On the Deformation of Porous Medium by Pressurized Flow

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Fluid injections into the underground occurs in many industrial processes as hydraulic fracturing for oil and gas recovery, wastewater disposal, enhanced geothermal energy systems (EGS) and Carbon storage technologies. Often, the increase in pore pressure due to the fluid injections lead to the activation of a preexisting underground shear fractures (named faults), forming unanticipated local earthquakes.

While studying the mechanism of injection induced earthquakes, the rock deformation due to the fluid injection is unknown. Understanding the rock deformation coupling with the pressure change, requires detailed experiments linking the global and local deformation with the pressure change during flow, which ultimately influence the earthquake triggering.

In this study we present a novel experiment on transparent plastic rocks, that offers a detailed analysis of the artificial rocks' deformation due to pressurized flow. In these experiments, we inject a fluid through the artificial rocks and analyze the internal deformation by capturing the displacement of fluorescent microspheres embedded in the artificial rock structure. Our analysis allows a straight-forward correlation between the deformation of rocks, the pressure change and the fluid flow. The study points a similarity between the material deformation due to internal pressure induced by the fluid injection and material deformation due to an external pulling.