

## **Formation of metastable cubic-perovskite in high-pressure phase transformation of $\text{Ca}(\text{Mg}, \text{Fe}, \text{Al})\text{Si}_2\text{O}_6$**

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### **ABSTRACT**

We have carried out in-situ X-ray diffraction experiments on high-pressure transformations of a Ca- and Fe- rich pyroxene ( $\text{Ca}_{1.03}\text{Mg}_{0.61}\text{Fe}_{0.23}\text{Al}_{0.14}\text{Si}_2\text{O}_6$ ) to investigate the stability of  $\text{Ca}_{0.5}(\text{Mg}, \text{Fe}, \text{Al})_{0.5}\text{SiO}_3$  perovskite (CM-perovskite) in a multi component system at about 32 GPa and up to 1900 °C. We observed that cubic CM-perovskite was formed at about 1300 °C and decomposed into cubic Ca-perovskites and orthorhombic Mg-perovskites and stishovite at 1800 °C when using a glass starting material. In another experiment using a crystalline pyroxene starting material, two cubic perovskites; Ca-perovskite and CM-perovskite, and orthorhombic Mg-perovskite formed simultaneously during the initial stage of the transformation. However, the cubic CM-perovskite subsequently decomposed into Mg- and Ca-perovskites and stishovite at 1200 °C. These results indicate that the assembly of cubic Ca-perovskite, orthorhombic Mg-perovskite and stishovite is stable and cubic CM-perovskite is a metastable phase at around 32 GPa and temperatures over 1000 °C in this system. Chemical analyses of product phases showed that Mg, Fe, and Al were preferentially partitioned into Mg-perovskite and the compositions of Ca-perovskite were close to pure  $\text{CaSiO}_3$ . The present study shows that CM-perovskite nucleates during the initial stage of  $\text{Ca}(\text{Mg}, \text{Fe}, \text{Al})\text{Si}_2\text{O}_6$  pyroxene transformation. Therefore, cold subducting slabs and impacted meteorites are the possible places in which CM-perovskite could exist. The Ca-rich glassy phase in a shocked chondrite (Tomioka and Kimura 2003) might have formed by vitrification of a metastable CM-perovskite-like phase.