

The incommensurately modulated structures and ordering sequence of Na-rich plagioclase feldspars

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Plagioclase feldspars, the solid solution between albite ($\text{NaAlSi}_3\text{O}_8$) and anorthite ($\text{CaAl}_2\text{Si}_2\text{O}_8$) are the most abundant group of minerals in the Earth's crust. Intermediate plagioclase formed at low temperature display satellite diffractions (*e*-diffraction), which are resulting from a well ordered aperiodic structure (*e*-plagioclase). The structures of highly ordered *e*-plagioclase feldspars with composition of $\sim\text{An}_{50}$ are solved recently, yet the ordering sequence of the incommensurately modulated structure is still unclear. The phase transition temperature is lower on the Na-rich side of the compositional range of *e*-plagioclase, therefore, different ordering states may be better reserved. Several Na-rich plagioclase feldspar crystals with composition ranging from An_{35} to An_{49} are analyzed with single crystal X-ray diffraction. The samples selected in this study are from different origins, some crystals are volcanic, others are metamorphic. The modulation orientation and period is not exclusively dependent on the composition. The *q*-vector (or wave vector) of *e*₁ ordering ends abruptly at around An_{45} , which fixes the composition of the lower end of Bøggild intergrowth loop. The ordering of tetrahedral sites in the structure seems to precede the M site ordering, as some samples display obvious T-O bond distance modulation with almost no M site occupancy modulation. The modulation orientation and period of *e*-plagioclase seems to be fixed as it was first formed, even though the modulation should be a dependent parameter on the temperature, pressure and composition of plagioclase. The results help us to constrain subsolidus phase relations in Na-rich plagioclase feldspars.