

BOROVOYE DIGITAL SEISMOGRAM ARCHIVE FOR UNDERGROUND NUCLEAR TESTS DURING 1966–1996

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Won-Young Kim and Paul G. Richards
Lamont-Doherty Earth Observatory of Columbia University
Palisades, NY 10964, USA

Vitaly Adushkin and Vladimir Ovtchinnikov
Institute for Dynamics of Geosphere, Moscow, Russia

Summary

Seismic waveform data digitally recorded at the Borovoye Geophysical Observatory (BRV), in northern Kazakstan since 1966 are available for analysis. The BRV archive for 711 Underground Nuclear Tests¹ (UNT) carried out by five nuclear powers since 1966 are reformatted into CSS 3.0² data format. The list of event numbers in the BRV archive for UNTs from various test sites is given in Table 1.

A major digital seismogram archive at Borovoye is being reformatted into a modern format suitable for analysis and preservation. Since 1991, the authors at the Lamont-Doherty Earth Observatory (LDEO) and at the Institute for Dynamics of Geosphere (IDG), Moscow have worked hard under the auspices of the IRIS Consortium, the Air Force Office of Scientific Research and Defense Threat Reduction Agency, U.S. Department of Defense, International Science and Technology Center (ISTC), Moscow, and other organizations to preserve the 30 years of digital seismogram archive at BRV (see a feature article in *EOS* by Richards, Kim and Ekström, 1992).

This release of the BRV digital seismogram data archive results from nearly 10 years of hard work by many engineers and analysts at IDG, Moscow. Drs. Nadezhda Belyashova and Natalia Mikhailova at the Institute of Geophysical Research, National Nuclear Center (NNC), Republic of Kazakstan helped to complete the BRV archive tape preservation project. Drs. Gregory van der Vink and David Simpson at the IRIS Consortium provided important help during the early years of the BRV archive preservation project. This note describes certain information regarding these waveform data archive and provides basic parameters needed to analyze them.

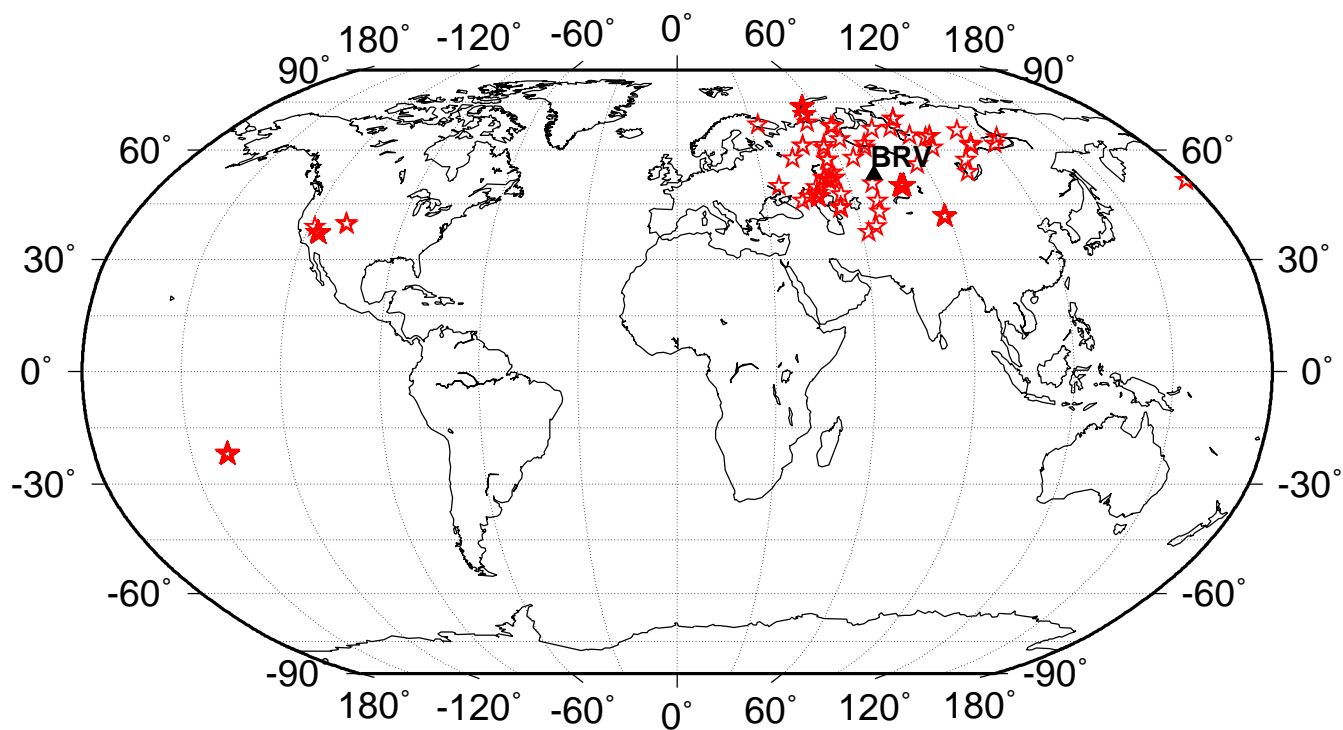
¹We shall use the distinction between a nuclear test and a nuclear explosion that was adopted in the revised protocol of 1990 for the Threshold Test Ban Treaty. Thus, a single underground nuclear test (UNT) can consist of a number of different underground nuclear explosions (UNEs) provided these are carried out within a time interval not exceeding 0.1 s and within an area delineated by a circle whose diameter is less than 2 km. Explosions with a time interval longer than 0.1 s, or a distance greater than 2 km, are counted as separate tests. We note that this distinction between UNTs and UNEs has been followed in official Russian documentation of the Soviet test program at STS, but with one exception, namely the nuclear test which was conducted at Degelen in a tunnel on January 30, 1974. (see Khalturin et al., 2001).

²Center for Seismic Studies version 3.0 relational database format.

Table 1: Borovoye Digital Archive for World-wide Underground Nuclear Tests, 1966–1996

| Country | Test site | Time period | BRV data |
|---|-----------------------------|---------------------------|----------|
| USSR | Semipalatinsk Test Site | 1966 Dec 18 – 1989 Oct 19 | 228 |
| | Novaya Zemlya | 1967 Oct 21 – 1990 Oct 24 | 31 |
| | Peaceful Nuclear Explosions | 1967 Oct 06 – 1988 Sep 06 | 80 |
| China | Lop Nor Test Site | 1970 Sep 22 – 1995 May 15 | 11 |
| France | Tuamotu Archipelago | 1977 Mar 19 – 1996 Jan 27 | 68 |
| United Kingdom | Nevada Test Site | 1978 Apr 11 – 1989 Dec 08 | 15 |
| United States | Nevada Test Site | 1967 May 23 – 1992 Mar 26 | 278 |
| Total number of UNTs in the BRV archive | | | 711 |

BRV Archive, Underground Nuclear Tests

Figure 1: The Borovoye archive for world-wide underground nuclear tests (*stars*) during 1966–1996.

1. Borovoye Archive for UNTs carried out by Former Soviet Union

Former Soviet Union (FSU or USSR) conducted its first nuclear test on August 29, 1949 and the last – 715th, nuclear test on October 24, 1990. The official publication from the Ministry of Atomic Energy & Ministry of Defense, Russian Federation (Mikhailov et al., 1996) lists a total of 715 nuclear tests and peaceful nuclear explosions. Among the 715 tests, 219 tests were atmospheric, underwater and space explosions, and remaining 496 tests were underground tests (see Table 2).

Table 2: Borovoye Archive for USSR Underground Nuclear Tests

| Location/Type | UNT | Air/Surface | Underwater | total | BRV archive |
|-----------------------------|------------|-------------|------------|------------|------------------|
| Semipalatinsk Test Site | 340 | 116 | | 456 | 228 |
| Novaya Zemlya Test Site | 39 | 86 | 5 | 130 | 31 |
| Peaceful Nuclear Explosions | 117 | | | 117 | 80 |
| Missile Test Range | | 10 | | 10 | |
| Weapons test | | 2 | | 2 | |
| Total | 496 | 214 | 5 | 715 | 339 (68%) |

Thus, the BRV archive provide data for about 2/3 of the announced UNTs at various test sites of the FSU.

2. BRV Archive Data from UNTs at Semipalatinsk Test Site, FSU

Official Russian publications (Mikhailov et al., 1996; USSR Nuclear Tests, 1997) have listed 340 underground nuclear tests that were conducted during 1961-1989 at the Semipalatinsk Test Site (STS) in Eastern Kazakstan. Only 271 of these nuclear tests appear to have been described with well-determined origin time, coordinates and magnitudes in the openly available technical literature (Khalturin et al., 2001). Thus, if we count only these 271 UNTs, then the BRV archive provide data for nearly 85% of these UNTs at Semipalatinsk Test Site.

In Figure 2, we show a map of the Semipalatinsk Test Site boundaries (as reported by the Soviet Union at the time of TTBT entry-into-force in 1990), together with the locations of 228 UNTs with BRV archive data. There are three source regions of the seismic data from UNTs at Semipalatinsk Test Site as shown in Figure 2. These are known as Balapan, Degelen and Murzhik subareas.

2.1 BRV Archive Data for Balapan Subarea of the Semipalatinsk Test Site

105 UNTs were conducted at Balapan subarea of the STS during 1965-1989. Among these, one UNT had yield of less than 1 ton and could not be identified by seismic method (see Mikhailov et al., 1996). BRV archive contains seismic data from 93 UNTs. These are listed in Table A1 and are plotted in Figure 2. Borovoye archive covers seismic data from over 90% of all

Semipalatinsk Test Site

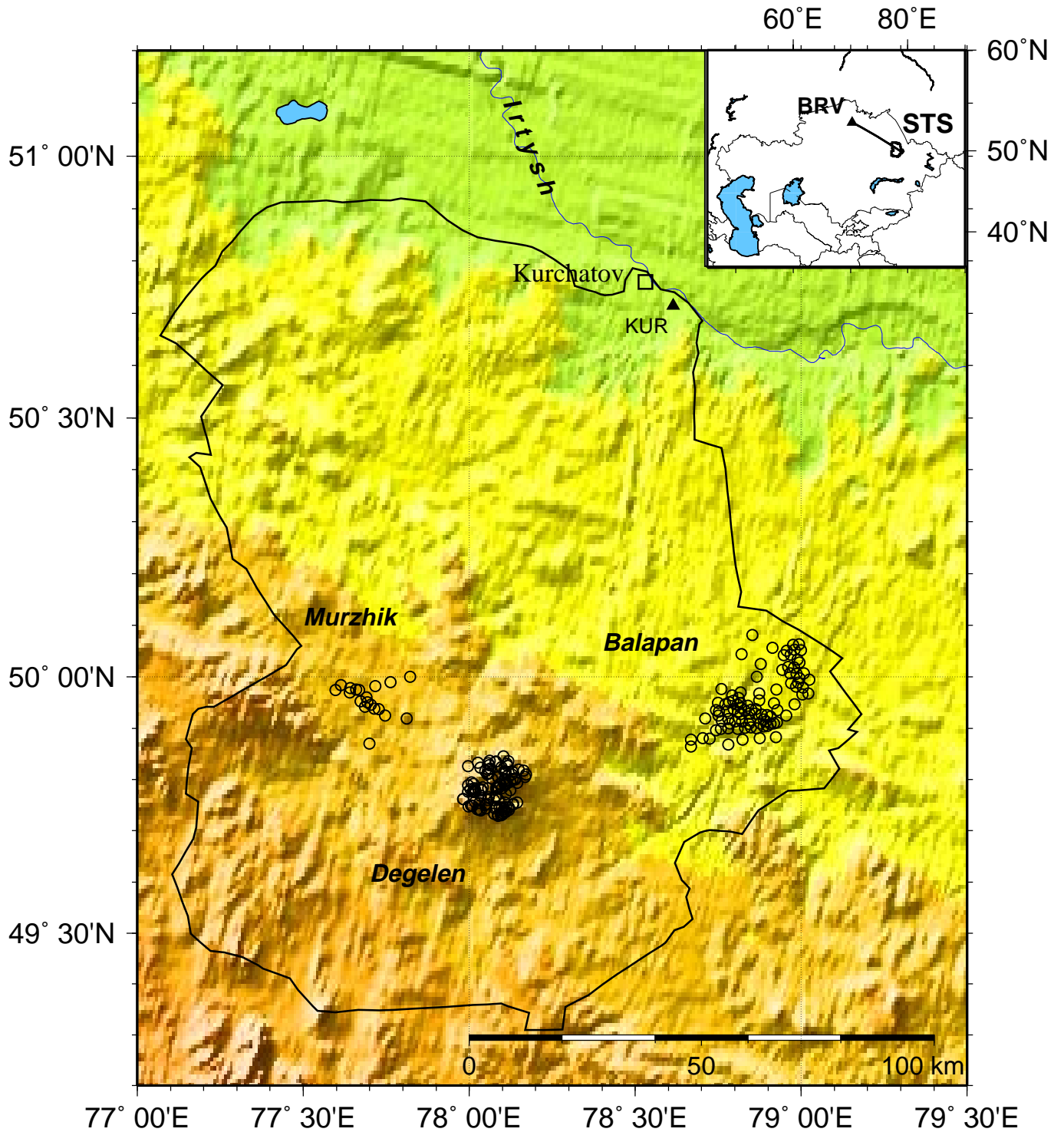


Figure 2: UNTs at Semipalatinsk Test Site (*circles*) recorded at Borovoye (BRV) during 1966-1989. Kurchatov was a restricted town supporting USSR nuclear testing in the region.

Table 3: Underground Nuclear Tests at the Semipalatinsk Test Site

| Location/subarea | UNT | <1 ton | Double | small | Detectable | BRV archive |
|-------------------------|-----|--------|--------|-------|------------|-------------|
| Balapan | 105 | 1 | 1 | 3 | 100 | 93 |
| Degelen | 209 | 14 | 12 | 26 | 155 | 116 |
| Murzhik | 26 | | 1 | 2 | 23 | 19 |
| Semipalatinsk Test Site | 340 | 15 | 14 | 31 | 278 | 228 |

UNTs conducted at Balapan subarea. For UNTs at Balapan subarea until Dec. 1972, ground truth information on location and origin times are taken from Bocharov (1989; see also Vergino, 1989). For UNTs since 1973, the location are from the ground truth information available from National Nuclear Center, Republic of Kazakstan (NNCRK; 1999), while the origin times are taken from the Lilwall and Farthing (1990) of the British Atomic Weapons Establishment (AWE). We take the body-wave magnitude given in Ringdal et al. (1992), which are the maximum likelihood mb's determined by AWE. All UNTs at the Balapan subarea were carried out in vertical shafts drilled down to about 500 m from the ground level. The Balapan subarea is nearly flat with an average elevation of about 300 m. Accurate origin times for 10 UNTs during 1985–1989 are given in Adushkin et al. (1997). These origin times are used to evaluate origin times of other UNTs since 1973 given in various catalogs. Our evaluation indicates that the origin times and location biases in the AWE catalog³ are smallest among the available catalogs. Our analysis indicates that the AWE origin times should be accurate within ± 0.15 sec.

2.2 BRV Archive Data for UNTs at Degelen Subarea of the Semipalatinsk Test Site

There are waveform data from 116 UNT at Degelen Mt. region of the STS in the BRV archive. Table A2 lists date, time, location and magnitude of these UNTs. Almost all UNTs in the Degelen subarea have been carried out in horizontal tunnels dug into granitic rocks of the Degelen Mt. For most UNTs till 1972, ground truth data are given in Bocharov (1989). For UNTs between 1973-1989, location is given for the portal of the tunnel (Leith, 1998), while the origin times are taken from Lilwall and Farthing (1990) of the British Atomic Weapons Establishment. Although, the locations are given up to five decimal digits, the accuracy of the actual shot points can be away from the given locations by as much as few hundred meters, thus these locations could be considered GT2 quality⁴

Notice that BRV waveform data archive contains four pairs of UNTs at STS which were exploded almost simultaneously, or within a short time interval, less than 10 sec (see Table 4).

The BRV archive also contains waveform data from three small UNTs at Degelen subarea which were not well documented in the open literature (see Khalturin et al., 2001). These UNTs are; Sep. 02, 1967 (#271), Jan. 29, 1971 (#332) and Dec. 28, 1988 (#707)(see Table A2).

³joint epicenter determination (JED) method described by Douglas (1967) to ISC data are use to obtain origin times and locations, using several UNTs at STS as master events for which ground truth information was given by Bocharov et al. (1989; also Vergino, 1989).

⁴GT2 is used here to indicate ground truth data with location accuracy of about ± 2 km.

Table 4: BRV archive for UNTs at STS which were detonated almost simultaneously

| Date | Time (hh:mm:sec) | $m_b(P)$ | Test id | Test site |
|---------------|------------------|----------|---------|-----------|
| Dec. 10, 1972 | 04:27:00.0 | 5.72 | 376 | Degelen |
| | 04:27:10.0 | 5.96 | 377 | Balapan |
| Oct. 29, 1977 | 03:06:59.97 | 5.60 | 473 | Degelen |
| | 03:07:04.92 | 5.56 | 474 | Balapan |
| Aug. 29, 1978 | 02:36:59.95 | 5.20 | 493 | Degelen |
| | 02:37:08.75 | 5.90 | 494 | Balapan |
| Nov. 29, 1978 | 04:33:00.17 | 5.21 | 507 | Degelen |
| | 04:33:04.99 | 5.96 | 506 | Balapan |

2.3 BRV Archive Data for UNTs at Murzhik Subarea of the Semipalatinsk Test Site

Waveform data from 19 UNTs from the Murzhik subarea in the STS are included in the BRV archive database (see Table A3). Locations and origin times for 13 UNTs from 1966 through 1972, are taken from Bocharov (1989). For UNTs since 1973 at Murzhik subarea, so far no ground truth data are available and the locations and origin times of six UNTs since 1973 through 1980, are taken from Lilwall and Farthing (1990). Note that for the UNT on Aug. 4, 1976, location and origin time are taken from Khalturin et al. (2001).

3. Borovoye Archive Data for UNTs at Novaya Zemlya Test Site

There are 39 UNTs at Novaya Zemlya Test Site (see Mikhailov et al., 1996) and the BRV archive provide seismic records from 31 UNTs. Table A4 lists parameters for BRV archive data from UNTs at Novaya Zemlya Test Site. Location, origin time and maximum likelihood body-wave magnitude are taken from Marshall et al. (1994). Note that longitude given in Marshall et al. (1994) is moved to the West by 0.009° as indicated by Richards (2000). Most of the UNTs conducted at the NZ Test Site are multiple explosions (see Table A4). In Figure 3, we show a map of the Northern and Southern Test Site boundaries of the Novaya Zemlya test sites (as reported by the Soviet Union at the time of TTBT entry-into-force in 1990), together with the locations of 31 UNTs with BRV archive data. Most of the UNTs are conducted in tunnels dug in the mountains south of the Matochkin Shar Strait as shown in Figure 3. Three UNTs with BRV archive data are conducted in vertical shafts at the southern Novaya Zemlya Test Site (Test No. 388, 392, 430 and 431 in Table A4).

4. Borovoye Archive Data for Peaceful Nuclear Explosions in FSU

The Former Soviet Union carried out 117 Peaceful Nuclear Explosions (PNE)⁵ throughout its territory as shown in Figure 4. BRV archive contains 80 PNEs which are listed in Table A5. Ground truth data are available for many of these PNEs (see Sultanov et al., 1999). Epicentral

⁵Here we are taking the definition of a PNE as a nuclear test conducted off recognized test sites.

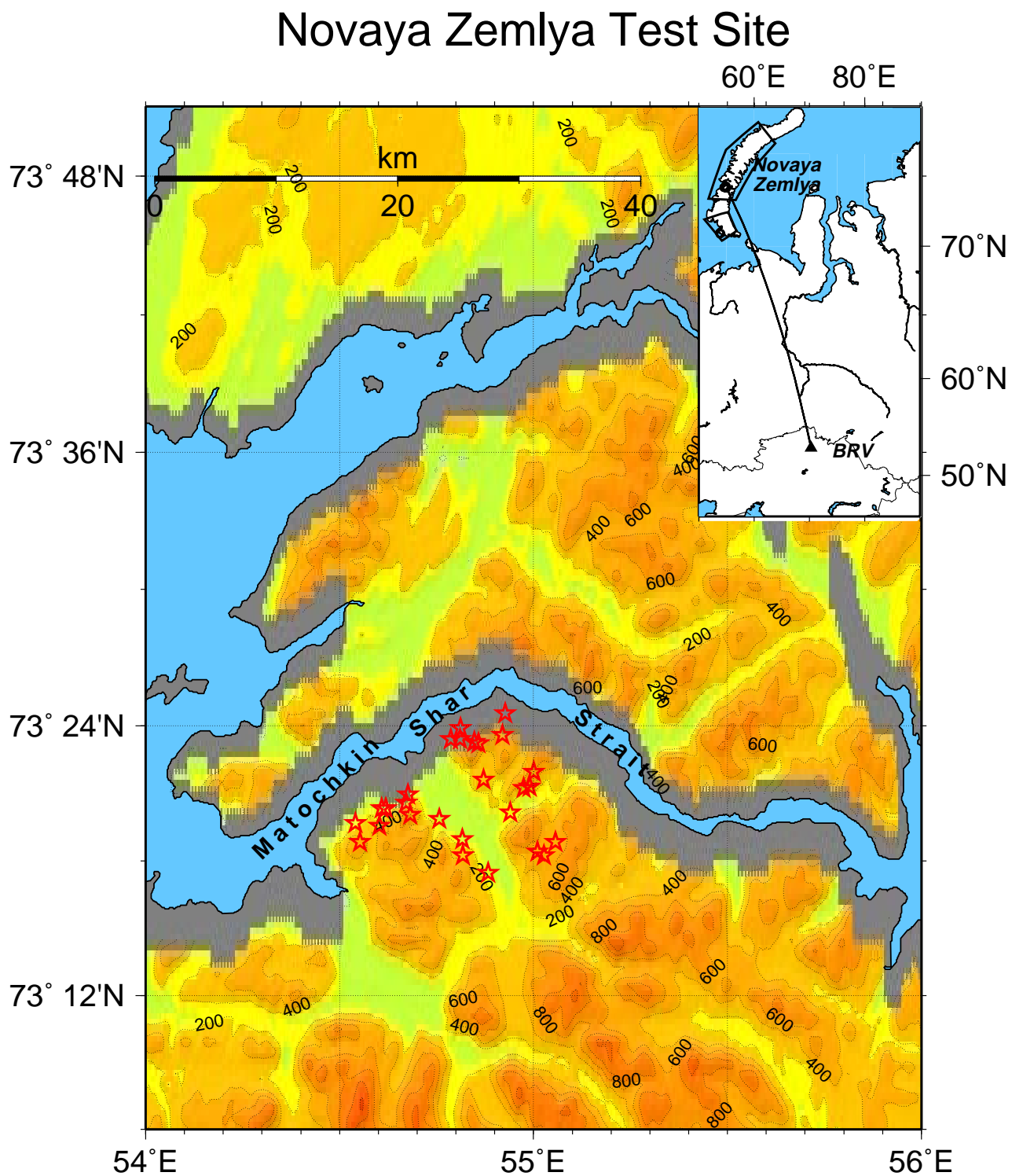


Figure 3: Locations of UNTs (*circles*) at Northern Novaya Zemlya Test Sites recorded at Borovoye during 1967-1990 are shown on topographic relief map. Southern and Northern Test Sites on Novaya Zemlya and great circle path between BRV and NZ test site is indicated (*inset*).

distance ranges from 2.8° to 29.7° from BRV and have a wide azimuthal coverage providing excellent data for studies of regional seismic wave propagation in Central Asia (see Figure 4). We will show an example waveform to illustrate the quality of the BRV archive data.

