KMS Technologies – KJT Enterprises Inc.

Presentation

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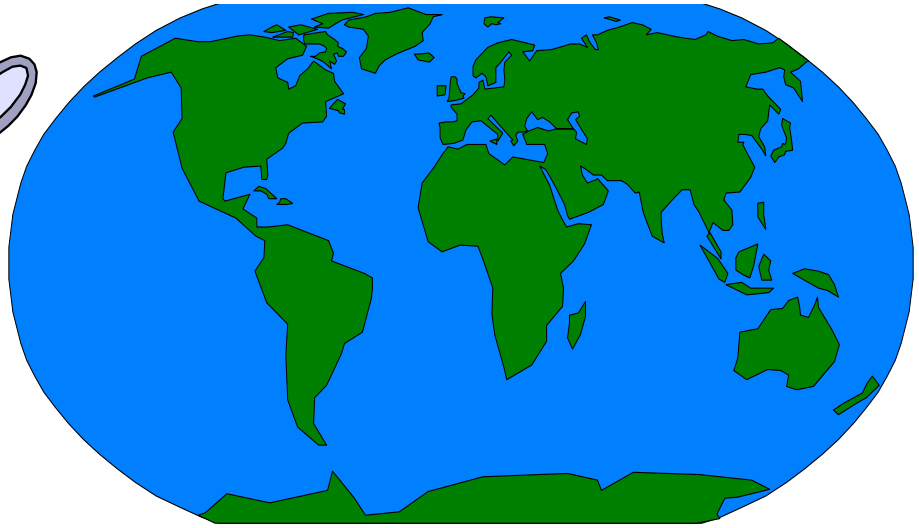
Translated by Kurt M. Strack

1992

Exploring the Earth with Geophysics

Society of Exploration Geophysicists

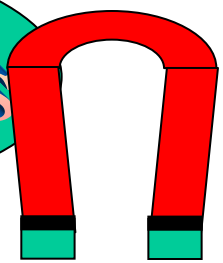
Exploring the Earth with Geophysics!



The Tools We Use

Gravity

Magnetics



Sound Waves

Electricity

The "Gravity" of the Situation!

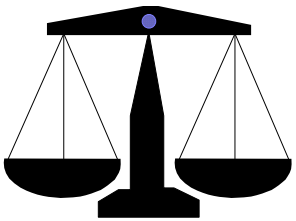


Figure courtesy of Lacoste-Romberg

In gravity prospecting, we measure very small variations in the force of gravity from rocks within the earth. Different types of rocks have different densities, and the dense rocks have the greater gravitational attraction.

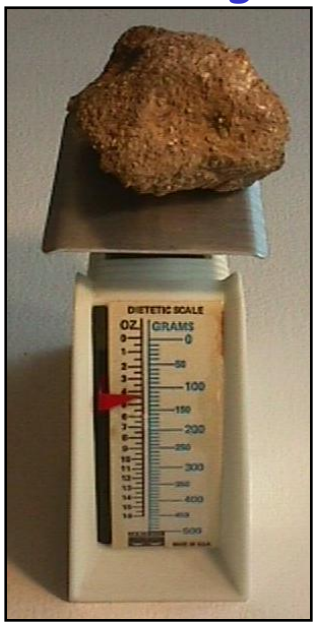
To the left is a "gravimeter" which measures the force of gravity in the earth.

A Fun Experiment You Can Do!

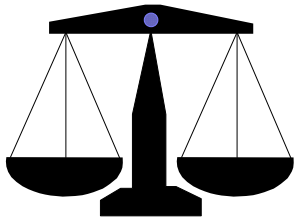
With a small kitchen scale, measure the weight of different rocks you find in your area. The heavier rocks have a greater gravitational pull than lightweight rocks.

Pyrite is a heavy rock

Sandstone is a lighter rock



Did you know … In oil exploration, we measure changes in gravity that may be only one-millionth or even one-ten millionth of the earth's total gravity field.



Magnetic Rocks

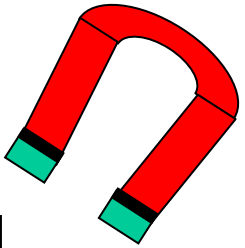
Figure courtesy of Scintrex, Ltd.

In Magnetic prospecting we look for variations in the magnetic field of the earth. The magnetic field of sedimentary rocks is usually much smaller than igneous or metamorphic rocks. This let's us measure the thickness of the sedimentary section of the earth's crust.

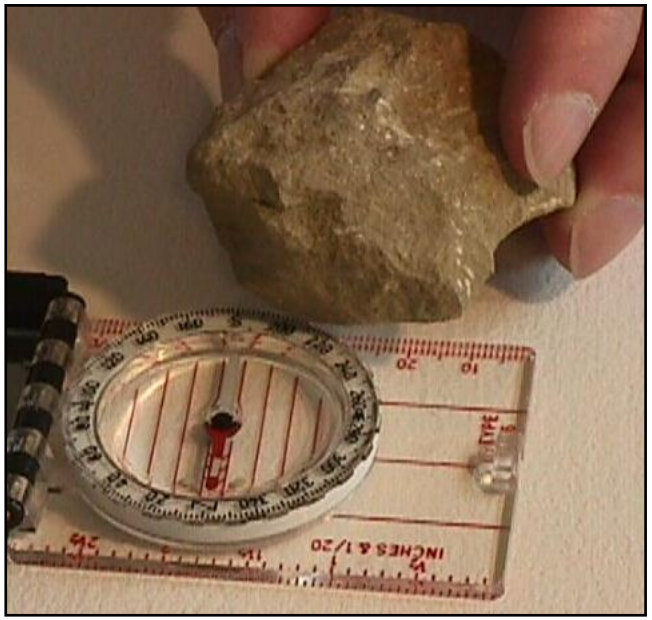
The instrument to the left is a "magnetometer" which let's us measure the magnetic field of the earth.

A Fun Experiment You Can Do!

Many rocks such as magnetite are naturally magnetic. Compare a piece of magnetite with a piece of sandstone by holding a compass near each rock. Does the compass behave the same?



