THE HYDRATION OF PERICLASE TO BRUCITE: AN EXPERIMENTAL STUDY

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The hydration of mantle minerals is an important process in geodynamics as it changes the rock density and thus buoyancy forces of mantle units that are incorporated into orogenic processes. It can be described in terms of the MgO-SiO_2-H_2O model system. For the sake of tractability, we selected the MgO-H_2O subsystem to investigate the hydration of periclase and the formation of brucite, a phenomenon which involves a positive volume change of the solids of about 100 %.

We did dedicated hydration experiments on periclase single crystals, which we machined to cubes with 3x3x3 mm edge length and reacted with water at temperatures ranging from 400 to 530 °C and pressures of 70 to 200 MPa using cold-seal hydrothermal pressure vessels. Run durations were between 30 min. and 2 h. Hydration produced reaction rims of fibrous brucite, which were separated from the reactant periclase by sharp reaction fronts. The end form of brucite is given in Figure 1. The reaction progress was determined from measurement of the remaining periclase and the newly formed brucite volume fractions. Reaction progress was recalculated as average thickness of the brucite layer.

We assumed linear growth kinetics

$$d = k(T)*t,$$

where d is the thickness of the brucite layer in mm, k(T) is the rate constant, and t is time in seconds.

Assuming that the interface reaction is thermally activated we have

$$k(T)=k_0*\exp(-E_A/R*T),$$

where T is the absolute temperature, E_A is the activation energy for the interface reaction, and k_0 is the pre-exponential factor. From our experiments we estimated 66.35 kJ/mole for E_A and 1.21 mm/s for k_0. Further experiments are in progress.

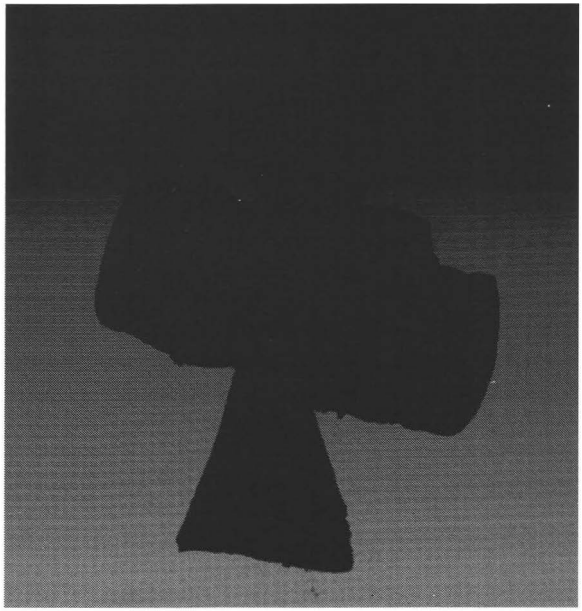

Figure 1, Brucite end form.