CTBTO | preparatory commission for the comprehensive nuclear-test-ban treaty organization
PREPARATORY COMMISSION

CTBTO Spectrum

CTBTO NEWSLETTER ISSUE 9 | JANUARY 2007

Who we are

The Comprehensive Nuclear-Test-Ban Treaty bans all nuclear weapon test explosions. It opened for signature in New York on 24 September 1996 and enjoys worldwide support.

The CTBTO Preparatory Commission was established to carry out the necessary arrangements for the implementation of the Treaty and to prepare for the first session of the Conference of the State Parties to the Treaty after its entry into force. It consists of all States Signatories and the Provisional Technical Secretariat.

Inside this issue

Forensic seismology and CTBT verification

By Professor Paul G. Richards
Lamont-Doherty Earth Observatory of Columbia University

The word 'forensic' means the application of scientific methods and techniques to the investigation of a crime. Various courts of law have developed standards of what it means to present objective technical evidence, derived from forensic studies. Such courts provide a framework, developed over decades, in which others will evaluate that evidence, to see if indeed a crime has been committed, and perhaps to identify the perpetrators.

In the context of Comprehensive Nuclear-Test-Ban Treaty (CTBT) verification, for a Treaty that is not yet in effect, it is not yet clear what will constitute persuasive evidence of a Treaty violation, nor how in practice such evidence will be prepared, or presented, or assessed. An underlying question here is: who will need to be persuaded? But with more than 2000 nuclear weapon test explosions conducted from 1945 to 1996, there are plenty of examples of what signals might be expected from a CTBT violation – that is, from a nuclear explosion conducted by a Signatory State – if a test explosion were conducted in the same fashion as most tests to date, that is, without attempts at concealment. And we can reasonably speculate what are the challenges to monitoring, if a test were to be conducted with an effort at evading the attention of monitoring systems.

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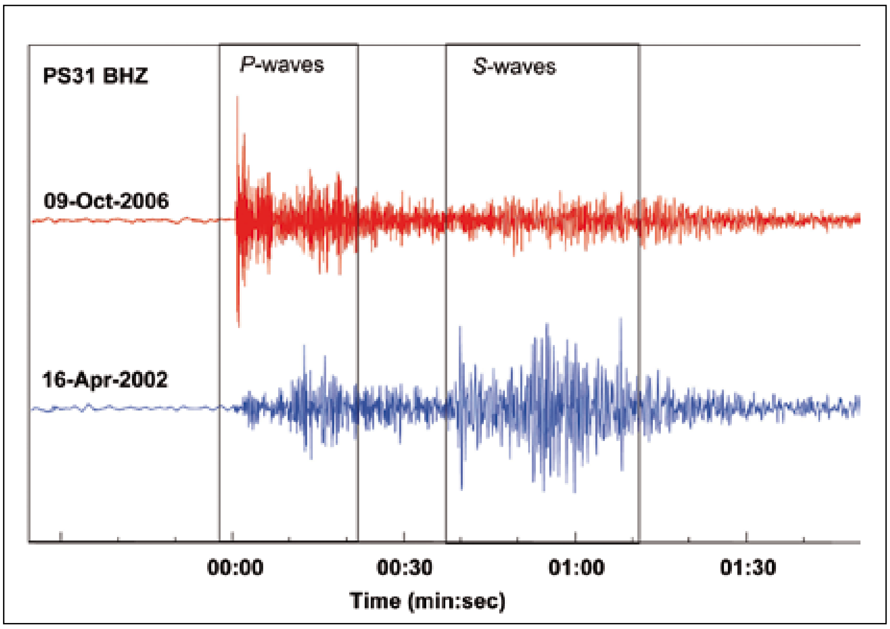

FIGURE 1: SEISMOGRAMS FROM PRIMARY SEISMIC STATION PS31, REPUBLIC OF KOREA. THE UPPER TRACE SHOWS THE WAVEFORM FOR THE ANNOUNCED NUCLEAR EXPLOSION IN THE DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA ON 09-OCT-2006, MB=4.1. THE LOWER TRACE IS FOR A CLOSE-BY SHALLOW EARTHQUAKE, MAGNITUDE MB=3.9. THE EXPLOSION GENERATES A LARGE P-WAVE AND PRODUCES LITTLE S-WAVE ENERGY RELATIVE TO THE EARTHQUAKE.

Treaty Status

Signatures	177
Ratifications	138
Annex 2 Ratifications	34

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North Korea: a real test for the CTBT…

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well-recorded world-wide. The PTS made available a good location in SEL1 within two hours. It issued the REB for 9 October within the timescale planned for after entry into force, and the REB location corroborated the location issued in SEL1. Moreover, the REB reduced the location uncertainty to less than the 1,000 square kilometres, the maximum allowed for an on-site inspection under the Treaty. Thus the PTS was able to provide States Signatories with valuable information that would assist them to make their judgements – the system worked as intended. This was achieved with less than 60% of IMS stations contributing to provisional operations, at a time when IDC's data processing systems and formal procedures are still incomplete or under development, and when the organization is in a test and provisional operation mode only. This bodes very well for the future verifiability of the CTBT.

