

Three-dimensional microstructure of brine-bearing quartzite: Evaluation of faceting effect using high-resolution X-ray CT

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We present three-dimensional (3D) X-ray computed tomography (CT) of the pore microstructure of a synthesized quartzite texturally equilibrated with NaCl aqueous fluid at 900C and 0.8GPa (Nakamura and Watson, 2001). The CT was taken with BL47XU at SPring-8 using 10 and 15 keV monochromatized X-rays (Uesugi et al., 2001; Tsuchiyama et al., 2001). The 3D CT image is composed of accumulated 2D slices with linear attenuation coefficient (LAC) distribution. The effective voxel size is 0.5x0.5x0.5um and imaging area is 500x500um in the sections. The high spatial resolution, plucking-free, and non-destructive features of the X-ray CT at BL47XU are suitable for precise determination of pore geometry. In the quartzite, decrease of the degree of neck-off for the channels at triple junctions surrounded by flat crystal surface was found as Waff and Faul (1996) predicted for olivine-basalt system based on the two-dimensional cross section of the experimental run charges. Most part of the fluid, however, distributes in isolated pockets at edges and corners of the quartzite grains and connectivity looks very small. There certainly is a possibility that the fluid pockets are interconnected via very thin (thinner than 0.5um) channels. Even so, permeability of the quartzite should be significantly decreased compared to the quartzite with ideal geometry for similar fluid fraction.

The high-resolution X-ray CT has a potential to be an indispensable tool to investigate rock microstructure in the complex systems having non-uniform grain size, anisotropic surface energy, and multi phase grains, where theoretical fluid geometry calculation and connectivity evaluation are difficult.