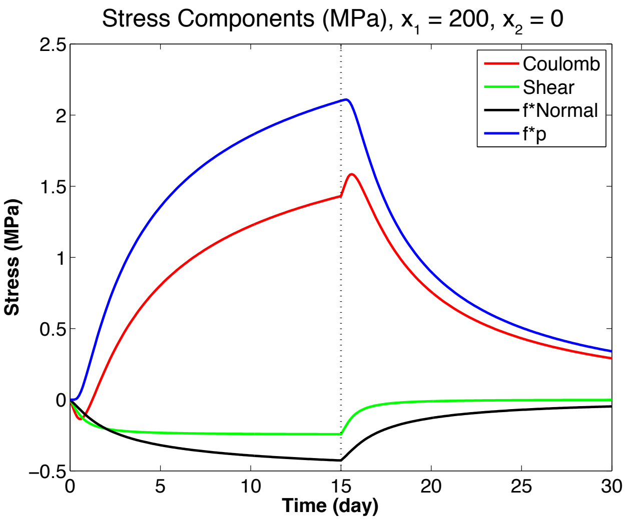
Since the pioneering studies at the Rocky Mountain Arsenal and Rangely, Colorado, induced seismicity associated with fluid injection has been understood to result from a decrease in effective normal stress due to increase in pore-fluid pressure. Much attention has thus been given to understanding the spatiotemporal distribution of pore-pressure resulting from injection, and the space-time evolution of seismicity has been used to infer subsurface hydraulic diffusivity. Yet, the association of earthquakes with fluid *production*, and *decreasing* pore-pressure requires that poroelastic effects must be dominant in some settings. Furthermore, laboratory experiments show that time to failure depends on stress history, suggesting that the space-time evolution of seismicity depends on fault frictional as well as hydraulic properties.

Theoretical models show that injection in a homogeneous medium poro-elastic coupling may increase or decrease the seismicity rate during injection, depending on the orientation of the faults relative to the injector. If injection induced stresses inhibit slip, abrupt shut-in can lead to locally sharp increases in seismicity rate (Segall and Lu, 2015, JGR). The largest induced earthquakes have been observed on faults that extend into the basement, due to the limited area of ruptures restricted to sedimentary strata. The potential for induced earthquakes on basement faults depends on whether or not faults are hydraulically connected to the injection horizons, as well as the fault zone permeability. If faults are hydraulically isolated from the injection horizons, poroelastic stressing can still increase the Coulomb stress, destabilizing faults (Chang and Segall, 2016, JGR), even in the absence of pore-pressure diffusion. Models also indicate that the time to reach a critical seismicity rate scales with distance-squared, although the inferred diffusivity is likely to be biased by frictional effects. In addition, as pointed out be Viesca (2015, AGU) fluid injection can induce aseismic slip which, under some stress conditions, could spread much more rapidly than pore-pressure diffusion.



Stress components as a function of time. Dotted vertical line indicates shut-in.

The maximum magnitude of induced events has been observed to occur post-injection, which presents a clear problem for so-called `stop light' systems. Dynamic rupture models under spatially variable stresses indicate that under high background stresses earthquake magnitudes are limited only by the sizes of available faults and heterogeneity of stress. In this limit, induced earthquakes would be expected to follow power law distributions, larger events occur only in proportion to the seismicity rate (van der Elst etal, 2015 AGU). Under lower ambient stresses ruptures are limited by the time varying volume of perturbed crust. This limit leads to a roll-over in frequency magnitude distribution for larger events, with a corner magnitude that increases with time; larger events occurring post shut-in are thus not unexpected. Observations from Basel support a temporal change in frequency magnitude statistics. Earthquake simulators (Dieterich, etal 2015 SRL) predict many observed features although existing models fail to incorporate known dynamic effects. The challenge for the future will be to incorporate thermo-poroelastic effects and slow tectonic loading into proper elastodynamic rupture models.