PNE on Oct. 17, 1978, 14:00:00.16

This PNE is conducted in Tyumen region at a location 63.185°N, 63.432°E and depth of burial of 593 meters (Sultanov et al., 1998). The event id is #503 (see Table A5) which is also called “Kraton” shaft KR-1 and had a yield of 22 kt. It was detonated in sandstone/shale material and had magnitude, $m_b(P)=5.5$. Figure 4 shows the location of the event (#503 in the figure).

The waveform data are recorded by STsR-SS 10-channel system, which has three-component, short-period seismometers (KS channels) and records with sampling rate of 31.25 samples per second ($dt=0.032$ s, $fN=15.6$ Hz) – channel names sZ07, sN08, and sE09. SS system also has three-component long-period seismometers (channels IZ02, IN03 and IE04), and a low-gain short-period vertical-component (channel, sZ01). Three channels (5, 6 and 10) are usually unused for recording seismic signals.

The instrument responses of KS channels are nearly flat to ground displacement between 0.6 to 5 Hz with a nominal gain of 1268 counts/micrometer at 1.5 Hz (Figure 11; Kim & Ekström, 1996). The vertical record from this PNE has peak amplitude of 842 counts which yields ground displacement of about 0.68 micrometer. Note that maximum digital counts available for the Borovoye digital archive data is 1024 counts (11 bit A/D with a sign bit).

For comparing the regional records from the Borovoye digital archive data with those recorded by recent broadband instrument from IMS and IRIS/GSN stations, it is useful to differentiate the BRV records, since they are recorded with the instrument response which produces nearly ground displacement records (see, Richards, Kim & Ekström, 1992).

The velocity record from this PNE is plotted in Figure 5. The vertical records in various frequency bands - 0.5–2 Hz through 8–10 Hz, are plotted with time axis in group velocity (km/s). Notice that regional characteristic phases, P_n , P_g , S_n and L_g are all well excited by the test. The P waves (P_n and P_g) as well as S_n waves are energetic at all frequency bands with strong coda following the onset arrivals, while L_g waves are relatively weak and show larger amplitude, but short duration (at around 3.3 km/s). The strong signal arrives at around 3 km/s cannot be easily identified. In general, the quality of the record is satisfactory. Notice that one of the short-period horizontal component record (sE09) is clipped.

To examine the periodicity of the signal, we calculate the spectrogram (Figure 6). The spectrogram shows time invariant spectral bands at 3.5, 6, 9.5 and 11.5 Hz which are usually associated with source multiplicity (see e.g., Kim et al, 1994). The average frequency difference (df) between these spectral banding is about 2.7 Hz which suggests a multiple source with time difference of about 0.4 sec (Figure 7).

In case of ripple fired quarry blasts or underwater explosions, complex interference pattern as well as spectral bandings due to source multiplicity and reverberations in the water column lowers the P_n/S_n ratios as noted by Kim et al. (1993, 1994 and 1996). Hence, relatively low P_n/S_n ratios of this PNE are not unusual. In such case, spectral bandings and cepstral peaks should be used as additional event screening criteria (see Annex 2 to the CTBT Protocol, September 1996).

PNE Centered at Borovoye

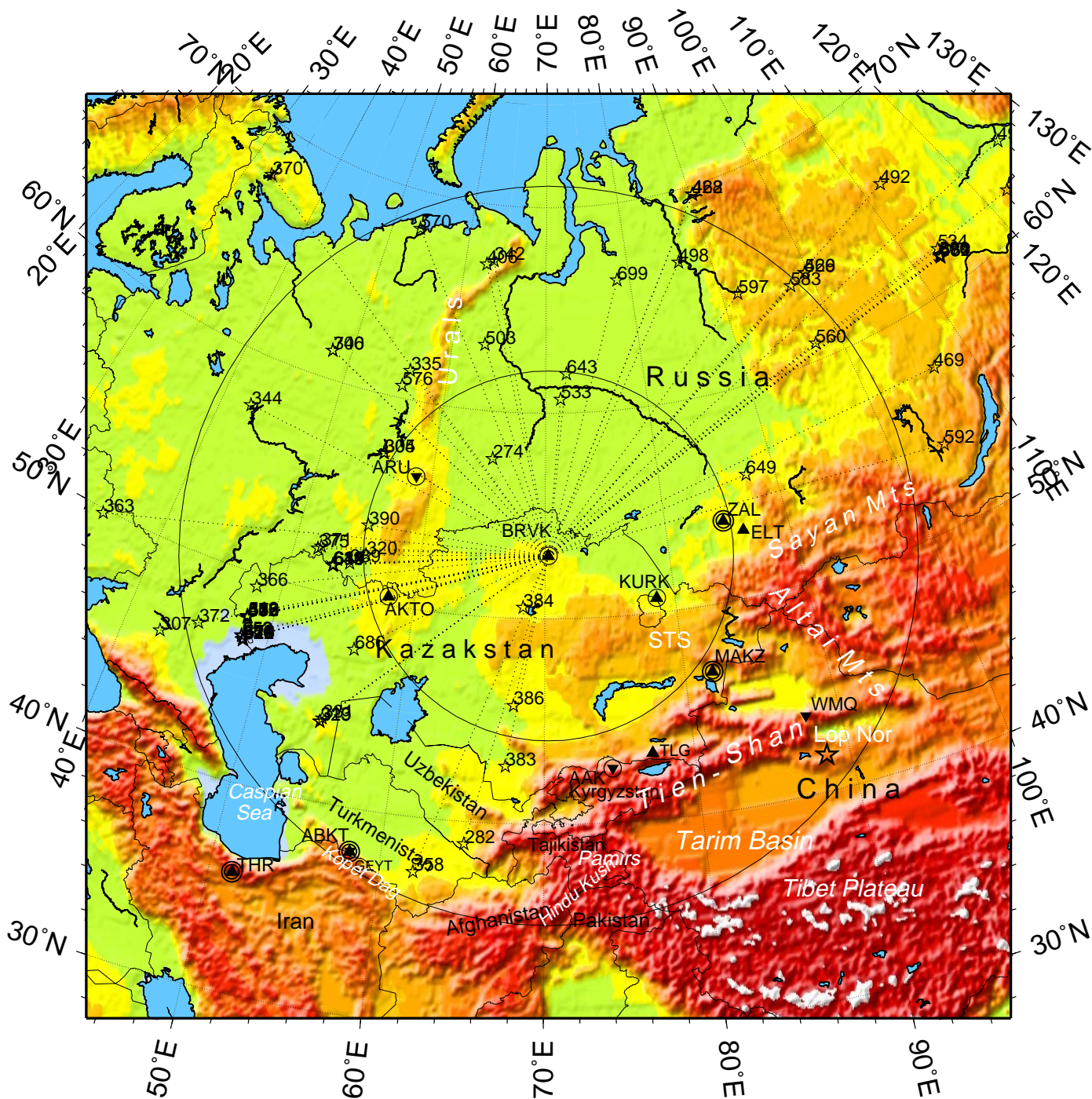


Figure 4: Soviet PNEs (*stars*) recorded at Borovoye during 1967-1988. Event id in Table 5A is indicated for each PNE. IMS primary (*double circle*), auxiliary (*single circle*), IRIS/GSN (*inverted triangle*) and Kazakstan Broadband Seismographic Network stations are indicated (*solid triangle*). Large circles around BRV indicate 1000 and 2000 km distance ranges from the station.

10/17/78, 14:00:00.16, 63.185°N, 63.432°E, h=593 m, PNE, Kraton shaft KR-1, 22 kT, mb=5.5, Sandstone/Shale

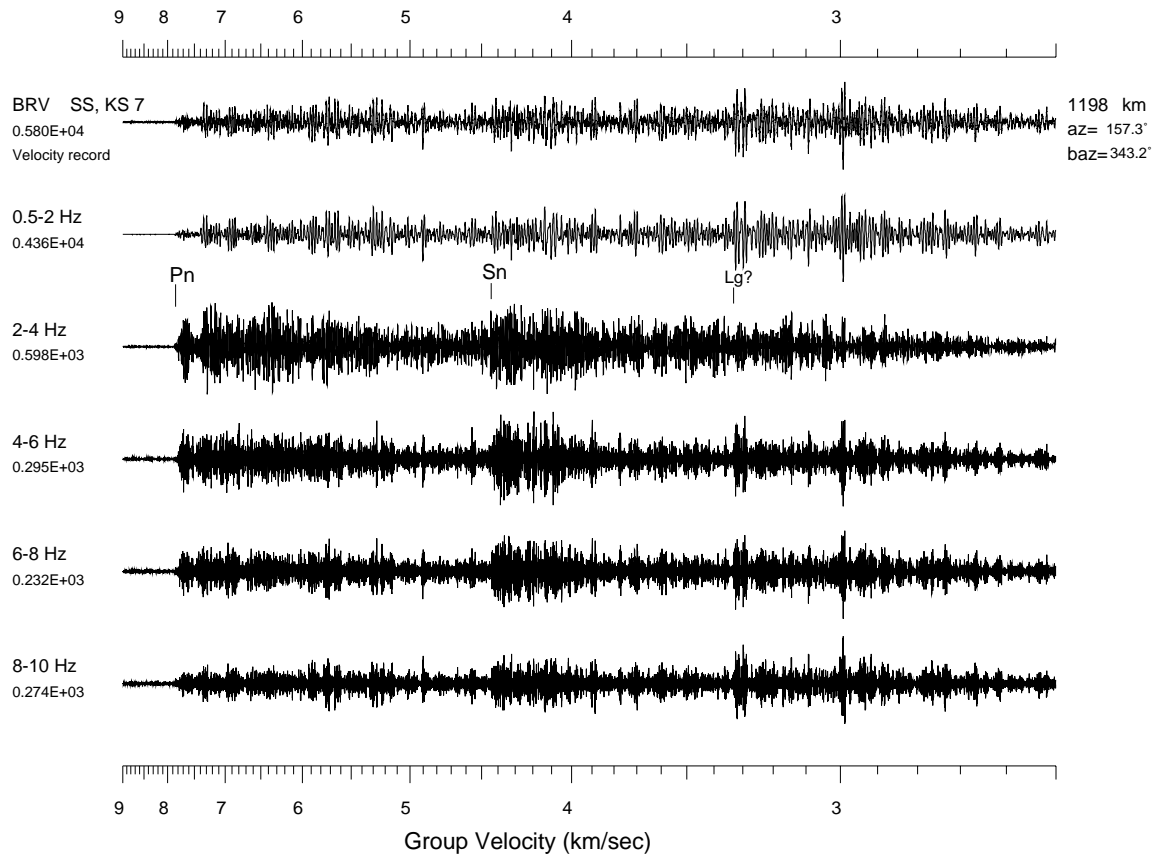


Figure 5: Vertical, velocity record filtered in various frequency bands – 0.5–2 Hz through 8–10 Hz, are plotted with time axis in group velocity (km/s). The *P* waves (*Pn* and *Pg*) as well as *Sn* waves are energetic at all frequency bands with strong coda following the onset arrivals, while *Lg* waves are relatively weak.

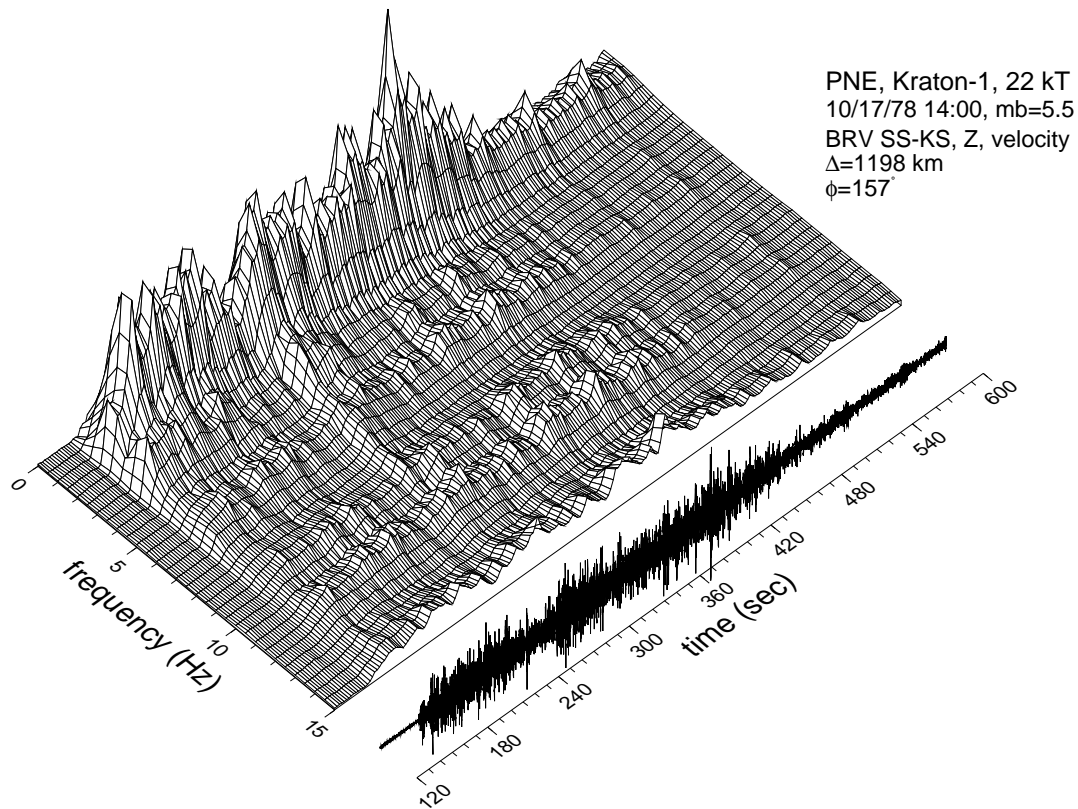


Figure 6: Spectrogram of the velocity record from PNE on 10/17/78. The spectrogram shows time invariant spectral bands at 3.5, 6, 9.5, 11.5 Hz which are usually associated with source multiplicity.

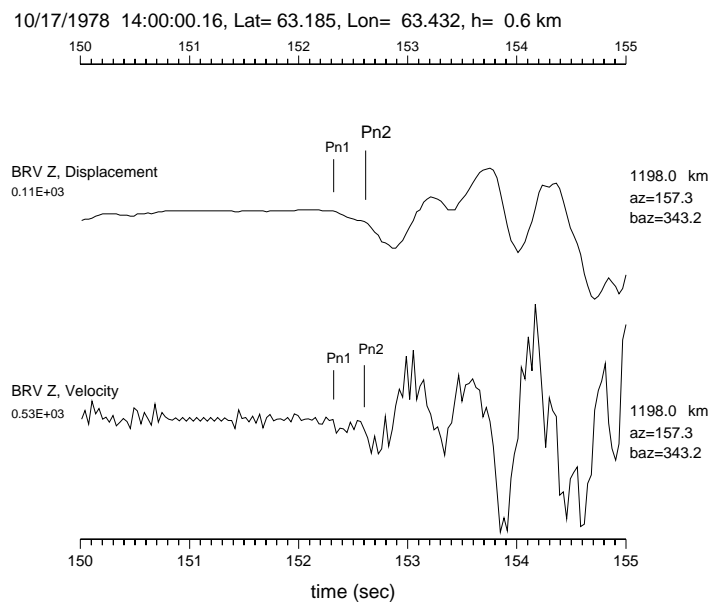


Figure 7: First few seconds of the records from the PNE on 10/17/78 are plotted to show possible multiple Pn arrivals marked as $Pn1$ & $Pn2$.

5. Borovoye Archive Data for Chinese Nuclear Tests

Since 1964, China carried out nuclear tests in Xinjiang-Uygru Autonomous Province in western China. During 1969 through 1996, 22 UNT are known to have been conducted at the Lop Nor Chinese Test Site. Borovoye archive has waveform data from 11 UNTs as listed in Table A6. The epicentral distance from the Chinese Test Site to BRV is about 1800 km. The locations and origin times of the UNTs at Lop Nor during 1969-1992 are determined by Douglas et al. (1993) and Gupta (1995) by using JED method. Engdahl (2001) also re-located most of the Chinese UNTs by cluster analysis. The locations given by Engdahl are plotted in Figure 8 and are given in Table A6. As noted by Douglas et al. (1993), epicenters of the UNTs at Lop Nor are clustered into three groups; A, B and C (see Figure 8). According to the topography and geology, it was argued that UNTs in subregion A are in vertical shafts, while UNTs in subregions B and C are detonated in horizontal tunnels.

6. Borovoye Archive Data for French Nuclear Test

France carried out over 190 nuclear tests at the Pacific Test Center – Tuamotu Archipelago, French Polynesia, during July 2, 1966 through July, 15, 1996. 137 UNTs were carried out in the region around Mururoa Atoll, Tuamotu Archipelago, while 10 UNTs were carried out in the region around Fangataufa Lagoon. The Borovoye archive provides waveform data from 68 tests at the French Polynesia test sites as listed in Table A7.

For seven UNTs at Tuamotu Archipelago, no seismologically determined locations are available in open literature. These are listed on official French list with nominal time and location (22°S, 139°W). These UNTs are listed in Table A7 with their “Site” column denoted as “-” (null) entries. Locations of the 61 UNTs of which we have BRV archive data, carried out by France at Tuamotu Archipelago, French Polynesia Test Site are plotted in Figure 9.

The distance range from the UNTs at the French Polynesia test sites to Borovoye is about 141.7° with station to event azimuth of about 47°. At this distance, *PKIKP* phase, which traveled through the inner core of the Earth is the first arrival *P* wave.

Note that France carried out four atmospheric nuclear tests at the Reggane, Algeria (26.17°N, 0.08°E) during 1960-1961. 13 UNTs were carried out at Hoggar, Algeria (24.05°N, 5.05°E; Sahara Desert) test site during 1961 through 1966. Unfortunately, none of these tests in the Sahara Desert are available in the Borovoye archive.

7. Borovoye Archive Data for U.S. Nuclear Tests

The United States conducted 1,054 nuclear tests of which 815 (plus 24 jointly with U.K.) were UNT (DOE/NV209 REV-15, Dec. 2000) from July 1945 through September 1992 (see Table 5). The BRV archive has waveform data from a total of 278 nuclear tests conducted by the US from May 1967 through March 1992. These UNTs are plotted in Figure 10 and are listed in Table A8.

