

Aluminum incorporation into phase A - a new hydrous silicate in the deep upper mantle

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A new aluminum bearing hydrous silicate was found in the experiments under the deep upper mantle conditions, using phase A ($\text{Mg}_7\text{Si}_2\text{O}_8(\text{OH})_6$) and $\text{Al}(\text{OH})_3$ as the starting materials. Using electron probe micro analysis (EPMA) and secondary ion mass spectrometry (SIMS), the composition was determined to be very close to $\text{Mg}_{5.5}\text{AlSi}_2\text{O}_8(\text{OH})_6$, which contained about 12 wt % of water. Almost pure phase was obtained in the subsequent experiments. The powder x-ray diffraction pattern and transmission electron diffraction patterns showed a hexagonal structure, with an abnormal large c axis. This new phase has similar stability region with phase A. At lower pressure and higher temperature, it breaks down into Chondrodite + Garnet + Brucite + Fluid, while at higher pressure and higher temperature, it breaks down into Al-superhydrous phase B + Garnet + Brucite + Fluid.

Besides, present study shows that phase A coexists with this aluminum bearing hydrous phase, with a small amount of aluminum (<1 wt%) incorporated into phase A structure, which predicts that phase A can preserve only trace of aluminum.

According to Inoue's unpublished data, aluminum can easily incorporate into some dense hydrous magnesium silicates and form aluminum bearing hydrous phases such as phase B, superhydrous phase B, and even perovskite. However, rather than aluminum bearing phase A, the present study shows a small amount of aluminum incorporation into phase A structure, and an appearance of a new aluminum bearing hydrous phase, with the composition very similar to phase A but structure very different from it. Further investigations are needed to clarify these two phases.

Keywords: Phase A, Aluminum incorporation, hydrous phase, upper mantle