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Acoustic emission rate stress sensitivity caused by stress perturbations during brittle creep deformation of Fontainebleau sandstone

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Three tri-axial compression experiments were performed on 7% porosity Fontainebleau sandstone cores, at 30MPa confining pressure and 10MPa pore pressure. During each tests, stress, strain, elastic wave velocities and acoustic emissions (AE) were recorded.

The first experiment was performed at a constant strain rate of $10^{-5}s^{-1}$ and brittle failure occurred at 440MPa shear stress. The AE rate increased up to failure. AE hypocenters delineate the fracture plane. Post failure AE rate follows Omori law with an exponent close to 1. Post failure damage is also located mainly along the fracture plane.

The second experiment was performed in creep, with constant shear stress stages at 400, 410, 415, 420 and 435MPa. The constant shear stress stages lasted from two days (for the lowest ones) to one hour for the last one. During this last stage, macroscopic failure occurred. AE hypocenters locations show that strain localisation was initiated early in the experiment, even before the first constant shear stress stage. Damage accumulated within a nucleation zone from which macroscopic failure was initiated.

The third experiment was also performed in creep, with the same constant shear stress staged loading as in the second experiment. However, in this case, small sinusoidal stress oscillations of 100s period were superimposed to the axial load and confining pressure (+/- 0.1MPa for the confining pressure and +/- 0.5MPa for the shear stress, both oscillations being anti-correlated). The acoustic emission rate closely followed the oscillations, both in primary, secondary and tertiary secondary creep.

These results suggest, that at least in intact porous rocks, small stress perturbations can well perturb the background micro-seismicity rate.