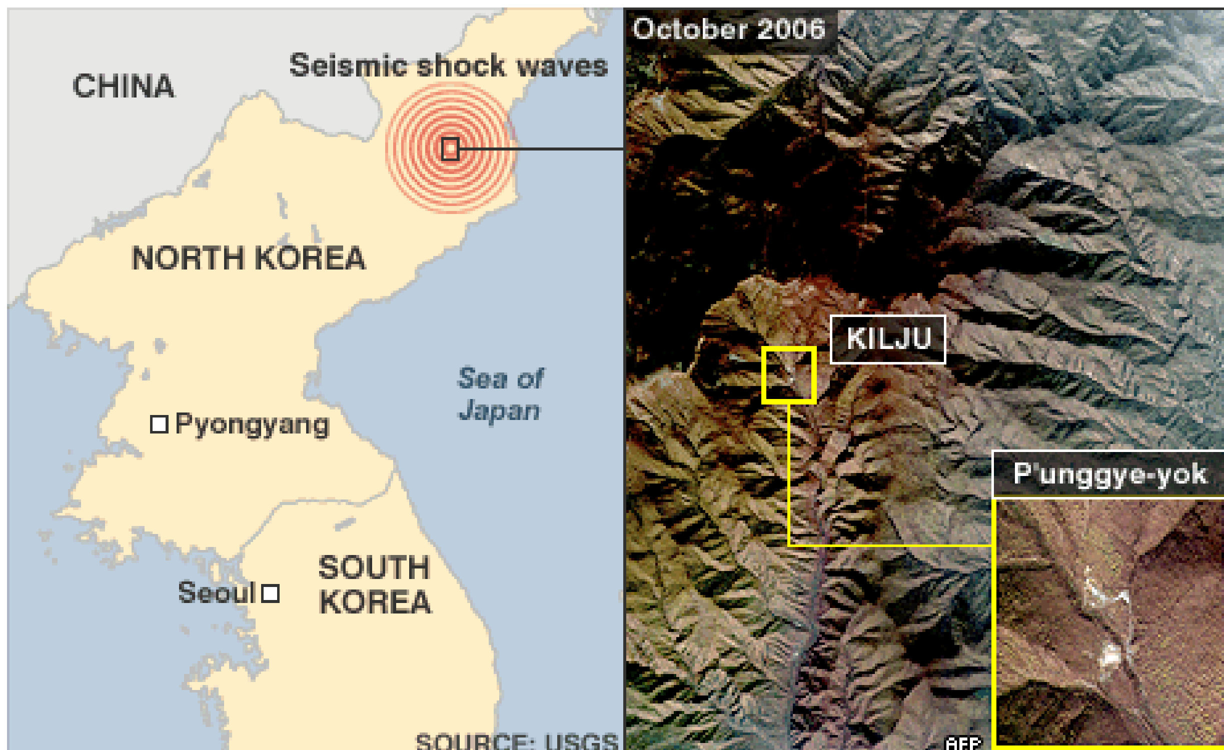
M5.1 NUCLEAR EXPLOSION - NORTH KOREA
Tuesday, February 12, 2013 at 02:57:51 UTC

At 02:57:51 UTC on February 12, 2013, monitoring stations of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) and many other stations around the world detected a shallow seismic event with explosion-like characteristics in the Democratic People's Republic of Korea (DPRK).



Highlighted is the location of this event which corresponds to a suspected nuclear test site.

Images and location information courtesy USGS and CTBTO

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Naturally occurring seismicity in North Korea is low increasing the likelihood that the event was not an earthquake.

This map shows the earthquakes since 2005.

