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地殻・最上部マントルの高電気伝導度を担う流体連結の空間スケールについて
On the space scale of fluid interconnection for the high electrical conductivity of the crust and uppermost mantle

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Our knowledge on the grain-scale fluid distribution is mostly based on microstructures of high-pressure experimental charges in a typically micrometer scale, whereas spatial resolutions of seismic tomography and magnetotelluric observations are both in a kilometer scale, thus there is a gap larger than 7 orders of magnitude. For estimating fluid fraction in the crust and mantle, it is necessary to clarify the critical length scale of fluid interconnection that determines the macroscopic physical parameters. A possible approach to lessen the gap is to observe xenoliths that were directly derived from the depths. For this purpose, we carried out Xray-CT observation of uppermost mantle and lower crust xenoliths from several localities in the world, including Ichinomegata (NE Japan), Eifel (Germany), SanCarlos and Kilbourne Hole (USA). Intergranular pores were observed in all the lherzolite and Hb-gabbro xenoliths from these localities, showing that the rocks were saturated with a free-fluid phase. The pore fluids are localized in interphase boundaries between different mineral phases, as found in the grain-growth experiment in a bimineralic system (Ohuchi and Nakamura, 2006, J. Geophys. Res.). Most of the monomineralic triple junctions are faceted and lack pore fluids, within the resolution limit of CT observation (typically 4-7 micrometer), thus pore fluids do not have larger scale interconnectivity. Although we do not rule out the possibility of presence of thinner, CT-imaginable fluid networks, such thin networks along grain edges and corners, if present, cannot account for the high electrical conductivity as observed for the crust and upper mantle of NE Japan arc. Fluid localization in a larger scale such as meterscale shear zones, or to the contrary, conductive 2D interphase boundaries of wet polycrystalline rocks are required.

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