Magnetite

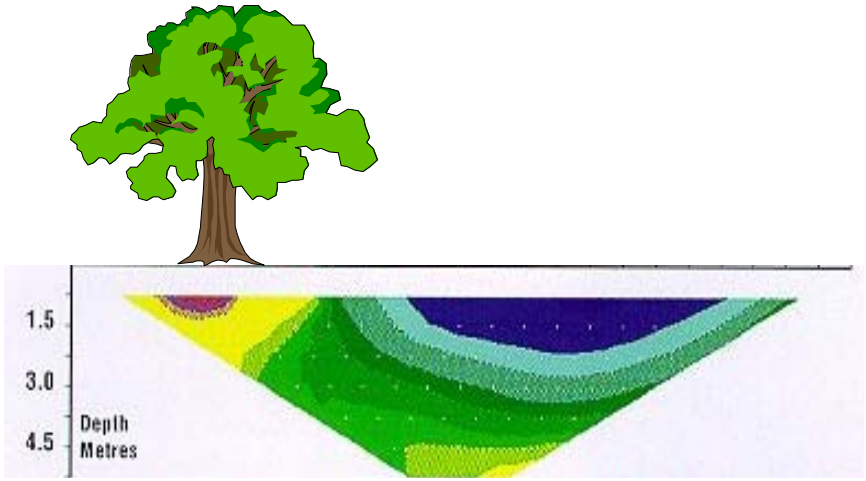


Sandstone

Electricity and Rocks

All rocks conduct electricity to varying degrees.
The resistance to electrical current flow is called "resistivity".
Resistance is measured using electrodes that are implanted in the earth. Resistivity surveys are commonly used for groundwater studies.

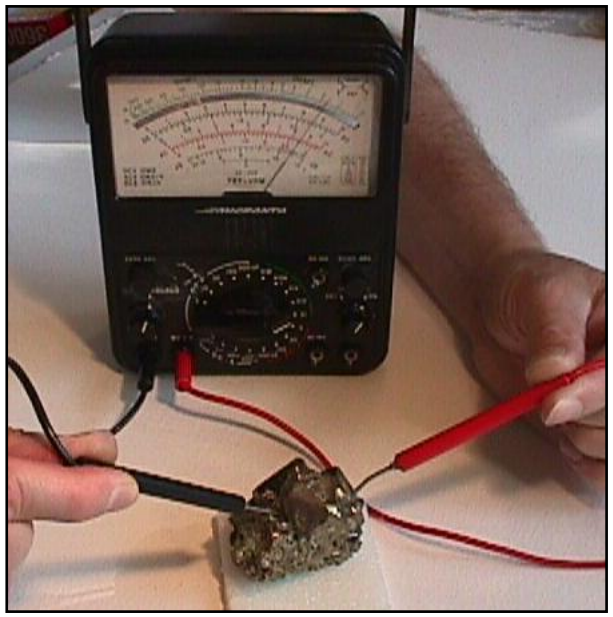
Figures courtesy of Scintrex, Ltd.



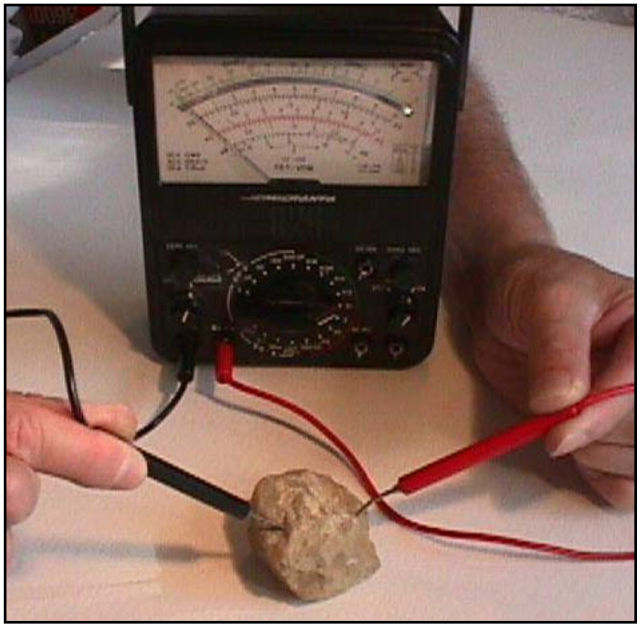
Fresh water is resistive,
brackish water is conductive.

A Fun Experiment You Can Do!

With an Ohmmeter, check the resistance of different rocks in your area. Do you find that some rocks are more "resistive" than others?

