Influence of water fugacity on flow properties of fine-grained anorthite aggregates under the lower crustal conditions

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Fluids in deep part of the crust have an important role in deformation and seismicity of the crust. In particular, water has great influence on rheological properties of rocks and minerals. Significant reductions of flow strength caused by water have been discovered for dominant mineral constituents of the crust and mantle (e.g., Griggs and Blacic, 1965). Flow strength is affected by water fugacity which rises sharply under the pressure corresponding to the lower crust. However, experimental data of crustal materials under the lower crustal conditions are insufficient.
In this study, we performed high temperature and high pressure deformation experiments to reveal rheological properties of feldspar under hydrous conditions. Axial compression tests on synthetic polycrystalline anorthite aggregates with 0.5 wt% of water were performed in a Griggs-type solid medium deformation apparatus at temperature of 900 ˚C and various confining pressures of 0.8-1.4 GPa. Times were changed to investigate the reduction of strength by diffusion of water into samples. Water contents incorporated in the samples were measured by a Fourier-transformed infrared spectroscopy (FTIR) method.
Strengths of wet anorthite tended to decrease with increasing time or strain magnitude. It was suggested that anorthite samples were still not saturated with water in time range of this study. Strengths of wet anorthite also decreased with increasing confining pressures. Differential stresses were significantly lower than predicted values by previous flow laws for wet anorthite obtained by low pressure experiments (<0.5 GPa). This implies that the effect of fugacity of water on strength in higher pressure might be larger than those predicted by lower pressure experiments (e.g., Rybacki et al., 2006). Our experiments show that the strength of hydrous rocks in the lower crust becomes lower than that predicted by previous studies.

Keywords: rheology, water fugacity, fine-grained anorthite aggregates

