

What is Seismic?

Geologists and geophysicists begin their search for natural gas by examining all available surface and subsurface information. This includes looking at local rock outcrops, examining drill cuttings from nearby wells, reviewing surface details and conducting seismic surveys.

A seismic survey gathers underground geologic information by transmitting acoustic (sound) waves into the earth and then recording the reflected signals that bounce back from underground layers and rock formations. The sound waves are generated by an energy source at the surface such as a blast from a small explosive in a shot hole, or vibrations generated from a convoy of “vibroseis” trucks. You may have seen these uniquely shaped trucks crawling along our local roads or in open fields. Every few feet they lower the truck’s track pad to the ground and vibrate precise sound patterns deep into the earth. At the surface, sensitive listening devices called “geophones” record the reflected signal waves. The geophones are connected by transmission cables to recording equipment located in nearby trucks.

Seismic data is a measurement of the time it takes the acoustic waves to be transmitted from the energy source to rock layers and back to the geophones located at the surface.

There are two types of seismic surveys that Fortuna Energy conducts:

2D survey — geophones are deployed in a single line.

- produces a flat, cross-sectional view into the earth along the seismic line.
- Helps to define regional geological structures.

3D survey — geophones are distributed in a grid pattern across a wide area, usually covering 20 to 30 square miles.

- more accurately positions subsurface geological features and prospective gas-bearing structures.

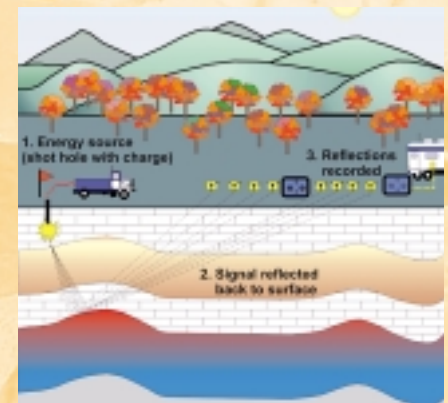
Surface Access for Seismic

All seismic fieldwork is performed in compliance with the most recent industry guidelines, government regulations and any landowner conditions. Environmentally responsible procedures are specified for farms, fields, forests, etc. An oil and gas lease or other approval is obtained from involved property owners for surface access and seismic operations on their land. The seismic crews are required to minimize the impact of their work and to cleanup as they go.

Due to our local terrain and widespread forested areas, helicopters are sometimes used to deploy cabling, recording equipment and drills. This reduces the time, cost and possible surface damage. The terrain type, operational conditions and regulations dictate the type of equipment and methods that will be used to set up and conduct the seismic surveys.



Seismic transmission cables and trucks



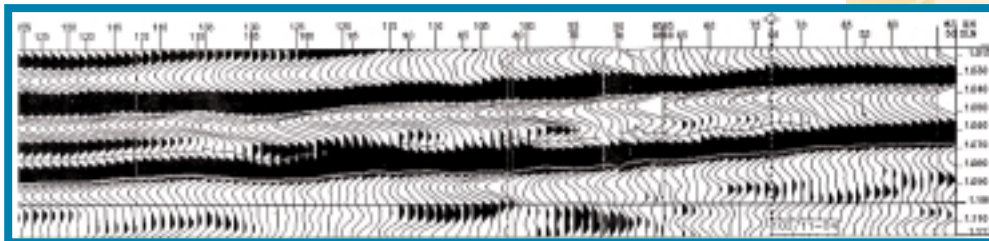
2D seismic line

Steps to Conducting a Seismic Survey

1. Geophysicists design the survey, a plan is drawn up, and a seismic firm is contracted to conduct the survey.
2. Verification is made that we have a lease or access approval for all properties that we will need to enter.
3. Local regulatory permits are applied for; no activity is conducted until all permissions and permits are in hand.
4. All utility lines (buried and surface) are located and avoided.
5. Sometimes brush cutting and/or snowplowing is required to facilitate access.
6. The seismic line is established, adhering to all permit conditions. The line is marked with survey stakes, position signs, and flagged arrows to show access routes.
7. Numbered and color-coded pin flags are placed to indicate specific locations for geophones or source points for charges. In order to comply with exploration regulations and prevent any possible damage, all source points must be offset from obstacles or structures.
8. The seismic line will be surveyed to provide accurate coordinates and elevations to be used for calculations at each source point. GPS (Global Positioning System) instrumentation is replacing conventional surveys for obtaining this data.
9. When explosive charges are the energy source, shot holes are drilled. In areas where drilling may be difficult, patterns of two to five shallow holes containing smaller charges may replace a single deeper hole.
10. The recording equipment (cable, geophones and recording devices) is normally delivered by truck, but sometimes is deployed by helicopter.
11. The seismic data is recorded.
12. Upon completion, the site is cleared of all traces of the seismic activity.



Seismic crew



Understanding Seismic

Seismic surveys are an important tool for identifying subsurface rocks of different thickness and hardness, as well as places where the geological formations are folded or faulted into possible natural gas traps. Geophysicists can identify the structure, outline, thickness and depth of the formation by interpreting the seismic section. However, because there is considerable risk and uncertainty in these interpretations, the decisions of where to drill a well will sometimes still result in a dry hole.

For further information, please access our website at www.fortunaenergy.com or contact our information desk at 607-795-2780
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