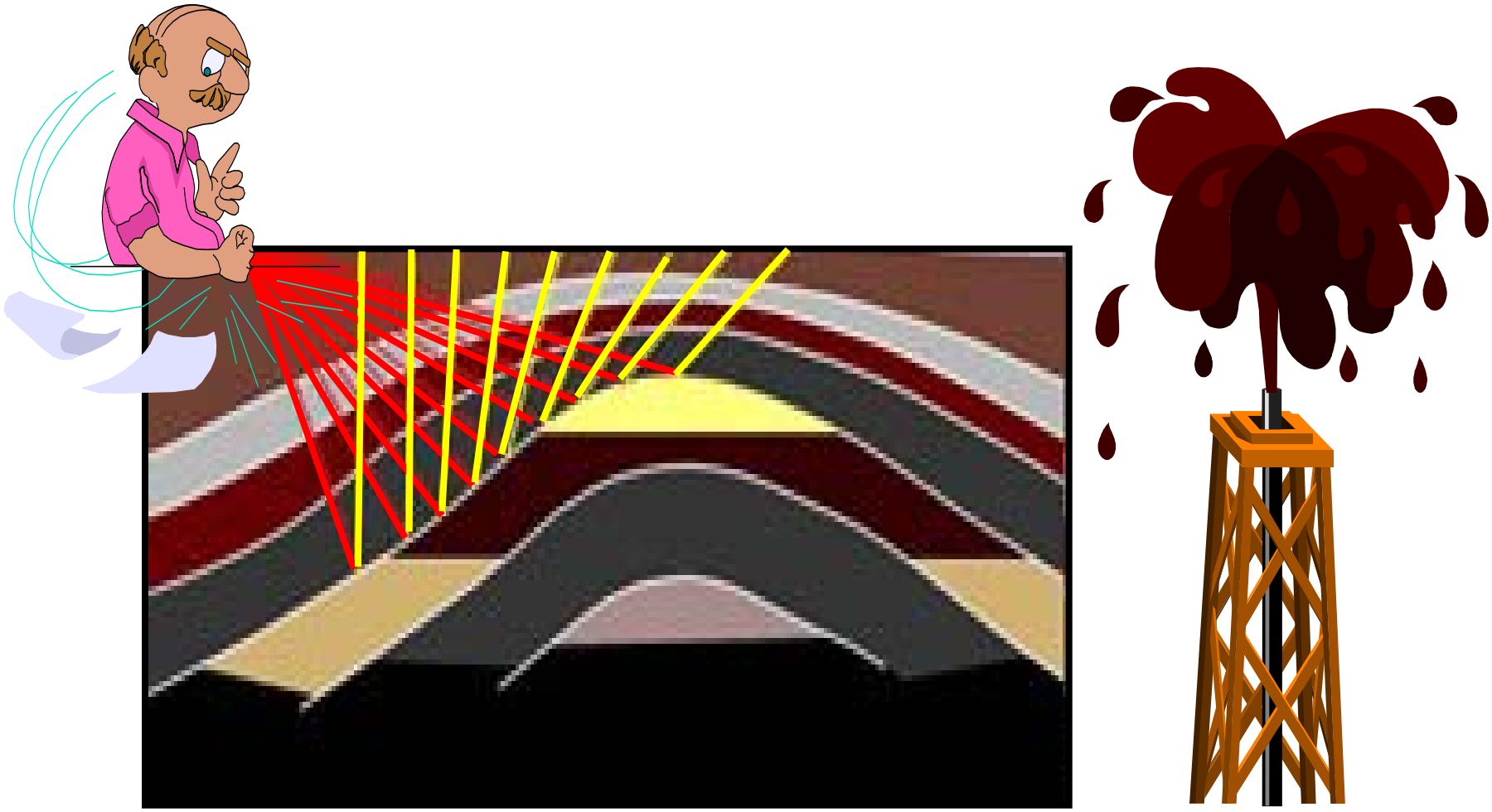


Pyrite has little resistance. It conducts electricity easily.

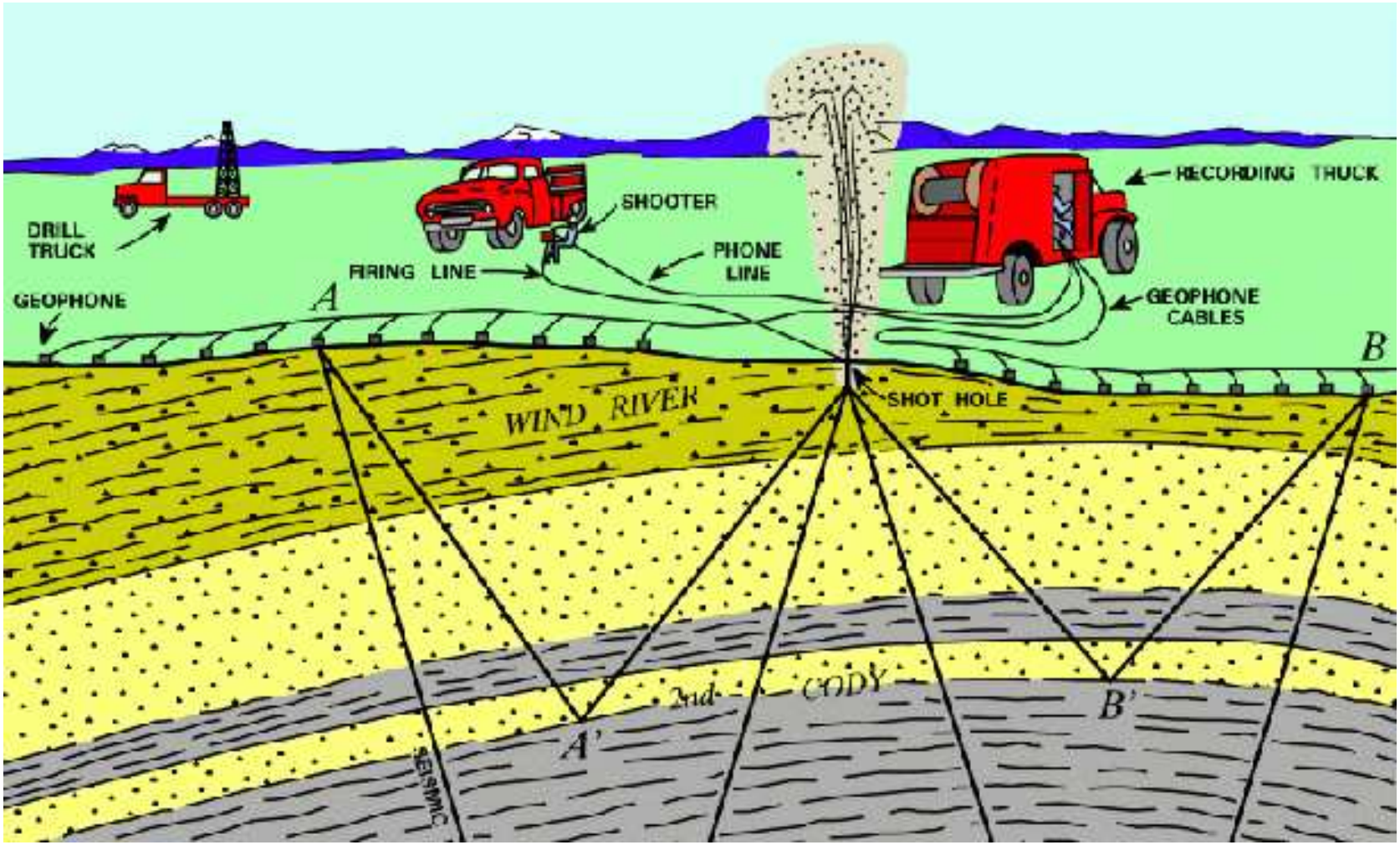


Sandstone is very resistive. It does not conduct electricity very easily.

