Do shallow injection wells contribute to the triggering of the 2020 M5.0 Mentone earthquake in the Delaware Basin, Texas?

Xinyu Tan[1,1] and Semechah K. Y. Lui[2,2]

[1]University of Toronto - Mississauga
[2]University of Toronto

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Abstract

The M5.0 earthquake that occurred in March 2020 near the town of Mentone in the Delaware Basin, Texas, is one of the largest induced earthquakes recorded in the central US. A former study shows that the triggering of this event can be attributed to the nearby deep injection. Interestingly, the shallow injection wells in this region have an injection volume five times larger than that of deep injection wells. In this study, we investigate the role of these shallow injection wells in the triggering of the M5.0 event despite their farther distance from the mainshock. By performing focal mechanism inversion and earthquake relocation, we determine the precise orientation of the south-facing normal fault plane where the mainshock occurred, followed by fully coupled poroelastic stress modeling of the change of Coulomb Failure Stress (ΔCFS) on the fitted fault plane due to the shallow injection in the region. Results show that shallow wells may cause up to 30 kPa of ΔCFS near the mainshock location, dominated by positive poroelastic stress change. Such perturbation surpasses the general triggering threshold of faults that are well aligned with the local stress field and suggests a nonnegligible role of these shallow injection in the triggering of the mainshock. Our study also highlights the effect of rock properties of injection layers on the magnitude and spatial extent of pore pressure and stress perturbations, supporting the importance of detailed geomechanical evaluation of the reservoir when developing relevant operational and safety policies.