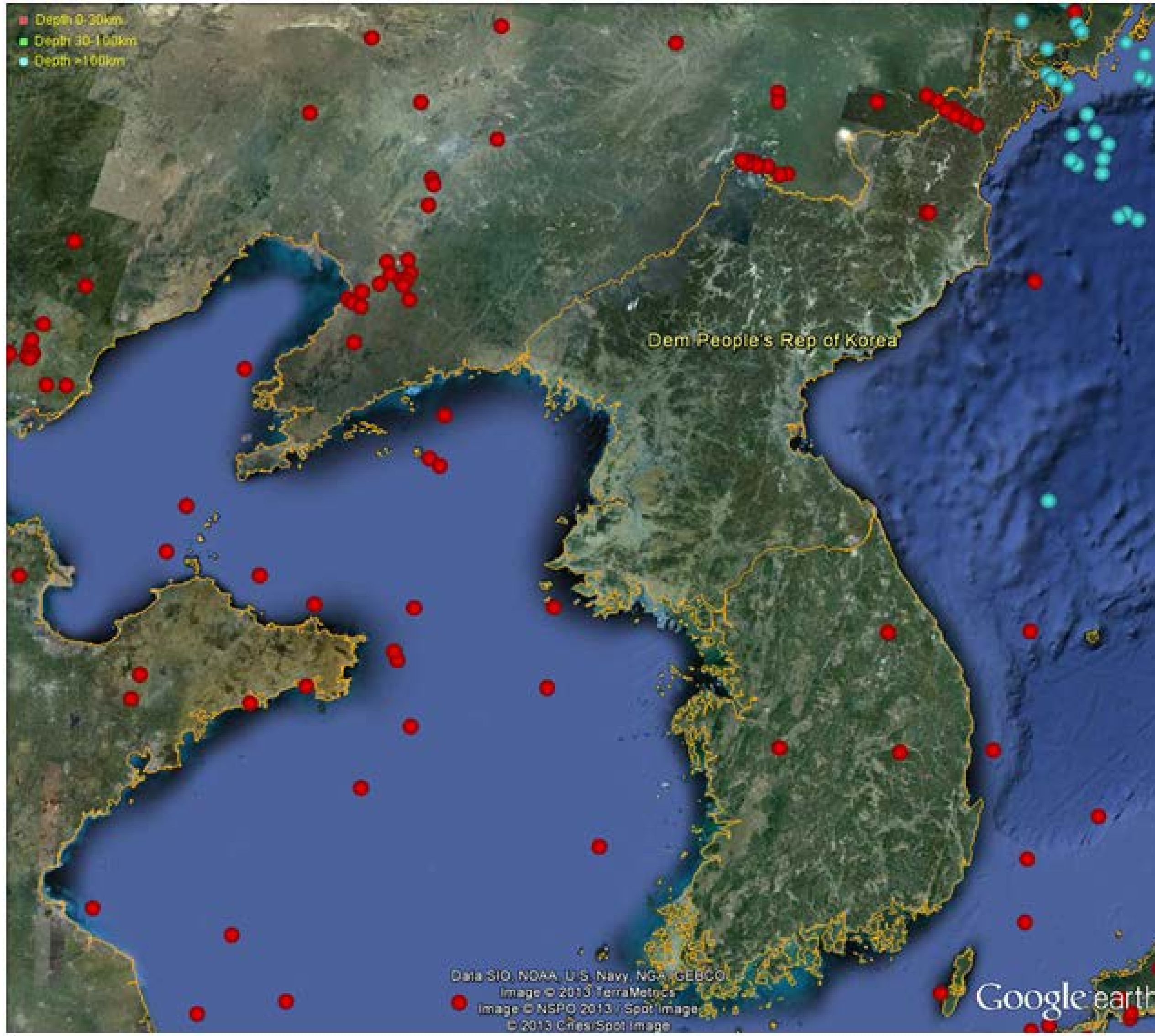

image courtesy CTBTO International Data Centre

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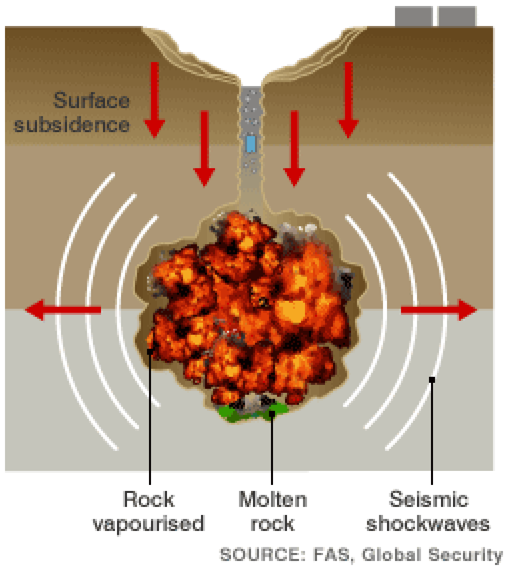
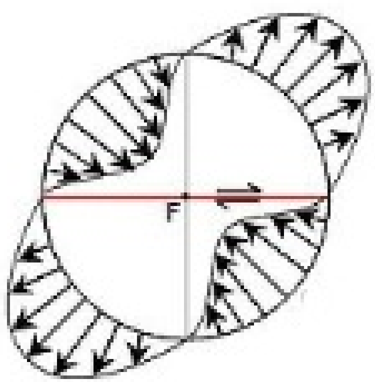
Analyzing seismograms recorded after an event can discriminate between a natural earthquake or an explosion.