Using Sound Waves to Find Oil

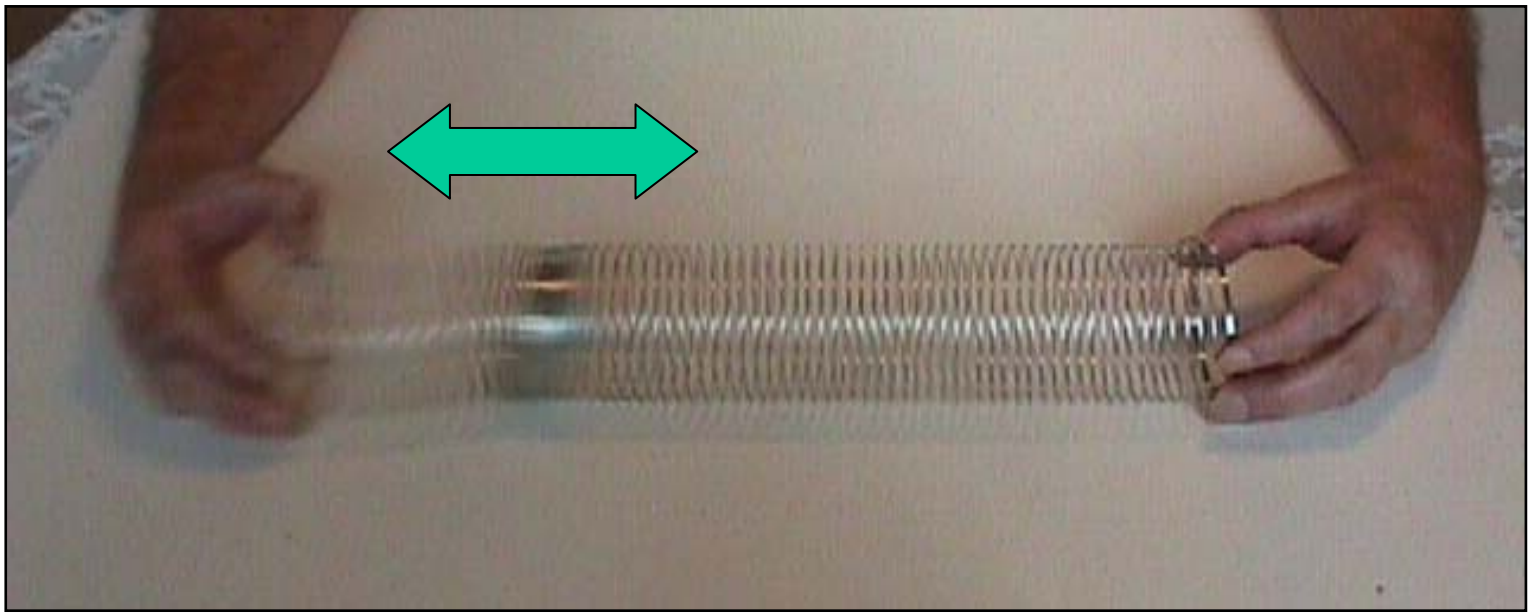


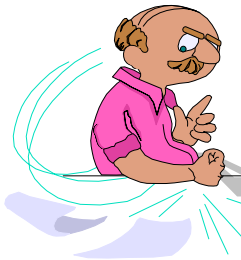
Sound Waves Can Help us See Inside the Earth
Like a Flashlight Can Help us See in the Dark



A Fun Experiment You Can Do!

Hold a slinky tightly in one hand and give a quick jerk of the slinky in the other hand in the direction of the arrow below. Watch the "Slinky Wave" travel down the slinky and then bounce (or reflect) off the other hand.

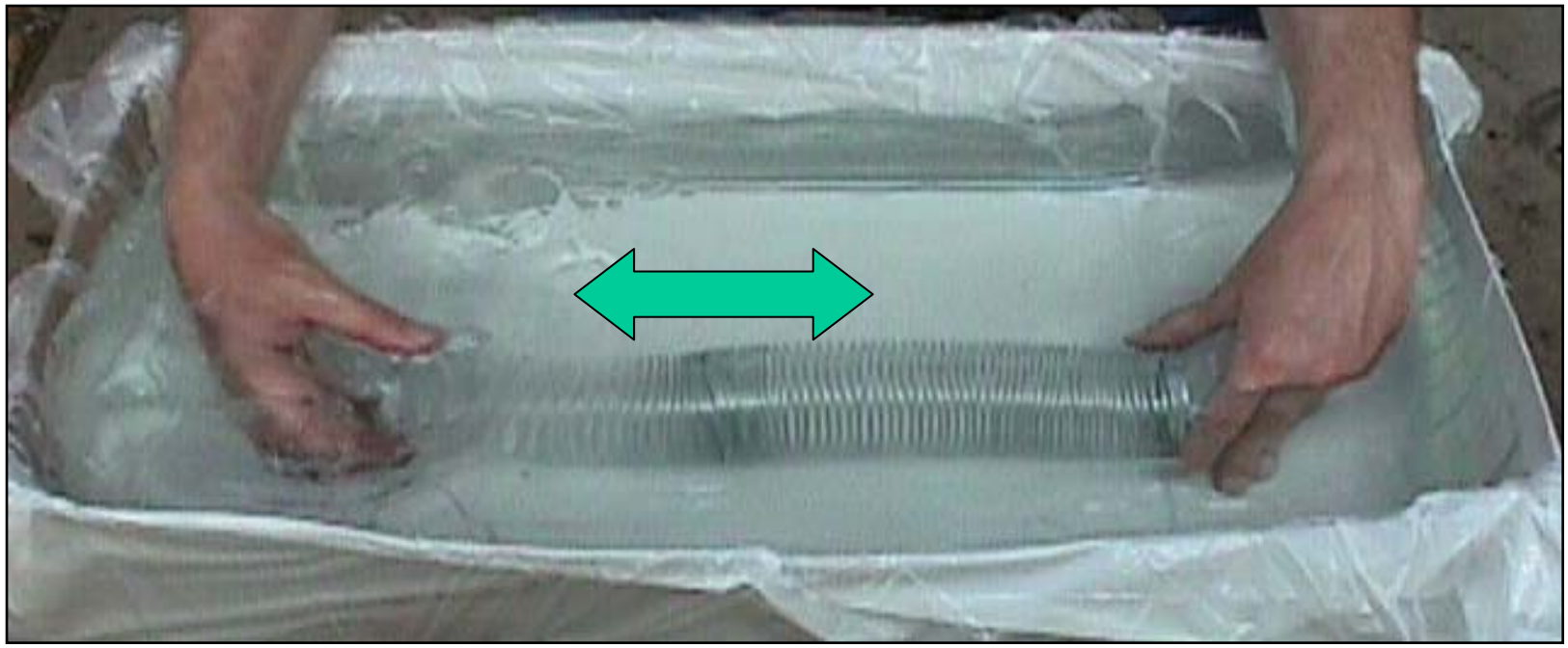




A Fun Experiment You Can Do!

