

Hosting Geophysical Instruments for EarthScope Experiments

EarthScope, a university research program funded by the National Science Foundation, is currently deploying thousands of geophysical instruments across the United States to explore the structure and evolution of the North American continent and to understand the processes controlling earthquakes and volcanoes. The USArray component of EarthScope uses seismometers to record earthquakes and magnetotelluric instruments to record naturally occurring variations in earth's magnetic field. Researchers can then apply mathematical models to the recorded data to develop images of earth's interior.

To collect data for this research, EarthScope staff and university researchers seek sites on private and public lands to temporarily install their instruments. The experiments the scientists are conducting fall into one of three categories: the Transportable Array, the Flexible Array and the Magnetotelluric Transportable Array. Each experiment requires a separate permit with requirements specific to the type of instrument being sited and the length of time the instrument remains in place. In all cases, the host is not liable for any loss of or damage to the instrument on their property. Because of the different criteria for each experiment, siting more than one type of instrument on the same property is rare.

Transportable Array

The Transportable Array consists of 400 portable seismometers spaced 70 kilometers apart that will leapfrog across the United States from west to east over a 10-year period. By the end of the project, 1600 sites will have been occupied. The seismometers are extremely sensitive and record local, regional and worldwide earthquakes. Researchers use the spatial distribution of these earthquake recordings to image the interior of the earth.

The housing for the seismometer requires a plastic tube placed inside a hole four feet wide and seven feet deep. Concrete is poured into the bottom to make a sealed container. About 20 feet from the vault, crews install a solar panel mounted to a pole. After about two years, the equipment is removed and the site is restored.



Flexible Array

The Flexible Array consists of groups of 50 to 150 seismometers deployed in dense arrays by university researchers and students. The objective of most Flexible Array experiments is to develop higher-resolution images of the crust and mantle in a specific region than can be obtained using Transportable Array data. Other Flexible Array experiments try to locate specific fault surfaces or portions of tectonic plates that are descending beneath earth's crust.

There are several different types of seismometers in the Flexible Array pool. Some instruments can be placed directly on the ground surface, while others require a temporary vault that fits into a three-foot deep hole. Some sites require installation of a solar panel affixed to a pole. The length of time the Flexible Array instruments remain in place depends on the type of seismometer being used for the project and ranges from as short as a day to as long as two years.



Magnetotelluric Transportable Array

The Magnetotelluric Transportable Array consists of 20 magnetotelluric stations that are being deployed in footprints of about 100 locations over the course of several months. Like the seismic Transportable Array, these instruments are spaced 70 kilometers apart. However, the Magnetotelluric Transportable Array stations are placed in specific regions of interest to researchers instead of being deployed in a uniform rolling grid. Magnetotelluric stations record electrical currents in the earth to image its interior.

The electronics for the magnetotelluric stations are buried three feet below ground in five separate holes that are a foot in diameter. Two 300-foot cables extend north-south and east-west from the sensor. Each station remains in place for less than a month, during which time no maintenance is required. After a month, crews remove the equipment and fill in the holes.

