Ground Motion and Atmospheric Pressure Waves from Nuclear Explosions

THE French test series in the summer of 1970 consisted of eight announced atmospheric explosions in the Tuamoto archipelago in the South Pacific, and ended with a small explosion on August 6 (ref. 1). In this series there were two large explosions on May 30 and July 3. The explosion on May 30 (Dragon) was fired at 1800 GMT above the Fangataufa lagoon about 1,400 km south-east of Tahiti[2,3]. The explosion on July 3 (Licorne) was fired at 1830 GMT at 1,800 feet above sea level above the Mururoa Atoll, about 60 km north-west of Fangataufa, and had a yield of about one megaton[4]. This article reports the long period seismologic and microbarologic signals from these two explosions, recorded at the Hagfors Observatory in Sweden. No short period seismologic signals were obtained.

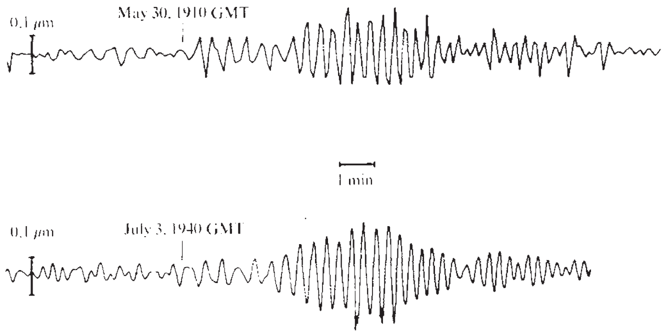

Fig. 1 Long period seismological signals recorded at the Hagfors Observatory in Sweden from two French explosions in the South Pacific, 1970.

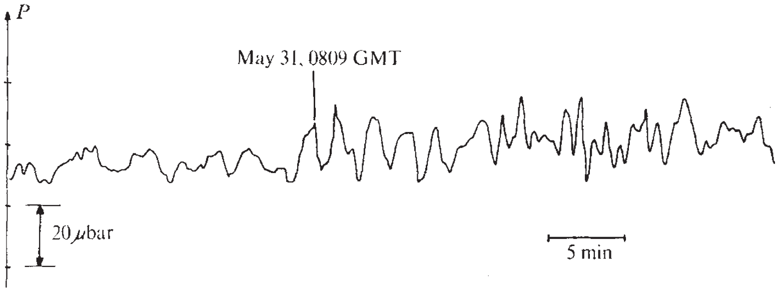

Fig. 2 Microbarologic signals recorded at the Hagfors Observatory in Sweden from the French explosion in the South Pacific, May 30, 1970.

The Hagfors Observatory, 350 km WNW of Stockholm, is operated by the Research Institute of the Swedish National Defence[5], and is equipped to detect long and short period seismologic and microbarologic signals and to record these signals in analogue and digital form. The long period seismologic equipment is now operating with a sensitivity ten to fifty times that of a standard seismological station.

Fig. 1 shows the long period records from the two explosions obtained with one of the long period vertical seismometers. The distances to the test islands are 15,280 km for Fangataufa and 15,230 km for Mururoa. The observed arrival times for the waves of period 30 s, 1910 GMT for the explosion of May 30 and 1940 for the explosion of July 3 are in good agreement with those calculated from distribution of lateral Rayleigh wave velocities determined earlier[6]. The maximum amplitude in the wave-train occurred at a period of about 20 s, and corresponds to a ground motion of 0.18 μm for the explosion of May 30, and of 0.24 μm for the explosion of July 3.

Microbarologic signals from the explosion of May 30 were recorded at the observatory, starting at 0809 GMT on May 31 (Fig. 2). The first part of the record shows a fundamental gravity mode, followed by a mixture of higher modes. The measured travel time of 14 h 09 min gives a group velocity of 304 ms^{-1}, in good agreement with earlier observations of waves from the same test area. An earlier study[7] has shown that the period of the first part of the microbarologic signal is a function of the yield of the explosion. If the variation of period with distance is taken into account, the observed period of 120 s corresponds to a yield of 600 ktm. Due to bad weather conditions on July 4, the pressure waves from the explosion of July 3 could not be discerned from the atmospheric microbarographic noise.

There seems to be no simple relation which is generally applicable by which the yield of an atmospheric explosion can be determined from recorded seismic signals. The seismic signals from such an explosion depend not only on the charge size but also on explosion altitude and ground properties. Model experiments[8,9] and theoretical calculations[10] show that for each charge size there exists an optimal explosion altitude, so that an explosion fired at that altitude gives larger seismic signals than if it were fired at any other altitude. The explosion of July 3 seems to have been fired below this optimal altitude. Rayleigh wave amplitudes calculated from explosions at high altitudes show a rather complex altitude dependence[11]. These calculations also show that the ground properties have great influence on the Rayleigh wave signal.

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Pulsed X-ray Emission from NP 0532 in the 20–200 keV Range

AN experiment was launched by balloon on June 23, 1970, at 05 h 30 min UT from Gap in France to study the pulsating emission from NP 0532 in the 20–200 keV energy range. Preliminary results are reported here.