American Mineralogist, Volume 100, pages 714-721, 2015

INVESTIGATING PETROLOGIC INDICATORS OF MAGMATIC PROCESSES IN VOLCANIC ROCKS Petalite under pressure: Elastic behavior and phase stability⁺

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ABSTRACT

The lithium aluminosilicate mineral petalite (LiAlSi₄O₁₀) has been studied with high-pressure single-crystal X-ray diffraction (HP-XRD) up to 5 GPa. Petalite undergoes two fully reversible pressure-induced first-order phase transitions, not previously reported in the literature, at ca. 1.5 and 2.5 GPa. The first of these transforms the low-pressure α -phase of petalite (*P*2/*c*) to an intermediate β' -phase that then fully converts to the high-pressure β -phase at ca. 2.5 GPa. The $\alpha \rightarrow \beta$ transition is isomorphic and is associated with tripling of the unit-cell volume. Analysis of the HP-XRD data show that although the fundamental features of the petalite structure are retained through this transition, there are subtle alterations in the internal structure of the silicate double-layers in the β -phase relative to the α -phase. Measurement of the unit-cell parameters of petalite as a function of pressure, and fitting of the data with third-order Birch-Murnaghan equation of state, has provided revised elastic constants for petalite. The bulk moduli of the α - and β -phase are 49(1) and 35(3) GPa, respectively. These values indicate that the compressibility of the α -phase of petalite lies between those of the alkali feldpsars and alkali feldspathoids, whereas the β -phase has a compressibility more comparable with layered silicates. Structure analysis has shown that the compression of the α -phase is facilitated by the rigid body movement of the Si₂O₇ units from which the silicate double-layers are constructed.

Keywords: Petalite, high-pressure, single-crystal X-ray diffraction, equation of state, phase transition