Public Abstract
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Utah is one of the top producers of oil and natural gas in the United States. Over the past 18 years, more than 4.2 billion gallons of wastewater from the petroleum industry have been injected into the Navajo Sandstone, Kayenta Formation, and Wingate Sandstone in Carbon and Emery County, Utah, where seismicity has increased during the same period. I investigated whether wastewater injection is related to the increased seismicity.
Previous studies have attributed all of the seismicity in central Utah to coal mining activity. I found that water injection might be a more important cause. In the coal mining area, seismicity rate increased significantly 1-5 years following the commencement of wastewater injection. The increased seismicity consists almost entirely of earthquakes with magnitudes of less than 3, and is localized in areas seismically active prior to the injection. I have established the spatiotemporal correlations between the coal mining activities, wastewater injection, and increased seismicity. I used simple groundwater models to estimate the change in pore pressure and evaluate the observed time gap between the start of injection and the onset of the increased seismicity in the areas surrounding the injection wells. To ascertain that the increased seismicity is not fluctuation of background seismicity, I analyzed the magnitude-frequency relation of these earthquakes and found a clear increase in the b-value following the wastewater injection. I conclude that the marked increase of seismicity rate in central Utah is induced by both mining activity and wastewater injection, which raised pore pressure along pre-existing faults.