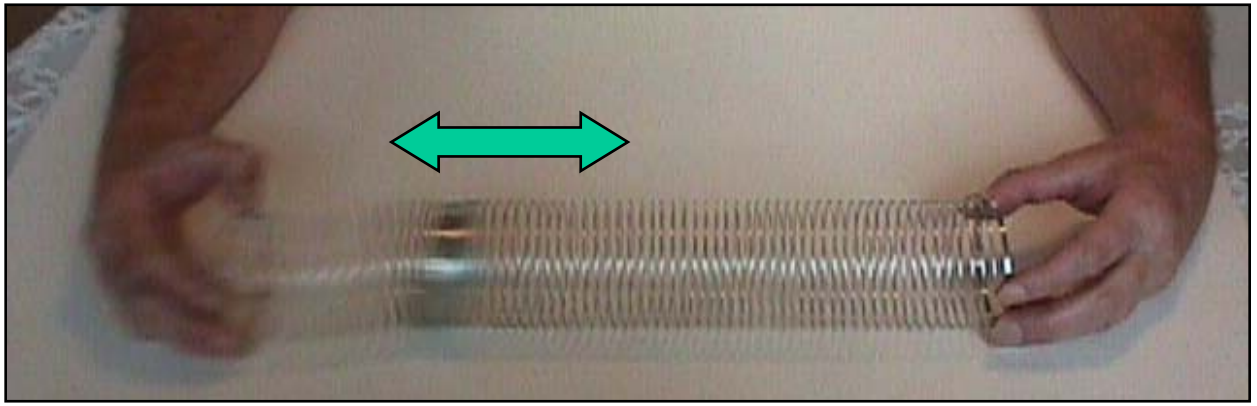
Now do the same experiment in a pan of water.
What is different? Does the Slinky Wave move slower?

Sound waves travel at different speeds in different kinds of rocks. By estimating the speed of sound waves, we can get a clue about the type of rocks they pass through.

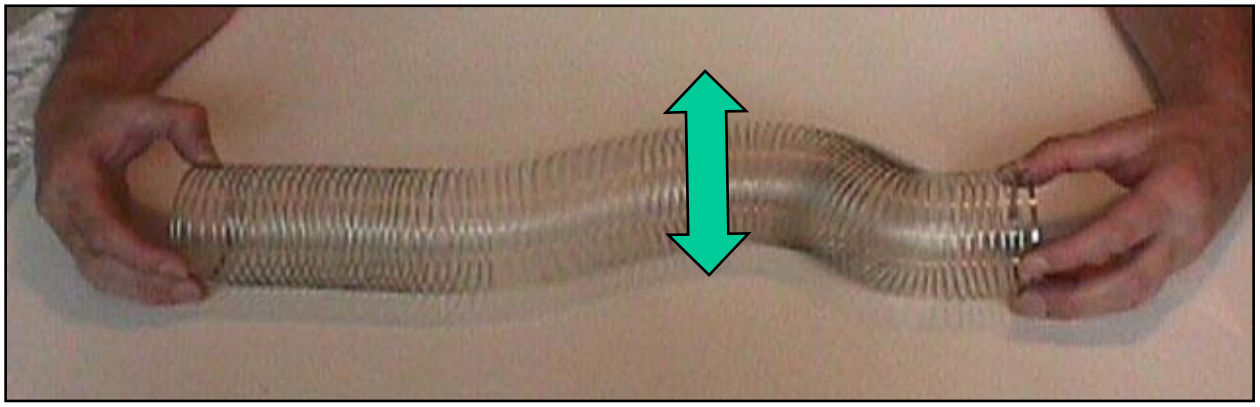


A Fun Experiment You Can Do!

Compressional, or P-Waves, vibrate in the direction they travel



Shear, or S-Waves, vibrate in the opposite direction they travel



We "listen" to sound waves using a geophone

A Geophone records SEISMIC energy like a microphone records music

A "Jughustler" plants the geophones on the ground

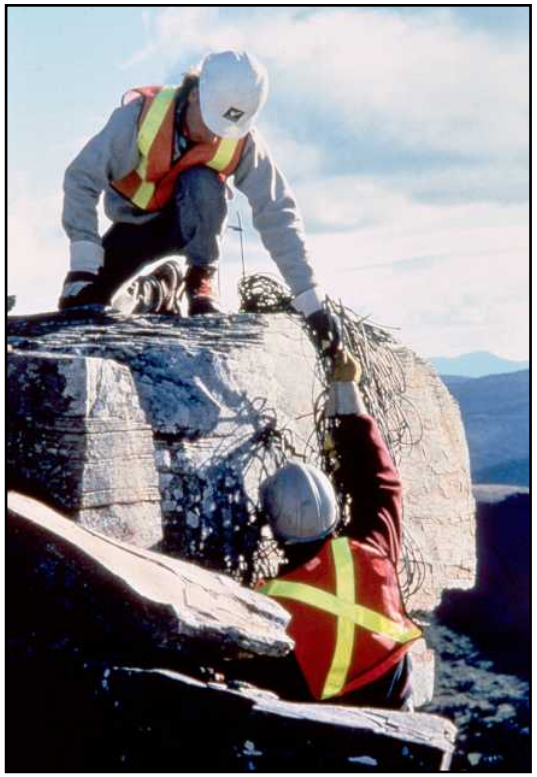
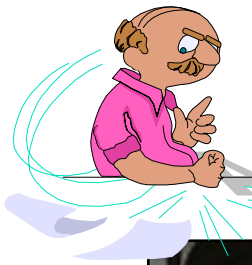


Figure courtesy of Brian Russell



A Fun Experiment You Can Do!

Try hooking up a geophone to a voltmeter, and then tap the geophone lightly.

Do you see the needle on the Voltmeter bounce?

A geophone converts vibrations into electrical energy.

