The Facts About Hydraulic Fracturing and Seismic Activity

Hydraulic fracturing is an essential well completion technology for the development of unconventional resources, such as natural gas that is trapped in shale rock formations. It is used to create a fracture network through which oil and gas can migrate to the wellbore. Hydraulic fracturing is accomplished by pumping a mixture of more than 99.5 percent water and sand, with some additives, into dense rock formations deep below the earth's surface. As indicated in Figure 1, multiple fracture sections or "stages" are carefully targeted for controlled stimulation. This process forms a network of narrow (a few millimeters wide) and limited extent (a few hundred feet long) fractures in the rock.

Hydraulic fracturing is accompanied by microseisms that can be recorded with sensitive listening devices and analyzed with established scientific methods. Microseismic mapping is used to understand and optimize field development of the resource, well completions, and stage treatments. This monitoring produces extensive data, and thus microseismic activity associated with hydraulic fracturing is thoroughly understood. A review of published research shows no cases of injuries or damage as a result of the very low level of seismicity related to this well-completion technique, in more than one million applications.

In one comprehensive study that monitored several thousand shale fracture treatments in various North American shale basins, the largest microseism recorded had a measured magnitude of about 0.8.[1] This is approximately 2,000 times less energy than a magnitude 3.0 earthquake, which is a magnitude commonly used to delineate deep earthquakes that can be felt at the surface of the earth, and much less than one that could cause surface damage.

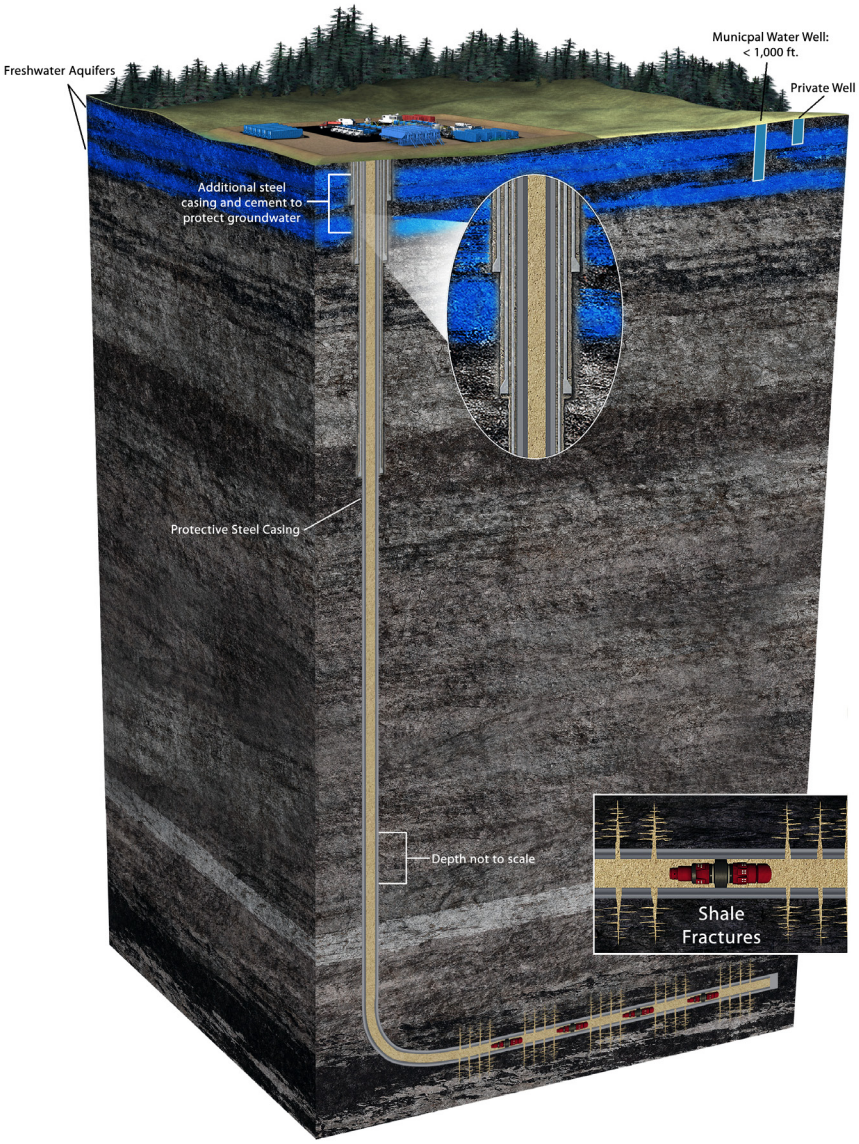

Figure 1. Horizontal well in an underground rock layer with multiple fracture stages created by hydraulic fracturing.

