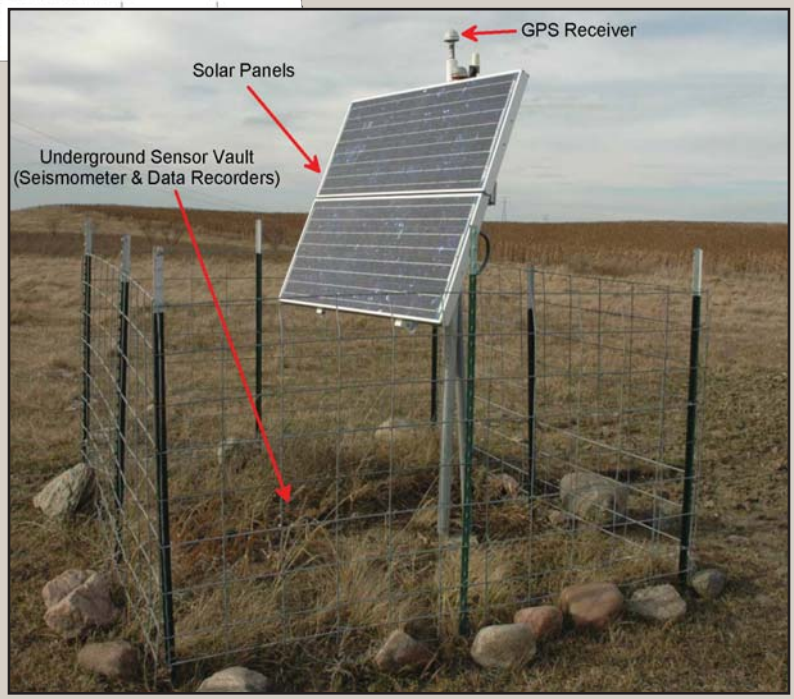
EarthScope Transportable Seismic Array Operational in North Dakota

by Fred J. Anderson

Figure 1. Location of currently operational transportable array stations in North Dakota. Stations installed this past summer (2009) are shown in red. Stations planned for installation throughout eastern North Dakota this year (2010) are shown in blue. The Westby and Maddock stations (in green) were installed in 2008 (IRIS, 2009).

Figure 2. View to the northwest of the TA seismic monitoring station located just northeast of Bismarck near Regan, ND. Each station will gather data continuously during its 24-month operational period. These stations receive the acoustic signals (i.e. the energy released from earthquakes as seismic waves) from earthquakes occurring all over the world.



Operational Broadband Seismic Stations in North Dakota

The Transportable Array (TA) is here! Currently, there are 30 operating broadband seismic monitoring stations in operation in North Dakota. These seismometers are part of the EarthScope Transportable Array project that is traversing the continental U.S. The Maddock station, located in central North Dakota, is a part of the USArray backbone seismic monitoring network and will remain in place after the TA stations in North Dakota have fulfilled their operational requirements and are removed and leapfrogged eastward to their new temporary locations. Seven monitoring stations remain to be installed in eastern North Dakota. Stations in Pembina, Grafton, Northwood, Oriska, Fort Ransom, Argusville, and Colfax are to be installed next spring (fig. 1).

At each of the station locations, a broadband seismometer, along with supporting data recording, power supply, and communications equipment, are installed and operating (fig. 2). These stations are designed specifically to record earthquakes that are "teleseismic" in character. In other words, earthquakes that can be felt by monitoring stations worldwide. Typically these quakes have magnitudes of 5.0 or greater and are located more than 620 miles (1,000 km) from the recording station. As an example, the largest reported earthquake to have occurred in 2009 (as of the time of this writing) was the magnitude 8.0 earthquake that occurred in the southwestern Pacific Ocean near the Tonga Trench in the Samoa Islands (fig. 3). Magnitude 8.0 earthquakes are very large and generally occur only once or twice per year (USGS-NEIC, 2009).

The compressional (i.e. P wave) energy released from this earthquake traveled over 6,000 miles and arrived in North Dakota at 11:48 AM - about 13 minutes after the earthquake occurred - and was recorded by the operating TA stations (fig. 4).

A more recent example of a teleseismic event is the devastating Magnitude 7.0 earthquake that occurred at 3:53 PM CST on Tuesday, January 12, 2010 in Haiti. The first arrival of seismic energy released from this earthquake (the P wave) was recorded at the Maddock station about seven minutes after the earthquake occurred at 4:00 PM CST.

Current Schedule of Seismic Station Operations

The 30 stations installed this summer will now remain in place and collect data for a 24-month operational period (IRIS, 2009). After the 24-month operational period, the stations will be removed and placed at monitoring sites located in states farther east, most likely Minnesota and Wisconisn. The seven stations in easternmost North Dakota, will be installed this spring (2010) while the Westby (A24A) station, originally installed in September of 2008 will be the first North Dakota station to be removed in September of 2010 (Table 1).

