Change of pore connectivity in granular materials under confining pressures

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The pore connectivity in Berea sandstone (porosity~20%) is remarkably reduced under confining pressures. Electrical conductivity in Berea sandstone decreased by 22% as the confining pressure was increased to 40 MPa, while the pore-fluid pressure was kept at atmospheric pressure (0.1 MPa). Measured volumetric strain showed that the change in porosity under the confining pressure was less than 1%. The observed relatively large decrease in conductivity requires a significant decrease in the connectivity of pores. The effective medium theory (Kirkpatrick, 1973) suggests that around 20% of conduction paths must be closed to decrease conductivity by 22%. The observation of pore structures with X-ray CT revealed that a lot of thin pores were involved in a network of pores. These thin pores are likely to close under confining pressures to reduce electrical conductivity. Compression tests on packed quartz sand also showed that a small decrease in porosity causes a relatively large decrease in conductivity.

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