Ground truth information on the nuclear tests in the US were published in 1971 and 1973 for years 1961–1970 and 1971–1973, respectively by Springer & Kinnaman (1971 & 1973). In the latest publication by DoE (see DoE/NV209 Rev 15, Dec. 2000), detonation times and locations

Lop Nor Test Site

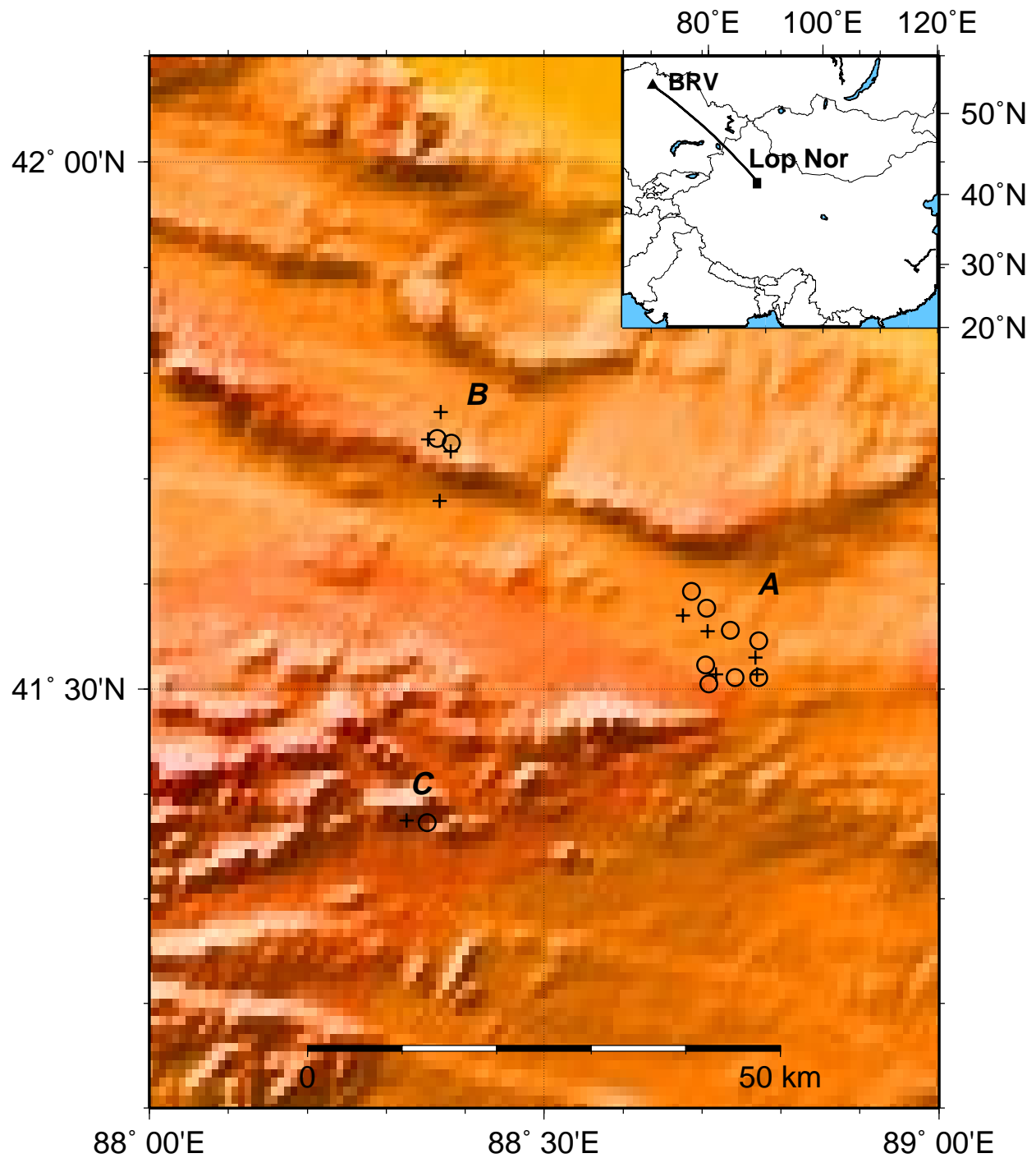


Figure 8: Locations of the UNTs at Lop Nor Chinese Test Site . Notice that UNTs are clustered into three groups: A, B and C. UNTs not contained in the BRV archive are plotted with crosses.

French Nuclear Tests

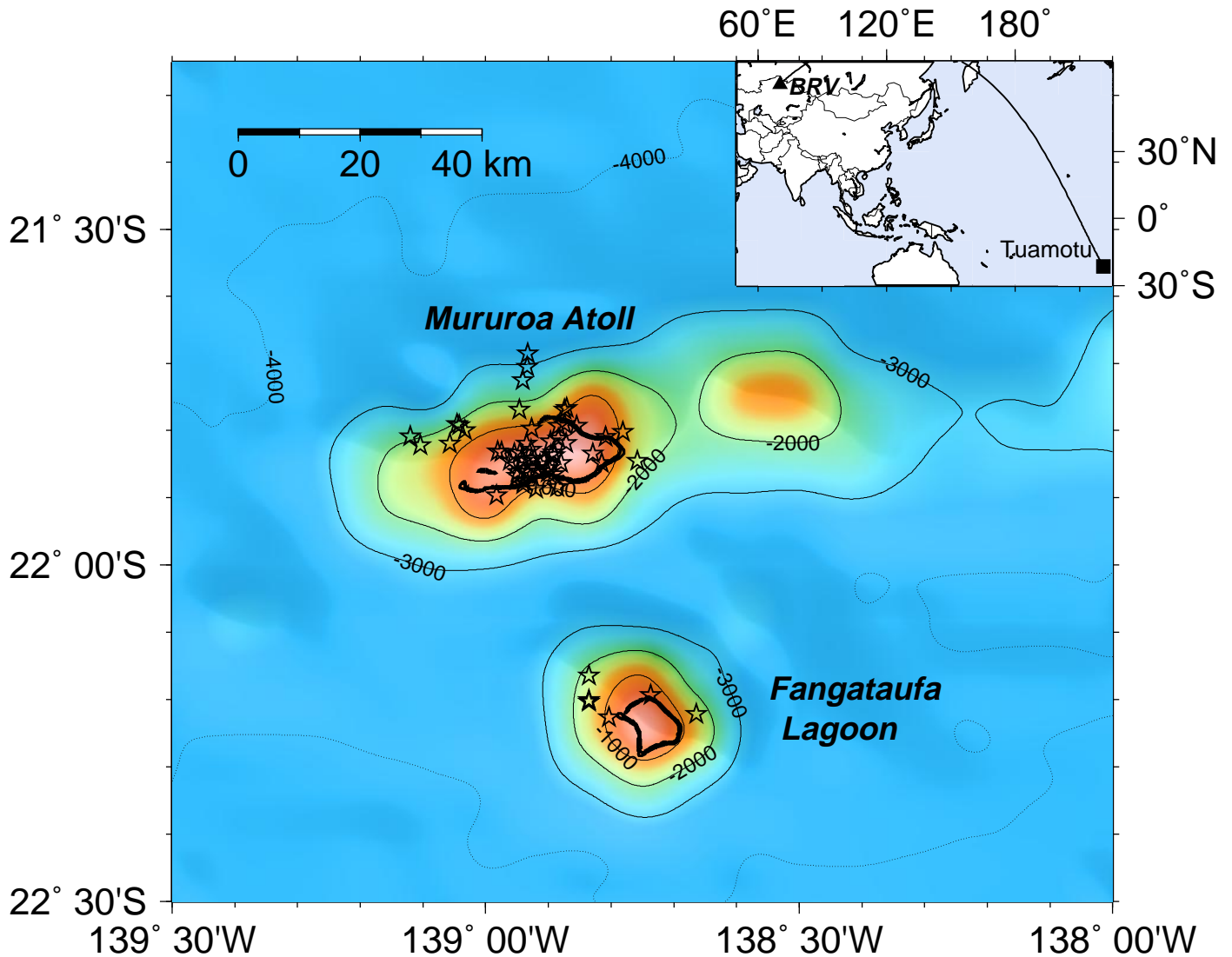


Figure 9: Locations of the French UNTs at Tuamotu Archipelago, French Polynesia. Notice that UNTs are clustered into two areas: Mururoa Atoll and Fangataufa Lagoon.

(latitude, longitude, and surface elevation) are included and are intended for use in the calibration of seismic stations that are part of the International Monitoring System (IMS) called for in the Comprehensive Nuclear Test Ban Treaty (CTBT).

Table 5: United States Nuclear Tests - Total - By Location

| Location | US | US-UK |
|--------------------------|--------------|-----------|
| Total South Atlantic | 3 | - |
| Bikini | 23 | - |
| Christmas Island | 24 | - |
| Enewetak | 43 | - |
| Johnston Island | 12 | - |
| Pacific | 4 | - |
| Total Pacific | 106 | - |
| Alamogordo, New Mexico | 1 | - |
| Amchitka, Alaska | 3 | - |
| Carlsbad, New Mexico | 1 | - |
| Central Nevada | 1 | - |
| Fallon, Nevada | 1 | - |
| Farmington, New Mexico | 1 | - |
| Grand Valley, Colorado | 1 | - |
| Hattiesburg, Mississippi | 2 | - |
| Nellis Air Force Range | 5 | - |
| Rifle, Colorado | 1 | - |
| Total Other | 17 | - |
| Atmospheric, NTS | 100 | - |
| Underground, NTS | 804 | 24 |
| Total NTS | 904 | 24 |
| TOTAL TESTS | 1,030 | 24 |

Time calibrations are obtained from the National Institute of Standards and Technology WWV radio stations. Tests were typically planned to be detonated on the exact hour, minute, or second. However, the firing systems always introduce some delay so that the actual detonation time could be as much as 150 milliseconds later than intended. When this delay is available, detonation times are given to the nearest 0.01 second, uncorrected for WWV propagation, otherwise a default value of 0.00 is given.

Latitude and **longitude** locations are the surface-ground-zero location of the drill hole or other emplacement location. Locations and surface elevations were originally surveyed in the respective State Plane Coordinates, North American Datum of 1927. These were then converted to latitude and longitude using the 1984 reference spheroid and surface elevation corrections. These corrections apply to all U.S. tests except for those in Alaska. These coordinates are presented to an accuracy of 0.001 degree or approximately 100 meters.

8. Borovoye Archive Data for British Nuclear Tests

Nevada Test Site

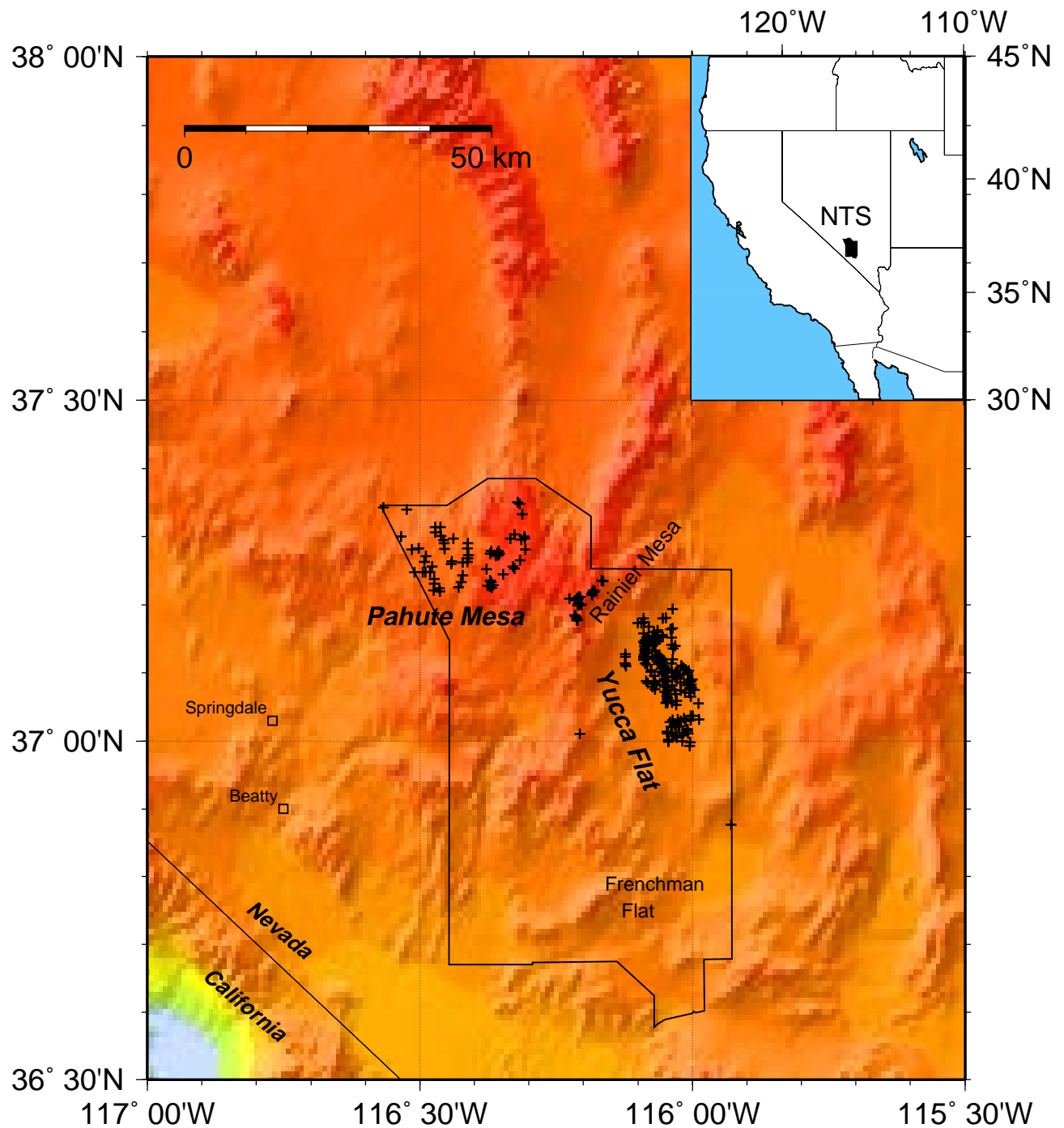


Figure 10: Locations of the UNTs carried out by the United States and jointly with United Kingdom at the Nevada Test Site (*crosses*). Most of the UNTs were clustered at Pahute Mesa, Yucca Flat and Rainier Mesa.

From October 3, 1952 through November 26, 1991, the United Kingdom conducted 45 nuclear tests of which 24 were UNTs carried out jointly with the United States at the Nevada Test Site (Table 6; Bolt, 1976). The BRV archive has waveform data from a total of 15 underground nuclear tests conducted by the U.K. from 1978 through 1989 at NTS (DOE/NV209 REV-15, Dec. 2000). These UNTs are plotted in Figure 10 and are listed in Table A9.

Table 6: United Kingdom Nuclear Tests - Total - By Location

| Location | Time period | Lat. | Long. | Atmospheric | UNT |
|----------------------------------|-------------|--------|---------|-------------|-----------|
| Monte Bello Island, W. Australia | 1952-1956 | 20.3°S | 115.5°E | 3 | - |
| Emu Field, S. Australia | 1953 | 28.7°S | 132.4°E | 2 | - |
| Maralinga, S. Australia | 1956-1957 | 30.2°S | 131.2°E | 7 | - |
| Malden Island, Line Islands | 1957 | 4.3°S | 154.3°W | 3 | - |
| Christmas Island, Line Islands | 1957-1958 | 1.7°N | 157.3°W | 6 | - |
| Nevada Test Site | 1962-1991 | 37.0°N | 116.0°W | - | 24 |
| TOTAL TESTS | | | | 21 | 24 |

9. Brief Description on Instrument Responses of the Borovoye STsR-TSG System

Three main seismograph systems have been used at Borovoye since 1965. They are; KOD system operated from 1966–Nov 1973 and had polarity reversal on all channels; STsR-SS system was operating from Feb 1973 to July 1994 and STsR-TSG system operating from Feb 1973 to July 1994. An additional system, called ASSTs, has been operated from Apr 1990 to July 1994. Instruments used at BRV during 1966–1996 are given in Table 7.

Instrument responses are included in the CSS 3.0 database. Most of the responses are given in discrete form as fap (frequency-amplitude-phase) files for particular channels and time period. Channel names, sample rates and nominal gains are also given in Table 7. Figure 11 shows the nominal amplitude response of the 24-channel STsR-TSG system (see Kim & Ekström, 1996).

BRV Archive Seismogram Data Format & Dropoffs

The original archive tapes at BRV were recorded by LMR-3 (June 1966 - Nov. 1973) and LMR-6 (Feb 1973 - July 1994) digital recorders (Adushkin & An, 1990), and these data loggers wrote up to 24 channels of digital data in 17 track, wide tape (35 mm). Each data sample is 16 bit (two-byte unsigned integer) and the data values are encoded in the lowest 11 bits (bits 0-11; bit 0 being the least significant bit). Therefore, data values range from 0 to 2047 unsigned integers. Four bits (bits 12 through 15) of the two-byte samples are not used, except the first 64 bytes of the first blocks, where the *time stamp* is encoded in bits 12 through 15. The time stamp provides information on channel number, digitizing interval, date, record start time (to nearest msec) and time correction.

Note that there are several drop offs of data points which were represented as “null” value in the original data. These drop offs were known to be due to the “time stamping” process in the original recording stage at BRV (Shishkevish, 1975). There are also “null” data values toward the end of the trace, and these are believed to be due to filling “null” values to fill the requested

Table 7: Instrument Characteristics at Borovoye (BRV)^(*)

| System name | Seismometer | Channel type | Ts ⁽¹⁾ (sec) | Ds ⁽²⁾ | Sm ⁽³⁾ (counts/ μ m) | fn ⁽⁴⁾ (Hz) | dt ⁽⁵⁾ (msec) | Channel number |
|-----------------|-------------|-------------------|----------------------------|-------------------|--|---------------------------|-----------------------------|----------------|
| KOD | SKM-3 | HG ⁽⁶⁾ | 3.5 | 1.0 | 3000 | 2.0 | 30 | 1,3,4 |
| | | LG(Z) | | | 300 | 2.0 | 30 | - |
| | SKD | | 30.0 | 0.71 | | | | - |
| STsR-SS | SKM-3 | HG | 2.0 | 0.5 | 2000 | 1.8 | 24 | 7,8,9 |
| | | (76-80) | | | 1000 | 1.8 | 32 | 7,8,9 |
| | | LG(Z) | | | 200 | 1.8 | 32 | 1 |
| | | | | | | 20 | 1.8 | 96 |
| | SKD | HG | 25.0 | 0.71 | 5 | 0.14 | 192 | 2,3,4 |
| | | | | | 0.5 | 0.14 | 192 | 1,5,10 |
| STsR-TSG | KS | HG | 1.5 | 0.71 | 4500 | 2.37 | 26 | 7,8,9 |
| | | (1977) | | | 2000 | 2.37 | 26 | 7,8,9 |
| | | | | | 1000 | 2.37 | 26 | 4,5 |
| | KSM | HG | 1.5 | 0.5 | 100000 | 1.43 | 26 | 10,11,12 |
| | | LG(Z) | | | 1000 | 1.43 | 26 | 3 |
| | KSVM | HG(Z) | 1.5 | 0.5 | 4600 | 1.43 | 26 | 2 |
| LG(Z) | | | | 50 | 1.43 | 26 | 1 | |
| DS | HG | 20.0 | 0.71 | 50 | 0.1 | 312 | 19,20,21 | |
| DSM | HG | 28.0 | 0.71 | 1000 | 0.07 | 312 | 22,23,24 | |
| | LG | | | 10 | 0.07 | 312 | 15,16,17 | |
| ASSTs | SSM-S | | 2.0 | - | 250 | - | - | - |

(*) KOD system operated from 1966–Nov 1973 and had polarity reversal on all channels, STsR system is operating from Feb 1973 to present, and ASSTs is operating from Apr 1990 to present.

(1) Ts = Seismometer natural period in second.

(2) Ds = Seismometer damping constant, critical damping = 0.71.

(3) Sm = Nominal sensitivity (gain) in count/micron for ground displacement.

(4) fn = Normalization frequency where nominal sensitivity is measured.

(5) dt = Sampling interval in millisecond.

(6) HG is actually the base channel and not necessarily a high-gain; LG = low-gain channels and (Z) indicates that it is only vertical component.

N.B., Nominal gains have changed from time to time, for example, during 1976-1980 data on SS-SKM channels and on 1977 data for TSG-KS channels.

time window when data were played back from the original 17-track tape in order to write the ADM format files.

It should be noted for these archive data that the data are of variable quality. Some signals are badly clipped. However, for some examples the data are of excellent quality.

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This has been a ten year project which started in the spring of 1991 with earlier support from the Joint Seismic Program (JSP) of the IRIS Consortium (IRIS Subawards #174 and #214 to LDEO and Subaward #201 to IDG) for copying aging original 35 mm magnetic tapes followed by reformatting the digital data into more readily useful data format. Throughout 1990's, we received partial supports from many agencies such as, AFOSR (under contract F49620-92-J-0497 to LDEO) and DTRA (under contracts DSWA01-97-C-0156, DSWA01-98-C-0152 and DTRA-01-00C-0031 all to LDEO). IDG received a major financial support from the International Science and Technology Center (ISTC) in Moscow through three-year ISTC Project K-063 (Aug., 1997–Aug., 2000).

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STsR-TSG Seismic System

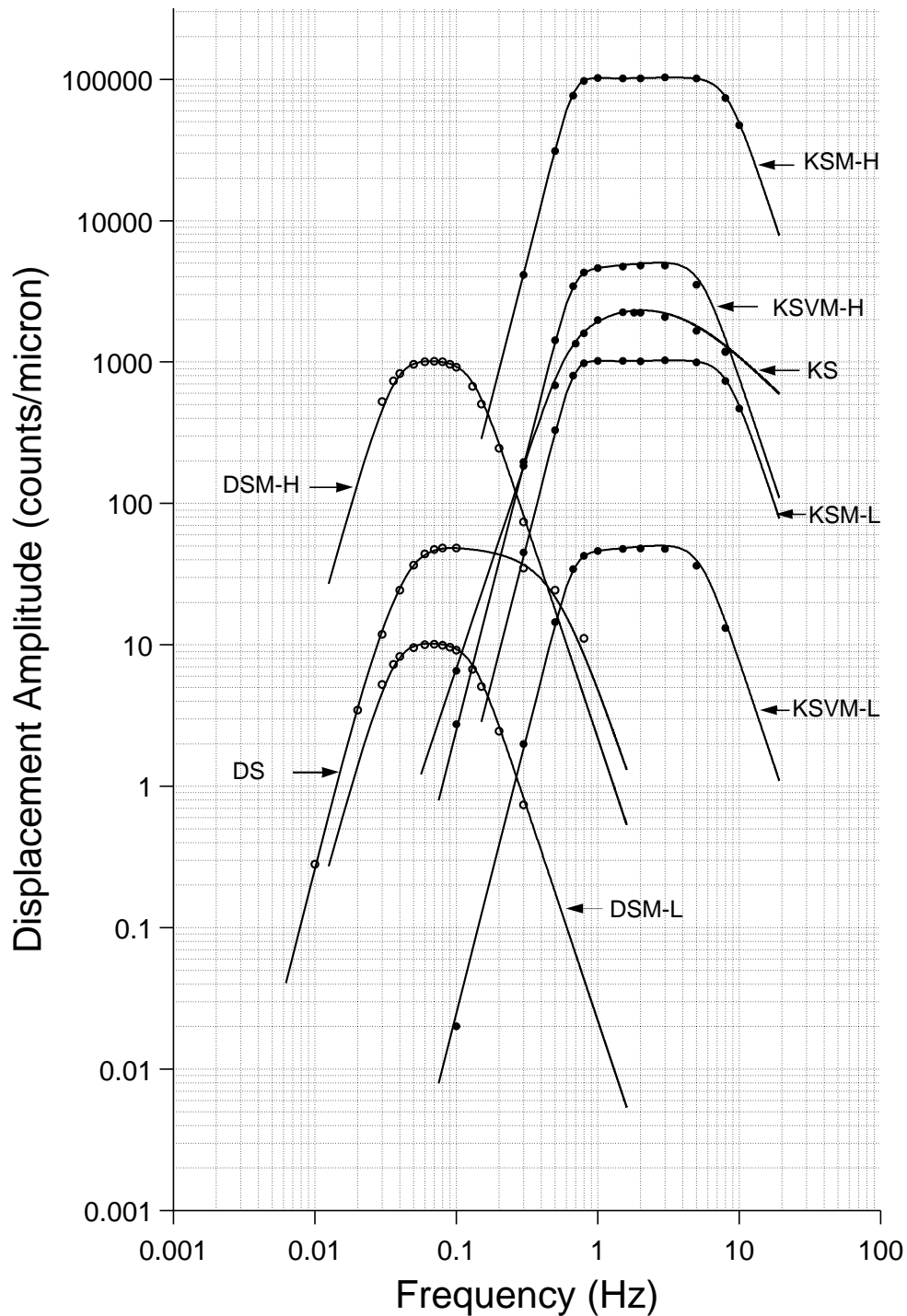


Figure 11: Summary of spectral amplitude responses for all vertical-component seismographs of the TSG system. For each seismograph, frequency-amplitude responses given in the log book at BRV (*closed circles*) and the amplitude responses obtained after the calibration pulse inversion (*solid lines*) are plotted together for comparison.

