Temperature dependence of water partitioning between olivine and wadsleyite

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1.Introduction

The pressure-induced olivine-wadsleyite phase transformation in the (Mg,Fe)2SiO4 system is generally considered to be responsible for the 410-km seismic discontinuity [Ringwood, 1975; Katsura and Ito, 1989].The water contents in wadsleyite and ringwoodite are about 3.0wt% [Kohlstedt et al., 1996; Inoue et al., 1995; Chen et al., 2002].The water is supplied to the Earth interior by subducting slabs.It affects the physical properties of the Earth interior such as diffusion, melting temperature and electric conductivity. Therefore, the mantle transition zone might be a main water reservoir. When discussing the water contents of mantle, the water partitioning between minerals are important. In this study, we discuss a temperature dependence of water partitioning between olivine and wadsleyite.

2.Experiment

High pressure experiments were carried out a 1000-ton KAWAI type high-pressure apparatus. The pressure medium was zirconia and gasket was pyrophyllite. The experiments was conducted from 13 to 14 GPa. Temperature was measured by a W97%Re3%-W75%Re25% thermocouple. The sample was heated by a LaCrO3 tube heater. The experiments was conducted from 1200ºC to 1600ºC. The heated sample was quenched by turning off the electric power supply. Recovered samples were examined by a micro-Raman spectrometer for phase identification. The water contents in all the samples were measured by using the Fourier Transform Infrared spectrometer (FTIR). The calculation of water contents was carried out based on the calibration of Paterson [Paterson, 1982].

3.Results

The water partitioning coefficients between olivine and wadsleyite are 3.2 at 1300ºC,13.6GPa, 1.5 at 1400ºC,13.7GPa, 1.2 at 1500ºC, 14.0GPa. The present results were compared with the results by Kohlstedt et al.(1996), Chen et al.(2002), Young et al.(1993). The water content in olivine is almost constant with temperature, whereas the water content in wadsleyite decreases with temperature. Thus the partitioning coefficients of water between olivine and wadsleyite decrease with increasing temperature.