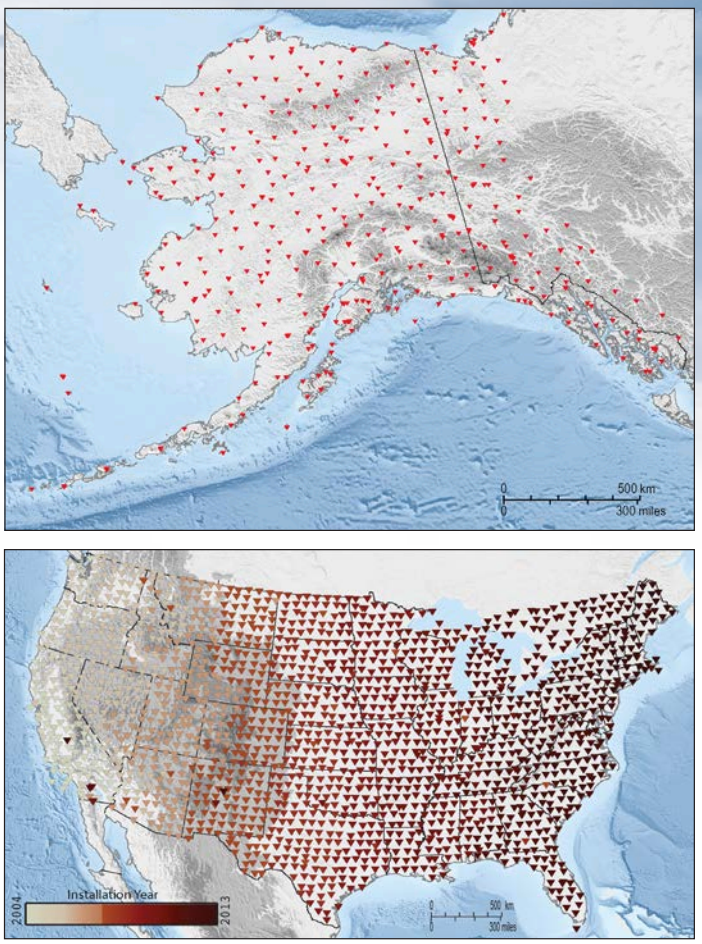
From Crust to Core: EarthScope comes to Alaska

What is EarthScope?

EarthScope is a community of scientists that conducts research using data from instruments that measure motions of Earth's surface and record seismic waves. The National Science Foundation provides funding for EarthScope, observing facilities like USArray and the Plate Boundary Observatory, as well as for individual researchers to conduct their own field experiments or perform unique analysis of the facility data.

Since 2003, USArray has installed a network of seismometers known as the Transportable Array across the Lower 48 and southern Canada. USArray has 400 high-quality, portable seismic stations that are placed in temporary sites across the United States in a rolling fashion from west to east. Unless adopted and made into a permanent installation, after 18 to 24 months, each USArray instrument is picked up and moved to the next carefully spaced array location. When completed, more than 2,000 locations will have been occupied during the program. The earthquake data gathered from these sites are analyzed to produce high-resolution images of Earth's interior and to understand the origin and characteristics of earthquakes and earthquake faults.

