High Lava Plains Seismic Experiment

Earthquakes & Volcanoes in Our Backyard

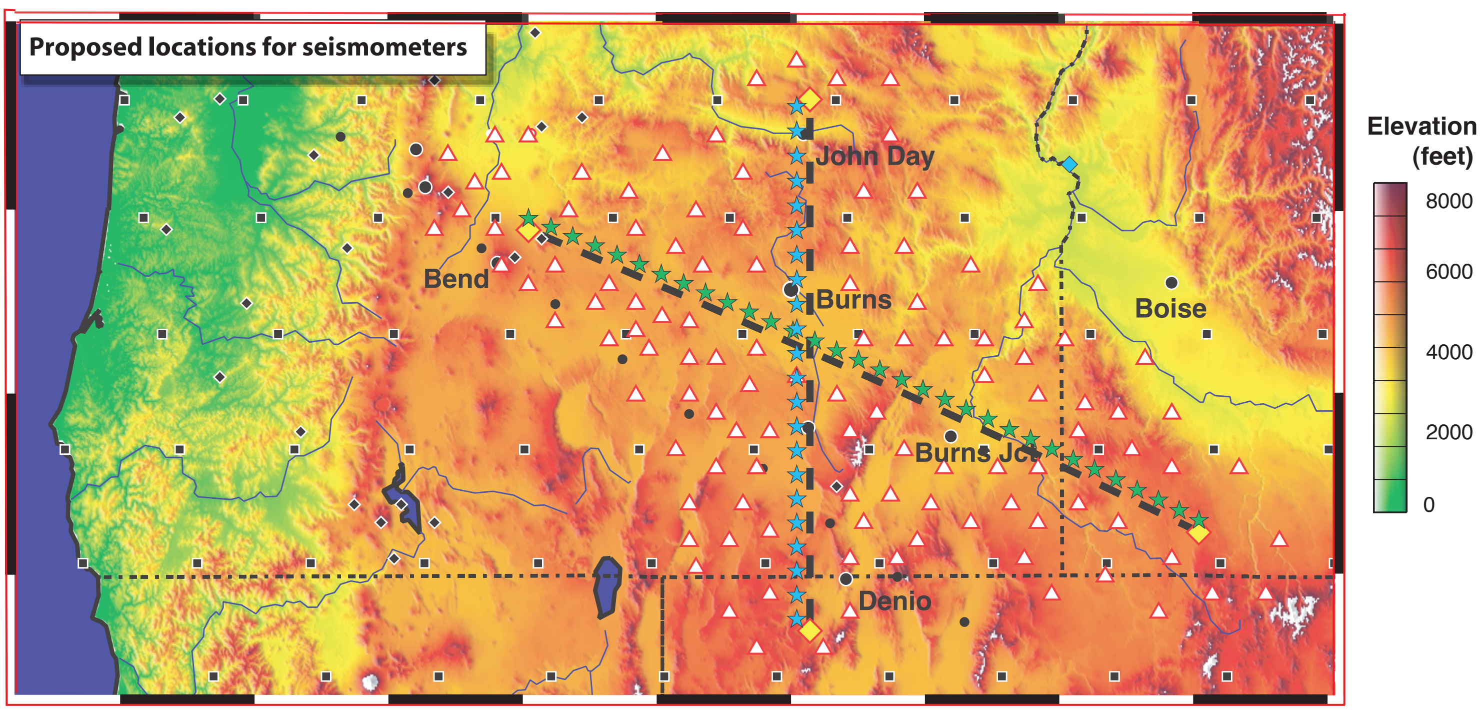
A major geologic investigation to examine the crust and deep layers of the earth to understand why the High Lava Plains was a focus for voluminous volcanism.

During the spring of 2006 teams of seismologists, geologists, and college students will begin setting up a wide network of seismometers that extend from Bend to western Idaho. This will be the biggest grid of this type ever set up in the world. It is part of a 3-year scientific study to examine the crust and the deeper layers beneath the region.

Why are they doing this? This area is covered with lava and ash-flows that represent an enormous outpouring from many widely spaced volcanoes. The rock layers were later broken up by countless earthquakes as the land rose and fell, producing both the Steens Mountain escarpment and the linear cliffs that stretch between Burns and Bend. Scientists wish to understand connection between surface geology and structures 100's of miles beneath the surface.

What does the network do? The portable seismic monitoring systems are capable of detecting extremely small movements of the earth generated by both distant earthquakes and by the small earthquakes that occur in Eastern Oregon but are too small to be felt by seismometers located elsewhere. The seismic stations will remain in place for 1 to 2 years and will record ground motion continuously during that time. Unless problems are detected with the equipment, instruments will be checked and the data collected every two to six months during the time they are in the ground.

Typical finished installation with an approximately 3-ft-long solar panel and a "doghouse"—a plastic-covered "Tuffbox" or other cooler-size container—that houses the electronic recording equipment. The seismometer is placed below ground in a tightly sealed 30-gallon drum that sits atop a thin layer of concrete. The top of the drum is slightly below ground level. Cables that run from the seismometer to the recording unit are fed out of the drum via PVC pipe installed through a watertight coupling in the top of the drum. The doghouse will be installed slightly above ground for access during servicing visits (See also photos next page for installation procedures.)

