Source Studies of Induced Earthquakes in Alberta (Canada) and Raton Basin (United States)

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Hydraulic-fracturing and waste-water disposal are the key reasons for inducing earthquakes in the western Canada and central United States, where multiple M4-5 earthquakes have raised significant scientific interest and public concern in recent years. As most of the induced events occur on unknown intraplate faults, identification of such faults serves as the foundation for understanding the inducing mechanism and risk management. The first part of this presentation reviews the source analysis of three “red-light” earthquakes (i.e., lead to shut down of wells, M>4) in Alberta, Canada. We utilized waveform matching techniques to detect seismic clusters and illustrated their spatial-temporal relationships to nearby hydraulic-fracturing wells. The fault system and potential fluid contribution were studied via focal mechanism and statistical analysis. The second part of this presentation focuses on elaborating fault structures with a dense nodal array in the Raton Basin, NM&CO, where we utilized a machine-learning based phase picker and identified ~10,000 events down to M-2. The earthquakes cluster at multiple fault systems, ranging from N-S normal to oblique dip-slip regimes. We also investigated the finite fault attributes of several M~3 earthquakes with the second moments method. The detailed fault structures and earthquake cycle statistics offer an observational base for physics-based mechanical modeling and hazard mitigation.

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Zoom Link: Here

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