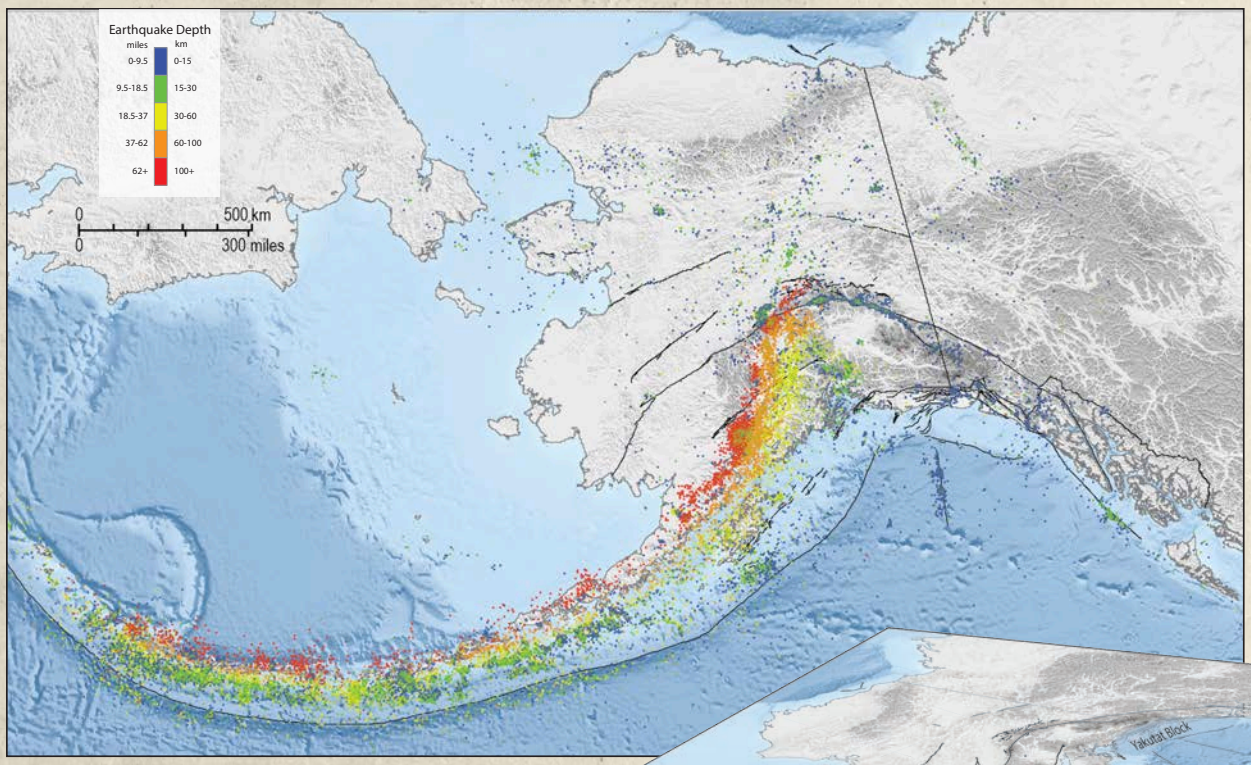


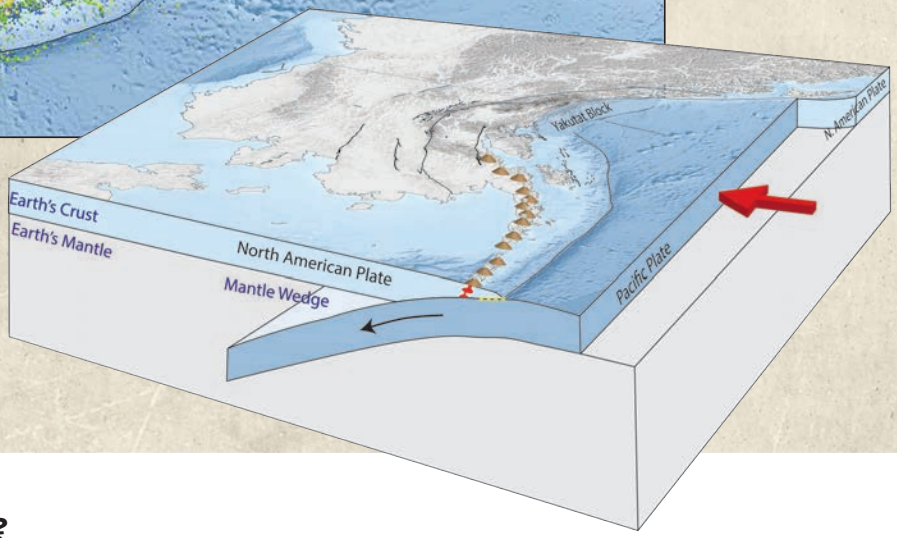
The maps above show the location of the Transportable Array sites proposed for Alaska and those already installed in the Lower 48 (shaded by install year).

Across North America, the PBO operates permanent GPS stations, borehole seismometers, strainmeters and more to measure deformations and motions of North America's crust. In 2004, PBO began installing instruments in Alaska to measure motions and deformations of crust and volcanoes. Currently, PBO operates 138 GPS and 12 tiltmeter continuously operating permanent stations throughout Alaska.

What is EarthScope's plan for Alaska?

Beginning in 2013, EarthScope is placing temporary seismic sensors in approximately 300 locations in Alaska and western Canada. This process will take three to five years to complete. A station spacing of 50 miles will enable scientists to gain new insight into the earthquake process and generate 3-D images of Earth from crust to core. These station locations will supplement the existing coverage of permanent seismic and GPS stations.





The map above shows the distribution of earthquakes with magnitude greater than 3.0 colored based on depth.

