

Direct observation of Ca-Na ordering and structure polarity in Ca-rich intermediate plagioclase feldspar with incommensurate modulated structure

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ABSTRACT

Ca-Na ordering and structural polarity of subcells in an intermediate plagioclase with modulated structure have been observed using Z-contrast imaging with an aberration-corrected scanning transmission electron microscope. Neighboring lamellar domains with $I1$ symmetry are related by inversion twin operation, instead of anti-phase domain boundaries (or APBs) as in all previously reported structure models. The boundaries between lamellar domains have $\bar{1}\bar{1}$ symmetry instead of $C\bar{1}$ symmetry. Modulated plagioclase has unique Ca-Na and Al-Si ordering structure that is different from those in end-member structures of anorthite and low albite. The modulated structures of intermediate plagioclase are not metastable structures formed during phase transition, but instead thermodynamically stable structures at low temperature due to Ca-Na ordering within the subcells with $I1$ symmetry.

Keywords: Intermediate plagioclase, aberration-corrected STEM, modulated structure, Z-contrast imaging, incommensurate modulation, ordering, *e*-plagioclase, bytownite