Seismicity induced by the Hutubi Underground Gas Storage Facility

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The Hutubi underground gas storage (UGS) facility in Xinjiang, China, with a maximum gas storage capacity of 10.7 billion m^3, provides an excellent opportunity to study seismicity induced by the annually cyclic injection and extraction of natural gas. To distinguish induced earthquakes, we first investigated the background seismicity probability using the ETAS model. Our statistical results suggest a potential link between gas injection and two groups of seismicity. We then relocated earthquakes with a dedicated mobile seismic network and a refined local velocity model. After relocation, these two groups of earthquakes moved much closer to the faults bounding the UGS and were situated at depth ~4 km, slightly deeper than the reservoir formation. Focal mechanism solutions of two largest earthquakes (Mw 2.8 and 3.0) in August 2013 show a reverse fault.Based on our high-resolution earthquake locations, we propose that these earthquakes are not hydrologically connected with the reservoir and thus are induced by poroelastic stress perturbations, which were quantified in our newly developed geomechanical model incorporating fully-coupled poroelasticity. The results shed light on seismic hazard assessments associated with large UGS that are actively developed globally.

Keywords: Underground gas storage, Cyclic injection and extraction, Induced earthquake by poroelastic stress, Geomechnical model

