"Two Minutes to Midnight" Great M 9.0 Japan Earthquake Recorded by EarthScope Seismometers in North Dakota

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At two minutes to midnight (CST) on March 10, 2011 the seismic energy released from the devastating M 9.0 earthquake that originated 45 miles off the east coast of Honshu, the largest of Japan's four main islands (fig. 1), was recorded by EarthScope Transportable Array (TA) broadband seismic monitoring stations deployed across North Dakota. The seismometer located near Noonan (fig. 2) in the northwest corner of the state was the station oriented nearest to the propagation path of seismic wave energy released from this great temblor, and the first to record the seismic energy released from the earthquake at 11:58:06 p.m. (CST) late that Thursday evening. The seismic energy released from this earthquake continued to race across the state, arriving at the remainder of the stations within seconds. Overall, the first compressional (p-wave) seismic energy released from this great earthquake took just over 11.5 minutes to reach the TA seismometers in North Dakota. It was reported by scientists at NASA that this event was large enough to redistribute Earth's mass just enough to potentially cause a shift in its rotational axis and hasten its revolution by about 1.8 microseconds (NASA, 2011).

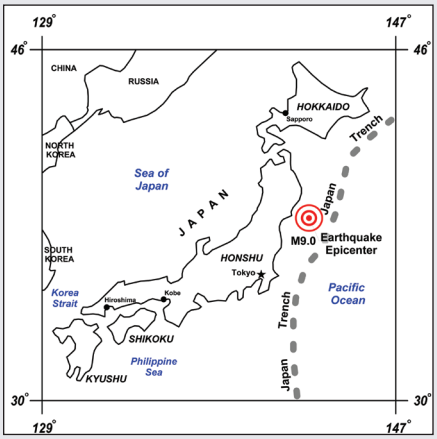

Figure 1. Location of the Great M 9.0 earthquake centered between the east coast of Honshu, Japan and the Japan Trench in the western Pacific Ocean.

At the time of the Great M 9.0 earthquake in Japan, there were 36 broadband seismometers deployed across the state as a part of the EarthScope project. Twenty-nine are in the process of being removed and transported to new locations further east in the U.S. after being operational for approximately two years. Seven stations remain in operation in North Dakota. Six of these are in the Red River Valley (fig. 2) and will remain operational until next summer (2012). The seismometer station at Maddock will remain permanently in place as a part of the USArray reference or "backbone" network. This station, the only one of its kind in North Dakota, will provide opportunities for scientists and engineers to document local and regional seismic events for many years to come.

It is very unlikely that North Dakota will ever experience an earthquake of any consequence or much greater than the M 4.5 event recorded near Huff, just 15 miles south of Bismarck, on July 8, 1968. North Dakota is located in the most stable and

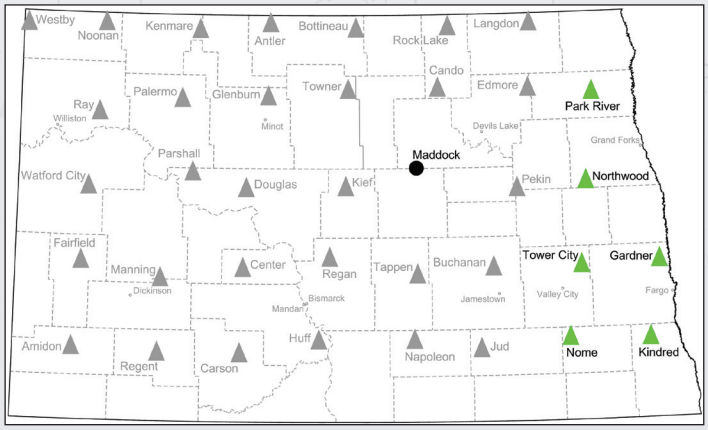

Figure 2. Location of EarthScope Transportable Array seismometers in North Dakota. The locations shown in gray are no longer in operation and were in the process of being removed at the time of this writing in the summer of 2011. The six locations shown in green are the TA station that will remain in place for another year. The seismometer at the Maddock station (shown in black) will remain in North Dakota, after the other TA seismometers have been removed, as part of the USArray reference network.

seismically quiet central portion of the North American Craton, a position it shares with the states of Minnesota, Wisconsin, and Michigan. However during this writing, a minor earthquake of M 2.5 occurred in southeastern Minnesota on Friday morning, April 29, 2011 at 02:20:13 a.m. CDT near Lake Mina, four miles west of Alexandria, just north of the I-94 corridor (USGS, 2011). This small temblor was reported to have occurred at a depth of 3.1 miles (5 km) and in terms of energy released was about equivalent to that of a large lightning bolt (IRIS, 2011). It was recorded by the EarthScope Transportable Array Seismometer at Kindred in northeastern Richland County at 02:20:42 a.m. CDT, about half a minute after the event occurred. It is unlikely that anyone in North Dakota felt this small earthquake. Some geologists have postulated that earthquakes like these, with relatively shallow depths and low magnitudes that occur in the relatively quiescent stable continental interiors of the north-central U.S., may be the result of the unloading or "rebound" of geologic strata, which began with the final retreat of glacial ice at the end of the last Ice Age.

IRIS, 2011, How Often Do Earthquakes Occur?: Incorporated Research Institutions for Seismology (IRIS), Education and Outreach Series, No. 3, http://www.iris.edu/edu/onepagers/no4.pdf

NASA, 2011, Japan Quake May Have Shortened Earth Days, Moved Axis: National Aeronautics and Space Administration, http://www.nasa.gov/topics/earth/features/japanquake/earth20110314.html

USGS, 2011, Preliminary Earthquake Report: U.S. Geological Survey, Earthquake Hazards Program, http://earthquake.usgs.gov/earthquakes/eqarchives/last_event/states/states_minnesota.php