An explosion generates a "sphere" of compressional waves travelling in all directions. A seismogram will show a strong and sudden signal of P-waves, with a similar signal recorded by all the seismometers around the explosion. Additionally, an underground explosion generates surface waves that are smaller than those expected for most earthquakes.

An earthquake is caused by the sliding of rocks along a fracture and will generate both compressional and shear waves concentrated in certain directions.



Schematic diagram showing the direction of initial movement of particles around the focus (F) of an earthquake on a W-E dextral strike-slip fault, viewed from above.

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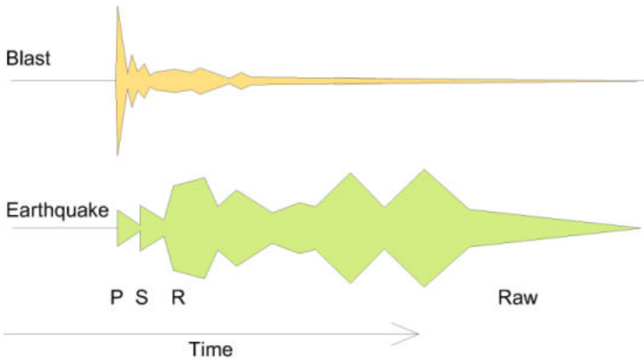
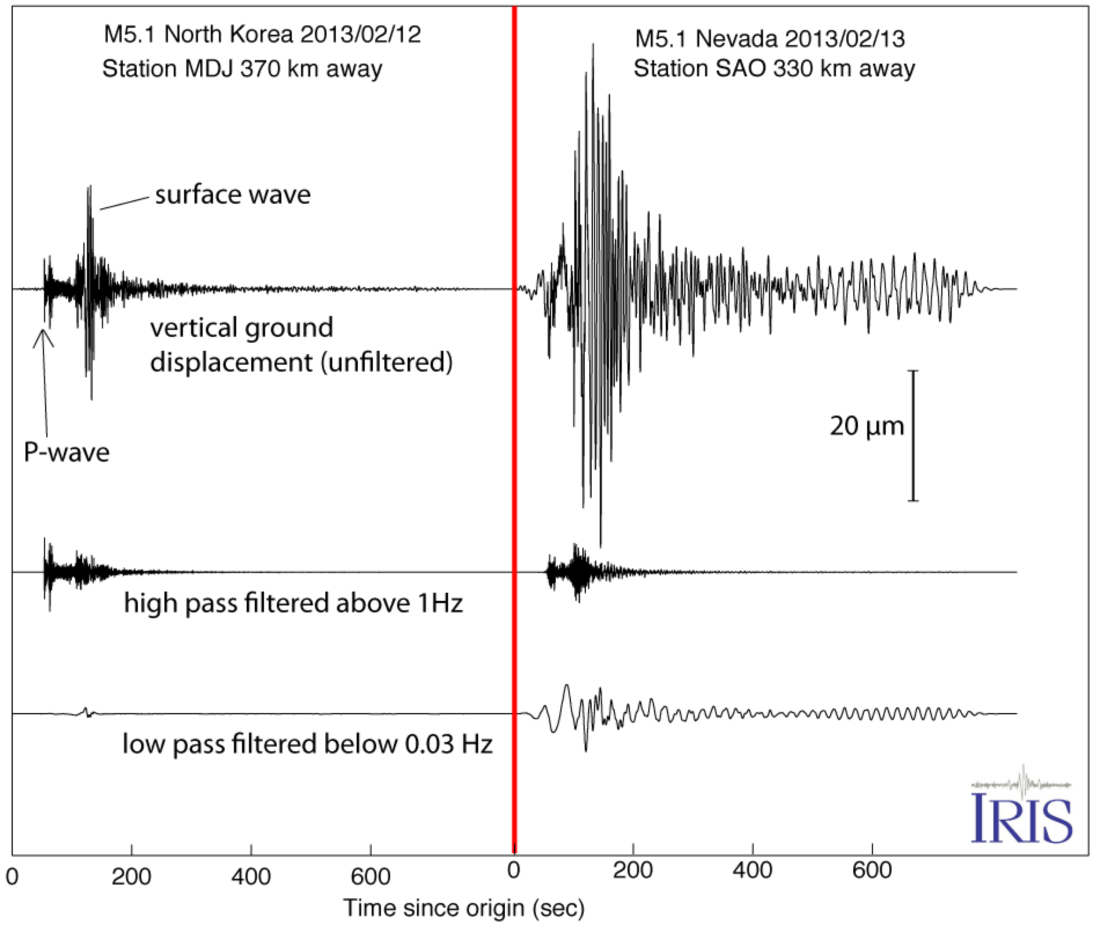
Generalized seismograms showing differences between an explosion and earthquake.