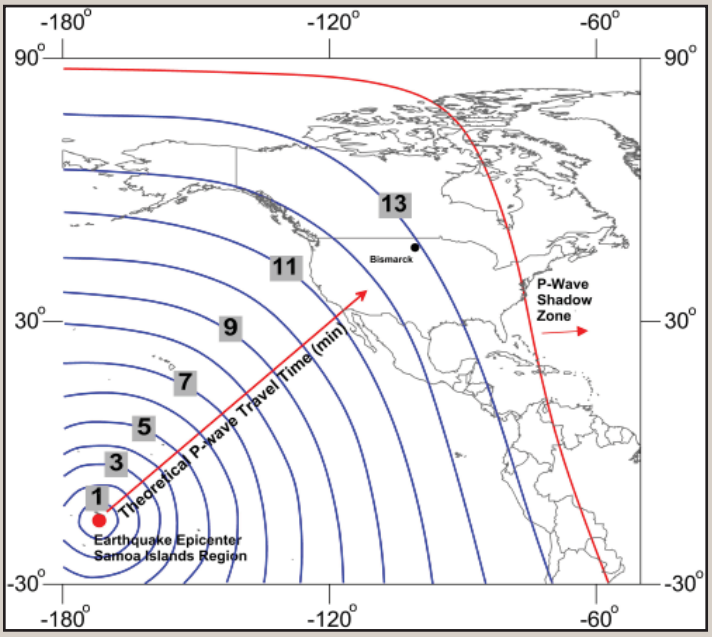


Figure 3. Location of the September 29, 2009 - magnitude 8.0 earthquake that occurred at the Tonga Trench in the Samoa Islands. First arrivals of compressional (P wave) earthquake energy released from this earthquake were received at EarthScope TA stations in operation in North Dakota around 13 minutes after the event occurred (USGS-NEIC, 2009).

The installation and operation of the TA seismometers in North Dakota has already begun to increase our knowledge and understanding of local and regional seismicity. Specifically, we are learning more about earthquake occurrence and probabilities in seismically "quiet" continental interiors, in addition to enhancing our understanding of regional and worldwide seismicity. The data collected during TA station deployment in North Dakota will provide earthquake scientists and engineers with a rich seismic data set for continued study and analysis for several years to come.

References

Vase 2.8, 2008, IRIS Data-Management Center (DMC), Seismic Waveform Extraction and Viewing Application: http://www.iris.edu/software/downloads/

IRIS, 2009, All Operating USArray Transportable Array Stations: www.iris.edu/earthscope/usarray/_US-TA-OpStationList.htm

USGS-NEIC, 2009, U.S. Geological Survey, National Earthquake Information Center, Theoretical P-Wave Travel Times for the Magnitude 8.0, September 29, 2009, Samoa Islands Region Earthquake: http://earthquake.usgs.gov/eqcenter/eqinthenews/2009/us2009mdbi/

Web Sites of Interest

U.S. Geological Survey – National Earthquake Information Center: www.earthquake.usgs.gov/regional/neic

Incorporated Research Institutions for Seismology (IRIS): www.iris.edu

The Rapid Earthquake Viewer: www.rev.seis.sc.edu

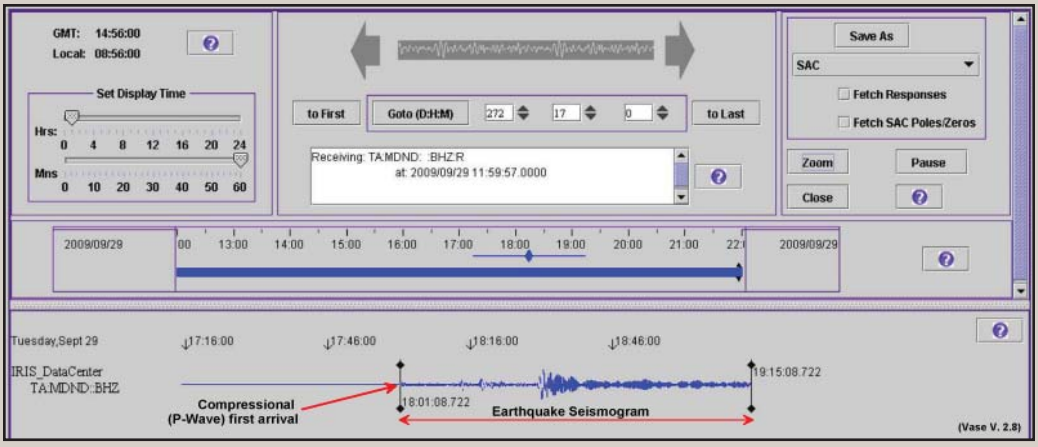
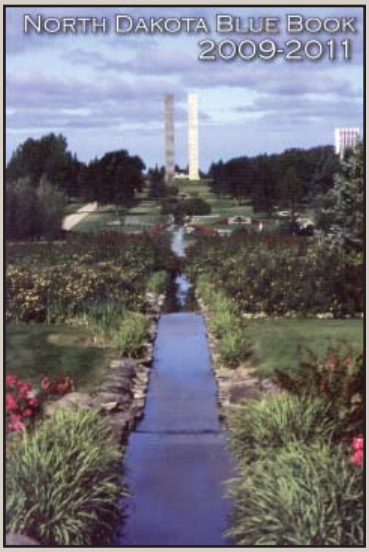


