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In-situ Synchrotron X-ray Powder Diffraction of Antigorite at High Pressure and Temperature

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Introduction

Antigorite plays key roles in subduction zone processes including transport of water and seismogenesis. The equation of state (EoS) of antigorite is critical for understanding of its stability field and for interpretation of seismological observations. Although a few compression tests have been conducted at room temperature [1], EoS is still poorly understood at high temperatures. We have conducted in-situ synchrotron X-ray powder diffraction experiments to understand EoS of antigorite.

Experimental

The sample is a natural antigorite collected from Inner Mongolia, China. The chemistry is shown in Table 1. The dark part in a BSE image has distinctly higher Al content than the bright part (Fig.1).

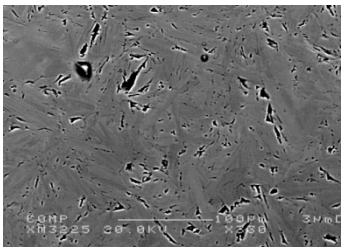

Fig.1 BSE image of the sample

Table 1: Chemistry of antigorite sample (wt%)

	Dark	Bright
SiO_2	45.00	45.16
Al_2O_3	0.26	0.07
FeO	0.47	0.45
MgO	40.29	40.53
CaO	0.00	0.01
Total	86.04	86.24

Selected-Area Electron Diffraction reveals that most of antigorite grains has m-value of 15 (the number of tetrahedra within a wave). There are also grains with m=16 and 17. The sample was finely ground and mixed with NaCl, and loaded in a multi-anvil type high-pressure apparatus (MAX80).

X-ray powder diffraction experiments were done by the energy dispersive method with 2θ=5º. The exposure time was around 1000 seconds. Experiments were conducted at pressures of 0.5~6 GPa and temperatures of 200~500 ºC. The pressure was estimated from the compression of NaCl.

Results

A typical diffraction spectrum is shown in Fig.2. Diffraction peaks of antigorite are indexed with the aid of reported indices [2].

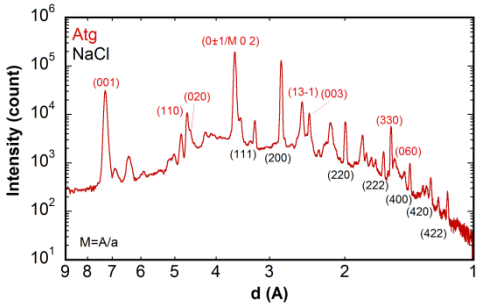

Fig.2 Diffraction spectrum at P= 0.007 GPa, T=27ºC

The identification of peaks (13-2) and (220) is essential for precise determination of lattice parameters. However, it is difficult to resolve these two peaks with the resolution of ~0.003 A (Fig.3). They can be resolved by using a powder X-ray diffractometer (Rigaku, SmartLab) employing the angle dispersive method. The resolution is ~0.0005 A (Fig.3). It is thus difficult to refine lattice parameters of antigorite by using the energy dispersive method. We are planning to apply a more precise method.

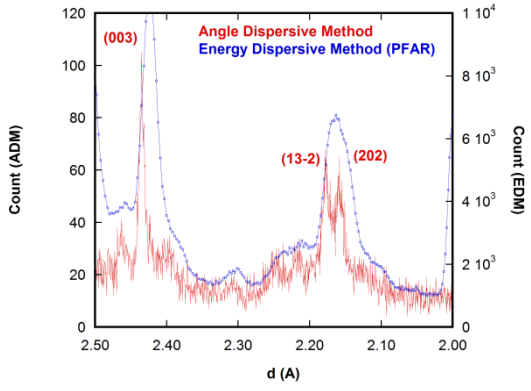

Fig.3 Angle dispersive method and energy dispersive method

References

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