Seismograms from two equidistant stations from the (left) 2013/02/12 North Korean M5.1 explosion and the (right) 2013/02/13 Nevada M5.1 earthquake.

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Efforts over a 50-year period to limit and ultimately ban nuclear testing led in 1996 to the signing of the Comprehensive Nuclear-Test-Ban Treaty (CTBT).

The CTBT bans all nuclear explosions in all environments.

The Partial Test Ban Treaty from 1963, which banned nuclear tests in the atmosphere, underwater and in space, and the Threshold Test Ban Treaty from 1974, which limited the yield of underground tests to 150 kilotons, represented significant steps towards achievement of the CTBT.

The CTBT will enter into force when it has been ratified by 44 states listed in the Treaty. Of these, 36 states have ratified the Treaty as of October 2012.

CTBT History and Political Situation

CTBTO Public Information
www.ctbto.org

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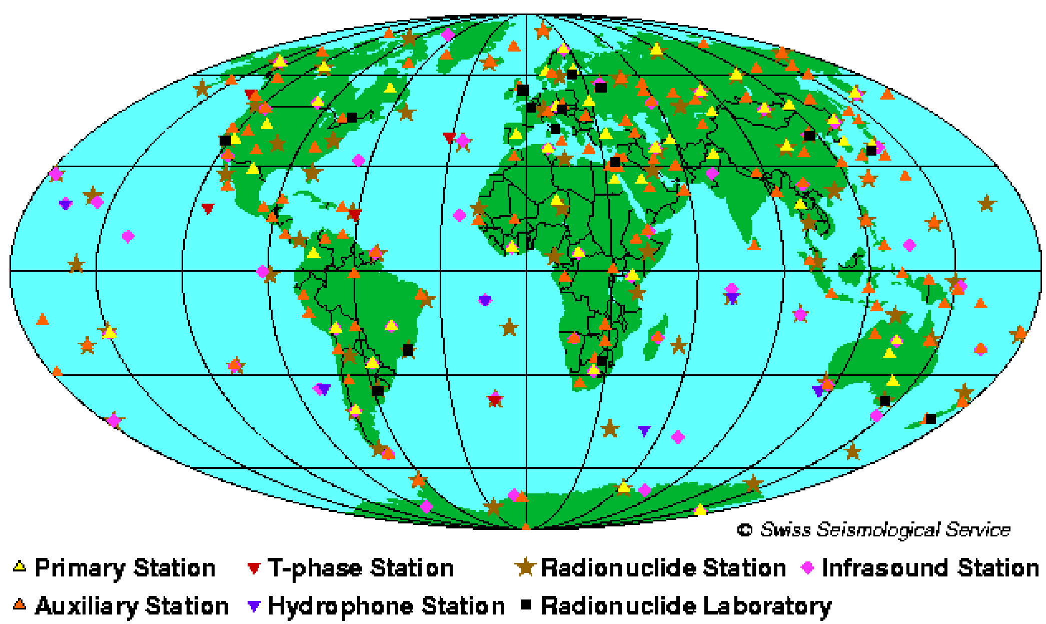
Since the Treaty is not yet in force, the organization is called the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) based in Vienna. The CTBTO's main tasks are the promotion of the Treaty and the build-up of the verification regime so that it is operational when the Treaty enters into force.