Figure 4. Seismic waveform data like this (displayed in Vase V. 2.8) is recorded from earthquakes around the world at the TA stations. This image shows the vertical component (z-axis) seismogram from the Maddock, ND (MDND) TA station that recorded the September 29, 2009 magnitude 8.0 earthquake originating in the Samoa Islands region of the southeastern Pacific Ocean. The first arrival of the compressional (P wave) energy released from the earthquake (highlighted in red) help seismologists and other scientists determine where (focus and epicenter) the earthquake occurred, and when the seismic wave energy arrived at a particular monitoring station (data from IRIS, DMC).

Table 1. Transportable Array (TA) seismic monitoring station operations schedule for North Dakota.

Station ID	City	County	Date of Station Installation	Approximate Date of Removal*	Station Status
A24A	Westby	Divide	9/12/08	9/12/10	Operating
MDND	Maddock	Benson	10/4/08	N/A**	Operating
E25A	Amidon	Slope	6/11/09	6/11/11	Operating
E26A	Regent	Hettinger	6/11/09	6/12/11	Operating
E27A	Carson	Grant	7/16/09	7/16/11	Operating
D27A	Center	Mercer	7/17/09	8/2/11	Operating
D25A	Fairfield	Billings	7/22/09	7/22/11	Operating
C27A	Douglas	McLean	7/22/09	7/22/11	Operating
D26A	Manning	Dunn	7/23/09	7/23/11	Operating
A26A	Kenmare	Burke	7/23/09	7/23/11	Operating
A25A	Noonan	Divide	7/24/09	7/27/11	Operating
C25A	Watford City	McKenzie	7/25/09	7/25/11	Operating
C26A	Parshall	McLean	7/26/09	7/26/11	Operating
B25A	Ray	Williams	7/28/09	7/28/11	Operating
B26A	Palermo	Mountrail	7/29/09	7/29/11	Operating
D28A	Regan	Burleigh	8/4/09	8/14/11	Operating
B27A	Glenburn	Ward	8/5/09	8/5/11	Operating
D29A	Tappen	Kidder	8/5/09	8/14/11	Operating
C30A	Pekin	Nelson	8/6/09	8/14/11	Operating
D30A	Buchanan	Stutsman	8/7/09	8/14/11	Operating
B28A	Towner	McHenry	8/10/09	8/10/11	Operating
A28A	Bottineau	Bottineau	8/11/09	8/11/11	Operating
C28A	Kief	Wells	8/13/09	8/14/11	Operating
E28A	Huff	Morton	8/18/09	8/18/11	Operating
B30A	Edmore	Ramsey	8/18/09	8/18/11	Operating
E29A	Napolean	Logan	8/19/09	8/19/11	Operating
A30A	Langdon	Cavalier	8/19/09	8/19/11	Operating
A29A	Rock Lake	Towner	8/20/09	8/20/11	Operating
E30A	Jud	LaMoure	8/20/09	8/20/11	Operating
B29A	Cando	Towner	8/21/09	8/21/11	Operating
A31A	Pembina	Pembina	QII-10	QII-12	Planned
B31A	Grafton	Walsh	QII-10	QII-12	Planned
C31A	Northwood	Grand Forks	QII-10	QII-12	Planned
D31A	Oriska	Barnes	QII-10	QII-12	Planned
E31A	Fort Ransom	Ransom	QII-10	QII-12	Planned
D32A	Argusville	Cass	QII-10	QII-12	Planned
E32A	Colfax	Richland	QII-10	QII-12	Planned

*Not Applicable. The Maddock broadband seismic monitoring station is a part of the USArray backbone seismic monitoring network and will remain in place permanently as a part of that network.
**Assumes a 24-month operational period.



Department of Mineral Resources Contributes to the 2009-2011 North Dakota Blue Book

Every two years the North Dakota Secretary of State's office, under direction of Alvin A. Jaeger, publishes the North Dakota Blue Book. The Blue Book reviews the state's social, economic, environmental, cultural, and political status and is meant to be a citizen's guide. The 2009-2011 Blue Book is the 28th edition although similar guides date back to 1887. Lynn Helms, Director of the Department of Mineral Resources; Ed Murphy, State Geologist; and State Paleontologist John Hoganson provided information about the state's energy and paleontological resources for this edition of the Blue Book.