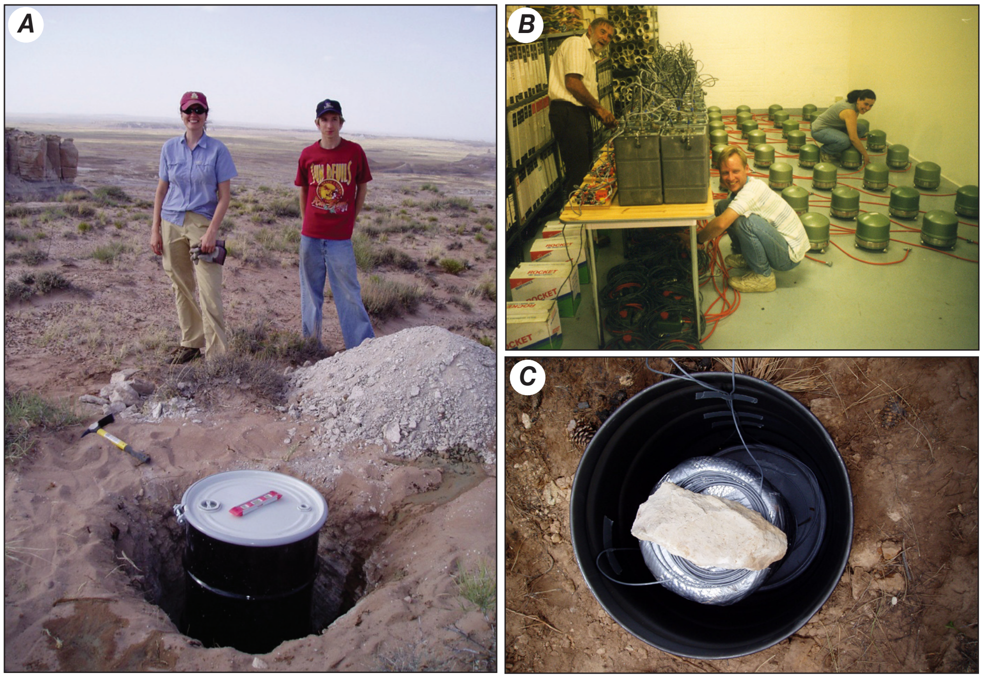


1st telemetered* array; to be set Summer 2007

2nd telemetered* array; to be set Summer 2008

△ Long-term seismometers, in for ~18 months; to be installed 2006 and 2007.

*Telemetered: Seismic recordings at each station are transmitted via radio to a central observing site.



Getting equipment ready:

(***A***) 30-gallon drum set in hole. The ideal site has 3 feet of soil above solid bedrock.

(***B***) Preparation for field installation includes a comprehensive “huddle” test where all of the equipment is operated for a period of one to two days to assure that it has survived the journey.

(***C***) Seismic sensor in drum with rock on top. Once the sensor is oriented correctly (within 1-2° of true north, not magnetic north) and leveled, a close-fitting insulating container is placed over it to help minimize rapid temperature swings in the vault. The rock is on top of the insulating container to hold it down.

Field Installations

The signals received from distant earthquakes are extremely faint, therefore stations need to be placed as far from “cultural” noise (traffic, railroads, farm equipment, etc.) as possible. We also look for sites where the seismometer can be placed directly on bedrock, preferably with about 3 feet of soil cover, and where there is little danger of flooding or groundwater infiltration. It is important that the whole vault assembly be watertight. To protect against vandalism, sites away from view of traffic are preferred.

Telemetered Arrays

In addition to the stand-alone stations (△ on map), two high-density telemetered arrays (★ and ★ lines on map) with ~10-km station spacing will extend in relatively N-S and NW-SE lines across the region. That system consists of 32 real-time telemetered seismic stations that transmit by line-of-site radio to a central recording site from which the data are retransmitted via internet to the computers in our home labs. The advantage of a telemetered system is that the data are viewed in real time and the stations never require servicing unless we see problems in the data. The NW-SE array (green stars) will be installed first. Active source lines (dashed line) involve several thousand small “geophones” that will be in the ground for 2 weeks in summer 2008. Borehole explosions will be fired along those lines. The blasts do not disturb the ground surface.

Seismic Imaging

Seismic imaging uses seismic waves to probe the earth beneath the stations. One method, called seismic “tomography”, is like a CAT scan of the human body. This is used to determine the hidden structures deep in the earth’s crust. Seismologists also use methods very similar to those used in oil and gas exploration that, together with tomography, will give a comprehensive picture of the earth’s structure beneath central and eastern Oregon, western Idaho, and northern Nevada.

Data Acquisition

The electronic recording equipment is housed in the doghouse (described with photo, opposite page). The data are written to a swappable hard drive or to memory cards (as used in digital cameras, for example) with several months recording capacity. A GPS antenna, mounted with a good view of the sky, feeds signals that provide millisecond timing accuracy to the recording unit, as well as accurate station coordinates. Once installed, the stations are serviced at 2 to 6 month intervals and memory disks are swapped out and returned to the service center in Burns for copying.

When will all of this take place?

Siting, permitting, and data collection/reduction take time!

- First stations will be in ground Spring 2006
- First data returned Summer 2006
- First telemetered array will be installed 2007
- Second telemetered array will be installed 2008
- Data from active lines will be collected in 2008

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