# Fluid distribution in the crust –inference from seismic velocity and electrical conductivity

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Aqueous fluids must play important roles in crustal dynamics including seismicity. Geophysical mapping of fluids will thus give us insights into crustal dynamics. Electrical conductivity profiles have suggested that fluids exist pervasively in the crust. However, the fluid distribution has not been quantitatively constrained. It must be due to our poor understanding of pores that govern seismic velocity and electrical conductivity under high pressures.

In order to understand pores governing physical properties under pressures, simultaneous measurements of elastic wave velocities and electrical conductivity were conducted on a brine saturated granitic rock (Aji granite) under pressures up to 150 MPa and microstructure of pores was observed by X-ray micro CT and SEM with ion-milling and FIB. X-ray micro CT images show that many grain boundaries are open at atmospheric pressure. Elastic wave velocity increases and electrical conductivity decreases with increasing confining pressure. Most of grain bouundary cracks are closed under high pressures (>100 MPa). The electrical conductivity is, however, still much higher than that of the solid phase. The brine must be interconnected under high pressures. SEM images suggest that wide aperture parts in grain boundaries are open even at high pressures and form conduction paths.

There should be cracks with various sizes in the crust: from grain boundaries to large faults. Though cracks are closed under pressure, there must be a variation in the aperture. Wide aperture parts may form conduction paths even under high pressures. The influence of wide aperture parts on physical properties can be evaluated by tube model. Electrical conductivity is proportional to the fluid volume fraction. A change in conductivity by 4 orders of magnitude requires a change in fluid volume fraction by 4 orders of magnitude. However, seismic velocity for tube model is insenstive to fluid volume fraction. Seismic velocity will thus show relatively small decrease for a large change in fluid fraction. Observed large variation in conductivity and relatively small variation in seismic velocity (e.g., Ogawa et al., 2001; Matsubara et al., 2004) are consistent with tube model. The variation in fluid fraction must reflect that in the amount of wide aperture parts, which is attributed to the variation the amount of cracks.

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