The International Monitoring System (IMS) will, when complete, consist of 337 facilities worldwide to monitor the planet for signs of nuclear explosions. Over 85 percent of the facilities are already up and running. The IMS uses four state-of-the-art technologies: seismic, hydroacoustic, infrasound and radionuclide. 44 stations of the IRIS/USGS GSN contribute to the IMS as auxiliary or primary stations.



IMS network

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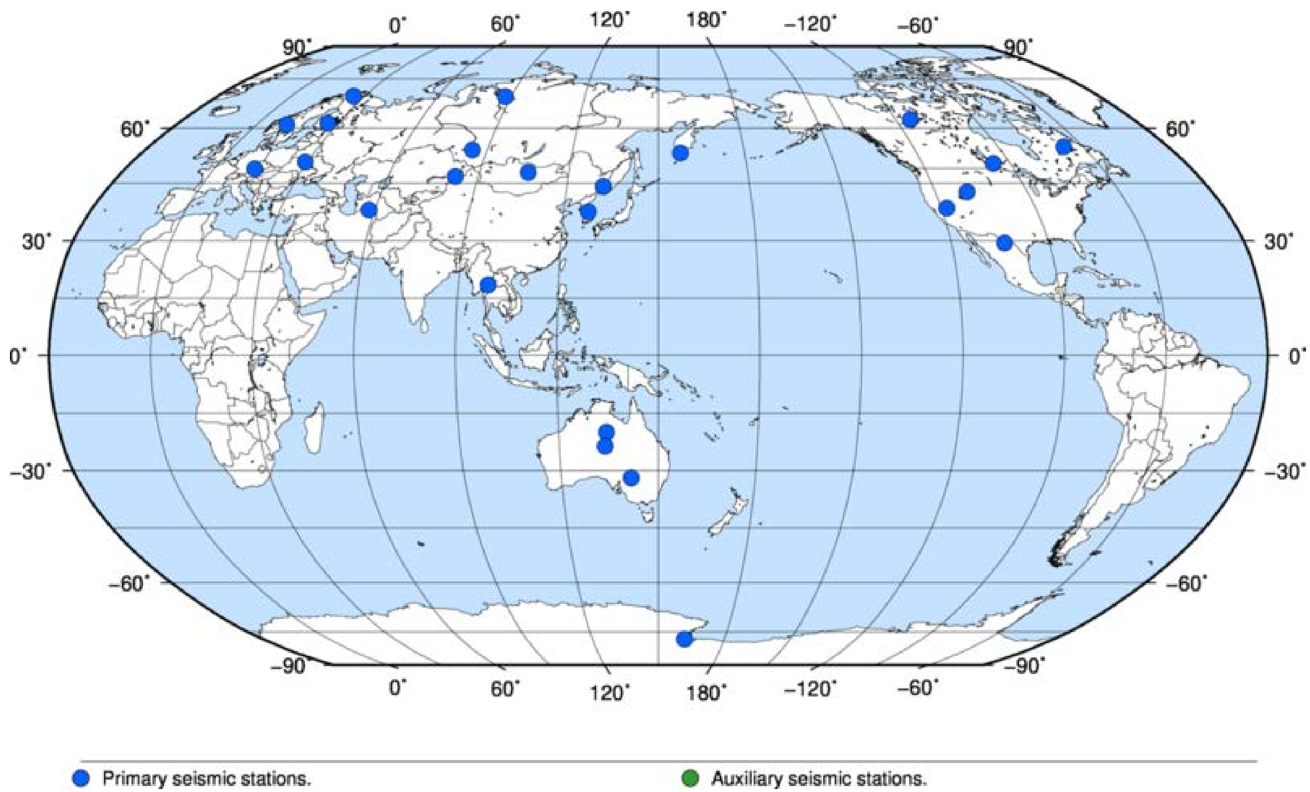
The CTBTO's first and preliminary automatic detections were made by up to 25 seismic stations around the world.