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Table A1: Borovoye archive data for underground nuclear test at Balapan subarea of STS, 1968–1988⁽¹⁾

| Test No. | Date Year-Mo-Da | Time (hr:mn:sec) | Latitude (°N) | Longitude (°E) | m_b (P) | Instrument type ⁽²⁾ | Comments |
|----------|-----------------|------------------|---------------|----------------|-----------|--------------------------------|-----------------|
| 285 | 1968-06-19 | 05:05:59.8 | 49.98025 | 78.98550 | 5.28 | KODB/M | Bocharov |
| 312 | 1969-11-30 | 03:32:59.7 | 49.92428 | 78.95575 | 6.02 | KODB/M | Bocharov |
| 341 | 1971-06-30 | 03:56:59.8 | 49.94600 | 78.98047 | 4.94 | KODB/M | Bocharov |
| 355 | 1972-02-10 | 05:03:00.0 | 50.02428 | 78.87808 | 5.27 | KODB/M | Bocharov |
| 373 | 1972-11-02 | 01:27:00.2 | 49.92697 | 78.81725 | 6.16 | KODB | Bocharov |
| 377 | 1972-12-10 | 04:27:10.0 | 50.02700 | 78.99556 | 5.96 | KODB/M | Bocharov/Double |
| 382 | 1973-07-23 | 01:23:00.11 | 49.96889 | 78.81750 | 6.17 | KODB/M | AWE/NNC |
| 416 | 1974-12-27 | 05:46:59.35 | 49.96583 | 79.00333 | 5.50 | TSG | AWE/NNC |
| 433 | 1975-10-29 | 04:46:59.82 | 49.95389 | 78.87389 | 5.61 | SS/TSG | AWE/NNC |
| 435 | 1975-12-25 | 05:16:59.65 | 50.04389 | 78.82000 | 5.69 | TSG | AWE/NNC |
| 440 | 1976-04-21 | 05:02:59.70 | 49.90056 | 78.83083 | 5.12 | SS/TSG | AWE/NNC |
| 443 | 1976-06-09 | 03:02:59.75 | 49.99361 | 79.02444 | 5.07 | TSG | AWE/NNC |
| 444 | 1976-07-04 | 02:56:59.94 | 49.90417 | 78.89944 | 5.85 | SS/TSG | AWE/NNC |
| 448 | 1976-08-28 | 02:56:59.99 | 49.97500 | 78.92639 | 5.74 | SS/TSG | AWE/NNC |
| 453 | 1976-11-23 | 05:02:59.75 | 50.01306 | 78.94333 | 5.79 | SS | AWE/NNC |
| 454 | 1976-12-07 | 04:56:59.85 | 49.94389 | 78.83917 | 5.80 | SS/TSG | AWE/NNC |
| 460 | 1977-05-29 | 02:57:00.01 | 49.94639 | 78.77167 | 5.75 | SS/TSG | AWE/NNC |
| 461 | 1977-06-29 | 03:07:00.35 | 49.99944 | 78.86667 | 5.20 | SS/TSG | AWE/NNC |
| 468 | 1977-09-05 | 03:02:59.86 | 50.05556 | 78.91417 | 5.73 | SS/TSG | AWE/NNC |
| 474 | 1977-10-29 | 03:07:04.92 | 50.05222 | 78.98028 | 5.56 | SS/TSG | AWE/NNC/Double |
| 478 | 1977-11-30 | 04:06:59.85 | 49.96722 | 78.87444 | 5.89 | SS/TSG | AWE/NNC |
| 487 | 1978-06-11 | 02:57:00.08 | 49.91333 | 78.80194 | 5.83 | SS/TSG | AWE/NNC |
| 488 | 1978-07-05 | 02:46:59.97 | 49.90000 | 78.86667 | 5.77 | SS/TSG | AWE/NNC |
| 494 | 1978-08-29 | 02:37:08.75 | 50.00611 | 78.96722 | 5.90 | SS | AWE/NNC/Double |
| 496 | 1978-09-15 | 02:36:59.90 | 49.92833 | 78.86167 | 5.89 | SS/TSG | AWE/NNC |
| 505 | 1978-11-04 | 05:05:59.81 | 50.04167 | 78.94722 | 5.56 | SS/TSG | AWE/NNC |
| 506 | 1978-11-29 | 04:33:04.99 | 49.95333 | 78.79528 | 5.96 | SS/TSG | AWE/NNC/Double |
| 514 | 1979-02-01 | 04:13:00.17 | 50.08083 | 78.85333 | 5.29 | SS/TSG | AWE/NNC |
| 521 | 1979-06-23 | 02:57:00.02 | 49.91472 | 78.84583 | 6.16 | TSG | AWE/NNC |
| 522 | 1979-07-07 | 03:46:59.81 | 50.03306 | 78.98917 | 5.84 | SS | AWE/NNC |
| 526 | 1979-08-04 | 03:56:59.97 | 49.90306 | 78.88778 | 6.13 | SS/TSG | AWE/NNC |
| 528 | 1979-08-18 | 02:51:59.61 | 49.94806 | 78.91889 | 6.13 | SS/TSG | AWE/NNC |
| 538 | 1979-10-28 | 03:16:59.45 | 49.99667 | 78.99500 | 5.98 | SS/TSG | AWE/NNC |
| 540 | 1979-12-02 | 04:36:59.95 | 49.90944 | 78.78444 | 5.99 | SS/TSG | AWE/NNC |
| 542 | 1979-12-23 | 04:56:59.93 | 49.93222 | 78.75278 | 6.13 | SS/TSG | AWE/NNC |
| 546 | 1980-04-25 | 03:57:00.03 | 49.97639 | 78.75944 | 5.45 | SS | AWE/NNC |
| 548 | 1980-06-12 | 03:27:00.11 | 49.98872 | 78.99108 | 5.52 | SS/TSG | AWE/NNC |
| 552 | 1980-06-29 | 02:33:00.19 | 49.94861 | 78.81806 | 5.69 | SS/TSG | AWE/NNC |
| 554 | 1980-09-14 | 02:42:41.63 | 49.93667 | 78.79750 | 6.21 | SS | AWE/NNC |
| 558 | 1980-10-12 | 03:34:16.58 | 49.96750 | 79.02250 | 5.88 | SS/TSG | AWE/NNC |
| 564 | 1980-12-14 | 03:47:08.91 | 49.90889 | 78.91861 | 5.93 | SS/TSG | AWE/NNC |
| 566 | 1980-12-27 | 04:09:10.56 | 50.06194 | 78.97528 | 5.87 | SS/TSG | AWE/NNC |
| 568 | 1981-03-29 | 04:03:52.51 | 50.01806 | 78.97881 | 5.49 | SS/TSG | AWE/NNC |

continue on next page

| Test No. | Date Year-Mo-Da | Time (hr:mn:sec) | Latitude (°N) | Longitude (°E) | m_b (P) | Instrument type ⁽²⁾ | Comments |
|----------|-----------------|------------------|---------------|----------------|-----------|--------------------------------|----------|
| 569 | 1981-04-22 | 01:17:13.82 | 49.89889 | 78.80861 | 5.94 | SS/TSG | AWE/NNC |
| 571 | 1981-05-27 | 03:58:14.82 | 49.98694 | 78.97056 | 5.30 | SS/TSG | AWE/NNC |
| 577 | 1981-09-13 | 02:17:20.76 | 49.91333 | 78.89444 | 6.06 | SS/TSG | AWE/NNC |
| 582 | 1981-10-18 | 03:57:05.14 | 49.92806 | 78.84472 | 6.00 | SS/TSG | AWE/NNC |
| 585 | 1981-11-29 | 03:35:11.11 | 49.90194 | 78.84889 | 5.62 | SS/TSG | AWE/NNC |
| 587 | 1981-12-27 | 03:43:16.62 | 49.93306 | 78.77833 | 6.16 | SS/TSG | AWE/NNC |
| 589 | 1982-04-25 | 03:23:07.88 | 49.91694 | 78.88778 | 6.03 | SS/TSG | AWE/NNC |
| 591 | 1982-07-04 | 01:17:16.65 | 49.95861 | 78.81167 | 6.08 | SS/TSG | AWE/NNC |
| 594 | 1982-08-31 | 01:31:03.17 | 49.91417 | 78.76139 | 5.20 | SS/TSG | AWE/NNC |
| 604 | 1982-12-05 | 03:37:15.04 | 49.93083 | 78.80972 | 6.08 | SS/TSG | AWE/NNC |
| 606 | 1982-12-26 | 03:35:16.68 | 50.06306 | 78.99389 | 5.58 | SS/TSG | AWE/NNC |
| 611 | 1983-06-12 | 02:36:46.01 | 49.92500 | 78.89806 | 6.02 | SS/TSG | AWE/NNC |
| 625 | 1983-10-06 | 01:47:09.08 | 49.92458 | 78.75069 | 5.95 | SS | AWE/NNC |
| 626 | 1983-10-26 | 01:55:07.33 | 49.91250 | 78.82167 | 6.04 | SS/TSG | AWE/NNC |
| 628 | 1983-11-20 | 03:27:06.86 | 50.05083 | 78.99917 | 5.33 | SS/TSG | AWE/NNC |
| 632 | 1984-02-19 | 03:57:05.85 | 49.89611 | 78.74306 | 5.77 | SS | AWE/NNC |
| 633 | 1984-03-07 | 02:39:08.80 | 50.05000 | 78.95611 | 5.56 | SS | AWE/NNC |
| 634 | 1984-03-29 | 05:19:10.66 | 49.91111 | 78.92694 | 5.86 | SS/TSG | AWE/NNC |
| 636 | 1984-04-25 | 01:09:05.99 | 49.93583 | 78.85056 | 5.90 | SS/TSG | AWE/NNC |
| 637 | 1984-05-26 | 03:13:14.85 | 49.97889 | 79.00556 | 6.01 | SS/TSG | AWE/NNC |
| 638 | 1984-07-14 | 01:09:12.99 | 49.90944 | 78.87722 | 6.10 | SS/TSG | AWE/NNC |
| 654 | 1984-10-27 | 01:50:12.93 | 49.93472 | 78.92806 | 6.19 | SS/TSG | AWE/NNC |
| 656 | 1984-12-02 | 03:19:08.85 | 50.00611 | 79.00889 | 5.77 | SS/TSG | AWE/NNC |
| 657 | 1984-12-16 | 03:55:05.07 | 49.94583 | 78.80861 | 6.12 | SS/TSG | AWE/NNC |
| 658 | 1984-12-28 | 03:50:13.09 | 49.88028 | 78.70389 | 6.00 | SS/TSG | AWE/NNC |
| 659 | 1985-02-10 | 03:27:09.98 | 49.89917 | 78.78056 | 5.83 | SS | AWE/NNC |
| 660 | 1985-04-25 | 00:57:08.97 | 49.92667 | 78.88083 | 5.84 | SS | AWE/NNC |
| 661 | 1985-06-15 | 00:57:03.25 | 49.90861 | 78.84278 | 6.05 | SS/TSG | IDG/NNC |
| 663 | 1985-06-30 | 02:39:05.26 | 49.86444 | 78.66861 | 5.92 | SS/TSG | IDG/NNC |
| 667 | 1985-07-20 | 00:53:16.91 | 49.94972 | 78.78389 | 5.89 | SS/TSG | AWE/NNC |
| 670 | 1987-03-12 | 01:57:19.57 | 49.93528 | 78.82889 | 5.31 | SS/TSG | AWE/NNC |
| 671 | 1987-04-03 | 01:17:10.28 | 49.91806 | 78.78028 | 6.12 | SS/TSG | AWE/NNC |
| 673 | 1987-04-17 | 01:03:07.09 | 49.87778 | 78.66889 | 5.92 | SS/TSG | AWE/NNC |
| 678 | 1987-06-20 | 00:53:07.09 | 49.93528 | 78.74417 | 6.03 | SS/TSG | AWE/NNC |
| 683 | 1987-08-02 | 00:58:09.27 | 49.88056 | 78.87472 | 5.83 | SS/TSG | IDG/NNC |
| 688 | 1987-11-15 | 03:31:09.08 | 49.89861 | 78.75806 | 5.98 | SS | AWE/NNC |
| 689 | 1987-12-13 | 03:21:07.31 | 49.96306 | 78.79306 | 6.06 | SS | IDG/NNC |
| 691 | 1987-12-27 | 03:05:07.00 | 49.87944 | 78.72500 | 6.00 | SS | IDG/NNC |
| 693 | 1988-02-13 | 03:05:08.327 | 49.93667 | 78.86389 | 5.97 | SS/TSG | IDG/NNC |
| 694 | 1988-04-03 | 01:33:08.294 | 49.90833 | 78.90833 | 5.99 | SS/TSG | IDG/NNC |
| 696 | 1988-05-04 | 00:57:09.261 | 49.94944 | 78.75028 | 6.09 | SS/TSG | IDG/NNC |
| 698 | 1988-06-14 | 02:27:08.98 | 50.01889 | 78.96056 | 4.80 | SS/TSG | AWE/NNC |
| 701 | 1988-09-14 | 03:59:59.69 | 49.87778 | 78.82306 | 6.03 | SS/TSG | AWE/NNC |
| 703 | 1988-11-12 | 03:30:06.26 | 50.04306 | 78.96889 | 5.24 | SS/TSG | AWE/NNC |
| 706 | 1988-12-17 | 04:18:09.291 | 49.88194 | 78.92472 | 5.83 | SS/TSG | IDG/NNC |
| 708 | 1989-01-22 | 03:57:09.02 | 49.93944 | 78.81944 | 6.10 | SS/TSG | AWE/NNC |
| 709 | 1989-02-12 | 04:15:09.342 | 49.91861 | 78.71111 | 5.86 | SS/TSG | IDG/NNC |
| 711 | 1989-07-08 | 03:47:00.03 | 49.86778 | 78.78028 | 5.55 | SS/TSG | AWE/NNC |

continue on next page

| Test No. | Date Year-Mo-Da | Time (hr:mn:sec) | Latitude (°N) | Longitude (°E) | $m_b(P)$ | Instrument type ⁽²⁾ | Comments |
|----------|-----------------|------------------|---------------|----------------|----------|--------------------------------|----------|
| 712 | 1989-09-02 | 04:16:59.85 | 50.00583 | 78.98556 | 4.94 | SS/TSG | AWE/NNC |
| 714 | 1989-10-19 | 09:49:59.81 | 49.92222 | 78.90833 | 5.86 | SS/TSG | AWE/NNC |

⁽¹⁾ Test No.=unique test number given in Mikhailov et al. (1996) for 715 nuclear tests in USSR; body-wave magnitude, $m_b(P)$, from Marshall et al. (1985); Bocharov=ground truth data from Bocharov (1989); NNC=ground truth location by the National Nuclear Center, RK (1999); AWE=origin time from Lilwall & Farthing (1990); Double=double tests either proceeded or followed by another test at Degelen by few seconds; ⁽²⁾ Instrument type=instrument used, KODB= KOD low-gain system; KODM= KOD high-gain system; SS=STsR-SS system; TSG=STsR-TSG system (see Kim & Ekström, 1996); Precision of the seismically determined origin times are indicated by their decimal points and the accuracy of the groundtruth information is also indicated by the decimal point.

Table A2: Borovoye archive data for underground nuclear test at Degelen subarea of STS, 1967–1989⁽¹⁾

| Test No. | Date Year-Mo-Da | Time (hr:mn:sec) | Latitude (°N) | Longitude (°E) | m_b (P) | Instrument type ⁽²⁾ | Comments |
|----------|-----------------|------------------|---------------|----------------|-----------|--------------------------------|-----------------|
| 264 | 1967-02-26 | 03:57:59.8 | 49.74569 | 78.08231 | 6.03 | KODB | Bocharov |
| 266 | 1967-04-20 | 04:08:01.0 | 49.74161 | 78.10542 | 5.56 | KODB | Bocharov |
| 267 | 1967-05-28 | 04:07:59.6 | 49.75642 | 78.01689 | 5.46 | KODB | Bocharov |
| 268 | 1967-06-29 | 02:56:59.9 | 49.81669 | 78.04903 | 5.34 | KODB/M | Bocharov |
| 269 | 1967-07-15 | 03:26:59.9 | 49.83592 | 78.11817 | 5.39 | KODB | Bocharov |
| 270 | 1967-08-04 | 06:58:00.3 | 49.76028 | 78.05550 | 5.32 | KODB/M | Bocharov |
| 271 | 1967-09-02 | 04:04:00.0 | 49.74194 | 78.02556 | 4.10 | KODB | Khalturin |
| 275 | 1967-10-17 | 05:04:00.2 | 49.78089 | 78.00383 | 5.63 | KODB/M | Bocharov |
| 277 | 1967-10-30 | 06:04:00.0 | 49.79436 | 78.00786 | 5.41 | KODB/M | Bocharov |
| 279 | 1967-12-08 | 06:03:59.8 | 49.81714 | 78.16378 | 5.31 | KODB | Bocharov |
| 280 | 1968-01-07 | 03:46:59.9 | 49.75442 | 78.03094 | 4.98 | KODB | Bocharov |
| 281 | 1968-04-24 | 10:35:59.7 | 49.84519 | 78.10322 | 4.91 | KODB | Bocharov |
| 284 | 1968-06-11 | 03:05:59.7 | 49.79300 | 78.14508 | 5.24 | KODB/M | Bocharov |
| 294 | 1968-11-09 | 02:54:00.1 | 49.80053 | 78.13911 | 4.75 | KODB | Bocharov |
| 296 | 1968-12-18 | 05:01:59.7 | 49.74594 | 78.09203 | 5.04 | KODB/M | Bocharov |
| 297 | 1969-03-07 | 08:26:59.8 | 49.82147 | 78.06267 | 5.66 | KODB/M | Bocharov |
| 300 | 1969-05-16 | 04:02:59.7 | 49.75942 | 78.07578 | 5.26 | KODB/M | Bocharov |
| 302 | 1969-07-04 | 02:46:59.6 | 49.74603 | 78.11133 | 5.24 | KODB/M | Bocharov |
| 303 | 1969-07-23 | 02:47:00.2 | 49.81564 | 78.12961 | 5.50 | KODB/M | Bocharov |
| 306 | 1969-09-11 | 04:02:00.0 | 49.77631 | 77.99669 | 4.91 | KODB/M | Bocharov |
| 308 | 1969-10-01 | 04:02:59.9 | 49.78250 | 78.09831 | 5.26 | KODB/M | Bocharov |
| 315 | 1969-12-29 | 04:02:00.0 | 49.73367 | 78.10225 | 4.22 | KODB | Bocharov |
| 316 | 1970-01-29 | 07:03:00.0 | 49.79558 | 78.12389 | 5.60 | KODB/M | Bocharov |
| 318 | 1970-03-27 | 05:02:59.6 | 49.74781 | 77.99897 | 4.93 | KODB/M | Bocharov |
| 319 | 1970-05-27 | 04:03:00.0 | 49.73131 | 78.09861 | 4.20 | KODB | Bocharov |
| 321 | 1970-06-28 | 01:58:00.0 | 49.80150 | 78.10681 | 5.87 | KODB/M | Bocharov |
| 324 | 1970-07-24 | 03:57:00.0 | 49.80972 | 78.12839 | 5.34 | KODB/M | Bocharov |
| 326 | 1970-09-06 | 04:02:59.9 | 49.78889 | 77.99750 | 5.53 | KODB/M | Bocharov |
| 330 | 1970-12-17 | 07:01:00.0 | 49.74564 | 78.09917 | 5.43 | KODB/M | Bocharov |
| 332 | 1971-01-29 | 05:03:00.0 | 49.80528 | 78.16861 | 4.47 | KODB | Khalturin |
| 333 | 1971-03-22 | 04:33:00.3 | 49.79847 | 78.10897 | 5.77 | KODB/M | Bocharov |
| 337 | 1971-04-25 | 03:32:59.9 | 49.76853 | 78.03392 | 6.08 | KODB/M | Bocharov |
| 338 | 1971-05-25 | 04:03:00.4 | 49.80164 | 78.13883 | 5.05 | KODB/M | Bocharov |
| 350 | 1971-11-29 | 06:02:59.9 | 49.74342 | 78.07850 | 5.46 | KODB/M | Bocharov |
| 351 | 1971-12-15 | 07:52:59.8 | 49.82639 | 77.99731 | 4.90 | KODB | Bocharov |
| 353 | 1971-12-30 | 06:21:00.2 | 49.74917 | 78.00611 | 5.84 | KODB/M | Bocharov |
| 356 | 1972-03-10 | 04:56:59.8 | 49.74531 | 78.11969 | 5.45 | KODM | Bocharov |
| 357 | 1972-03-28 | 04:22:00.1 | 49.73306 | 78.07569 | 5.18 | KODB/M | Bocharov |
| 360 | 1972-06-07 | 01:28:00.0 | 49.82675 | 78.11547 | 5.42 | KODB/M | Bocharov |
| 365 | 1972-08-16 | 03:16:59.8 | 49.76547 | 78.05883 | 5.11 | KODB/M | Bocharov |
| 376 | 1972-12-10 | 04:27:00.0 | 49.81939 | 78.05822 | 5.72 | KODB/M | Bocharov/Double |
| 378 | 1972-12-28 | 04:27:00.0 | 49.73919 | 78.10625 | 4.60 | KODB | Bocharov |
| 379 | 1973-02-16 | 05:03:00.0 | 49.81583 | 78.10667 | 5.48 | KODB/M | AWE/Leith |

