): Protolith and melting process constraints

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In NW Portugal a migmatite massif surrounding a synorogenic granite occurs within the axial zone of the Variscan Orogen. This massif includes: metatexites (patch and stromatic) and diverse granitoid rocks including: (i) diatexites, (ii) leucocratic granites, (iii) and two-mica mesocratic granites. The patch metatexites show anastomosed foliation marked by aligned Bt between grains of Qtz + Pl ± $Grt_{(Alm-Prp)}$. The Grt can be total or partially replaced by Crd + Qtz + Sil. There are coarser biotite selvedge skirting fibrolytic Sil + Qtz + Pl + Crd + Bt ± Kfs clusters. The stromatic metatexites have micaceous and quartz-feldspathic bands. The former contain Bt + Sil + Crd + Grt + Qtz + Pl. The latter contain large crystals of Qtz + Pl + Kfs+Bt. The diatexites have Qtz + Pl + Kfs + Bt and schlieren with Bt + Sil + Crd ± Grt. The leucocratic granitic bodies have essentially Qtz + Pl + Kfs and Bt and/or Tml clusters. The two-mica granites have Qtz + Pl + Kfs + Bt + Apt and rare schlieren of Bt + Sil ± And ± Grt ± Zrn. In all lithologies $Kfs_{(Or77-90)}$ is anhedral and replaces plagioclase.

The geochemistry study shows that all granitoid rocks are peraluminous, calc-alkaline with high K. The variation in HSFE is positively related to the content of $FeO_{(t)}$ + MgO and LILE don't show any correlation. The migmatites REE chondrit-normalized patterns are very similar to each other and to NIBAS standard [1]. The leucocratic granites have a REE pattern similar to leucosome, with positive Eu anomaly and variable HREE fractionation. The diatexites show variable REE fractionation and no Eu anomaly.The mesocratic granites show a REE pattern typical of two-mica granites. The enrichment in HREE is related with (i) accessory minerals retention in the melanosome, and (ii) the presence/absence of garnet in granites and leucosomes. This variations in the composition must be related to the input of accessory minerals from the protolith and the degree of melting (Bea,1996), instead of fractional crystallization or magma mixing.

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Mineral abbreviations according IUGS-SCMR recommendations.

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