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# Experimental investigations of effective visco-elastic properties of sandstones

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The effective visco-elastic properties of reservoir rocks are strongly dependent on characteristics of the pore geometry and of the inherent viscous pore fluids, saturation degree and excitation frequency. Constraining these dependencies is important for the interpretation of seismic data from geothermal or oil and gas reservoirs. Thus, experimental studies are needed that focus on effective visco-elastic properties in the frequency range of seismic field data. For this purpose, some laboratory apparatuses were developed in the past, using the forced oscillation method, in which stress and strain of a harmonically loaded sample are recorded and analyzed. In most of these studies, Young's modulus and seismic wave attenuation were measured at frequencies below 100 Hz (e.g., [1-4]).However, to interpret complete seismic surveys, laboratory data are required up to even higher frequencies. Therefore, we developed a forced oscillation setup aiming at measuring the effective visco-elastic properties of partially and fully saturated rock samples in the seismic frequency range up to 1 kHz. Cylindrical samples are excited to axial oscillations during which the axial force and the axial as well as the lateral strain of the sample are measured to derive Young's modulus and Poisson's ratio and the two corresponding attenuation coefficients by a sliding-window fast Fourier transformation.

We present forced-oscillation experiments with varying amplitude (amplitude sweep) or frequency (frequency sweep) on different materials at ambient conditions. Calibration experiments were performed on visco-elastic polymethyl methacrylate (PMMA), commonly called Plexiglas, and elastic AlCuMgPb-alloy. These well characterized standard materials with contrasting behavior were already used to test similar apparatuses (e.g., [1-4]). The determined visco-elastic properties do not vary with amplitude in the investigated axial strain range of 4e-06 to 5e-05 (PMMA) or 3e-07 to 5e-06 (AlCuMgPb-alloy), but show a frequency dependence for PMMA. For example, the Poisson's ratio of PMMA decreases continuously with increasing frequency, in agreement with previously reported trends [2]. Currently, we perform forced-oscillation experiments on samples of Berea sandstone with a porosity of approximately 18 %. The axial strain range, in which the four mentioned visco-elastic properties show no amplitude dependence, is identified in amplitude sweeps and used in the subsequent frequency sweeps.

## References

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