continue on next page

| Test No. | Date Year-Mo-Da | Time (hr:mn:sec) | Latitude (°N) | Longitude (°E) | m_b (P) | Instrument type ⁽²⁾ | Comments |
|----------|-----------------|------------------|---------------|----------------|-----------|--------------------------------|------------------|
| 381 | 1973-07-10 | 01:27:00.15 | 49.79111 | 78.01278 | 5.34 | KODB | AWE/Leith |
| 391 | 1973-10-26 | 04:27:00.14 | 49.75222 | 78.13250 | 5.23 | KODB/M | AWE/Leith |
| 414 | 1974-12-16 | 06:23:00.14 | 49.76778 | 78.08167 | 4.94 | TSG | AWE/Leith |
| 415 | 1974-12-16 | 06:41:00.34 | 49.83306 | 78.02667 | 4.89 | TSG | AWE/Leith |
| 434 | 1975-12-13 | 04:56:59.99 | 49.81333 | 78.10861 | 5.00 | SS/TSG | AWE/Leith |
| 436 | 1976-01-15 | 04:46:59.97 | 49.81000 | 78.17139 | 5.18 | SS/TSG | AWE/Leith |
| 441 | 1976-04-21 | 04:58:00.16 | 49.75472 | 78.10750 | 4.94 | SS/TSG | AWE/Leith |
| 442 | 1976-05-19 | 02:57:00.2 | 49.77750 | 78.01556 | 4.72 | SS | AWE/Leith |
| 445 | 1976-07-23 | 02:33:00.19 | 49.74333 | 78.05167 | 4.96 | SS | AWE/Leith |
| 451 | 1976-10-30 | 04:57:00.21 | 49.83139 | 78.05722 | 4.62 | SS/TSG | AWE/Leith |
| 456 | 1976-12-30 | 03:57:00.31 | 49.78028 | 78.03667 | 5.09 | TSG | AWE/Leith |
| 457 | 1977-03-29 | 03:56:59.95 | 49.77639 | 78.01750 | 5.41 | SS/TSG | AWE/Leith |
| 459 | 1977-04-25 | 04:07:00.16 | 49.81333 | 78.10861 | 5.07 | SS/TSG | AWE/Leith |
| 463 | 1977-07-30 | 01:57:00.11 | 49.75056 | 78.04917 | 5.13 | SS/TSG | AWE/Leith |
| 465 | 1977-08-17 | 04:26:59.97 | 49.83083 | 78.11389 | 5.01 | SS/TSG | AWE/Leith |
| 473 | 1977-10-29 | 03:06:59.97 | 49.83417 | 78.08028 | 5.60 | SS/TSG | AWE/Leith/Double |
| 479 | 1977-12-26 | 04:03:00.24 | 49.81083 | 78.05417 | 4.91 | SS/TSG | AWE/Leith |
| 482 | 1978-03-26 | 03:56:59.96 | 49.76194 | 77.98250 | 5.69 | SS/TSG | AWE/Leith |
| 483 | 1978-04-22 | 03:07:00.01 | 49.75167 | 78.13167 | 5.35 | TSG | AWE/Leith |
| 485 | 1978-05-29 | 04:56:59.85 | 49.79139 | 78.09444 | 4.68 | SS/TSG | AWE/Leith |
| 489 | 1978-07-28 | 02:46:59.89 | 49.75500 | 78.14500 | 5.75 | TSG | AWE/Leith |
| 493 | 1978-08-29 | 02:36:59.95 | 49.81333 | 78.10861 | 5.20 | SS | AWE/Leith/Double |
| 501 | 1978-10-15 | 05:37:00.14 | 49.73667 | 78.11111 | 5.15 | SS/TSG | AWE/Leith |
| 504 | 1978-10-31 | 04:17:00.19 | 49.78861 | 78.10750 | 5.25 | SS/TSG | AWE/Leith |
| 507 | 1978-11-29 | 04:33:00.17 | 49.78333 | 78.01556 | 5.21 | SS/TSG | AWE/Leith/Double |
| 509 | 1978-12-14 | 04:43:00.03 | 49.81583 | 78.10667 | 4.74 | SS/TSG | AWE/Leith |
| 511 | 1978-12-20 | 04:33:00.04 | 49.81083 | 78.05417 | 4.71 | SS/TSG | AWE/Leith |
| 518 | 1979-05-06 | 03:17:00.07 | 49.76194 | 77.98250 | 5.22 | SS/TSG | AWE/Leith |
| 519 | 1979-05-31 | 05:55:00.05 | 49.81278 | 78.05944 | 5.27 | SS/TSG | AWE/Leith |
| 532 | 1979-09-27 | 04:13:00.00 | 49.75056 | 78.04917 | 4.42 | SS/TSG | AWE/Leith |
| 535 | 1979-10-18 | 04:17:00.11 | 49.82417 | 78.09750 | 5.23 | SS/TSG | AWE/Leith |
| 539 | 1979-11-30 | 04:53:00.58 | 49.78306 | 78.08667 | 4.42 | SS/TSG | AWE/Leith |
| 541 | 1979-12-21 | 04:42:00.09 | 49.79222 | 78.11300 | 4.71 | SS/TSG | AWE/Leith |
| 545 | 1980-04-10 | 04:07:00.19 | 49.78250 | 78.05722 | 4.98 | SS/TSG | AWE/Leith |
| 547 | 1980-05-22 | 03:57:00.14 | 49.77972 | 78.03639 | 5.53 | SS/TSG | AWE/Leith |
| 553 | 1980-07-31 | 03:33:00.07 | 49.79056 | 78.09083 | 5.33 | SS/TSG | AWE/Leith |
| 555 | 1980-09-25 | 06:21:13.06 | 49.78333 | 78.08056 | 4.83 | SS/TSG | AWE/Leith |
| 573 | 1981-06-30 | 01:57:15.34 | 49.76750 | 78.08083 | 5.16 | SS/TSG | AWE/Leith |
| 574 | 1981-07-17 | 02:37:18.12 | 49.80139 | 78.13139 | 5.07 | TSG | AWE/Leith |
| 575 | 1981-08-14 | 02:27:15.24 | 49.75222 | 78.05306 | 4.88 | SS/TSG | AWE/Leith |
| 584 | 1981-11-20 | 04:57:05.07 | 49.73667 | 78.10417 | 5.00 | SS | AWE/Leith |
| 586 | 1981-12-22 | 04:31:05.27 | 49.83417 | 78.08028 | 4.96 | SS/TSG | AWE/Leith |
| 588 | 1982-02-19 | 03:56:13.42 | 49.82333 | 78.03333 | 5.40 | SS/TSG | AWE/Leith |
| 590 | 1982-06-25 | 02:03:07.16 | 49.77139 | 78.11083 | 4.57 | SS/TSG | AWE/Leith |
| 593 | 1982-08-23 | 02:43:06.70 | 49.74028 | 78.03083 | 4.44 | SS | AWE/Leith |
| 596 | 1982-09-21 | 02:57:03.17 | 49.77917 | 78.12472 | 5.15 | SS/TSG | AWE/Leith |
| 605 | 1982-12-25 | 04:23:08.38 | 49.78111 | 78.03500 | 4.47 | SS/TSG | AWE/Leith |
| 608 | 1983-03-30 | 04:17:10.22 | 49.78500 | 78.04056 | 4.61 | SS/TSG | AWE/Leith |

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| Test No. | Date Year-Mo-Da | Time (hr:mn:sec) | Latitude (°N) | Longitude (°E) | m_b (P) | Instrument type ⁽²⁾ | Comments |
|----------|-----------------|------------------|---------------|----------------|-----------|--------------------------------|-----------------|
| 609 | 1983-04-12 | 03:41:08.26 | 49.78556 | 78.08472 | 4.65 | SS/TSG | AWE/Leith |
| 610 | 1983-05-30 | 03:33:47.04 | 49.74111 | 78.12028 | 5.43 | SS | AWE/Leith |
| 612 | 1983-06-24 | 02:56:13.85 | 49.73972 | 78.03583 | 4.46 | SS/TSG | AWE/Leith |
| 617 | 1983-09-11 | 06:33:13.10 | 49.78472 | 78.08417 | 4.48 | SS/TSG | AWE/Leith |
| 629 | 1983-11-29 | 02:19:08.80 | 49.73028 | 78.09583 | 5.31 | SS | AWE/Leith |
| 631 | 1983-12-26 | 04:29:09.25 | 49.79000 | 78.10917 | 5.48 | SS/TSG | AWE/Leith |
| 635 | 1984-04-15 | 03:17:11.46 | 49.76056 | 78.08917 | 5.72 | SS/TSG | AWE/Leith |
| 648 | 1984-09-09 | 02:59:08.85 | 49.80444 | 78.08750 | 4.89 | SS/TSG | AWE/Leith |
| 650 | 1984-10-18 | 04:57:08.32 | 49.72944 | 78.08639 | 4.25 | SS/TSG | AWE/Leith |
| 655 | 1984-11-23 | 03:55:07.48 | 49.81250 | 78.05944 | 4.38 | SS/TSG | AWE/Leith |
| 668 | 1985-07-25 | 03:11:09.23 | 49.81917 | 78.14944 | 4.82 | SS/TSG | AWE/Leith |
| 669 | 1987-02-26 | 04:58:24.32 | 49.83417 | 78.08111 | 5.40 | SS/TSG | AWE/Leith |
| 676 | 1987-05-06 | 04:02:08.11 | 49.77583 | 78.01222 | 5.60 | SS/TSG | AWE/Leith |
| 677 | 1987-06-06 | 02:37:09.25 | 49.83667 | 78.06167 | 5.40 | SS/TSG | AWE/Leith |
| 680 | 1987-07-17 | 01:17:09.18 | 49.77583 | 78.01972 | 5.80 | SS | AWE/Leith |
| 685 | 1987-09-18 | 02:32:10.01 | 49.80444 | 78.08750 | 4.30 | SS | AWE/Leith |
| 687 | 1987-10-16 | 06:06:06.99 | 49.72972 | 78.08667 | 4.60 | SS/TSG | AWE/Leith |
| 690 | 1987-12-20 | 02:55:09.14 | 49.77583 | 78.01222 | 4.80 | SS/TSG | AWE/Leith |
| 692 | 1988-02-06 | 04:19:09.13 | 49.77583 | 78.01972 | 4.70 | SS/TSG | AWE/Leith |
| 695 | 1988-04-22 | 09:30:09.44 | 49.79028 | 78.10694 | 4.90 | SS/TSG | AWE/Leith |
| 702 | 1988-10-18 | 03:40:09.16 | 49.78000 | 78.01722 | 4.90 | SS/TSG | AWE/Leith |
| 704 | 1988-11-23 | 03:57:08.99 | 49.77944 | 78.03722 | 5.40 | SS/TSG | AWE/Leith |
| 707 | 1988-12-28 | 05:28:10 | 49.80111 | 78.06861 | 3.74 | SS/TSG | Khalturin/Leith |
| 710 | 1989-02-17 | 04:01:09.22 | 49.82778 | 78.05972 | 5.00 | SS/TSG | AWE/Leith |
| 713 | 1989-10-04 | 11:30:00.16 | 49.74833 | 78.00944 | 4.60 | SS/TSG | AWE/Leith |

⁽¹⁾ Test No.=unique test id number given in Mikhailov et al. (1996) for nuclear tests in USSR; Body-wave magnitude, $m_b(P)$, from Marshall et al. (1985) and Ringdal et al. (1992). Bocharov=ground truth data from Bocharov (1989); Leith=ground truth location by Leith (1998) for entrance to the tunnels; AWE=origin time from Lilwall & Farthing (1990); Khalturin=location and origin time from Khalturin et al. (2000); Double=double tests either proceeded or followed by another test at Balapan by few seconds; ⁽²⁾ Instrument type=instrument used, KODB=KOD low-gain system; KODM=KOD high-gain system; SS=STsR-SS system; TSG=STsR-TSG system (see Kim & Ekström, 1996); Precision of the seismically determined origin times are indicated by their decimal points and the accuracy of the groundtruth information is also indicated by the decimal point.

Table A3: Borovoye archive data for underground nuclear test at Murzhik subarea of STS, 1967–1980⁽¹⁾

| Test No. | Date Year-Mo-Da | Time (hr:mn:sec) | Latitude (°N) | Longitude (°E) | m_b (P) | Instrument type ⁽²⁾ | Comments |
|----------|-----------------|------------------|---------------|----------------|---------------|--------------------------------|-----------|
| 262 | 1966-12-18 | 04:58:00.0 | 49.92458 | 77.74722 | 5.92 | KODB | Bocharov |
| 272 | 1967-09-16 | 04:04:00.3 | 49.93719 | 77.72811 | 5.25 | KODB/M | Bocharov |
| 273 | 1967-09-22 | 05:04:00.0 | 49.95964 | 77.69106 | 5.16 | KODB | Bocharov |
| 278 | 1967-11-22 | 04:03:59.9 | 49.94194 | 77.68683 | 4.41 | KODB | Bocharov |
| 301 | 1969-05-31 | 05:01:59.4 | 49.95031 | 77.69422 | 5.29 | KODB/M | Bocharov |
| 314 | 1969-12-28 | 03:47:00.2 | 49.93733 | 77.71422 | 5.79 | KODB/M | Bocharov |
| 323 | 1970-07-21 | 03:02:59.7 | 49.95242 | 77.67289 | 5.38 | KODB/M | Bocharov |
| 328 | 1970-11-04 | 06:02:59.8 | 49.98922 | 77.76244 | 5.44 | KODB/M | Bocharov |
| 339 | 1971-06-06 | 04:02:59.7 | 49.97542 | 77.66028 | 5.53 | KODB/M | Bocharov |
| 340 | 1971-06-19 | 04:04:00.1 | 49.96903 | 77.64081 | 5.54 | KODB/M | Bocharov |
| 347 | 1971-10-09 | 06:02:59.7 | 49.97789 | 77.64144 | 5.37 | KODB/M | Bocharov |
| 348 | 1971-10-21 | 06:02:59.7 | 49.97381 | 77.59733 | 5.58 | KODB/M | Bocharov |
| 367 | 1972-08-26 | 03:46:59.7 | 49.98197 | 77.71661 | 5.36 | KODB/M | Bocharov |
| 380 | 1973-04-19 | 04:32:59.92 | 49.984 | 77.614 | 5.36 | KODB/M | AWE |
| 447 | 1976-08-04 | 02:57:00 | 49.87 | 77.70 | 4.20 | SS | Khalturin |
| 481 | 1978-03-19 | 03:46:59.82 | 49.945 | 77.704 | 5.19 | SS/TSG | AWE |
| 515 | 1979-02-16 | 04:04:00.50 | 49.974 | 77.668 | 5.39 | SS/TSG | AWE |
| 524 | 1979-07-18 | 03:17:04.92 | 49.919 | 77.812 | 5.16 | SS/TSG | AWE |
| 544 | 1980-04-04 | 05:32:59.83 | 50.000 | 77.823 | 4.90 | SS/TSG | AWE |

⁽¹⁾ Test No.=nuclear test number given in Mikhailov et al. (1996), which lists 715 nuclear tests conducted by USSR; Bocharov=ground truth data from Bocharov (1989); AWE=origin time and location from Lilwall & Farthing (1990); Khalturin=location and origin time from Khalturin et al. (2000); Body-wave magnitude, $m_b(P)$, from Marshall et al. (1985) and Ringdal et al. (1992). ⁽²⁾ Instrument type=instrument used, KODB= KOD low-gain system; KODM= KOD high-gain system; SS=STsR-SS system; TSG=STsR-TSG system.

Table A4: Borovoye archive data for underground nuclear test at Novaya Zemlya Test Sites, 1967–1990⁽¹⁾

| Test No. | Date Year-Mo-Da | Time (hr:mn:sec) | Lat. (°N) | Long. (°E) | m_b (P) | Inst. type ⁽²⁾ | Comments |
|----------|-----------------|---|-----------|------------|-----------|---------------------------|------------------------------|
| 276 | 1967-10-21 | 04:59:58.49 | 73.390 | 54.810 | 5.98 | KODB/M | salvo exp. in two tunnels |
| 293 | 1968-11-07 | 10:02:05.49 | 73.387 | 54.858 | 6.13 | KODB/M | salvo exp. in single tunnel |
| 309 | 1969-10-14 | 07:00:06.61 | 73.390 | 54.787 | 6.18 | KODB/M | 3 explosions |
| 327 | 1970-10-14 | 05:59:57.57 | 73.304 | 55.027 | 6.79 | KODB/M | 3 explosions 150-1500 kt |
| 345 | 1971-09-27 | 05:59:55.75 | 73.393 | 54.920 | 6.67 | KODB/M | 4 explosions 150-1500 kt |
| 368 | 1972-08-28 | 05:59:56.87 | 73.388 | 54.847 | 6.49 | KODB/M | 4 explosions |
| 385 | 1973-09-12 | 06:59:54.81 | 73.314 | 55.056 | 6.97 | KODB/M | highest yield Soviet UNT |
| 388 | 1973-09-27 | 07:00:01.12 | 70.731 | 53.827 | 5.89 | KODB/SS | Southern Test Site |
| 392 | 1973-10-27 | 07:00:00.61 | 70.780 | 54.026 | 6.98 | KODB/M/SS | Southern Test Site |
| 427 | 1975-08-23 | 08:59:58.25 | 73.334 | 54.682 | 6.55 | TSG | salvo exp. with 8 explosions |
| 430 | 1975-10-18 | 08:59:59.40 | 70.816 | 53.744 | 6.75 | TSG | 2 expls. shaft Yu-6N |
| 431 | 1975-10-18 | Single explosion in shaft Yu-7 simultaneously with test #430 both Sothern Test Site | | | | | |
| 432 | 1975-10-21 | 11:59:58.03 | 73.307 | 55.010 | 6.60 | SS/TSG | 5 explosions |
| 449 | 1976-09-29 | 02:59:57.70 | 73.360 | 54.871 | 5.83 | SS/TSG | 2 expls. reference for JED |
| 450 | 1976-10-20 | 07:59:58.07 | 73.398 | 54.812 | 4.98 | SS/TSG | 4 explosions |
| 467 | 1977-09-01 | 02:59:57.97 | 73.339 | 54.619 | 5.66 | TSG | 4 explosions |
| 471 | 1977-10-09 | 10:59:58.12 | 73.409 | 54.927 | 4.36 | SS/TSG | single explosion 0.001-20 kt |
| 491 | 1978-08-10 | 07:59:57.93 | 73.291 | 54.883 | 6.00 | SS/TSG | 6 explosions |
| 499 | 1978-09-27 | 02:04:58.60 | 73.349 | 54.676 | 5.63 | SS/TSG | 7 explosions |
| 531 | 1979-09-24 | 03:29:59.75 | 73.343 | 54.672 | 5.77 | TSG | 3 explosions |
| 536 | 1979-10-18 | 07:09:58.75 | 73.316 | 54.816 | 5.79 | SS/TSG | 4 explosions |
| 557 | 1980-10-11 | 07:09:57.47 | 73.336 | 54.940 | 5.76 | SS | 7 explosions |
| 580 | 1981-10-01 | 12:14:57.23 | 73.304 | 54.818 | 5.97 | TSG | 4 explosions |
| 599 | 1982-10-11 | 07:14:58.63 | 73.339 | 54.608 | 5.58 | TSG | 4 explosions |
| 616 | 1983-08-18 | 16:09:58.90 | 73.354 | 54.974 | 5.91 | SS | 5 explosions |
| 624 | 1983-09-25 | 13:09:58.22 | 73.328 | 54.541 | 5.77 | SS/TSG | 4 explosions |
| 651 | 1984-10-25 | 06:29:58.12 | 73.355 | 54.990 | 5.82 | SS/TSG | 4 explosions |
| 682 | 1987-08-02 | 02:00:00.20 | 73.326 | 54.602 | 5.82 | SS/TSG | 5 explosions |
| 697 | 1988-05-07 | 22:49:58.34 | 73.314 | 54.553 | 5.58 | SS/TSG | 3 explosions |
| 705 | 1988-12-04 | 05:19:53.30 | 73.366 | 55.001 | 5.89 | SS/TSG | 5 explosions |
| 715 | 1990-10-24 | 14:57:58.45 | 73.331 | 54.757 | 5.70 | SS/TSG | 8 expls. last Sovie test |

⁽¹⁾ Test No.=unique test id number given in Mikhailov et al. (1996) for nuclear tests in USSR; Body-wave magnitude, $m_b(P)$, from Marshall et al. (1994); location and origin time from Marshall et al. (1994) and Richards (2000).

⁽²⁾ Inst. type= instrument used; KODB= KOD low-gain system; KODM= KOD high-gain system; SS=STsR-SS system; TSG=STsR-TSG system. ⁽³⁾ salvo exp.= salvo explosion means two or more separate explosions where a period of time between successive individual explosions does not exceed 5 seconds and where the burial points of all explosive devices can be connected by segments of straight lines, each of them connecting two burial points and does not exceed 40 kilometers in length.