The first data were made available to CTBTO Member States in little more than one hour, and before North Korea announced that they had conducted a nuclear test.



IMS stations shown are just those used in the initial location of this event.

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Comparison of the first automatic location estimates of the 2006, 2009 and 2013 nuclear tests by North Korea.

The location accuracy is currently approximately +/- 16.2 km, indicating that the location of today's event is largely identical with the two previous nuclear tests.

As with the two previous nuclear tests, the signal was emitted from close to the surface.

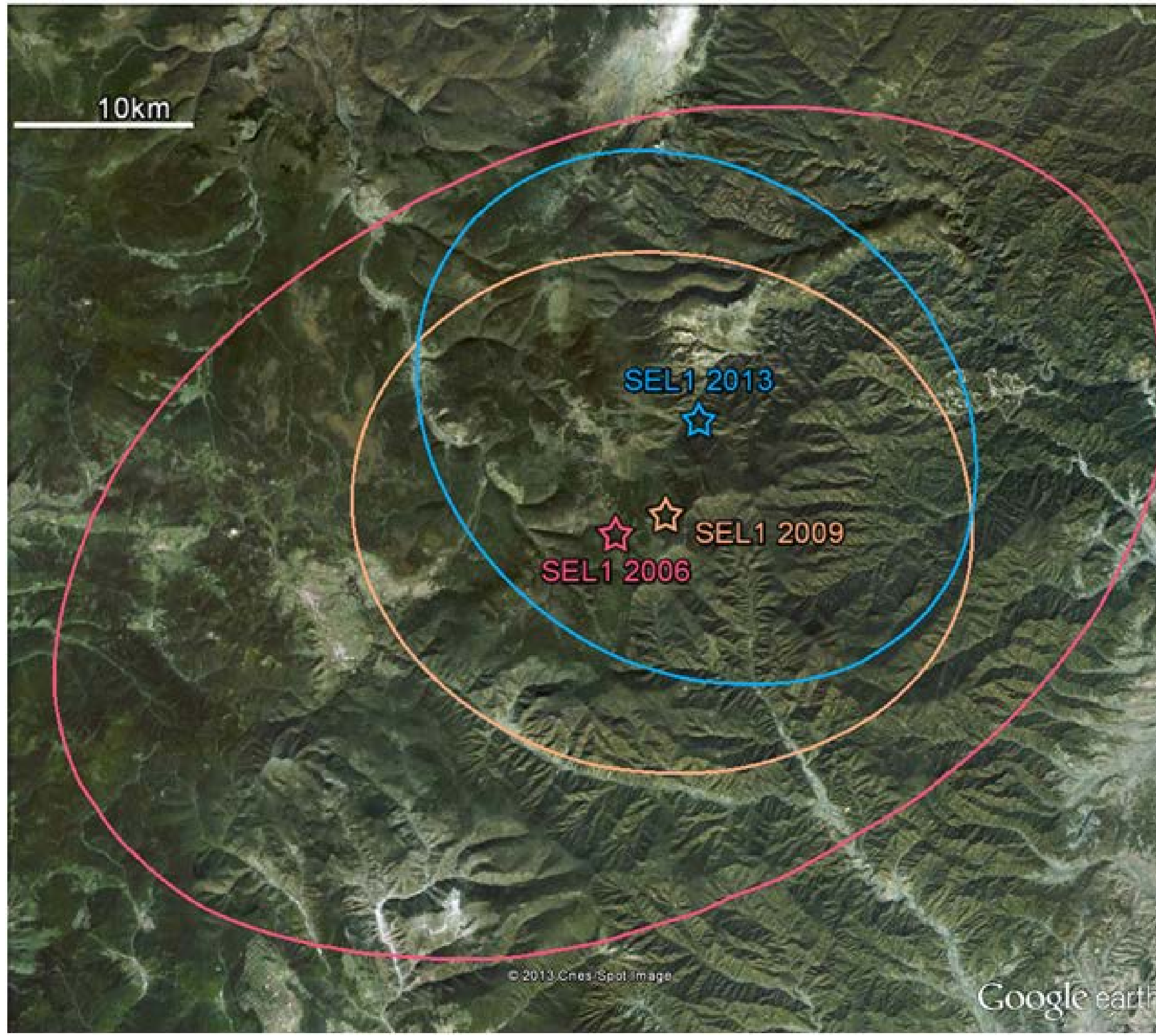

image courtesy CTBTO International Data Centre

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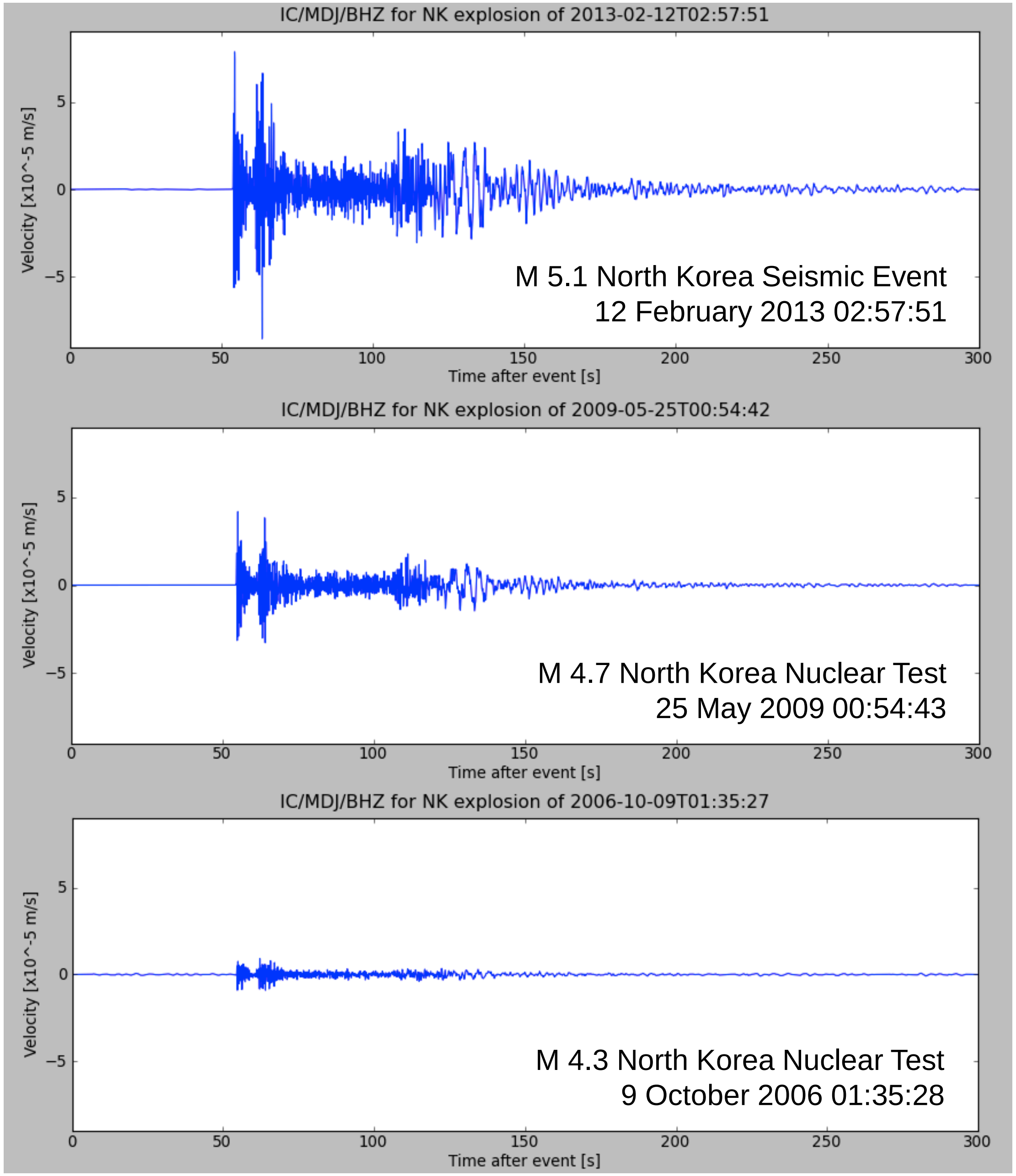
IRIS DMC

Recordings were also available immediately from stations in the Global Seismic Network (GSN).

The plot displays, to a common scale, the 2013, 2009, and 2006 nuclear tests in North Korea on a GSN station MDJ.