Also included in the IMS network are radionuclide particulate stations and radionuclide noble gas stations, although the latter are currently operating only on an experimental basis. Radionuclide monitoring results relevant to this DPRK event will be described in the next edition of *CTBTO Spectrum.* ■

Calendar of Meetings 2007

Preparatory Commission:

28th Session	19 – 22 June 2007
29th Session	12 – 15 November 2007

Working Group A:

31st Session	4 – 6 June 2007
32nd Session	8 – 10 October 2007

Working Group B:

28th Session	5 – 16 February 2007
29th Session I	21 May – 1 June 2007
29th Session II	20 August – 7 Sept. 2007

Advisory Group:

28th Session I	23 – 27 April 2007
28th Session II	14 – 18 May 2007
29th Session	10 – 14 September 2007

Joint Session for WGA and WGB:

Monday, 12 February 2007
Monday, 21 May 2007
Monday, 3 September 2007

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Notes & quotes

Promoting the CTBT at the NAM Summit

The CTBTO Preparatory Commission was invited to participate with 'guest status' at the XIV Summit of the Non-Aligned Movement (NAM), held in Havana, Cuba, from 11 to 15 September 2006.

The Non-Aligned Movement has been a staunch supporter of the CTBT. Out of the 118 NAM countries, 102 have signed the Treaty and 69 have ratified it. Facility Agreements have been concluded with 13 countries. The CTBTO Preparatory Commission has sent delegations to all the major NAM meetings.

The CTBTO Executive Secretary, Mr Tibor Tóth, met with high-level representatives from the following countries: Colombia, Cuba, Dominica, Guatemala, Lesotho, Mozambique, the Philippines, and Trinidad and Tobago.

In all of his contacts, Mr Tóth explored ways and means to promote signature and ratification of the Treaty and offered assistance by the Provisional Technical Secretariat. He also underlined the political and technical benefits of the verification regime, including its potential scientific and civil applications. In addition, he reported about the status of ratification and the build-up of the International Monitoring System network, and mentioned the opportunities for training and e-learning for Member States.

In the Final Document of the Summit Meeting, the Heads of State or Government stressed "the significance of achieving universal adherence to the CTBT, including by all nuclear weapon States, which should contribute to the process of nuclear disarmament." They reiterated that "if the objectives of the Treaty were to be fully realized, the continued commitment of all States Signatories, especially the nuclear weapon States, to nuclear disarmament would be essential." ■

Forensic seismology and CTBT verification …

By Professor Paul G. Richards

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Nuclear explosion monitoring entails a series of steps, beginning with detection of signals (did a particular station detect anything?) and association (can we gather all the different signals, recorded by different stations, that originate from the same 'event'?). The next steps involve making a location estimate and an identification (did it have the characteristics of an earthquake, a mining blast, a nuclear weapon test?). Then follow the steps of yield estimation (how big was it?) and attribution (if it was a nuclear test, what country carried it out?).

Many different technologies contribute to nuclear explosion monitoring, with seismology playing a major role in monitoring the underground and underwater environments of a possible nuclear test.

It is intrinsically difficult to do this work because there are so many events generating seismic signals. The International Seismological Centre, located in Berkshire, United Kingdom, provides the most thorough documentation of global seismicity. Its bulletin, published about two years in arrears, now reports several hundred events per day, most of them very small earthquakes occurring in well-monitored regions. Because the CTBT is a comprehensive ban on nuclear testing, all seismic events are potentially suspect and require some level of attention. But though monitoring is difficult, extensive resources are applied to do the work.

The fact that so many events are detected and located should not be seen so much as a problem in monitoring, but rather as a testament to the sensitivity of monitoring networks, which continue to improve in part because of ever-increasing needs to study earthquake hazards. The work of monitoring – for both earthquakes and explosions – is done in practice by hundreds of professionals who process the vast majority of seismic events routinely, and who also look out for the occasional events that in the context of CTBT verification exhibit interesting characteristics, and which may then become the subject of special studies.

These special events have stimulated the development of effective new discrimination techniques and a better appreciation of overall monitoring capability. Examples include a mine collapse in 1989 in Germany and two such collapses in 1995 (in Russia and in the United States); a small earthquake of magnitude 3.5 and its smaller aftershock in 1997 beneath the Kara Sea near Russia's former nuclear test site on Novaya Zemlya; and two underwater explosions in 2000 associated with the loss of a Russian submarine in the Barents Sea; the series of nuclear explosions carried out by India and Pakistan in 1998; and the nuclear test conducted by the Democratic People's Republic of Korea (DPRK) on 9 October 2006.

The mining collapses were seismically detected all over the world, and caused concern because their mix of surface waves and body waves as recorded at great distances from the source appeared explosion-like using the classical Ms: mb discriminant. In this method, the strength of surface waves (Ms) is compared with that of body waves (mb). For seismic sources of a certain size, as determined by their mb value, surface waves are significantly stronger for shallow earthquakes than they are for an underground explosion.

But a careful analysis of regional waves from these events showed that although the surface waves were quite weak, and in this respect seemed explosion-like, they had the wrong sign. Therefore the motion at the source was implosive (the ground had moved inward toward the source), rather than explosive. Indeed, mining collapses are an implosion

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