Table A5: Borovoye archive data for Peaceful Nuclear Explosions in the Former Soviet Union, 1967–1988⁽¹⁾

| Test No. | Date Year-Mo-Da | Time (hr:mn:sec) | Latitude (°N) | Longitude (°E) | Depth (m) | m_b (P) | Distance (°) | Az (°) | Instrument type |
|----------|-----------------|------------------|---------------|----------------|-----------|-----------|--------------|--------|-----------------|
| 274 | 1967-10-06 | 06:59:57.5 | 57.70 | 65.20 | 172 | 4.7 | 5.46 | 330.2 | KODB |
| 282 | 1968-05-21 | 03:59:11.98 | 38.918 | 65.032 | 2440 | 5.4 | 14.59 | 196.4 | KODB |
| 304 | 1969-09-02 | 04:59:58.61 | 57.220 | 55.393 | 1212 | 4.8 | 9.45 | 302.1 | KODB |
| 305 | 1969-09-08 | 04:59:58.70 | 57.220 | 55.417 | 1208 | 4.8 | 9.44 | 302.1 | KOD |
| 307 | 1969-09-26 | 06:59:58.14 | 45.848 | 42.600 | 712 | 5.6 | 19.23 | 259.2 | KOD |
| 313 | 1969-12-06 | 07:02:59.85 | 43.867 | 54.800 | 407 | 5.8 | 13.73 | 234.2 | KOD |
| 320 | 1970-06-25 | 04:59:55.5 | 52.20 | 55.70 | 702 | 4.9 | 8.88 | 270.3 | KODB |
| 329 | 1970-12-12 | 07:00:59.83 | 43.85 | 54.80 | 497 | 6.0 | 13.74 | 234.2 | KOD |
| 331 | 1970-12-23 | 07:00:59.76 | 44.025 | 54.933 | 470 | 6.0 | 13.55 | 234.3 | KOD |
| 335 | 1971-03-23 | 06:59:58.38 | 61.40 | 56.20 | 127 | 5.5 | 11.25 | 323.4 | KOD |
| 342 | 1971-07-02 | 17:00:01.13 | 67.283 | 63.467 | 542 | 4.7 | 14.60 | 349.5 | KODB |
| 344 | 1971-09-19 | 11:00:01.08 | 57.508 | 42.643 | 610 | 4.5 | 16.23 | 296.9 | KODB |
| 346 | 1971-10-04 | 10:00:00.14 | 61.358 | 48.092 | 595 | 4.6 | 14.49 | 313.6 | KODB |
| 352 | 1971-12-22 | 06:59:59.0 | 47.897 | 48.133 | 986 | 6.0 | 14.94 | 258.7 | KOD |
| 358 | 1972-04-11 | 06:00:01.92 | 37.35 | 62.05 | 1720 | 4.9 | 16.72 | 203.3 | KODB |
| 363 | 1972-07-09 | 07:00:01.25 | 49.80 | 35.40 | 2483 | 4.8 | 21.77 | 275.6 | KODB |
| 366 | 1972-08-20 | 03:00:00.01 | 49.400 | 48.142 | 489 | 5.7 | 14.28 | 264.1 | KOD |
| 370 | 1972-09-04 | 07:00:00 | 67.75 | 33.10 | 131 | 4.6 | 22.92 | 324.0 | KODB |
| 371 | 1972-09-21 | 09:00:00.31 | 52.118 | 52.068 | 485 | 5.0 | 11.08 | 272.4 | KODB |
| 372 | 1972-10-03 | 09:00:00.18 | 46.853 | 44.938 | 485 | 5.6 | 17.34 | 259.3 | KODB |
| 375 | 1972-11-24 | 09:00:00.04 | 51.990 | 51.867 | 675 | 4.5 | 11.22 | 271.9 | KODB |
| 383 | 1973-08-15 | 02:00:00.02 | 42.775 | 67.408 | 600 | 5.3 | 10.46 | 191.7 | KOD/SS |
| 384 | 1973-08-28 | 03:00:00.04 | 50.527 | 68.323 | 395 | 5.2 | 2.81 | 206.4 | KOD/SS |
| 386 | 1973-09-19 | 03:00:00.18 | 45.758 | 67.825 | 615 | 5.1 | 7.47 | 193.3 | KOD/SS |
| 389 | 1973-09-30 | 05:00:00.35 | 51.65 | 54.55 | 1145 | 5.2 | 9.69 | 268.0 | KODB |
| 390 | 1973-10-26 | 05:59:59.5 | 53.65 | 55.40 | 2026 | 4.8 | 8.89 | 279.8 | KODB |
| 406 | 1974-08-29 | 15:00:00.39 | 67.085 | 62.625 | 583 | 5.0 | 14.51 | 348.1 | SS |
| 428 | 1975-09-29 | 11:00:00.43 | 69.578 | 90.337 | 834 | 4.8 | 18.91 | 21.7 | SS |
| 438 | 1976-03-29 | 07:00:00.23 | 47.897 | 48.133 | 986 | 4.3 | 14.94 | 258.7 | SS/TSG |
| 446 | 1976-07-29 | 05:00:00.5 | 47.870 | 48.150 | 1000 | 5.9 | 14.94 | 258.6 | SS/TSG |
| 452 | 1976-11-05 | 03:59:59.98 | 61.458 | 112.860 | 1522 | 5.3 | 24.00 | 52.6 | SS |
| 462 | 1977-07-26 | 17:00:00.22 | 69.575 | 90.375 | 850 | 5.0 | 18.92 | 21.7 | SS/TSG |
| 466 | 1977-08-20 | 22:00:00.78 | 64.108 | 99.558 | 600 | 5.0 | 18.57 | 42.1 | TSG |
| 469 | 1977-09-10 | 16:00:00.18 | 57.251 | 106.551 | 550 | 4.8 | 20.88 | 63.9 | SS/TSG |
| 470 | 1977-09-30 | 06:59:58.43 | 47.897 | 48.161 | 1500 | 5.0 | 14.92 | 258.7 | SS |
| 490 | 1978-08-09 | 18:00:00.79 | 63.678 | 125.522 | 567 | 5.6 | 29.74 | 47.3 | SS |
| 492 | 1978-08-24 | 18:00:00.35 | 65.925 | 112.338 | 577 | 5.1 | 24.25 | 41.7 | SS/TSG |
| 498 | 1978-09-21 | 15:00:00.19 | 66.598 | 86.210 | 886 | 5.2 | 15.62 | 23.9 | SS/TSG |
| 500 | 1978-10-08 | 00:00:00.0 | 61.55 | 112.85 | 1545 | 5.2 | 23.99 | 52.4 | SS |
| 502 | 1978-10-17 | 04:59:59.06 | 47.850 | 48.120 | 1040 | 5.8 | 14.97 | 258.6 | SS |
| 503 | 1978-10-17 | 14:00:00.16 | 63.185 | 63.432 | 593 | 5.5 | 10.74 | 343.2 | SS |
| 510 | 1978-12-18 | 07:59:58.5 | 47.860 | 48.160 | 630 | 5.9 | 14.94 | 258.6 | SS/TSG |
| 513 | 1979-01-17 | 07:59:58.5 | 47.920 | 48.120 | 995 | 6.0 | 14.93 | 258.8 | SS/TSG |

continue on next page

| Test No. | Date Year-Mo-Da | Time (hr:mn:sec) | Latitude (°N) | Longitude (°E) | Depth (m) | $m_b(P)$ | Distance (°) | Az (°) | Instrument type |
|----------|-----------------|------------------|---------------|----------------|-----------|----------|--------------|--------|-----------------|
| 523 | 1979-07-14 | 04:59:58.0 | 47.880 | 48.120 | 849 | 5.6 | 14.95 | 258.7 | SS/TSG |
| 527 | 1979-08-12 | 18:00:00.21 | 61.803 | 122.430 | 982 | 4.9 | 28.52 | 51.4 | SS/TSG |
| 529 | 1979-09-06 | 18:00:00.31 | 64.110 | 99.562 | 599 | 4.9 | 18.57 | 42.1 | SS/TSG |
| 533 | 1979-10-04 | 16:00:00.03 | 60.675 | 71.455 | 837 | 5.4 | 7.64 | 4.3 | SS/TSG |
| 534 | 1979-10-07 | 21:00:00.22 | 61.85 | 113.10 | 1545 | 5.0 | 24.12 | 51.7 | SS/TSG |
| 537 | 1979-10-24 | 05:59:59.0 | 47.850 | 48.140 | 915 | 5.8 | 14.96 | 258.6 | SS/TSG |
| 556 | 1980-10-08 | 06:00:00.29 | 46.757 | 48.275 | 1050 | 5.2 | 15.43 | 254.8 | SS |
| 560 | 1980-11-01 | 13:00:00.42 | 60.80 | 97.55 | 720 | 5.2 | 16.60 | 51.5 | TSG |
| 570 | 1981-05-25 | 05:00:00.32 | 68.20 | 53.50 | 1511 | 5.5 | 17.10 | 338.6 | SS |
| 576 | 1981-09-02 | 03:59:59.99 | 60.60 | 55.70 | 2088 | 4.4 | 10.94 | 319.3 | TSG |
| 578 | 1981-09-26 | 05:00:00.28 | 46.790 | 48.313 | 1050 | 5.2 | 15.39 | 254.8 | TSG |
| 579 | 1981-09-26 | 05:03:59.94 | 46.771 | 48.304 | 1050 | 5.3 | 15.41 | 254.8 | TSG |
| 583 | 1981-10-22 | 14:00:00.36 | 63.80 | 97.55 | 581 | 5.1 | 17.64 | 41.9 | TSG |
| 592 | 1982-07-30 | 21:00:00.00 | 53.80 | 104.15 | 554 | 5.0 | 20.00 | 74.2 | TSG |
| 597 | 1982-09-25 | 18:00:00.18 | 64.35 | 91.80 | 554 | 5.2 | 15.74 | 35.8 | TSG |
| 613 | 1983-07-10 | 04:00:00.00 | 51.363 | 53.306 | 907 | 5.3 | 10.51 | 267.5 | SS |
| 614 | 1983-07-10 | 04:04:59.94 | 51.367 | 53.327 | 917 | 5.3 | 10.50 | 267.5 | SS |
| 615 | 1983-07-10 | 04:09:59.85 | 51.380 | 53.340 | 841 | 5.3 | 10.49 | 267.6 | SS |
| 618 | 1983-09-24 | 05:00:00.03 | 46.783 | 48.315 | 1050 | 5.2 | 15.39 | 254.8 | SS |
| 619 | 1983-09-24 | 05:05:00.03 | 46.788 | 48.297 | 1050 | 5.1 | 15.40 | 254.8 | SS |
| 620 | 1983-09-24 | 05:10:00.08 | 46.767 | 48.310 | 920 | 5.0 | 15.40 | 254.8 | SS |
| 621 | 1983-09-24 | 05:15:00.14 | 46.749 | 48.303 | 1100 | 5.2 | 15.42 | 254.7 | SS |
| 622 | 1983-09-24 | 05:19:59.93 | 46.754 | 48.288 | 950 | 5.4 | 15.42 | 254.8 | SS |
| 623 | 1983-09-24 | 05:25:00.00 | 46.766 | 48.274 | 1100 | 5.3 | 15.43 | 254.8 | SS |
| 639 | 1984-07-21 | 02:59:59.81 | 51.358 | 53.319 | 846 | 5.4 | 10.51 | 267.5 | SS |
| 640 | 1984-07-21 | 03:04:59.71 | 51.371 | 53.337 | 955 | 5.3 | 10.49 | 267.6 | SS |
| 641 | 1984-07-21 | 03:09:59.85 | 51.391 | 53.351 | 844 | 5.4 | 10.48 | 267.6 | SS |
| 643 | 1984-08-25 | 19:00:00.33 | 61.90 | 72.10 | 726 | 5.3 | 8.89 | 5.5 | SS |
| 649 | 1984-09-17 | 21:00:00.03 | 55.834 | 87.526 | 557 | 5.0 | 10.37 | 67.6 | TSG |
| 652 | 1984-10-27 | 06:00:00.10 | 46.90 | 48.15 | 1000 | 5.0 | 15.43 | 255.4 | SS/TSG |
| 653 | 1984-10-27 | 06:05:00.00 | 46.95 | 48.10 | 1000 | 5.0 | 15.43 | 255.6 | SS/TSG |
| 679 | 1987-07-07 | 00:00:00.0 | 61.50 | 112.85 | 1502 | 5.1 | 23.99 | 52.5 | SS |
| 681 | 1987-07-24 | 02:00:00.0 | 61.45 | 112.80 | 1515 | 5.1 | 23.97 | 52.7 | SS |
| 684 | 1987-08-12 | 01:30:00.5 | 61.45 | 112.80 | 815 | 5.0 | 23.97 | 52.7 | SS |
| 686 | 1987-10-03 | 15:15:00.03 | 47.60 | 56.20 | 1002 | 5.3 | 10.49 | 244.3 | SS/TSG |
| 699 | 1988-08-22 | 16:20:00.07 | 66.280 | 78.491 | 829 | 5.3 | 13.83 | 13.9 | SS/TSG |
| 700 | 1988-09-06 | 16:19:59.94 | 61.361 | 48.092 | 820 | 4.8 | 14.49 | 313.7 | SS/TSG |

(¹) Test No.=nuclear test number given in Mikhailov et al. (1996); Date and Time=origin time of the tests given in Sultanov et al. (1999); Latitude and Longitude=location the tests given in Sultanov et al. (1999); $m_b(P)$ =body-wave magnitude of the tests given in Sultanov et al. (1999); Distance=epicentral distance in degrees from the PNE to Borovoye; Az=azimuth in degrees from the station to PNE; Precision of the origin time⁶ is indicated by their decimal point. Location accuracies are also indicated by the decimal point.

⁶whole second or one hundredth of a second

Table A6: Borovoye archive data for Chinese Underground Nuclear Tests at Lop Nor, 1969–1995⁽¹⁾

| N | Date Year-Mo-Da | Time (hr:mn:sec) | Latitude (°N) | Longitude (°E) | m_b (P) | Event id | Instrument type ⁽²⁾ | Comments |
|----|--------------------|---------------------|------------------|-------------------|------------------|-------------|-----------------------------------|-----------|
| 01 | 1969-09-22 | 16:15:01.57 | 41.373 | 88.352 | 5.2 | CH01 | KODB | C, tunnel |
| 02 | 1976-10-17 | 05:00:01.37 | 41.734 | 88.383 | 4.9 | CH04 | SS | B, tunnel |
| 03 | 1978-10-14 | 01:00:00.25 | 41.511 | 88.772 | 4.9 | CH05 | SS/TSG | A, shaft |
| 04 | 1983-10-06 | 10:00:00.52 | 41.523 | 88.705 | 5.5 | CH07 | SS/TSG | A, shaft |
| 05 | 1984-10-03 | 06:00:00.58 | 41.577 | 88.706 | 5.4 | CH08 | SS | A, shaft |
| 06 | 1984-12-19 | 06:00:00.86 | 41.738 | 88.365 | 4.7 | CH09 | SS/TSG | B, tunnel |
| 07 | 1987-06-05 | 05:00:00.73 | 41.505 | 88.709 | 6.2 | CH10 | SS/TSG | A, shaft |
| 08 | 1990-08-16 | 05:00:00.16 | 41.511 | 88.742 | 6.2 | CH13 | SS/TSG | A, shaft |
| 09 | 1993-10-05 | 01:59:58.99 | 41.593 | 88.687 | 5.9 | CH16 | TSG | A, shaft |
| 10 | 1994-10-07 | 03:26:00.37 | 41.556 | 88.736 | 5.9 | CH18 | TSG | A, shaft |
| 11 | 1995-05-15 | 04:06:00.31 | 41.546 | 88.772 | 6.1 | CH19 | TSG | A, shaft |

⁽¹⁾ location and origin time from Engdahl (2001), teleseismic body-wave magnitude from PDE. ⁽²⁾ Instrument type= instrument used, KODB= KOD low-gain system; KODM= KOD high-gain system; SS=STsR-SS system; TSG=STsR-TSG system.

Table A7: Borovoye archive data for French Underground Nuclear Tests, 1977–1996⁽¹⁾

| N | Date Year-Mo-Da | Time (hr:mn:sec) | Latitude (°N) | Longitude (°E) | m_b (P) | Instrument type ⁽²⁾ | Site |
|----|--------------------|---------------------|------------------|-------------------|------------------|-----------------------------------|---------|
| 01 | 1977-03-19 | 23:00:59.89 | -21.887 | -138.920 | 5.92 | SS | Mururoa |
| 02 | 1977-11-24 | 16:59:59.92 | -21.884 | -138.886 | 5.86 | SS/TSG | Mururoa |
| 03 | 1978-03-22 | 17:30:00.45 | -21.705 | -138.934 | 4.73 | SS/TSG | Mururoa |
| 04 | 1978-11-30 | 17:31:59.98 | -21.868 | -138.950 | 5.86 | TSG | Mururoa |
| 05 | 1979-06-18 | 23:27:00.66 | -21.810 | -138.809 | 4.71 | SS | Mururoa |
| 06 | 1979-07-25 | 17:57:00.00 | -21.880 | -138.940 | 6.11 | SS | Mururoa |
| 07 | 1980-03-23 | 19:37:00.00 | -21.861 | -138.939 | 5.63 | SS | Mururoa |
| 08 | 1980-04-01 | 19:31:00.22 | -21.845 | -138.758 | 5.05 | SS | Mururoa |
| 09 | 1980-07-19 | 23:47:00.00 | -21.861 | -138.934 | 5.73 | SS/TSG | Mururoa |
| 10 | 1980-12-03 | 17:33:00.00 | -21.875 | -138.939 | 5.58 | TSG | Mururoa |
| 11 | 1981-07-08 | 22:23:00.30 | -21.791 | -139.046 | 5.14 | TSG | Mururoa |
| 12 | 1981-12-05 | 16:58:01.08 | -21.685 | -138.933 | 4.68 | SS | Mururoa |
| 13 | 1981-12-08 | 16:47:00.23 | -21.797 | -138.927 | 5.14 | SS | Mururoa |
| 14 | 1982-07-01 | 17:02:00.20 | -21.769 | -138.946 | 5.08 | SS | Mururoa |
| 15 | 1982-07-25 | 18:02:00.00 | -21.836 | -138.896 | 5.60 | TSG | Mururoa |
| 16 | 1983-04-19 | 18:53:00.17 | -21.819 | -138.872 | 5.70 | SS/TSG | Mururoa |
| 17 | 1983-05-25 | 17:31:00.12 | -21.861 | -138.917 | 5.87 | SS/TSG | Mururoa |
| 18 | 1983-06-28 | 17:46:00.24 | -21.767 | -138.871 | 5.32 | TSG | Mururoa |
| 19 | 1983-07-20 | 20:30:00 | -21.85 | -138.90 | 5.0 | SS/TSG | - |
| 20 | 1983-08-04 | 17:14:00.20 | -21.835 | -138.829 | 5.13 | SS/TSG | Mururoa |
| 21 | 1983-12-07 | 17:28:00.28 | -21.829 | -138.928 | 4.89 | SS | - |
| 22 | 1984-05-08 | 17:26:00 | -21.85 | -138.90 | 5.3 | SS | - |
| 23 | 1984-05-12 | 17:31:00.04 | -21.863 | -138.901 | 5.57 | SS/TSG | Mururoa |
| 24 | 1984-06-12 | 17:17:00 | -21.85 | -138.90 | 4.5 | TSG | - |
| 25 | 1984-06-16 | 17:43:59.98 | -21.849 | -138.880 | 5.28 | SS/TSG | Mururoa |
| 26 | 1984-11-02 | 20:45:00.13 | -21.857 | -138.920 | 5.64 | SS/TSG | Mururoa |
| 27 | 1984-12-06 | 17:29:00.16 | -21.837 | -138.890 | 5.56 | SS | Mururoa |
| 28 | 1985-05-08 | 20:28:00.24 | -21.831 | -138.981 | 5.64 | SS/TSG | Mururoa |
| 29 | 1985-06-03 | 17:30:00.61 | -21.816 | -138.897 | 4.83 | SS/TSG | Mururoa |
| 30 | 1985-10-24 | 17:50:00 | -21.85 | -138.90 | 4.5 | TSG | - |
| 31 | 1985-10-26 | 16:35:00.24 | -21.849 | -138.815 | 5.30 | TSG | Mururoa |
| 32 | 1985-11-24 | 16:01:00.66 | -21.802 | -138.781 | 4.55 | SS/TSG | Mururoa |
| 33 | 1985-11-26 | 17:42:00.06 | -21.856 | -138.899 | 5.76 | SS/TSG | Mururoa |
| 34 | 1986-04-26 | 17:02:00.67 | -21.725 | -138.941 | 4.45 | SS/TSG | Mururoa |
| 35 | 1986-05-27 | 17:15:00 | -21.85 | -138.90 | 4.7 | SS/TSG | - |
| 36 | 1986-05-30 | 17:25:00.11 | -21.862 | -138.949 | 5.58 | SS/TSG | Mururoa |
| 37 | 1986-11-10 | 16:58:00 | -21.85 | -138.90 | 4.9 | TSG | - |
| 38 | 1986-11-12 | 17:02:00.32 | -21.843 | -138.927 | 5.28 | TSG | Mururoa |
| 39 | 1986-12-10 | 17:15:00.18 | -21.833 | -138.892 | 5.23 | SS/TSG | Mururoa |
| 40 | 1987-05-20 | 17:05:00.12 | -21.850 | -138.913 | 5.51 | SS | Mururoa |
| 41 | 1987-06-06 | 18:00:00.71 | -21.769 | -138.874 | 4.40 | SS | Mururoa |
| 42 | 1987-06-21 | 17:55:00.12 | -21.865 | -138.891 | 5.10 | SS/TSG | Mururoa |
| 43 | 1987-10-23 | 16:50:00.31 | -21.845 | -138.907 | 5.54 | SS | Mururoa |
| 44 | 1987-11-05 | 17:30:00.36 | -21.791 | -138.874 | 5.36 | SS | Mururoa |

continue on next page

| N | Date Year-Mo-Da | Time (hr:mn:sec) | Latitude (°N) | Longitude (°E) | m_b (P) | Instrument type ⁽²⁾ | Site |
|----|--------------------|---------------------|------------------|-------------------|------------------|-----------------------------------|------------|
| 45 | 1987-11-19 | 16:31:00.16 | -21.845 | -138.941 | 5.74 | SS/TSG | Mururoa |
| 46 | 1987-11-29 | 17:59:00 | -21.85 | -138.90 | 4.6 | TSG | Mururoa |
| 47 | 1988-05-11 | 17:00:00.27 | -21.833 | -138.945 | 5.27 | SS/TSG | Mururoa |
| 48 | 1988-05-25 | 17:01:00.14 | -21.845 | -138.961 | 5.50 | SS/TSG | Mururoa |
| 49 | 1988-11-23 | 17:01:00.33 | -21.835 | -138.954 | 5.29 | TSG | Mururoa |
| 50 | 1988-11-30 | 17:54:59.98 | -22.194 | -138.737 | 5.58 | TSG | Fangataufa |
| 51 | 1989-05-11 | 16:45:00.52 | -21.812 | -138.884 | 5.16 | SS/TSG | Mururoa |
| 52 | 1989-06-03 | 17:30:00.20 | -21.842 | -138.922 | 5.16 | SS/TSG | Mururoa |
| 53 | 1989-06-10 | 17:29:59.86 | -22.222 | -138.664 | 5.52 | SS/TSG | Fangataufa |
| 54 | 1989-10-31 | 16:57:00.26 | -21.793 | -138.855 | 5.30 | TSG | Mururoa |
| 55 | 1989-11-20 | 17:29:00.27 | -21.793 | -138.884 | 5.19 | SS/TSG | Mururoa |
| 56 | 1990-06-02 | 17:29:58.95 | -21.820 | -138.935 | 5.30 | SS/TSG | Mururoa |
| 57 | 1990-06-26 | 17:59:58.40 | -22.204 | -138.835 | 5.50 | TSG | Fangataufa |
| 58 | 1990-07-04 | 17:59:58.80 | -21.809 | -139.120 | 4.90 | TSG | Mururoa |
| 59 | 1990-11-14 | 18:11:58.41 | -22.201 | -138.835 | 5.60 | TSG | Fangataufa |
| 60 | 1990-11-21 | 16:59:58.42 | -21.897 | -138.983 | 5.40 | SS | Mururoa |
| 61 | 1991-05-18 | 17:14:58.67 | -21.800 | -139.033 | 5.00 | SS/TSG | Mururoa |
| 62 | 1991-05-29 | 18:59:58.40 | -22.227 | -138.803 | 5.50 | SS/TSG | Fangataufa |
| 63 | 1991-06-14 | 17:59:58.47 | -21.822 | -139.104 | 5.10 | SS/TSG | Mururoa |
| 64 | 1991-07-15 | 18:09:58.69 | -21.832 | -138.975 | 5.30 | SS/TSG | Mururoa |
| 65 | 1995-10-27 | 21:59:58.43 | -21.852 | -138.952 | 5.40 | TSG | Mururoa |
| 66 | 1995-11-21 | 21:29:58.62 | -21.820 | -139.057 | 4.80 | TSG | Mururoa |
| 67 | 1995-12-27 | 21:29:58.46 | -21.792 | -139.042 | 5.10 | TSG | Mururoa |
| 68 | 1996-01-27 | 21:29:58.16 | -22.165 | -138.835 | 5.20 | TSG | Fangataufa |

