High pressure electrical conductivity in a brine-saturated rock and microstructure of pores

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Pores in rocks will close under pressures to increase seismic velocities and decrease transport properties. Experimental studies have shown that the interconnected fluid path is maintained even at the pressure of 1 GPa (e.g., Brace et al., 1965). Watanabe et al. (2019) suggested that wide aperture parts in cracks form interconnected paths to govern electrical conductivity at high pressures. In order to understand the nature of wide aperture parts in cracks, we conducted SEM-EBSD and FIB-SEM observations on a granitic rock (Aji granite). SEM-EBSD studied the crystallographic orientation of grains to distinguish grain boundary and intragrain cracks. FIB-SEM made sequential images of grain boundary and intragrain cracks. One quartz-quartz grain boundary crack shows large variation in aperture along the crack. Quartz grain boundaries are faceted and euhedral small quartz grains (a few micrometers) are seen within wide aperture parts. These observations suggest that the grain boundary was filled with a fluid at high temperature. On the other hand, an intragrain crack in a quartz grain shows little variation in the aperture. Microstructure of pores must be controlled by coexisting fluids in depths.

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