An in-situ X-ray diffraction study on the high-pressure decomposition reaction of albite under differential stresses

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In subducting oceanic crust, the gabbro-eclogite transformation is important because this transformation may change of physical properties of the crust to the large density increase and perhaps low viscosity because of fine grain size of new phases. As the stress environment is influenced by the rate of transformation each other, it is important to understand the effects of deformation on the rate and mechanism of the transformation.

Decomposition of plagioclase is one of the principal reactions in the gabbro-eclogite transformation. In this study, we have carried out in-situ X-ray diffraction experiments on the high-pressure decomposition reaction from albite into jadeite and quartz or coesite under differential stresses.

The deformation experiments were conducted using multi-anvil type deformation apparatus (D-CAP) newly installed at BL-14C2 of Photon Factory. Polycrytstalline starting material with about 10micron grain size was prepared by annealing the natural albite powder at 2GPa and 1353K for 2 hours. The starting materials were first compressed hydrostatically toabout 2-3.5GPa and heated to 673-873K in the stability field of high pressure phases. Some specimens were annealed at this condition for 1 hour. And then, uniaxial differential stresses were applied to the sample at the fixed speed of upper and lower anvils (10^{-4}-10^{-5}mm/s). These transformation and deformation processes were observed by time-resolved two-dimensional X-ray diffraction (2DXRD) measurements every 20 minutes using monochromatic X-ray (50 keV) and imaging plate. 2DXRD patterns are used to obtain the transformed fraction and differential stress of the sample. Plastic strain of the sample was measured from the X-ray radiography images.

The albite decomposition was not observed at 673 K and 1.5 GPa during deformation in 3hours, in which the plastic strain of the sample reached to about 15%. At 873K and 1.7GPa reaction occurred during deformation.We could observe changes of transformed fraction, differential

stress, and plastic strain with time during the syndeformational
reaction, which provides important information on the coupling of
reaction and deformation.