Vibrators Shake the Earth

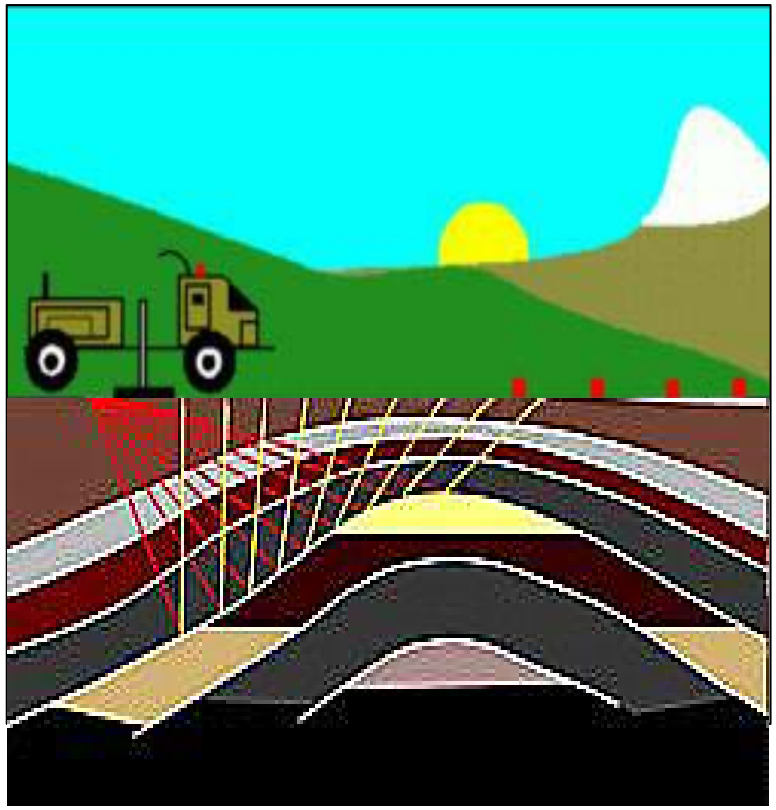


Figure courtesy of Industrial Vehicles

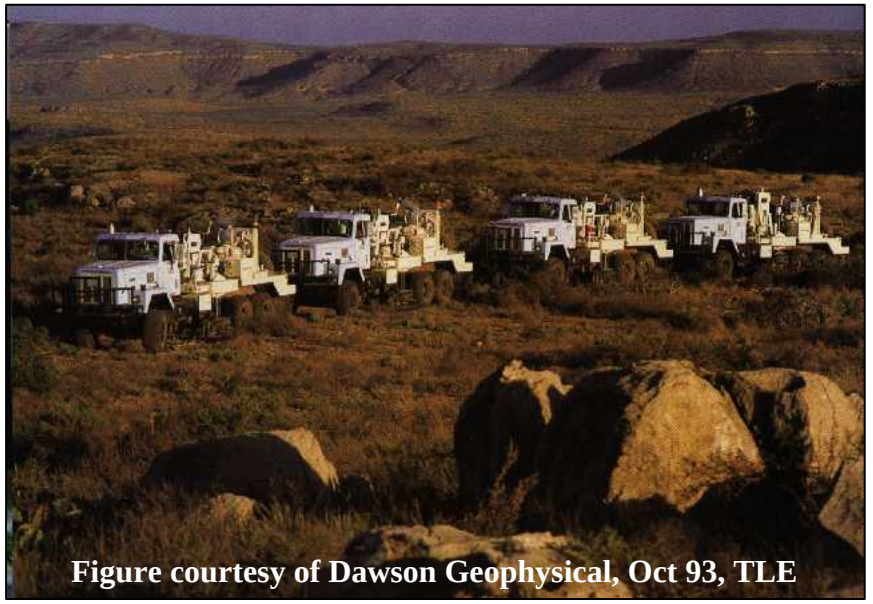


Figure courtesy of Dawson Geophysical, Oct 93, TLE

Signals from the geophones go into the "Doghouse" where they are recorded on magnetic tape

Figures courtesy of Brian Russell

We can even record seismic data in the ocean!

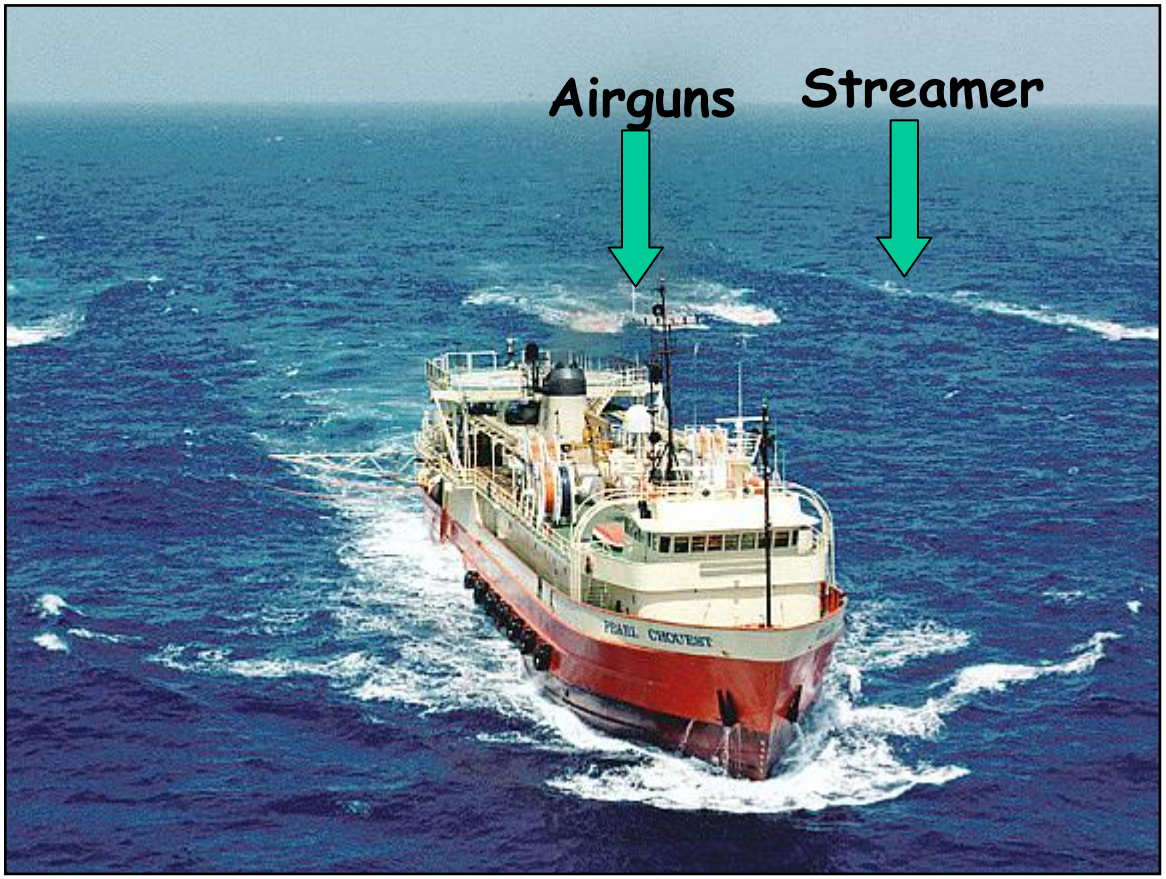
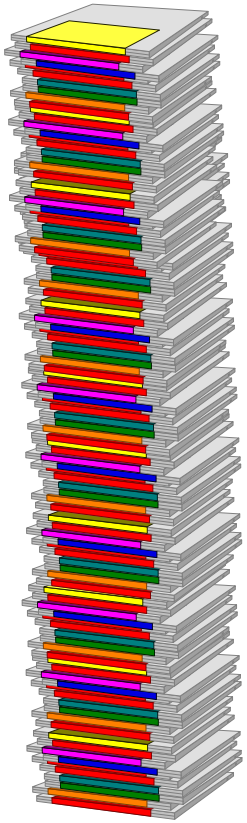


