



## FACT SHEET

*Ohio State University Extension, 2120 Fyffe Road, Columbus, OH 43210*

“Shale Oil and Gas Development” Fact Sheet Series

# Seismic Testing and Oil & Gas Production

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## Introduction

Seismic testing may be accomplished in a variety of ways. With increased oil and gas activity in Ohio, many individuals have seen a form of seismic testing being recorded along highways throughout the state. Seismic testing may be used during several stages of the oil and gas exploration process. It may begin during the initial phases of exploration and may extend throughout various stages of oil and gas development. Some testing may occur on rights-of-ways only along a highway. If a landowner is potentially approached by a company performing seismic tests, there are several considerations a landowner should take under advisement.

## Permitting Seismic Testing

It is important for landowners to consider the scope of their involvement when permitting seismic testing. One question a landowner should consider is what the legal nature of the activity is. Allowing seismic testing is neither a binding contract nor an oil and gas lease. It is simply written permission for a company to conduct seismic testing on, across, and below a landowner's property. A seismic testing company is not permitted to drill an oil and gas well. Usually, the permission agreement will involve a per-acre reimbursement for the area under scrutiny.

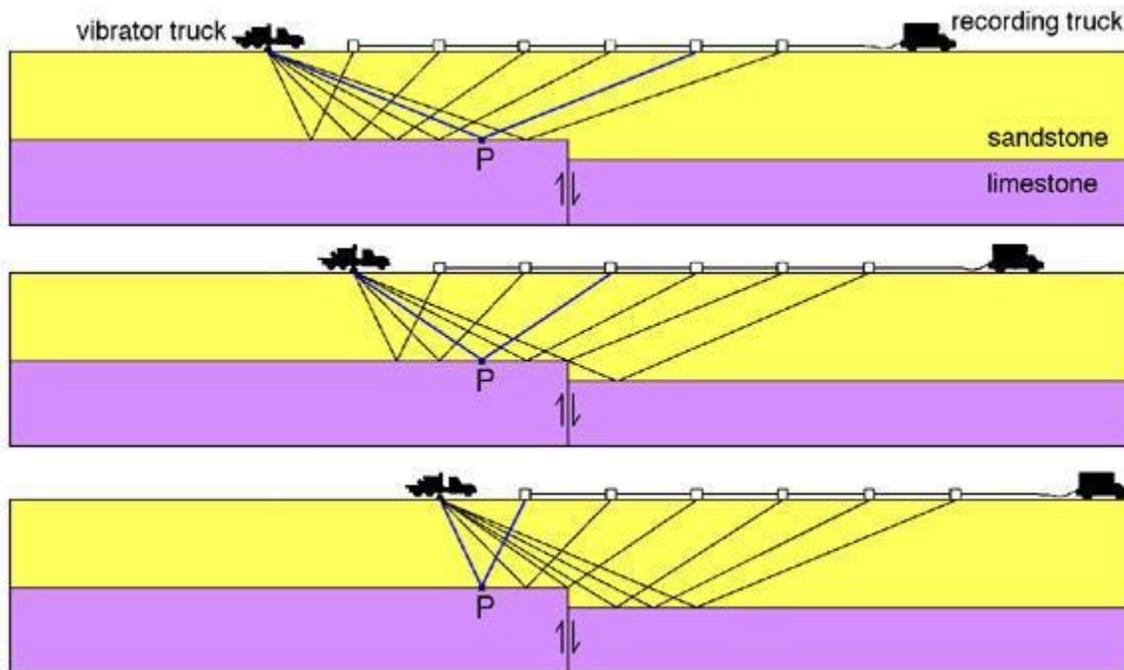
The scope of activity on a landowner's property is subject to a number of factors. It may include ingress and egress routes, mapping of seismic lines, and temporary cables and equipment. Seismic operations have the potential to impact farming operations as well. A farmer should be highly proactive and communicate with the company and seismic crews performing the test in order to ensure minimal impact on agricultural operations.

