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Compressibility mechanisms of alkali feldspars: New data from reedmergnerite

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Abstract

Structural and volume compressibility data for reedmergnerite, $NaBSi_3O_8$, were obtained by single-crystal X-ray diffraction at pressures up to 4.7 GPa. The bulk modulus was determined to be 69.8(5) GPa with the pressure derivative constrained to 4. Unit-cell compression is anisotropic, as indicated by unit strain tensors. Tetrahedral bond lengths and angles remained relatively constant over the pressure interval, whereas Na-O bonds decreased systematically. T-O-T angles underwent a variety of behaviors, remaining constant or decreasing with pressure.

The compression for reedmergnerite is similar to that of low-albite, wherein bending of the (Al,B)-Oco-Si angle compresses the Na-bearing zigzag channels. In contrast, microcline compresses by shearing the four-membered rings, which in turn compresses the K-bearing channels. At about 4 GPa, a new bond between K and Obm appears that alters the compression mechanism and explains the discontinuity in the pressure variation of crystallographic parameters observed by Allan and Angel (1997). Thus, the compression mechanism of the alkali feldspars is dominated by the compression of alkali containing channels. However, because of low symmetry, this can be accomplished in several ways. The observed variety of compression pathways resulted from T-O-T angle bending energetics that were coupled with the effects of alkali cation bonding.