Grain shape and pressure sensitivity of transport properties in granular materials

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The connectivity of pores is a key factor in controlling transport properties of rocks. Even in porous rocks, it is sensitive to the confining pressure. Electrical conductivity in brine-saturated Berea sandstone (porosity~20%) decreased by ~22% as the confining pressure was increased to 40 MPa, while the pore-fluid pressure was kept at the atmospheric pressure. From the volumetric strain measurement, the change in porosity should be less than 1%. The observed relatively large decrease in conductivity must be caused by a significant reduction of the connectivity of pores under pressure. In order to understand the influence of pressure on the connectivity of pores, we conducted compression tests on granular materials: spherical glass beads and oblate quartz sand. Compressional wave velocity increases with increasing pressure similarly in both materials, while electrical conductivity decreases significantly only in quartz sand. This suggest the important role of grain shape in governing the pressure sensitivity of connectivity of pores. X-ray micro CT images of granular materials impregnated with epoxy resin were analyzed to study the structure of pores. Changes in electrical conductivity under pressure and the structure of pores will be presented for different grain shapes.

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