⁽¹⁾ Time, location and teleseismic body-wave magnitude from Marshall et al. (1993), for tests till 1989. For tests since 1990, hypocenter parameters are taken from ISC Bulletin. The Site column indicate tests conducted at Mururoa Atoll or Fangataufa Lagoon regions in the Tuamotu Archipelago. Seven tests with no known seismologically determined locations are indicated by "-" in the Site column and a nominal locations are given [center of the Mururoa site]. ⁽²⁾ Instrument type= instrument used, KODB= KOD low-gain system; KODM= KOD high-gain system; SS=STsR-SS system; TSG=STsR-TSG system.

Table A8: Borovoye archive data for US Underground Nuclear Tests, 1967–1992⁽¹⁾

| Test No. | Date Year-Mo-Da | Time (hr:mn:sec) | Lat. (°N) | Long. (°E) | m_b (P) | Inst. type ⁽²⁾ | Location/Yield |
|----------|-----------------|------------------|-----------|------------|-----------|---------------------------|------------------------------------|
| 501 | 1967-05-23 | 14:00:00.04 | 37.275 | -116.371 | 5.7 | KODB | Scotch/155 kt |
| 502 | 1967-05-26 | 15:00:01.50 | 37.248 | -116.481 | 5.5 | KODB | NTS/76 kt |
| 505 | 1967-06-26 | 16:00:00.08 | 37.202 | -116.209 | 5.1 | KODB | NTS |
| 511 | 1967-08-18 | 20:12:30.04 | 37.012 | -116.037 | 4.6 | KODB | NTS |
| 513 | 1967-08-31 | 16:30:00.04 | 37.178 | -116.210 | 5.0 | KODB | NTS |
| 514 | 1967-09-07 | 13:45:00.00 | 37.153 | -116.054 | 0.0 | KODB | NTS |
| 517 | 1967-09-27 | 17:00:00.04 | 37.099 | -116.054 | 5.7 | KODB/M | NTS |
| 518 | 1967-10-18 | 14:30:00.08 | 37.116 | -116.059 | 5.7 | KODB | NTS |
| 519 | 1967-10-25 | 14:30:00.06 | 37.032 | -116.027 | 0.0 | KODB | NTS |
| 525 | 1967-12-15 | 15:00:00.04 | 37.037 | -116.003 | 0.0 | KODB | NTS |
| 526 | 1968-01-18 | 16:30:00.13 | 37.146 | -116.067 | 0.0 | KODB | NTS/7.4 kt |
| 527 | 1968-01-19 | 15:00:00.00 | 37.156 | -116.055 | 0.0 | KODB | NTS |
| 528 | 1968-01-19 | 18:15:00.08 | 38.634 | -118.133 | 6.3 | KODB | Central Nevada |
| 530 | 1968-01-26 | 16:00:00.11 | 37.281 | -116.515 | 0.0 | KODB | Cabriolet/2.3 kt |
| 532 | 1968-02-21 | 15:30:00.00 | 37.117 | -116.055 | 5.8 | KODB | NTS |
| 538 | 1968-03-22 | 15:00:00.04 | 37.333 | -116.312 | 5.6 | KODB | NTS |
| 541 | 1968-04-10 | 14:00:00.00 | 37.154 | -116.080 | 4.6 | KODB | NTS |
| 542 | 1968-04-18 | 14:05:00.00 | 37.152 | -116.038 | 4.9 | KODB | NTS |
| 544 | 1968-04-26 | 15:00:00.07 | 37.295 | -116.457 | 6.3 | KODB | Boxcar/1.3 Mt |
| 545 | 1968-05-03 | 16:00:00.04 | 37.029 | -116.021 | 4.1 | KODB | NTS |
| 547 | 1968-05-17 | 13:00:00.00 | 37.120 | -116.060 | 4.7 | KODB | NTS |
| 551 | 1968-06-15 | 13:59:59.97 | 37.265 | -116.316 | 5.9 | KODB | NTS |
| 571 | 1968-11-04 | 15:15:00.09 | 37.130 | -116.087 | 5.0 | KODB | NTS |
| 575 | 1968-11-20 | 18:00:00.03 | 37.010 | -116.207 | 4.9 | KODB | NTS |
| 577 | 1968-12-08 | 16:00:00.14 | 37.343 | -116.567 | 4.8 | KODB | NTS/30 kt |
| 578 | 1968-12-12 | 15:10:00.08 | 37.121 | -116.081 | 0.0 | KODB | 6 detonations |
| 581 | 1968-12-19 | 16:30:00.04 | 37.231 | -116.474 | 6.3 | KODB/M | Benham/1.15 Mt |
| 582 | 1969-01-15 | 19:00:00.07 | 37.148 | -116.067 | 0.0 | KODB | NTS/10 kt |
| 583 | 1969-01-15 | 19:30:00.04 | 37.209 | -116.226 | 5.3 | KODB | NTS |
| 585 | 1969-01-30 | 15:00:00.04 | 37.053 | -116.030 | 4.8 | KODB | NTS |
| 592 | 1969-03-20 | 18:12:00.04 | 37.022 | -116.031 | 4.6 | KODB | NTS |
| 593 | 1969-03-21 | 14:30:00.41 | 37.133 | -116.088 | 4.9 | KODB | NTS |
| 595 | 1969-04-30 | 17:00:00.04 | 37.090 | -116.007 | 5.3 | KODB | NTS |
| 597 | 1969-05-07 | 13:45:00.04 | 37.283 | -116.502 | 5.8 | KODB | NTS |
| 599 | 1969-05-27 | 14:15:00.04 | 37.075 | -115.996 | 5.0 | KODB | NTS |
| 601 | 1969-06-12 | 14:00:00.04 | 37.009 | -116.031 | 4.4 | KODB | NTS |
| 603 | 1969-07-16 | 13:02:30.04 | 37.119 | -116.056 | 4.7 | KODB | NTS |
| 604 | 1969-07-16 | 14:55:00.04 | 37.139 | -116.088 | 5.6 | KODB | NTS |
| 605 | 1969-08-14 | 14:30:00.04 | 37.160 | -116.064 | 0.0 | KODB | NTS |
| 606 | 1969-08-27 | 13:45:00.04 | 37.021 | -116.039 | 4.7 | KODB | NTS |
| 608 | 1969-09-10 | 21:00:00.01 | 39.356 | -107.949 | 5.0 | KODB | Grand Valley, CO/Rulison/40 kt |
| 609 | 1969-09-12 | 18:02:20.42 | 36.877 | -115.929 | 4.5 | KODB | NTS |
| 610 | 1969-09-16 | 14:30:00.04 | 37.314 | -116.462 | 6.2 | KODB/M | NTS |
| 613 | 1969-10-02 | 22:06:00.04 | 51.403 | +179.179 | 6.5 | KODB/M | Amchitka, AK/Milow/ \approx 1 Mt |

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| Test No. | Date Year-Mo-Da | Time (hr:mn:sec) | Lat. (°N) | Long. (°E) | m_b (P) | Inst. type ⁽²⁾ | Location/Yield |
|----------|-----------------|------------------|-----------|------------|-----------|---------------------------|------------------------------|
| 620 | 1969-11-21 | 14:52:00.04 | 37.031 | -116.003 | 5.0 | KODB | NTS |
| 622 | 1969-12-05 | 17:00:00.04 | 37.180 | -116.212 | 5.0 | KODB | NTS |
| 624 | 1969-12-10 | 15:30:00.07 | 37.168 | -116.080 | 0.0 | KODB | NTS |
| 625 | 1969-12-17 | 15:00:00.04 | 37.083 | -116.002 | 5.5 | KODB | NTS |
| 627 | 1969-12-18 | 19:00:00.04 | 37.120 | -116.036 | 5.2 | KODB | NTS |
| 628 | 1970-01-23 | 16:30:00.21 | 37.141 | -116.038 | 4.6 | KODB | NTS |
| 629 | 1970-01-30 | 17:00:00.04 | 37.031 | -116.036 | 4.6 | KODB | NTS |
| 630 | 1970-02-04 | 17:00:00.04 | 37.098 | -116.027 | 5.6 | KODB | NTS |
| 632 | 1970-02-05 | 15:00:00.04 | 37.164 | -116.040 | 4.6 | KODB | NTS/25 kt |
| 633 | 1970-02-11 | 19:15:00.04 | 37.201 | -116.206 | 4.7 | KODB | NTS |
| 634 | 1970-02-25 | 14:28:38.04 | 37.037 | -115.999 | 5.2 | KODB | NTS |
| 635 | 1970-02-26 | 15:30:00.04 | 37.116 | -116.062 | 5.3 | KODB | NTS |
| 636 | 1970-03-06 | 14:24:00.94 | 37.173 | -116.093 | 4.3 | KODB | NTS/8.7 kt |
| 637 | 1970-03-06 | 15:00:00.21 | 37.140 | -116.032 | 4.3 | KODB | NTS |
| 639 | 1970-03-23 | 23:05:00.04 | 37.086 | -116.022 | 5.5 | KODB | NTS |
| 640 | 1970-03-26 | 19:00:00.20 | 37.300 | -116.535 | 6.5 | KODB/M | NTS |
| 641 | 1970-04-21 | 14:30:00.04 | 37.055 | -115.989 | 4.4 | KODB | NTS/12.7 kt |
| 642 | 1970-04-21 | 15:00:00.04 | 37.112 | -116.083 | 4.6 | KODB | NTS |
| 643 | 1970-05-01 | 14:13:00.04 | 37.059 | -116.029 | 4.2 | KODB | NTS |
| 644 | 1970-05-01 | 14:40:00.17 | 37.136 | -116.035 | 4.3 | KODB | NTS |
| 646 | 1970-05-05 | 15:30:00.17 | 37.216 | -116.185 | 5.0 | KODB | NTS |
| 648 | 1970-05-15 | 13:30:00.17 | 37.166 | -116.036 | 5.1 | KODB | NTS |
| 650 | 1970-05-21 | 14:15:00.03 | 37.071 | -116.014 | 5.1 | KODB | NTS |
| 651 | 1970-05-26 | 14:16:00.17 | 37.183 | -116.214 | 5.0 | KODB | NTS |
| 652 | 1970-05-26 | 15:00:00.05 | 37.113 | -116.063 | 5.5 | KODB | NTS/105 kt/90/35ton |
| 655 | 1970-06-26 | 13:00:00.04 | 37.114 | -116.087 | 4.3 | KODB | NTS |
| 657 | 1970-10-14 | 14:30:00.04 | 37.071 | -116.006 | 5.5 | KODB | NTS |
| 659 | 1970-11-05 | 15:00:00.04 | 37.029 | -116.013 | 4.9 | KODB | NTS |
| 662 | 1970-12-16 | 16:00:00.09 | 37.100 | -116.009 | 5.1 | KODB | NTS |
| 665 | 1970-12-17 | 16:05:00.16 | 37.129 | -116.084 | 5.8 | KODB | NTS/220 kt |
| 666 | 1970-12-18 | 15:30:00.20 | 37.173 | -116.100 | 5.1 | KODB | NTS/10 kt |
| 667 | 1971-06-16 | 14:50:00.04 | 37.033 | -116.015 | 4.9 | KODB | NTS |
| 668 | 1971-06-23 | 15:30:00.04 | 37.022 | -116.024 | 4.8 | KODB | NTS |
| 670 | 1971-06-24 | 14:00:00.16 | 37.147 | -116.068 | 4.9 | KODB | NTS |
| 671 | 1971-06-29 | 18:30:00.16 | 37.177 | -116.212 | 4.9 | KODB | NTS |
| 673 | 1971-07-08 | 14:00:00.08 | 37.110 | -116.052 | 5.5 | KODB | NTS/83 kt |
| 679 | 1971-08-18 | 14:00:00.03 | 37.057 | -116.037 | 5.4 | KODB | NTS |
| 681 | 1971-09-29 | 14:00:00.04 | 37.011 | -116.008 | 4.4 | KODB | NTS |
| 683 | 1971-10-08 | 14:30:00.15 | 37.114 | -116.038 | 4.7 | KODB | NTS |
| 684 | 1971-10-14 | 14:30:00.16 | 37.180 | -116.054 | 4.4 | KODB | NTS |
| 685 | 1971-11-06 | 22:00:00.06 | 51.456 | +179.102 | 6.8 | KODB/M | Amchitka, AK/Cannikin/< 5 Mt |
| 687 | 1971-11-30 | 15:45:00.15 | 37.160 | -116.071 | 4.7 | KODB | NTS |
| 688 | 1971-12-14 | 21:09:59.16 | 37.124 | -116.090 | 4.7 | KODB | NTS |
| 698 | 1972-05-02 | 19:15:00.04 | 37.208 | -116.210 | 5.0 | KODB | NTS |
| 700 | 1972-05-17 | 14:10:00.16 | 37.121 | -116.089 | 4.4 | KODB | NTS |
| 701 | 1972-05-19 | 17:00:00.05 | 37.065 | -116.003 | 4.9 | KODB | NTS |
| 706 | 1972-07-20 | 17:16:00.16 | 37.214 | -116.184 | 4.9 | KODB | NTS |
| 707 | 1972-07-25 | 13:30:00.06 | 37.012 | -116.016 | 3.8 | KODB | NTS |

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| Test No. | Date Year-Mo-Da | Time (hr:mn:sec) | Lat. (°N) | Long. (°E) | m_b (P) | Inst. type ⁽²⁾ | Location/Yield |
|----------|-----------------|------------------|-----------|------------|-----------|---------------------------|------------------------------|
| 709 | 1972-09-21 | 15:30:00.19 | 37.082 | -116.037 | 5.7 | KODB | NTS |
| 710 | 1972-09-26 | 14:30:00.16 | 37.121 | -116.087 | 4.4 | KODB | NTS |
| 716 | 1972-12-21 | 20:15:00.24 | 37.140 | -116.084 | 4.8 | KODB | NTS |
| 719 | 1973-03-08 | 16:10:00.19 | 37.104 | -116.028 | 5.4 | KODB | NTS |
| 722 | 1973-04-25 | 22:25:00.03 | 37.005 | -116.029 | 4.7 | KODB | NTS |
| 723 | 1973-04-26 | 17:15:00.17 | 37.123 | -116.059 | 5.6 | KODB | NTS |
| 726 | 1973-05-17 | 16:00:00.12 | 39.793 | -108.368 | 5.1 | KODB | Rifle, CO/Rio Blanco/3x33 kt |
| 729 | 1973-06-05 | 17:00:00.17 | 37.185 | -116.216 | 5.1 | KODB | NTS |
| 730 | 1973-06-06 | 13:00:00.08 | 37.245 | -116.347 | 6.1 | KODB/M/SS | NTS |
| 731 | 1973-06-21 | 14:45:00.08 | 37.092 | -116.028 | 5.1 | KODB | NTS |
| 732 | 1973-06-28 | 19:15:12.40 | 37.148 | -116.087 | 4.9 | KODB/SS | NTS |
| 736 | 1973-10-12 | 17:00:00.08 | 37.200 | -116.204 | 4.8 | KODB | NTS |
| 753 | 1974-07-10 | 16:00:00.09 | 37.075 | -116.033 | 5.7 | SS | NTS |
| 756 | 1974-08-30 | 15:00:00.16 | 37.152 | -116.084 | 5.8 | SS | NTS |
| 758 | 1974-09-26 | 15:05:00.17 | 37.133 | -116.069 | 5.6 | SS | NTS |
| 768 | 1975-02-28 | 16:15:00.09 | 37.106 | -116.057 | 5.7 | SS | NTS |
| 773 | 1975-05-14 | 14:00:00.16 | 37.221 | -116.475 | 6.0 | SS/TSG | NTS |
| 774 | 1975-06-03 | 14:20:00.17 | 37.340 | -116.524 | 5.9 | TSG | NTS |
| 775 | 1975-06-03 | 14:40:00.11 | 37.095 | -116.037 | 5.7 | TSG | NTS |
| 778 | 1975-06-19 | 13:00:00.09 | 37.350 | -116.321 | 6.1 | TSG | NTS |
| 779 | 1975-06-26 | 12:30:00.16 | 37.279 | -116.369 | 6.2 | SS | NTS |
| 782 | 1975-10-28 | 14:30:00.16 | 37.290 | -116.412 | 6.4 | SS/TSG | NTS |
| 784 | 1975-11-20 | 15:00:00.09 | 37.225 | -116.368 | 6.0 | SS | NTS |
| 787 | 1976-01-03 | 19:15:00.16 | 37.297 | -116.334 | 6.2 | TSG | NTS |
| 788 | 1976-02-04 | 14:20:00.11 | 37.069 | -116.031 | 5.8 | SS | NTS |
| 790 | 1976-02-12 | 14:45:00.16 | 37.271 | -116.489 | 6.3 | TSG | NTS |
| 791 | 1976-02-14 | 11:30:00.16 | 37.243 | -116.421 | 6.0 | SS/TSG | NTS |
| 794 | 1976-03-14 | 12:30:00.16 | 37.306 | -116.472 | 6.3 | SS | NTS |
| 795 | 1976-03-17 | 14:15:00.09 | 37.256 | -116.329 | 6.1 | SS | NTS |
| 796 | 1976-03-17 | 14:45:00.09 | 37.107 | -116.053 | 5.8 | TSG | NTS |
| 799 | 1976-07-27 | 20:30:00.08 | 37.075 | -116.045 | 5.3 | SS | NTS |
| 804 | 1976-12-08 | 14:49:30.08 | 37.079 | -116.002 | 4.9 | SS/TSG | NTS |
| 805 | 1976-12-21 | 15:09:00.17 | 37.124 | -116.068 | 4.2 | SS | NTS |
| 807 | 1976-12-28 | 18:00:00.08 | 37.100 | -116.037 | 5.5 | SS/TSG | NTS |
| 808 | 1977-02-16 | 17:53:00.16 | 37.007 | -116.032 | 4.8 | SS | NTS |
| 810 | 1977-04-05 | 15:00:00.17 | 37.120 | -116.063 | 5.6 | SS/TSG | NTS |
| 811 | 1977-04-27 | 15:00:00.08 | 37.095 | -116.029 | 5.4 | SS/TSG | NTS |
| 812 | 1977-05-25 | 17:00:00.08 | 37.094 | -116.046 | 5.3 | SS | NTS |
| 815 | 1977-08-04 | 16:40:00.07 | 37.087 | -116.008 | 5.0 | SS/TSG | NTS |
| 818 | 1977-08-19 | 17:55:00.10 | 37.110 | -116.055 | 5.6 | SS/TSG | NTS |
| 821 | 1977-09-27 | 14:00:00.16 | 37.151 | -116.068 | 4.8 | SS | NTS |
| 822 | 1977-10-26 | 14:15:00.08 | 37.008 | -116.018 | 4.4 | SS/TSG | NTS |
| 824 | 1977-11-09 | 22:00:00.08 | 37.072 | -116.051 | 5.7 | SS/TSG | NTS |
| 825 | 1977-11-17 | 19:30:00.08 | 37.021 | -116.026 | 4.7 | SS/TSG | NTS |
| 826 | 1977-12-14 | 15:30:00.07 | 37.136 | -116.087 | 5.7 | SS/TSG | NTS |
| 829 | 1978-02-23 | 17:00:00.16 | 37.124 | -116.065 | 5.6 | SS/TSG | NTS |
| 830 | 1978-03-16 | 15:00:00.07 | 37.085 | -116.082 | 4.1 | SS | NTS |
| 831 | 1978-03-23 | 16:30:00.20 | 37.102 | -116.052 | 5.6 | SS/TSG | NTS |