At right is a 3-D view of Alaska's tectonics. The Pacific Plate subducts beneath the North American Plate under Alaska. Along the boundary between these two plates large magnitude earthquakes and volcanoes occur.

Why is Alaska of interest to EarthScope?

Alaska is a geoscience frontier with enormous areas that have yet to be investigated. The tens of thousands of earthquakes that occur yearly in Alaska provide a remarkable dataset to study the crustal structure, volcanic centers and major fault systems throughout the region.

How will installation in Alaska be different than in the Lower 48?

The vast, complex terrain of Alaska makes the installation of seismic stations more challenging. The lack of roads throughout most of Alaska is an obstacle that will be overcome with the use of helicopters. However, the pattern of marching sites across Alaska, as was done in the Lower 48, will not be replicated. Instead, sites will migrate out from logistical hubs.

Weather, permafrost, limited direct sunlight for much of the year, and Alaska's curious wildlife will influence Transportable Array station design, installation and maintenance.

How is the Transportable Array different from what the Alaska Earthquake Center currently operates within Alaska?

The Alaska Earthquake Center and its partners operate more than 400 seismic stations, concentrated in areas of greatest seismic hazard. The center is charged by the state with providing rapid authoritative information about earthquakes occurring in Alaska. Real-time data collecting and processing support the Alaska Earthquake Center's mission to inform the public, state and federal agencies of significant earthquakes.

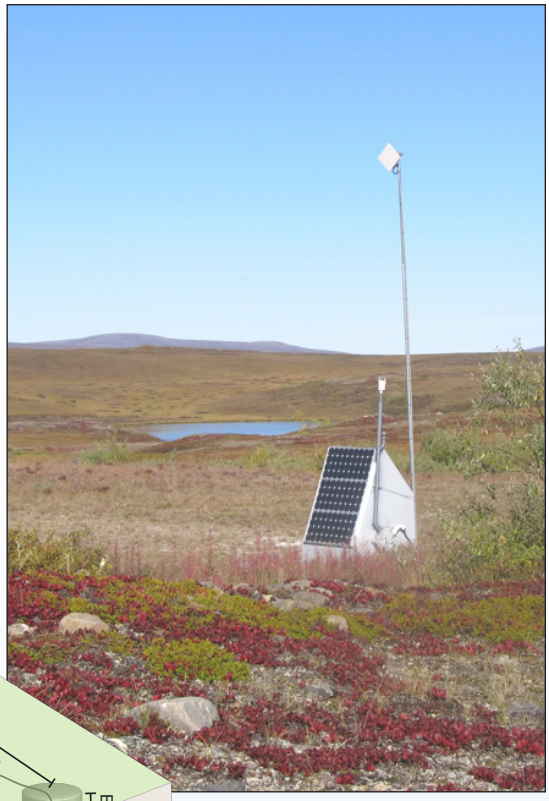
EarthScope's mission, however, isn't to monitor earthquakes, but to utilize North America as a natural laboratory. The Transportable Array allows fundamental insight into how the earth operates by imaging its interior with unprecedented detail. The Transportable Array is designed to cover as much land area as possible, while maintaining the uniform network spacing required to properly image Earth's interior.

What is a Transportable Array seismic station?

The heart of a Transportable Array station is the seismic sensor, an instrument capable of detecting minute vibrations in the earth. Transportable Array stations don't create noise or motion. To reduce interference from surface vibrations and to protect the sensor, the seismometer is placed 3 to 15 feet below the surface, depending on ground conditions. A fiberglass enclosure fitted with solar panels is placed about 10 feet from the sensor. The enclosure houses batteries and communications electronics. Data are transmitted through radio, cellular, broadband or satellite communications systems to hub locations, and then sent to the EarthScope data center. The overall footprint of the station is about 10 feet by 20 feet.