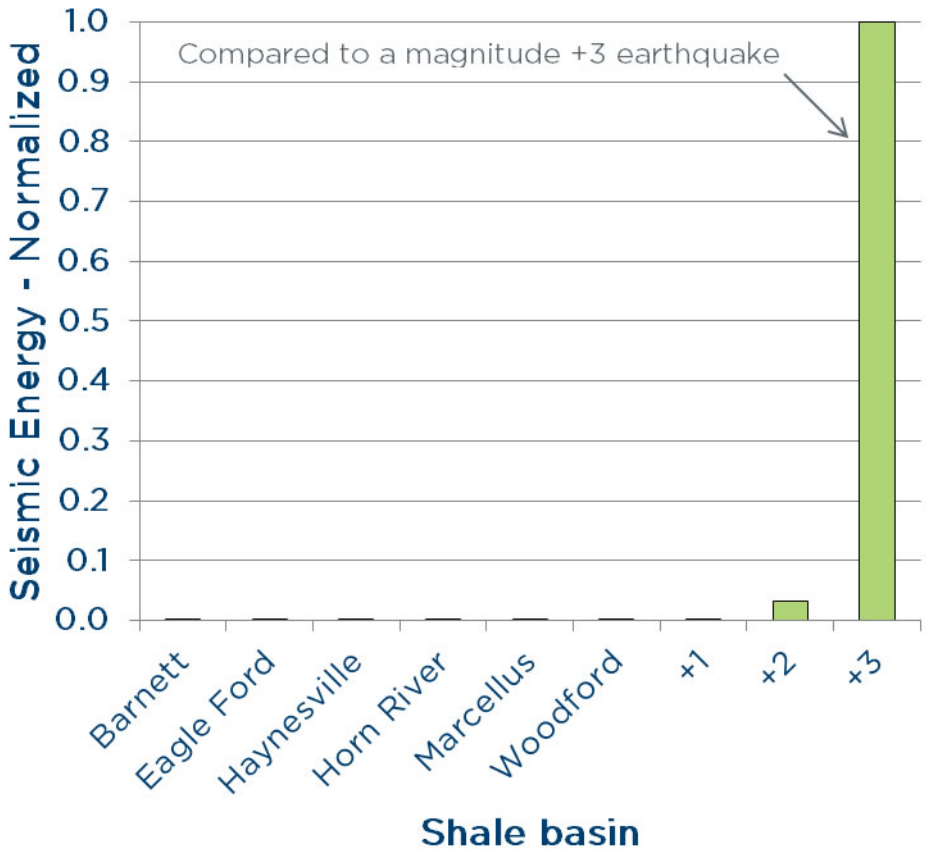

Figure 2. Measurements of the energy of maximum microseismicity induced by hydraulic fracturing in major North American shale basins[1]; compared to a magnitude +3 earthquake which feels similar to the passing of a nearby truck.[2]

Figure 2 shows the maximum energy of the microseisms recorded during this study. In most basins, the microseismic energy induced by fracturing ranges from 10,000 to 1,000,000 times smaller than a 3.0 earthquake. This is so minimal that it can hardly be distinguished on the graph. Given that a 3.0 magnitude has been described as equivalent to the passing of a nearby truck[2], microseisms resulting from hydraulic fracturing are extremely small and not a hazard for humans, animals, structures or the environment.

Hydraulic fracturing is a technology that has been monitored, researched, and studied for decades to help improve its effectiveness and ensure its safety. Microseismic analysis has been used extensively for monitoring fracture behavior and is well-documented in the geoscience literature. The continued development of monitoring and modeling capabilities to improve the process will provide ongoing assurance of the safety and effectiveness of this critical well-completion procedure.

1. Warpinski, N.R., Du, J. and Zimmer, "U. Measurements of Hydraulic-Fracture Induced Seismicity in Gas Shales." Paper SPE 151597 presented at the SPE Hydraulic Fracture Technology Conference, The Woodlands, Texas. 6-8 February 2012.
2. USGS Earthquake web site, 2012, Link: http://earthquake.usgs.gov/learn/topics/mag_vs_int.php