Grain growth experiment of albitic feldspar

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Feldspar is one of the main constituent minerals of the Earth’ s crust. The grain growth and the mechanical behavior of plastic deformation of feldspar have well studied for anorthite ($CaAl_2Si_2O_8$) previously, because this mineral controls the strength of the lower crust. On the other hand, the grain growth of albite ($NaAlSi_3O_8$) has not been studied previously. In this study, we examined the grain growth of albite. Grain growth follows the grain growth law and the rate constant was determined in the experiments.
The starting materials were prepared as follows. Albite powders for industrial use were pulverized using an automatic pulverizer (HERZOG HSM-250A at AIST Tsukuba Central 7) and fine-grained fractions less than a few hundred nm were separated by decantation. The fine-grained powders were hot pressed using a multi-purpose high temperature furnace (Fuji Dempa High Multi 10000 at AIST Chubu) at temperature of 1080 ºC and pressure of 120 MPa for 16 hours. The initial grain size is about 200 nm by linear intercept method after thermal etching.
The grain growth experiments were performed by annealing the sample in a tube furnace (Carbolite 14/450 at AIST Tsukuba Central 7) at the atmospheric pressure. To avoid the melting during the experiments, it is necessary to determine the subsolidus temperatures before annealing experiments. The results suggest that the sample were melted at the temperatures above 1070 ºC.
We obtained the preliminary results at the temperature of 1050 ºC. The grains grow to the grain size of about 370 nm after 140 hours annealing. The regression of the results yields the growth exponent of 2.5 and the rate constant of 1.8×10^{-22} $m^{2.5}s^{-1}$. To compare the result with the previously obtained results for anorthite (Dresen et al., 1996), we calculate the rate constant of 1.35×10^{-18} $m^{2.6}s^{-1}$ at 1050 ºC. The obtained rate constant for albite is four order of magnitude slower than that for anorthite. The results suggest that once fine grained feldspar with composition close to albite is formed, these grains will never grow and affect the mechanical behavior for long time. This process is presumably important not only for the generation of earthquakes along inland active faults but also subduction megathrust earthquakes.

Keywords: Albite, Grain growth, Hot press, Crustal rheology