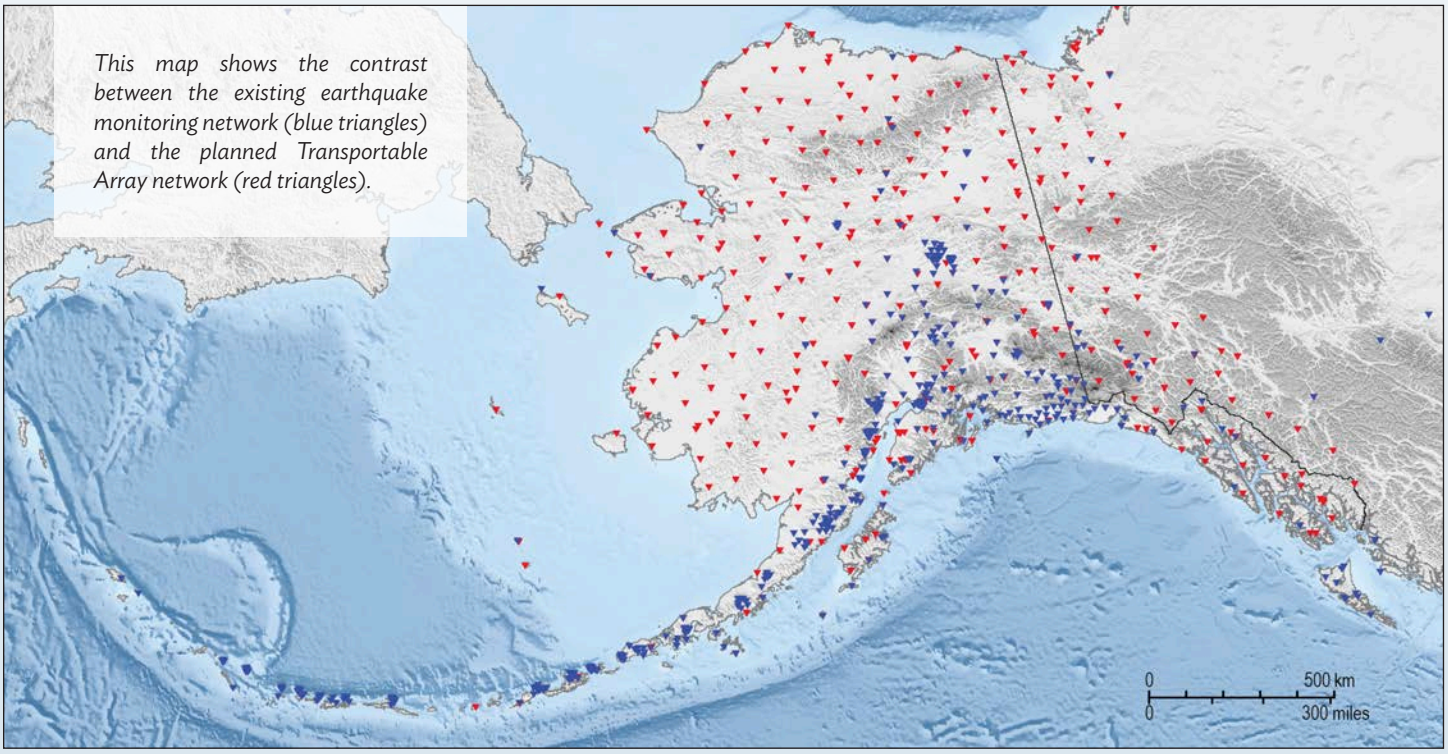
How is a seismic station installed and does it require maintenance?

Installation of a Transportable Array seismic station takes one to two days. Many locations within Alaska and Canada require helicopters to sling equipment into position to minimize ground disturbance. The seismometer and other equipment operate continuously and are monitored remotely. If the seismometer malfunctions, it is identified at the data center and a service trip may be necessary to correct the problem. Where possible, fixed wing aircraft will be used to get personnel to the site for maintenance.



USArray photo

The photo and diagram above demonstrate a new station design created specifically for Alaska. Located at Toolik Field Station, the site combines basics of the Transportable Array's Lower 48 station design, with attributes used in the existing seismic monitoring network in state. Specific attention to weather conditions, sunlight and wildlife are included in the new design.



This map shows the contrast between the existing earthquake monitoring network (blue triangles) and the planned Transportable Array network (red triangles).

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What is the long-term impact for Alaska?

The Transportable Array will have lasting impacts on earthquake monitoring in Alaska. Currently, there are large regions of the state that lack seismic instrumentation. This project will temporarily remedy that and, as a result, may uncover unique or particularly active areas. A better understanding of Alaska's tectonics and faults will aid scientists in understanding how the earth reacts before, during and after an earthquake. Finally, the Alaska Earthquake Center may adopt some of the new stations, incorporating them into the existing network.

Where can I find more information about EarthScope and earthquakes?

USArray Website:
http://www.usarray.org
View signals at the closest station: http://usarray.seis.sc.edu

Incorporated Research Institutions for Seismology:
http://www.iris.edu

Alaska Earthquake Center:
http://www.aeic.alaska.edu, email: ta@gi.alaska.edu

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