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Discriminating between natural vs induced seismicity from long-term deformation history of intraplate faults

To assess whether recent seismicity is induced by human activity or is of natural origin, I will present analysis of fault displacements on high-resolution seismic reflection profiles for two regions in the central United States (CUS): the Fort Worth Basin (FWB) of Texas, and the northern Mississippi embayment (NME). Since 2009 earthquake activity in the CUS has increased dramatically, and numerous publications suggest that this increase is primarily due to induced earthquakes caused by deep-well injection of wastewater, both flowback water from hydrofracturing operations and produced water accompanying hydrocarbon production. Alternatively, some argue that these earthquakes are natural, and that the seismicity increase is a normal variation that occurs over millions of years. The analysis shows that within the NME, faults deform both Quaternary alluvium and underlying sediments dating from Paleozoic through Tertiary, with displacement increasing with geologic unit age, documenting a long history of natural activity. In the FWB, a region of ongoing wastewater injection, basement faults show deformation of the Proterozoic and Paleozoic units, but little or no deformation of younger strata. Specifically, vertical displacements in the post-Pennsylvanian formations, if any, are below the resolution (~15 m) of the seismic data, far less than expected had these faults accumulated deformation over millions of years. The results support the assertion that recent FWB earthquakes are of induced origin; this conclusion is entirely independent of analyses correlating seismicity and wastewater injection practices, and based on structural geology analysis techniques.