ANALYSIS OF WASTEWATER INJECTION AND PROSPECT REGIONS FOR INDUCED SEISMICITY IN THE TEXAS PANHANDLE, USA

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ABSTRACT

Subsurface injection of wastewater co-produced alongside oil and gas (O&G) has been linked to an increasing number of earthquake events throughout the southern mid-continent of the United States. In Texas, the average count of seismic events per year have risen over the past decade. This study aims to compare injection of produced water into the subsurface and increased number of earthquakes in the Panhandle Region of Texas. For this study, saltwater disposal and enhanced oil recovery through underground injection control (UIC) wells in the Texas Panhandle were analyzed from 1983-2018. During this same period, a total of 64 earthquakes of $M \geq 2.5$ were recorded. The average earthquake rates increased from 1.21 events per year (1983-2007) to 3.50 events per year (2008-2018). A total of 1,926 active UIC wells in the Texas Panhandle were identified from the Railroad Commission of Texas database during the study period. This research identified 54 geologic stratigraphic formations present in the region and focused on the 34 target formations into which wastewater was injected. Cumulative UIC volumes were found to be localized by geographic regions and geologic formations, where a total of 2.26 billion barrels (Bbbls, where 1 barrel = 159 liters) of wastewater were injected. Approximately 87% of the total disposal volume (1.96 Bbbls) was injected into seven geologic formations, including the igneous Precambrian basement; another 27 formations received less than 100 million barrels (MMbbls) each. Monthly UIC rates in the Panhandle fluctuated in time, similar to overall O&G industry activity. From this analysis, 61% of earthquake events are considered to be possibly or probably induced by a combination of UIC and O&G practices. Additionally, this research identified regions at risk of potentially hosting future earthquakes induced by current UIC and O&G operations. Understanding how and where UIC practices and O&G operations are affecting seismicity rates in the State of Texas can allow researchers and regulators propose strategies to reduce or mitigate negative externalities such as induced seismicty.

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