

Direct observation of the quartz-coesite transformation by using IH-DAC

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We have developed an induction heating diamond anvil cell (IH-DAC) for Raman micro-spectroscopy. This has two experimental advantages for kinetic study of phase transformation in minerals at high temperature and high pressure. First, the induction heating, which is a new method for heating a DAC, keeps the sample chamber to be heated uniformly and stably for long time. Second, Raman micro-spectroscopy enables to identify polymorph at short time with the spatial resolution of about 2 micrometers.

The quartz-coesite phase transformation kinetics has been directly observed with IH-DAC under 650-1000K, 4-6GPa. High pressure experiments were performed under a dry and quasi-hydrostatic conditions using NaCl as pressure medium. Oriented thin sections of 30-50 micrometers thickness and powdered sample of about 1 micrometer of synthetic quartz were prepared as starting material. During the sequence of reaction from quartz to coesite under HT and HP, it was directly observed under a polarizing microscope that quartz thin section transforms to coesite. The interference color of the thin section gradually changed from the rim to the inside (Fig.1) and many cracks were made in the thin section. The area of changed interference color was identified as coesite by micro-Raman in situ measurement. In the experiment of powdered sample, relative intensity of intense Raman band of coesite to that of quartz was monitored every 3-10 minutes. The measurement of aggregate of randomly oriented particles permits ignoring the polarizations of the Raman intensity due to the orientation of single crystal. The raw relative intensities were converted the transformed volume fraction as a function of time (Fig.2) by a calibration curve. By the converted fitting data by the Avrami equation (Avrami,1939,1940,1941;Chan,1956), the value of exponent n was determined approximately as 1.0. These results suggest that the quartz-coesite phase transformation is controlled by phase boundary reactions.

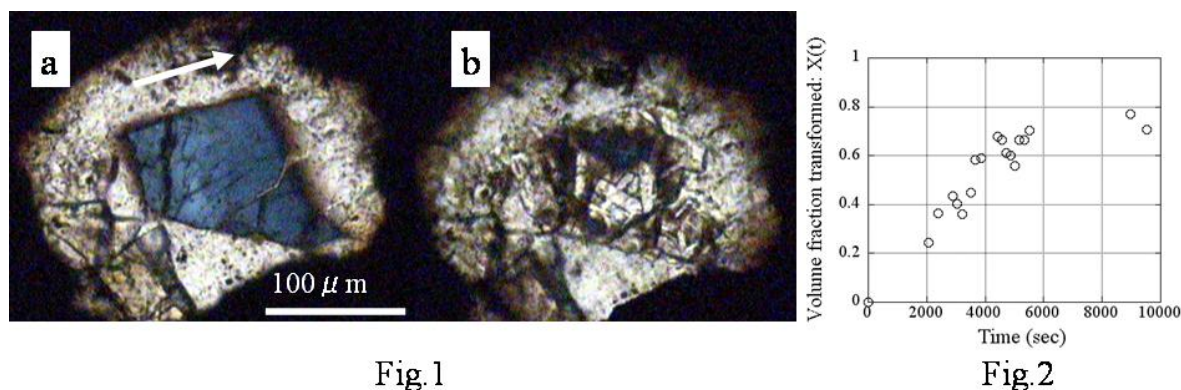


Fig.1

Fig.2

Fig 1 Polarizing microphotograph of the sample at 3.5GPa and 480°C. (a)28 minutes and (b)63 minutes after starting to heat. The arrow in Fig.1(a) shows the direction of c axis.

Fig.2 Transformation-Time data at 5.4GPa and 380°C