MDJ is located a few hundred km north-northeast of the test site



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Comparing the 2006, 2009, and 2013 North Korea nuclear tests, with no filtering or waveform manipulation of the data. The signal is almost identical, except for size, which helps to confirm similar source type and location.

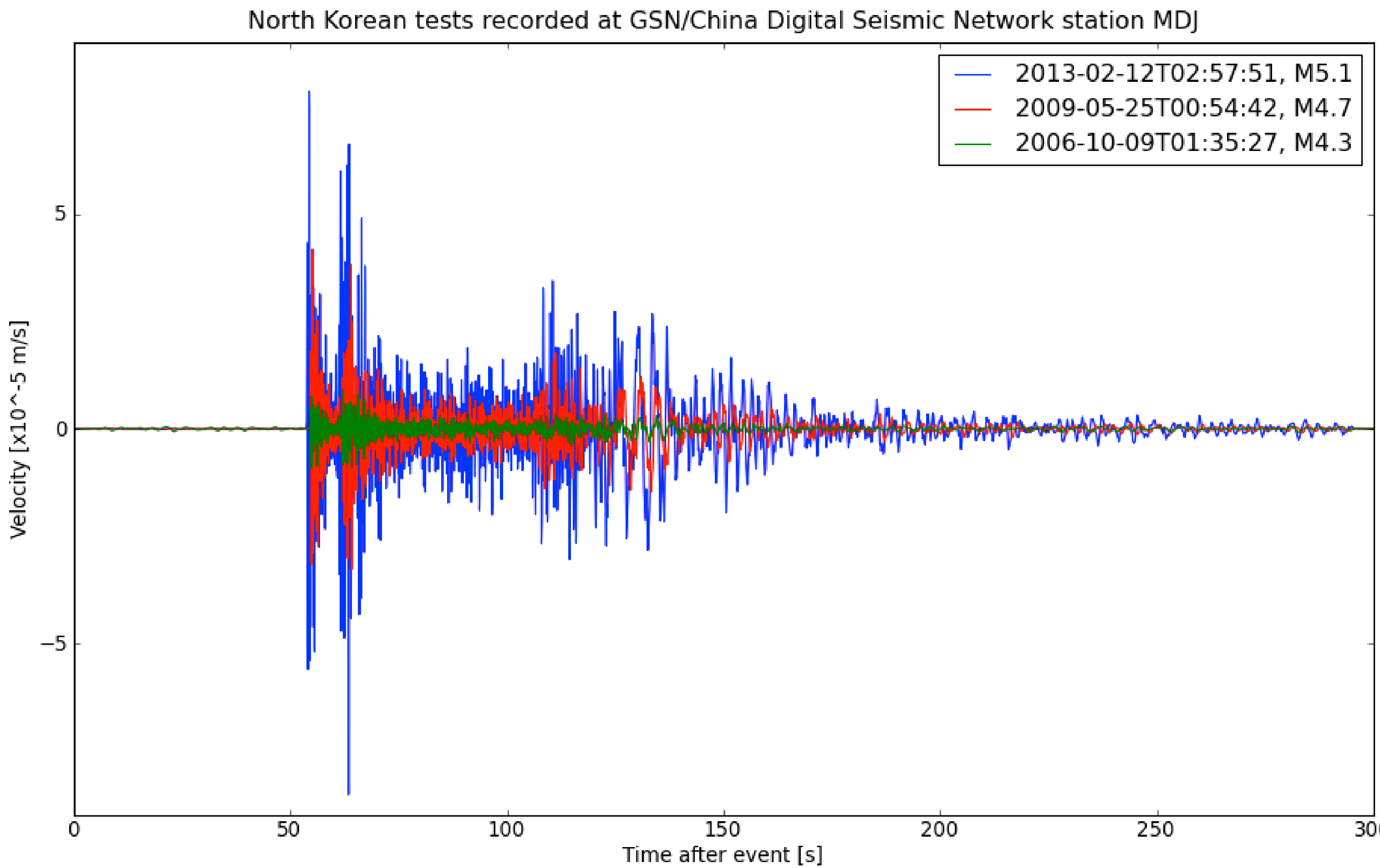

Image courtesy Andy Frassetto