## The Seismic Process

The use of human-generated seismic waves has been developed mainly due to commercial enterprise, particularly the petroleum industry. Seismic reflection or seismic testing is used by petroleum geologists and geophysicists to map and interpret potential petroleum reservoirs. The general principle of seismic reflection is to send elastic waves into the Earth, where each layer within the Earth reflects a portion of the wave's energy back and allows the rest to refract through.

These reflected energy waves are recorded over a predetermined time period (called the record length) by receivers that detect the motion of the ground in which they are placed. The typical receiver used on land is a small, portable instrument known as a geophone, which converts ground motion into an analogue electrical signal. The seismic waves are often created by large vehicles equipped with heavy plates (known by the trademark name "Vibroseis" trucks) that vibrate on the ground. By analyzing the time it takes for the seismic waves to reflect off of subsurface formations and return to the surface, a geophysicist can map subsurface formations and abnormalities to predict where oil or gas may be trapped in sufficient quantities for exploration activities.

Until relatively recently, seismic surveys were conducted along a single line on the ground, and their analysis created a two-dimensional picture like a slice through the earth beneath that line, showing the subsurface geology along that line. This is referred to as two-dimensional or 2D seismic data.



In the last 20-30 years, with the development of computers, geophysicists have been able to take seismic testing to a new level by conducting three-dimensional, or 3D, seismic tests. Recorded reflections received at each receiver point come from all directions, and analysis can then be

performed on super-desk-top computer programs to create a three-dimensional image of the subsurface. Today, almost all oil and gas exploratory wells are preceded by 3-D seismic surveys. A series of related reflections on several seismograms is often referred to as a reflection event. By correlating reflection events, a seismologist can create an estimated cross-section of the geologic structure that generated the reflections. Interpretation of large surveys is usually performed with programs using high-end three dimensional computer graphics. 3D surveys can be conducted in almost any environment - in the ocean, in swamps, on land and in urban areas. A seismic survey may cover many square miles of land and costs thousands of dollars per acre to map. The data obtained from such a survey is therefore very valuable. Seismic data is licensed, bought and sold by seismic survey companies, brokers and exploration companies. There are three phases of seismic surveys: data acquisition, processing, and interpretation.

## **Data Acquisition**

A Vibroseis truck has a large metal plate under the center of the truck body that is lowered onto the ground so that the entire weight of the truck is on the plate. The plate is then caused to vibrate at a specified power and frequency, creating seismic waves that travel into the ground. A single vibrator truck can generate more than 40,000 pounds of ground force, and usually multiple trucks are clustered together to create the energy at each source point, creating a combined ground force measured in thousands or hundred-thousands of pounds.

## **Vibroseis Trucks**

Residents standing near a vibroseis truck may be able to detect it, but this process should not cause any interruptions of daily life or damage to structures.



*Vibroseis Trucks in Monroe County, Ohio*

## **Data Processing**

The data recorded from a seismic survey is originally in its "raw" or "unprocessed" form. Before it can be used it must go through a series of computerized processes. These processes - filtering, stacking, migrating and other computer analysis, make the data useable and require powerful

computers and sophisticated computer programs. As computers have become more powerful and processing techniques more sophisticated, it has become common to re-process seismic data acquired in earlier years, creating new opportunities for exploration that could not originally be derived from the data. Processing of data can be very expensive and time-consuming, depending on the size of the area surveyed and the amount of data acquire. Processing of data from one survey may take six months or more and cost hundreds of thousands of dollars.

## **Data Interpretation**

Finally, the resulting processed data must be interpreted by the geophysicist or geologist. All seismic data is subject to interpretation, and no two experts will interpret data identically. Geology is still a subjective science. Although dry holes have been greatly reduced by 3D seismic technology, they have not been eliminated. The proper interpretation of 3D data is a critical step in the process.

## **References**

*Frequently Asked Questions*; Cougar Land Services, 2012.  
<http://www.cougarlandservices.net/faq.aspx>

*How do seismic surveys work?*; April 15, 2009. <http://www.oilandgaslawyerblog.com/seismic-surveys/>