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Critical role of detecting fault structures in the induced seismicity risk analysis

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Summary

Prior knowledge of fault architecture tends plays an important role in the case of injection-induced seismicity and related risk and hazard analysis. In most cases, reactivated faults due to fluid injection are inferred by the spatial distribution of induced-seismicity hypocenters. The objective of this study is to combine precise event locations of induced seismicity during hydraulic fracturing with high-resolution 3-D seismic images, in order to investigate fault-system behavior. This case study is located in the foreland of the northern Canadian Rocky Mountains, where the complex architecture of the buried fault system is imaged by depth-migrated 3-D multicomponent seismic data, and subtle structural features are enhanced using seismic-attribute analysis. Robust and precise event hypocenters are obtained by combining a kinematic method for locating event epicenters with a focal-depth method that leverages independent velocity information implicit in horizon correlations using P-P and P-S 3-D seismic images. The results demonstrate that during stimulation by fluid injection, fault-zone interaction can occur through transverse structures that provide pathways for fault activation at distances of up to 2 km from the injection wells.

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