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| Test No. | Date Year-Mo-Da | Time (hr:mn:sec) | Lat. (°N) | Long. (°E) | m_b (P) | Inst. type ⁽²⁾ | Location/Yield |
|----------|-----------------|------------------|-----------|------------|-----------|---------------------------|----------------|
| 833 | 1978-04-11 | 17:45:00.07 | 37.233 | -116.369 | 5.5 | SS | NTS |
| 839 | 1978-07-12 | 17:00:00.08 | 37.079 | -116.045 | 5.5 | SS/TSG | NTS |
| 840 | 1978-08-31 | 14:00:00.16 | 37.276 | -116.358 | 5.6 | SS | NTS |
| 841 | 1978-09-13 | 15:15:00.16 | 37.209 | -116.212 | 4.6 | SS | NTS |
| 842 | 1978-09-27 | 17:00:00.07 | 37.074 | -116.021 | 5.0 | SS | NTS |
| 843 | 1978-09-27 | 17:20:00.08 | 37.080 | -116.052 | 5.7 | SS | NTS |
| 848 | 1978-12-16 | 15:30:00.16 | 37.273 | -116.411 | 5.5 | TSG | NTS |
| 849 | 1979-01-24 | 18:00:00.10 | 37.105 | -116.013 | 4.5 | SS | NTS |
| 850 | 1979-02-08 | 20:00:00.09 | 37.102 | -116.056 | 5.5 | SS/TSG | NTS |
| 851 | 1979-02-15 | 18:05:00.16 | 37.152 | -116.073 | 4.8 | SS | NTS |
| 852 | 1979-03-14 | 18:30:00.10 | 37.028 | -116.041 | 4.3 | SS/TSG | NTS |
| 854 | 1979-06-11 | 14:00:00.17 | 37.290 | -116.456 | 5.5 | SS | NTS |
| 855 | 1979-06-20 | 15:00:13.54 | 37.108 | -116.016 | 4.0 | SS | NTS |
| 856 | 1979-06-28 | 14:44:00.17 | 37.143 | -116.088 | 5.0 | SS | NTS |
| 857 | 1979-08-03 | 15:07:30.16 | 37.084 | -116.071 | 4.5 | SS | NTS |
| 858 | 1979-08-08 | 15:00:00.11 | 37.015 | -116.009 | 4.8 | SS/TSG | NTS |
| 860 | 1979-09-06 | 15:00:00.09 | 37.088 | -116.054 | 5.8 | TSG | Hearts/140 kt |
| 862 | 1979-09-26 | 15:00:00.09 | 37.229 | -116.365 | 5.6 | SS/TSG | NTS |
| 865 | 1980-02-28 | 15:00:00.09 | 37.127 | -116.089 | 4.4 | SS/TSG | NTS |
| 867 | 1980-04-03 | 14:00:00.09 | 37.150 | -116.083 | 4.7 | SS | NTS |
| 868 | 1980-04-16 | 20:00:00.09 | 37.101 | -116.031 | 5.3 | SS | NTS |
| 872 | 1980-06-12 | 17:15:00.09 | 37.282 | -116.455 | 5.6 | SS/TSG | NTS |
| 874 | 1980-07-25 | 19:05:00.08 | 37.256 | -116.478 | 5.5 | SS | NTS |
| 876 | 1980-09-25 | 14:45:00.09 | 37.056 | -116.049 | 4.6 | SS | NTS |
| 879 | 1980-10-31 | 18:00:00.09 | 37.211 | -116.206 | 4.7 | SS | NTS |
| 880 | 1980-11-14 | 16:50:00.08 | 37.111 | -116.020 | 4.1 | SS | NTS |
| 882 | 1981-01-15 | 20:25:00.09 | 37.087 | -116.046 | 5.7 | SS | NTS |
| 887 | 1981-06-06 | 18:00:00.08 | 37.303 | -116.326 | 5.6 | SS | NTS |
| 894 | 1981-10-01 | 19:00:00.10 | 37.082 | -116.010 | 5.1 | SS | NTS |
| 895 | 1981-11-11 | 20:00:09.09 | 37.076 | -116.069 | 4.9 | SS | NTS |
| 897 | 1981-12-03 | 15:00:00.10 | 37.148 | -116.072 | 4.8 | SS | NTS |
| 898 | 1981-12-16 | 21:05:00.09 | 37.114 | -116.124 | 4.4 | SS | NTS |
| 899 | 1982-01-28 | 16:00:00.10 | 37.091 | -116.052 | 5.6 | SS | NTS/139 kt |
| 900 | 1982-02-12 | 14:55:00.08 | 37.224 | -116.464 | 5.4 | SS/TSG | NTS |
| 901 | 1982-02-12 | 15:25:00.09 | 37.348 | -116.317 | 5.4 | SS/TSG | NTS |
| 902 | 1982-04-17 | 18:00:00.09 | 37.017 | -116.011 | 4.5 | SS | NTS |
| 905 | 1982-05-07 | 18:17:00.11 | 37.069 | -116.046 | 5.7 | SS | NTS |
| 907 | 1982-06-24 | 14:15:00.09 | 37.236 | -116.371 | 5.6 | SS | NTS |
| 908 | 1982-07-29 | 20:05:00.08 | 37.102 | -116.076 | 4.4 | TSG | NTS |
| 909 | 1982-08-05 | 14:00:00.09 | 37.084 | -116.007 | 5.7 | TSG | NTS/138 kt |
| 912 | 1982-09-23 | 16:00:00.09 | 37.212 | -116.208 | 4.9 | SS | NTS |
| 914 | 1982-09-23 | 17:00:00.09 | 37.175 | -116.089 | 4.9 | SS | NTS |
| 916 | 1982-11-12 | 19:17:00.10 | 37.024 | -116.033 | 4.1 | SS/TSG | NTS |
| 917 | 1982-12-10 | 15:20:00.09 | 37.080 | -116.073 | 4.8 | SS/TSG | NTS |
| 918 | 1983-02-11 | 16:00:00.10 | 37.056 | -116.046 | 4.1 | SS | NTS |
| 919 | 1983-02-17 | 17:00:00.09 | 37.163 | -116.064 | 4.0 | SS | NTS |
| 920 | 1983-03-26 | 20:20:00.09 | 37.301 | -116.461 | 5.2 | SS/TSG | NTS |
| 921 | 1983-04-14 | 19:05:00.12 | 37.073 | -116.047 | 5.7 | SS/TSG | NTS |

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| Test No. | Date Year-Mo-Da | Time (hr:mn:sec) | Lat. (°N) | Long. (°E) | m_b (P) | Inst. type ⁽²⁾ | Location/Yield |
|----------|-----------------|------------------|-----------|------------|-----------|---------------------------|----------------|
| 923 | 1983-05-05 | 15:20:00.08 | 37.146 | -116.090 | 4.4 | SS | NTS |
| 925 | 1983-05-26 | 15:00:00.09 | 37.103 | -116.007 | 4.5 | SS | NTS |
| 926 | 1983-06-09 | 17:10:00.09 | 37.158 | -116.090 | 4.5 | SS | NTS |
| 927 | 1983-08-03 | 13:33:00.10 | 37.119 | -116.090 | 4.2 | SS | NTS |
| 928 | 1983-08-11 | 14:00:00.12 | 36.998 | -116.004 | 4.4 | SS | NTS |
| 930 | 1983-09-01 | 14:00:00.08 | 37.273 | -116.356 | 5.5 | SS | NTS/143 kt |
| 931 | 1983-09-21 | 15:00:00.09 | 37.210 | -116.210 | 4.1 | SS | NTS |
| 932 | 1983-09-21 | 16:25:00.08 | 37.121 | -116.056 | 4.2 | SS | NTS |
| 933 | 1983-09-22 | 15:00:00.12 | 37.106 | -116.050 | 4.1 | SS/TSG | NTS |
| 935 | 1983-12-09 | 16:00:00.11 | 37.013 | -116.047 | 4.0 | SS/TSG | NTS |
| 936 | 1983-12-16 | 18:30:00.09 | 37.140 | -116.073 | 5.2 | SS/TSG | NTS |
| 937 | 1984-01-31 | 15:30:00.08 | 37.113 | -116.123 | 4.3 | SS/TSG | NTS |
| 938 | 1984-02-15 | 17:00:00.11 | 37.221 | -116.182 | 5.1 | SS/TSG | NTS |
| 939 | 1984-03-01 | 17:45:00.09 | 37.066 | -116.047 | 5.9 | SS | NTS |
| 940 | 1984-03-31 | 14:30:00.08 | 37.146 | -116.085 | 4.5 | SS | NTS |
| 944 | 1984-05-31 | 13:04:00.10 | 37.103 | -116.049 | 5.8 | SS/TSG | NTS |
| 945 | 1984-06-20 | 15:15:00.09 | 37.000 | -116.044 | 4.7 | SS | NTS |
| 947 | 1984-07-25 | 15:30:00.08 | 37.268 | -116.412 | 5.4 | SS | NTS |
| 948 | 1984-08-02 | 15:00:00.09 | 37.017 | -116.009 | 4.6 | SS/TSG | NTS |
| 949 | 1984-08-30 | 14:45:00.10 | 37.090 | -116.000 | 4.5 | SS/TSG | NTS |
| 951 | 1984-09-13 | 14:00:00.00 | 37.087 | -116.072 | 5.0 | SS | NTS |
| 953 | 1984-11-10 | 16:40:00.09 | 37.000 | -116.018 | 4.4 | SS/TSG | NTS |
| 955 | 1984-12-15 | 14:45:00.00 | 37.281 | -116.306 | 5.4 | SS/TSG | NTS |
| 957 | 1985-03-15 | 16:31:00.10 | 37.058 | -116.046 | 4.8 | SS | NTS |
| 958 | 1985-03-23 | 18:30:00.08 | 37.180 | -116.090 | 5.3 | SS/TSG | NTS |
| 959 | 1985-04-02 | 20:00:00.09 | 37.095 | -116.033 | 5.8 | SS/TSG | NTS |
| 960 | 1985-04-06 | 23:15:00.09 | 37.201 | -116.208 | 4.8 | SS/TSG | NTS |
| 961 | 1985-05-02 | 15:20:00.08 | 37.253 | -116.326 | 5.7 | SS | NTS |
| 962 | 1985-06-12 | 15:15:00.08 | 37.248 | -116.490 | 5.5 | SS/TSG | NTS |
| 963 | 1985-06-12 | 17:30:00.09 | 37.088 | -116.085 | 4.6 | SS/TSG | NTS |
| 964 | 1985-06-26 | 18:03:00.08 | 37.124 | -116.123 | 4.3 | SS/TSG | NTS |
| 965 | 1985-07-25 | 14:00:00.09 | 37.297 | -116.439 | 5.2 | SS | NTS |
| 967 | 1985-08-17 | 16:25:00.09 | 37.002 | -116.044 | 4.6 | SS | NTS |
| 968 | 1985-09-27 | 14:15:00.08 | 37.090 | -116.003 | 4.7 | SS | NTS |
| 970 | 1985-10-09 | 23:20:00.09 | 37.210 | -116.211 | 4.2 | SS | NTS |
| 971 | 1985-10-16 | 21:35:00.09 | 37.110 | -116.122 | 4.6 | SS/TSG | NTS |
| 974 | 1985-12-28 | 19:01:00.09 | 37.238 | -116.474 | 5.3 | SS/TSG | NTS |
| 975 | 1986-03-22 | 16:15:00.08 | 37.083 | -116.067 | 5.1 | SS/TSG | NTS/29 kt |
| 976 | 1986-04-10 | 14:08:30.10 | 37.218 | -116.184 | 4.9 | SS/TSG | NTS |
| 978 | 1986-04-22 | 14:30:00.09 | 37.264 | -116.441 | 5.3 | SS/TSG | NTS |
| 979 | 1986-05-21 | 13:59:00.08 | 37.125 | -116.061 | 3.9 | SS | NTS |
| 980 | 1986-06-05 | 15:04:00.06 | 37.098 | -116.016 | 5.3 | SS | NTS |
| 982 | 1986-07-17 | 21:00:00.06 | 37.279 | -116.356 | 5.7 | SS | NTS/119 kt |
| 983 | 1986-07-24 | 15:05:00.09 | 37.143 | -116.072 | 4.4 | SS | NTS |
| 986 | 1986-09-30 | 22:30:00.10 | 37.300 | -116.308 | 5.5 | SS/TSG | NTS |
| 987 | 1986-10-16 | 19:25:00.09 | 37.220 | -116.463 | 5.6 | SS/TSG | NTS |
| 988 | 1986-11-14 | 16:00:00.07 | 37.100 | -116.049 | 5.8 | SS/TSG | NTS |
| 989 | 1986-12-13 | 17:50:05.09 | 37.263 | -116.413 | 5.5 | SS/TSG | NTS |

continue on next page

| Test No. | Date Year-Mo-Da | Time (hr:mn:sec) | Lat. (°N) | Long. (°E) | m_b (P) | Inst. type ⁽²⁾ | Location/Yield |
|----------|-----------------|------------------|-----------|------------|-----------|---------------------------|---------------------------|
| 990 | 1987-02-03 | 15:20:00.08 | 37.181 | -116.049 | 2.2 | SS/TSG | NTS |
| 991 | 1987-02-11 | 16:45:00.07 | 37.011 | -116.046 | 4.5 | SS | NTS |
| 992 | 1987-03-18 | 18:28:00.09 | 37.210 | -116.209 | 4.3 | SS/TSG | NTS |
| 993 | 1987-04-18 | 13:40:00.00 | 37.248 | -116.510 | 5.5 | SS/TSG | NTS |
| 995 | 1987-04-30 | 13:30:00.09 | 37.233 | -116.424 | 5.5 | SS/TSG | NTS |
| 996 | 1987-06-18 | 15:20:00.08 | 37.194 | -116.036 | 4.1 | SS/TSG | NTS |
| 997 | 1987-06-20 | 16:00:00.18 | 37.220 | -116.179 | 3.5 | SS | NTS |
| 998 | 1987-06-30 | 16:05:00.10 | 36.999 | -116.044 | 4.1 | SS/TSG | NTS |
| 1000 | 1987-08-13 | 14:00:00.09 | 37.061 | -116.046 | 5.9 | SS/TSG | Tahoka |
| 1001 | 1987-09-24 | 15:00:00.06 | 37.228 | -116.376 | 5.7 | SS/TSG | NTS |
| 1002 | 1987-10-23 | 16:00:00.09 | 37.142 | -116.080 | 5.2 | SS/TSG | Borate |
| 1004 | 1987-12-02 | 16:30:00.08 | 37.235 | -116.164 | 4.1 | TSG | NTS |
| 1005 | 1988-02-15 | 18:10:00.09 | 37.314 | -116.472 | 5.3 | SS | Kernville |
| 1006 | 1988-04-07 | 17:15:00.08 | 37.013 | -116.045 | 4.0 | SS | NTS |
| 1007 | 1988-05-13 | 15:35:00.11 | 37.124 | -116.073 | 4.8 | SS/TSG | NTS |
| 1008 | 1988-05-21 | 22:30:00.14 | 37.032 | -115.988 | 4.3 | SS | Laredo |
| 1009 | 1988-06-02 | 13:00:00.09 | 37.260 | -116.442 | 5.4 | SS/TSG | NTS |
| 1012 | 1988-07-07 | 15:05:30.07 | 37.252 | -116.378 | 5.6 | SS | NTS |
| 1013 | 1988-08-17 | 17:00:00.09 | 37.297 | -116.307 | 5.5 | SS | Kersage/JVE/100 to 150 kt |
| 1015 | 1988-08-30 | 18:00:00.09 | 37.086 | -116.069 | 5.0 | SS/TSG | NTS |
| 1016 | 1988-10-13 | 14:00:00.08 | 37.089 | -116.050 | 5.9 | SS | NTS |
| 1019 | 1988-12-10 | 20:30:00.06 | 37.199 | -116.210 | 5.0 | SS/TSG | Misty Echo |
| 1020 | 1989-02-10 | 20:06:00.06 | 37.077 | -116.001 | 5.2 | SS/TSG | NTS |
| 1021 | 1989-02-24 | 16:15:00.08 | 37.128 | -116.123 | 4.4 | SS/TSG | NTS |
| 1022 | 1989-03-09 | 14:05:00.09 | 37.143 | -116.068 | 5.0 | SS/TSG | NTS |
| 1025 | 1989-06-22 | 21:15:00.08 | 37.283 | -116.413 | 5.3 | SS | NTS |
| 1026 | 1989-06-27 | 15:30:00.02 | 37.275 | -116.354 | 4.9 | SS/TSG | NTS |
| 1028 | 1989-10-31 | 15:30:00.09 | 37.263 | -116.492 | 5.7 | TSG | NTS |
| 1032 | 1990-03-10 | 16:00:00.08 | 37.112 | -116.056 | 5.0 | SS | NTS |
| 1034 | 1990-06-13 | 16:00:00.09 | 37.262 | -116.421 | 5.7 | SS/TSG | Bullion |
| 1035 | 1990-06-21 | 18:15:00.00 | 36.993 | -116.005 | 4.0 | TSG | NTS |
| 1036 | 1990-07-25 | 15:00:00.06 | 37.207 | -116.215 | 4.7 | SS/TSG | NTS |
| 1039 | 1990-10-12 | 17:30:00.08 | 37.248 | -116.495 | 5.6 | SS/TSG | Tenabo |
| 1040 | 1990-11-14 | 19:17:00.07 | 37.227 | -116.372 | 5.4 | TSG | NTS |
| 1041 | 1991-03-08 | 21:02:45.08 | 37.104 | -116.075 | 4.4 | TSG | NTS |
| 1042 | 1991-04-04 | 19:00:00.00 | 37.296 | -116.314 | 5.6 | TSG | NTS |
| 1044 | 1991-08-15 | 16:00:00.00 | 37.087 | -116.003 | 4.2 | TSG | NTS |
| 1045 | 1991-09-14 | 19:00:00.08 | 37.226 | -116.429 | 5.5 | TSG | Hoya/20 to 150 kt |
| 1046 | 1991-09-19 | 16:30:00.07 | 37.236 | -116.167 | 4.0 | TSG | Distant Zenith/< 20 kt |
| 1047 | 1991-10-18 | 19:12:00.00 | 37.063 | -116.046 | 5.2 | TSG | NTS |
| 1048 | 1991-11-26 | 18:35:00.07 | 37.096 | -116.070 | 4.6 | TSG | NTS |
| 1049 | 1992-03-26 | 16:30:00.00 | 37.272 | -116.361 | 5.5 | TSG | Junction/20 to 150 kt |

⁽¹⁾ time, location, yield and test id from DOE/NV-209-REV 15, December 2000. $m_b(P)$, body-wave magnitude from PDE/ISC. ⁽²⁾ KODB= KOD low-gain system; KODM= KOD high-gain system; SS=STsR-SS system; TSG=STsR-TSG system.

Table A9: Borovoye archive data for Joint US-UK Nuclear Tests, 1978–1989⁽¹⁾

| Test No. | Date Year-Mo-Da | Time (hr:mn:sec) | Latitude (°N) | Longitude (°E) | m_b (P) | Instrument name ⁽²⁾ | Test name |
|----------|-----------------|------------------|---------------|----------------|---------------|--------------------------------|-----------|
| 834 | 1978-04-11 | 15:30:00.16 | 37.300 | -116.328 | 5.3 | SS | Fondutta |
| 846 | 1978-11-18 | 19:00:00.17 | 37.127 | -116.085 | 5.1 | SS/TSG | Quargel |
| 859 | 1979-08-29 | 15:08:00.17 | 37.121 | -116.067 | 4.7 | SS | Nessel |
| 869 | 1980-04-26 | 17:00:00.08 | 37.248 | -116.423 | 5.4 | SS | Colwick |
| 878 | 1980-10-24 | 19:15:00.12 | 37.075 | -116.000 | 4.4 | SS | Dutchess |
| 881 | 1980-12-17 | 15:10:00.09 | 37.325 | -116.316 | 5.1 | SS | Serpa |
| 896 | 1981-11-12 | 15:00:00.10 | 37.108 | -116.050 | 5.4 | SS | Rousanne |
| 903 | 1982-04-25 | 18:05:00.09 | 37.256 | -116.423 | 5.4 | SS | Gibne |
| 922 | 1983-04-22 | 13:53:00.08 | 37.111 | -116.023 | 4.0 | SS | Armada |
| 941 | 1984-05-01 | 19:05:00.09 | 37.106 | -116.023 | 5.4 | SS/TSG | Mundo |
| 954 | 1984-12-09 | 19:40:00.09 | 37.270 | -116.498 | 5.5 | SS/TSG | Egmont |
| 973 | 1985-12-05 | 15:00:00.07 | 37.053 | -116.046 | 5.7 | SS | Kinibito |
| 981 | 1986-06-25 | 20:27:45.09 | 37.265 | -116.500 | 5.5 | SS | Darwin |
| 999 | 1987-07-16 | 19:00:00.08 | 37.104 | -116.024 | 4.8 | SS/TSG | Midland |
| 1030 | 1989-12-08 | 15:00:00.09 | 37.231 | -116.410 | 5.5 | SS/TSG | Barnwell |

⁽¹⁾ time, location, yield and test ids from DOE/NV-209-REV 15, December 2000. $m_b(P)$, body-wave magnitude from PDE/ISC. From March 01, 1962 through November 26, 1991, a total of 24 unclear tests are conducted at the Nevada Test Site for United Kingdom (UK). ⁽²⁾ SS=STsR-SS system and TSG=STsR-TSG system.