Recent Seismic Activity in Kansas: Events and Responses

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Induced or Triggered Seismicity

• Defined: Earthquake activity related to human activity; associated with deep wastewater injection, geothermal energy, large reservoirs

• Potential examples in midcontinent include Arkansas, Colorado, Ohio, Oklahoma, Texas
Historic Kansas Earthquakes
Earthquake Activity - March 12 to 18, 2014

Kansas Geological Survey
Data from Oklahoma Geological Survey, USGS
18 March 2014
Kansas Responses

• Governor’s Task Force on Induced Seismicity
  KGS, KCC, KDHE
• USGS, OGS
• Proposed permanent network
• Public information, legislative interaction
• Interstate Oil and Gas Compact
  Commission/Groundwater Protection Council
Kansas Response Plan (Draft)
Induced Seismicity: The Potential for Triggered Earthquakes in Kansas

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Introduction
Earthquake activity in the Earth’s crust is known as seismicity. When linked to human activities, it is commonly referred to as “induced seismicity.” Industries that have been associated with induced seismicity include oil and gas production, mining, geothermal energy production, construction, underground nuclear testing, and impoundment of large reservoirs (National Research Council, 2012). Nearly all instances of induced seismicity are not felt on the surface and do not cause damage.

In the early 2000s, concern began to grow over an increase in the number of earthquakes in the vicinity of a few oil and gas exploration and production operations, particularly in Oklahoma, Arkansas, Ohio, Colorado, and Texas. Horizontal drilling in conjunction with hydraulic fracturing has often been singled out for blame in the public discourse. Hydraulic fracturing, popularly called “fracking,” does cause extremely low-level seismicity, too small to be felt, as do explosions associated with quarrying, mining, dam building, and other industrial activities. Although the actual process of hydraulic fracturing has been suspected of inducing larger earthquakes a few times worldwide, the U.S. Geological Survey has found no evidence to suggest that it has contributed much to increases in the rate of earthquakes (Hayes, 2012).

Felt earthquakes associated with any oil and gas production activities are rare. In the United States, only a small fraction of the hundreds of thousands of wells currently in operation have been suspected of inducing earthquakes large enough to be felt or cause damage (National Research Council, 2012). Most often, detected seismic activity associated with oil and gas operations is thought to be triggered when wastewater is injected into a disposal well. In the disposal process, waste products—such as saltwater produced with oil and gas and recovered hydraulic fracturing fluids—are injected into deep and confined porous rock.

Identifying a link between earthquakes and human activities is difficult. Complex subsurface geology and limited data about that geology make it hard to pinpoint the cause of many seismic events in the midcontinent, particularly in regions historically prone to naturally occurring low-level seismic activity. In south-central Kansas, for example, several small earthquakes have been recorded near disposal wells starting in September 2013, about three years after horizontal drilling activities in the Mississippian limestone play—and associated water disposal—had crossed over the state line into Kansas from Oklahoma. However, the region also experienced several small historical earthquakes long before the increased oil activity, making it difficult to determine the cause of the recent seismic events. Although some areas of Kansas are at greater risk of seismicity than others, whether natural or induced, none of the state is in a high-hazard earthquake zone (fig. 1).

Scientists continue to monitor and evaluate possible instances of induced seismicity. In states with significant increases in seismic activity, including Oklahoma, monitoring has increased in localized areas where unusually high rates of seismicity have occurred near oil and gas production activities. To
Summary

• Felt earthquakes related to hydraulic fracturing are extremely rare.
• Some earthquakes may be due to deep fluid injection, including wastewater disposal.
• Need for better reporting of injection data (volumes, pressures), improved seismic monitoring, fault mapping, and public communication.
• A state issue.
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