*NATURE* | NEWS

# Nuclear detectives sniff out North Korea

**Radioisotopes may provide key details on nuclear test.**

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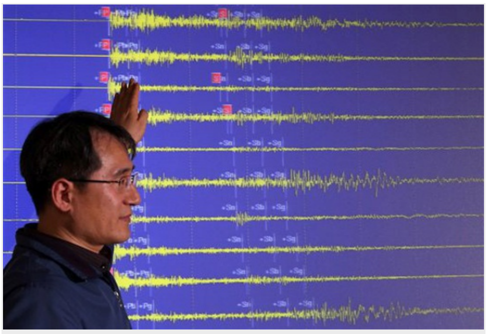
With this morning's announcement by North Korea that it has conducted its third nuclear test, experts are closely watching a network of seismic monitoring stations for hints of what sort of test it was. Ratios of radioisotopes could help to verify the explosion and perhaps even provide clues about the type of device detonated — but only if the radioactive gases can be identified before they decay.



*Lee Ji-eun, Yonhap/AP*

A South Korean official explains what looks like the seismic signature of an underground nuclear test that North Korea conducted on 12 February.

Seismic stations detected the underground blast at 11:57 a.m. local time. The data, from the US Geological Survey and the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), showed a sudden, strong earthquake occurring at a depth of about 1 kilometre from the surface in the same region as North Korea's two previous nuclear tests. The blast, which registered on seismographs at around 5.0 in magnitude, was roughly twice the power of the country's last test in 2009. That puts it in the range of several kilotonnes of TNT, according to Tibor Tóth, head of the CTBTO in Vienna, which monitors globally for clandestine nuclear testing.

The seismic signature, together with North Korea's open declaration of having conducted a test, are strong evidence for a nuclear detonation. But "the smoking gun will be the potential radionuclide release”, says Lassina Zerbo, who oversees the CTBTO's data centre. In particular, researchers will be looking for radioactive isotopes of xenon produced in the explosion.

**Plutonium or uranium?**

Xenon, a noble gas, interacts only weakly with the environment and can thus slip unimpeded through the rocks and backfill that North Korea's scientists will have used to seal the entrance to the test tunnel. Once airborne, it can drift towards the CTBTO's monitoring stations, which are located in countries including China, Japan and Mongolia, where it can be detected using a specially developed gas chromatograph. The US Air Force also has special aircraft that can search for xenon from above, although it does not share its data openly.

Xenon data would provide strong evidence of a test and could give details about the type of nuclear weapon used, says Anders Ringbom, a researcher at the Swedish Defence Research Agency in Stockholm. Ratios of various xenon isotopes can point towards whether North Korea's latest weapon was made of plutonium or uranium, he says. Both the 2006 and 2009 tests were believed to have been conducted using plutonium, but the country is suspected of having a uranium-enrichment programme and may have developed a uranium device. A uranium bomb would be particularly worrying because, until now, North Korea has been forced to rely on its limited supply of plutonium for weapons.

The ratios of xenon isotopes might even be able to reveal whether North Korea tested a weapon that was 'boosted' with tritium and deuterium, two hydrogen isotopes. Such a device would release more energy than simple fission and would thus be smaller and more powerful than a conventional atomic bomb. "It looks like boosting will also affect the ratios, but it might be more complicated," Ringbom says.

The detection of xenon might not be able to say that much, however, warns David Keir, programme director at the Verification Research, Training and Information Centre, a London-based non-profit organization. Other civilian nuclear facilities also produce xenon, and such releases could trigger a false detection or muddy the result. "The thing is, a nuclear weapon and a nuclear reactor are substantially the same thing," Keir says. "The real smoking gun is if you can get inspection on the ground."

And it may be that monitoring stations will see nothing. Although a station in Canada detected xenon after the first test in 2006, its monitors failed to see anything following the country's larger test in 2009. This may have been partly due to the fact that North Korea's scientists had become better at sealing their tunnels, but "there's also a certain amount of luck involved" in detection, Ringbom admits.

Whatever detection is achieved, it will have to be obtained fairly quickly if it is to provide substantive insight: xenon-133m, a metastable isotope needed to pin down the type of weapon, has a half-life of just 2.2 days. But Ringbom remains optimistic that a signal will appear in the coming days. "If our measurement is good then we might be able to say something," he says.

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## Corrections

**Corrected:** An earlier version of this article incorrectly stated the time of the detonation as 9:57 a.m. local time.