Effect of pore collapse and grain crushing on the frequency dependence of elastic wave velocities in a porous sandstone

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Abstract

A saturated Bleurswiller sandstone, of 25% porosity, was compacted by increasing the confining pressure over the critical pressure P* which characterizes the onset of pore collapse and grain crushing. The frequency-dependence of the Young's moduli were measured before and after the compaction using forced-oscillation method in a triaxial cell. For the intact and compacted samples, we observed one dispersive transition within the seismic band (0.01-100 Hz). The dispersion is consistent with crack-to-pore squirt flow, making the transition from the relaxed to the unrelaxed fluid-flow regime. The induced compaction shifted the critical frequency of the squirt-flow dispersion towards higher frequencies, thus moving it out of the seismic band and allowing Biot-Gassmann to fully apply. This result is a consequence of an increase in the crack aspect ratio after compaction. In addition, the dispersion of elastic modulus after compaction increases from about 25% to 30%, related to the increase of crack fraction.
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