Figure courtesy of Veritas

For offshore surveys the seismic sensors are installed in long streamers behind a boat. Airguns serve as the energy source.

Seismic surveys generate lots of data!

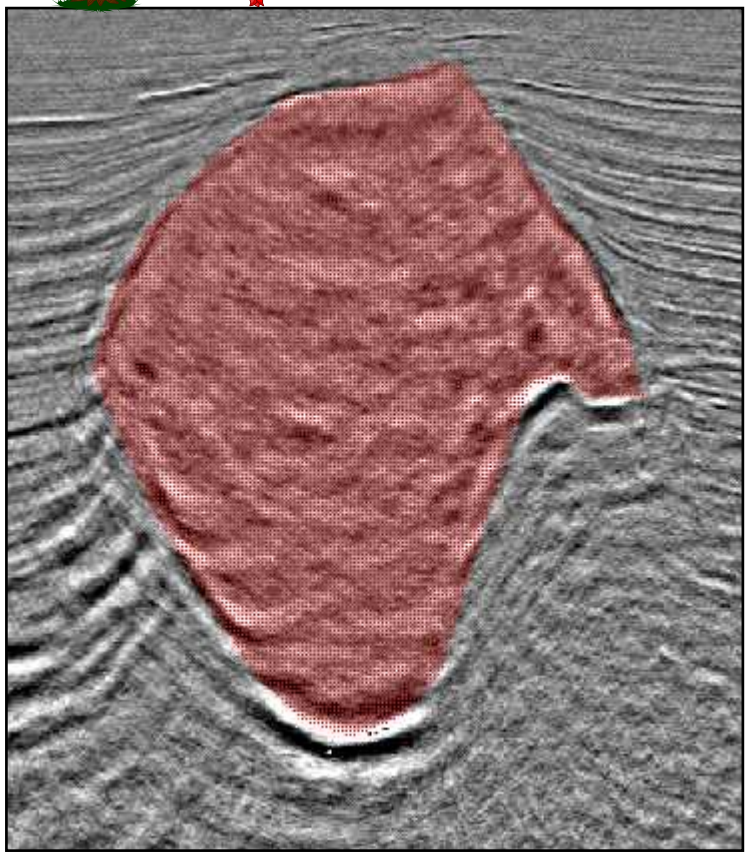
200,000,000,000 Bytes



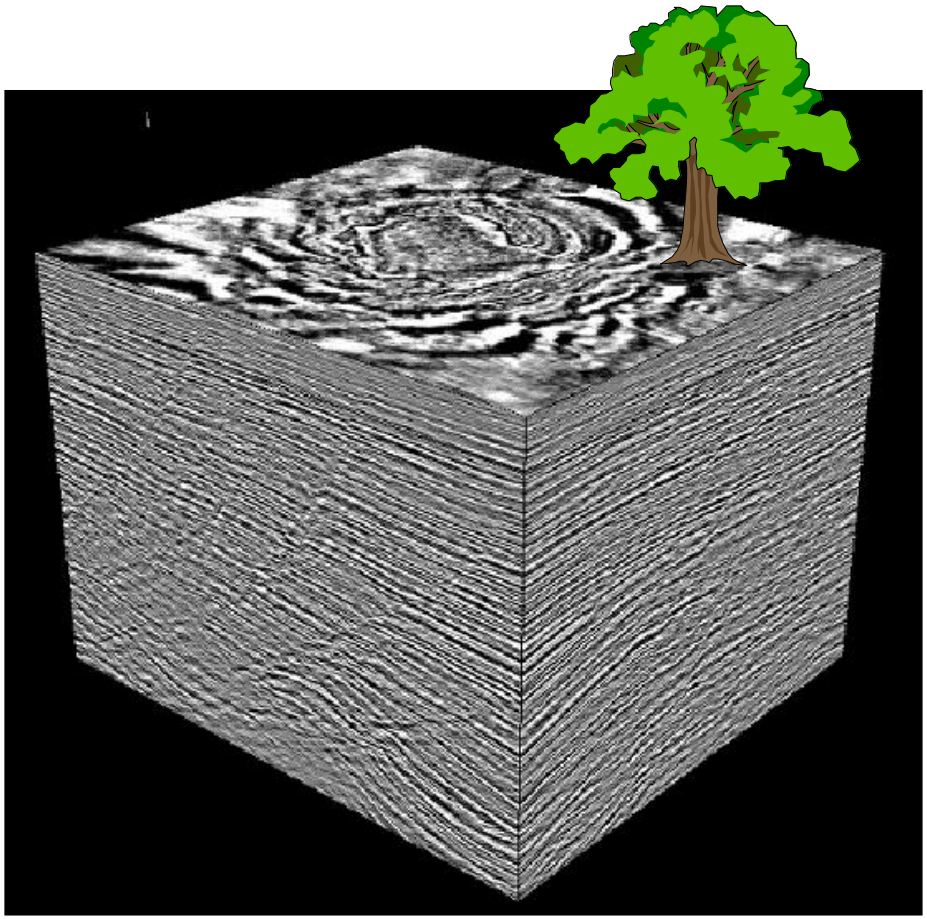
Stack of
133,000
Diskettes

If you put all the data created by a small 3D seismic survey on 3-1/2" diskettes, and you stacked the diskettes in one single pile, the pile would be higher than the Empire States Building in New York City!!

