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High Pressure and Temperature Apparatus for Study of Intercrystalline Fluid via Velocity and Conductivity Measurements

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Intercrystalline fluid can significantly affect rheological and transport properties of rocks. Its influences are strongly dependent on its distribution. The dihedral angle between solid and liquid phases has been widely accepted as a key parameter that controls solid-liquid textures. The liquid phase is expected to be interconnected if the dihedral angle is less than 60 degree. However, observations contradictory to dihedral angle values have been reported. Watanabe and Peach (2002) suggested the coexistence of grain boundary fluid with a positive dihedral angle. For good understanding of fluid distribution, it is thus critical to study the nature of grain boundary fluid.

We have developed a high pressure and temperature apparatus for study of intercrystalline fluid distribution. It was specially designed for measurements of elastic wave velocities and electrical conductivity. Elastic wave velocities (Vp and Vs) and electrical impedance can be simultaneously measured to constrain intercrystalline fluid distribution. Elastic wave velocities are measured by the pulse reflection method, and electrical conductivity by 2-electrode method. The apparatus mainly consists of a conventional cold-seal vessel with an external heater. The pressure medium is silicon oil with the viscosity of 10 Pa s. The pressure and temperature can be controlled from 0 to 200 MPa and from 20 to 200 degree C, respectively. Dimensions of a sample are 9 mm in diameter, and 15 mm in length.

Halite-water system is used as an analog for crustal rocks. The dihedral angle has been studied systematically at various pressure and temperature conditions [Lewis and Holness, 1996]. The dihedral angle is larger than 60 degree at lower pressure and temperature. It decreases to smaller than 60 degree with increasing pressure and temperature. A sample is prepared by cold-pressing and annealing of wet NaCl powder.

In this poster, we will show features of our apparatus and report preliminary performance tests.

Keywords: crust, fluid, seismic velocity, electrical conductivity, water