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X 線その場観察を用いた高圧下における緑泥石の脱水分解反応
In situ X-ray diffraction analysis of the experimental dehydration of chlorite at high pressure

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1. Introduction

Water in hydrous minerals is transported to deep Earth by subducting slab, which dehydrate at certain pressure and temperature. Exist of deep Earth's water affect the physical properties of Earth's minerals such as melting point, viscosity, elastic velocity, and so on. Therefore it is important to study the effect of water for the subducting slab materials. Moreover determination of the stability region of hydrous minerals is important to understand the mechanism of transport of water.

Serpentine ($Mg_6Si_4O_{10}(OH)_8$) is major hydrous mineral in subducting slab. There are many experimental reports for serpentine under high pressure. The stability field has already determined by in situ X-ray diffraction experiments. Chlorite ($(Mg,Al)_6(Si,Al)_4O_{10}(OH)_8$) should be also an important hydrous mineral in the subducted slab, because Al is included in slab materials. However there are few experimental reports for chlorite under high pressure.

So in this study, the dehydration reactions of chlorite have been studied by time-resolved X-ray diffraction analysis under high pressure and temperature.

2. Experimental

Time-resolved dehydration experiments of chlorite were conduced by in situ X-ray diffraction using the high-pressure apparatus MAX80 at PF-AR, KEK. Natural chlorite was used as a starting material, and sealed by Au caps plus diamond sleeve. Temperature was measured by W-Re thermocouple, and pressure was calculated by equation of state of NaCl and Au. Experiments were conduced between 3 to 8 GPa and up to 900 deg C. Time-resolved X-ray diffraction was measured at intervals of 50 deg C with checking diffraction change. When dehydration occurred at each pressure, it kept a few hours, and quenched. The quenched sample was analyzed by scanning electron microscope.

3. Results and discussion

In all experiments, chlorite was quickly dehydrated to forsterite + pyrope + fluid within 1 hour. Dehydration boundaries of chlorite were determined at 3 to 8 GPa, with compared with the previous works. The boundary has negative P/T slope at 5 to 8 GPa. Chlorite was stable at ~ 800 deg C below 4 GPa. The dehydration boundary in the present study is consistent with previous phase equilibrium boundary by quench experiment. This means that, chlorite become to equilibrium state rapidly when slab cross the dehydration boundary.

The dehydration boundaries of chlorite and serpentine are compared. Pressure range of dehydration of chlorite is narrower than that of serpentine, which means that dehydration depth of chlorite does not change so much compared to serpentine by temperature profile of slab.

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