Seismic data looks like an "Xray" image of the Earth



2D Seismic Data



3D Seismic Data

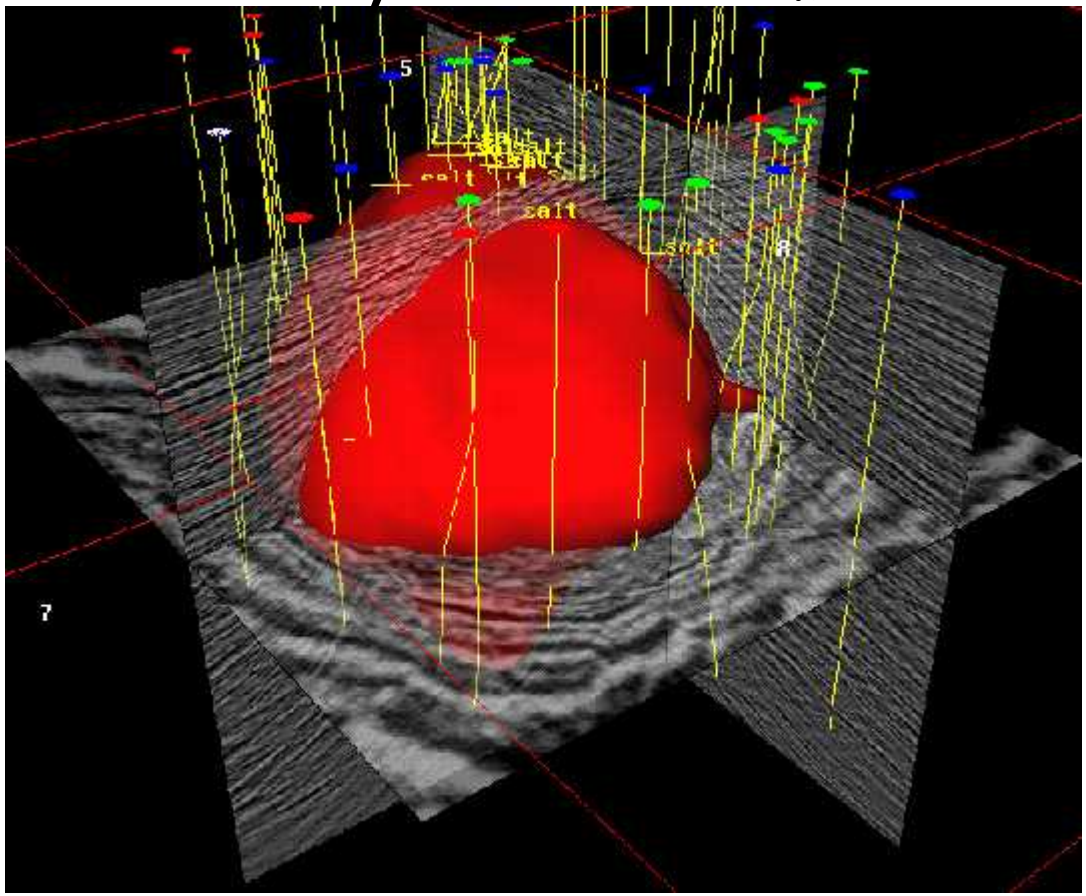
Figures courtesy of Phillips Petroleum Co.

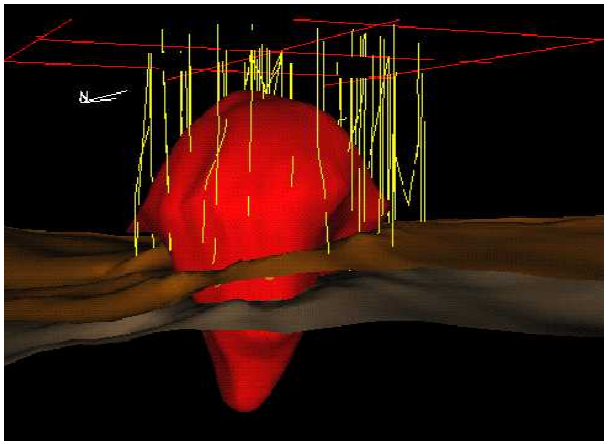
An "Interpreter" studies the seismic data to learn about the shape and kind of rocks and where to drill an oil well

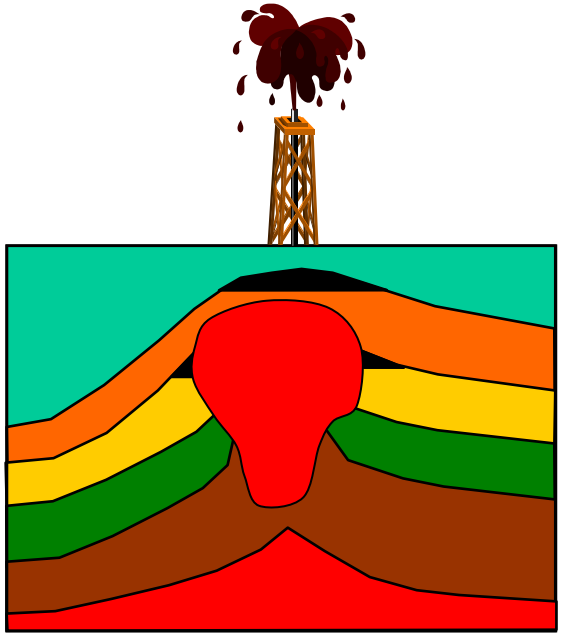
Figure courtesy of Brian Russell

Here seismic data has found a huge salt body in the Gulf of Mexico

This salt body is over three miles wide!







Figures courtesy of Phillips Petroleum Co.

If you like math and science

can be a geophysicist, too!

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