

Coherent pyroxene-akimotoite phase transformation in NWA 5011 shocked chondrite

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Introduction

Akimotoite is a major constituent phase through Earth's transition zone [1]. Up to now this phase transition has been observed as incoherent nucleation and growth in and around opaque shock melt veins [2]. In this abstract we are reporting the possible first coherent pyroxene-akimotoite transformation along the cleavages of pyroxene.

Results and Discussion

The NWA 5011 shocked chondrite consists of shock veins in various thickness and chondrules. A mixed-type pyroxene chondrule (approx. 1 mm in diameter) contains numerous subchondrules observed in the sample. One of the subchondrules exhibits dense cleavage network in which the angle between two cleavage plains is nearly right (87°). Therefore this orientation of crystal face is $\{110\}$. The BSE-images revealed that plain of cleavages enriched in Fe and it shows microgranular texture. However, the microgranular character is slightly overhanging from the original boundary of cleavages to the host grain area. The thickness of "overhanged" transition area is observed up to $0.5\mu\text{m}$, and parallel to the direction of cleavages. In some areas between the cleavages incoherent pyroxene-akimotoite phase transformation occurs. Raman spectra have been collected along the cleavage, which confirmed the pyroxene-akimotoite phase transition. The Fe-enrichment in cleavage is possible due to weathering processes, or melting and subsequent metal-sulfide formation. The most characteristic feature of the Raman spectra is the presence of main vibrations of ringwoodite and stishovite besides akimotoite peaks. This feature confirms that inside the fragments far from boundary of shock melt veins lower P - T regime transformation products in the $\text{Mg}_4\text{Si}_4\text{O}_{12}$ - $\text{Mg}_3\text{Al}_2\text{Si}_3\text{O}_{12}$ system can survive due to the fast temperature drop. This suggests subsequent evidence for high P - T regime change in shock melt veins within a small affected area.

[1] Tomioka & Fujino (1999) *Am. Min.* **84**, 267-271. [2] Hu *et al* (2012) 43rd LPSC, abs#2728.

Single crystal elasticity of the $\text{Na}_{1.07}\text{Mg}_{1.58}\text{Al}_{4.91}\text{Si}_{1.26}\text{O}_{12}$ NAL phase and seismic heterogeneity in the deep mantle

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Subducted mid-oceanic ridge basalts (MORB) are likely to be important components of the lower mantle. As a consequence of plate tectonics, basaltic oceanic crust is subducted into the mantle introducing chemical heterogeneity. Compared to average peridotitic mantle, MORB are enriched in silicon, aluminium, calcium and alkalis. At lower mantle conditions, experimental studies have shown that subducted MORB comprises more than 20 % of an aluminium rich phase, the so called NAL (new aluminium phase) phase. Evidence for the existence of the NAL phase has been observed in sublithospheric diamonds, where composite multiphase inclusions have been found with similar bulk compositions to NAL. If present, NAL will be a contributor to the bulk elastic properties of the lower mantle and knowledge of its elasticity is crucial for investigating the consequences of subducted crust for the seismology of the mantle.

NAL crystallising in MORB form complex solid solutions and have the general formula $\text{XY}_2\text{Z}_6\text{O}_{12}$ where X is a large monovalent or divalent cation (Ca^{2+} , K^+ , Na^+), Y a middle-sized cation (Mg^{2+} , Fe^{2+} or Fe^{3+}), and Z a small sized cation (Al^{3+} and Si^{4+}). Here we report the crystal structure refinement of NAL synthesized at lower mantle conditions with a composition close to that expected to crystallise in a subducting slab. We also report for the first time its full elastic tensor experimentally determined by Brillouin scattering spectroscopy at room and high pressure. We complement these experimental results with first-principles calculations, performed using density-functional theory and density-functional perturbation theory.