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Edited by

H. Gjøystdal

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VI.5 Microearthquake Surveillance of Svalbard

Up until now only very limited data have been available for the study of the seismic activity in and around Svalbard, and most of the studies so far have been based on teleseismic data (Hodgson et al, 1965; Sykes, 1965; Husebye et al, 1975; Bungum, 1977). However, even if only about 1-2 intraplate earthquakes from Svalbard are reported every year from the teleseismic recordings, the large (M_s=5.9) event in the Storfjorden area on 18 January 1976 clearly showed that a certain seismic hazard is present. The fact that this event had a faulting mechanism atypical for intraplate earthquakes (Bungum, 1977) also emphasized the need for a closer investigation, which could be done only by installing seismic stations on the archipelago itself.

A program for such microearthquake surveillance of the Svalbard Archipelago was initiated by installation of seismic stations in Barentsburg (BBG), Longyearbyen (LYR) and Pyramiden (PRD), in cooperation between the Russian mining trust 'Arktikugol', Store Norske Spitsbergen Kullkompani, the Norwegian Polar Institute and NTNF/NORSAR (Bungum et al, 1978). The installation of the seismometers (Sprengnether MEQ-800) was done in December 1977, and the operation during the first few weeks was somewhat unstable; this was due to various technical problems most of them instabilities related to installation in sub-zero temperatures. For this reason, reliable time corrections were not available for the data analyzed in this report. When analyzing the first 2½ months of data, we consequently had to use only the S-P times, from which locations were calculated using a maximum likelihood procedure which also uses all available information about the various errors involved. (For details, see Section VI.7). The adopted relation between the S-P times and epicentral distance was based upon the results of Mitchell et al, 1978.

Seismograms have been available and read from the three microearthquake stations for various time intervals between 8 December 1977 and 24 February 1978 and from KBS for December and January. A total of 687 earthquakes have been detected at one or more of the stations, 515 of which (or 75%) are local events. The best station is LYR, where an average of 7.5 local events per day (corrected for down times) have been detected. The number for PRD is 4.3 and for BBG 4.8, whereas the poorest station in this respect is the WWSSN station KBS, where only 2.0 local events per day were detected (see also Section VI.6). Magnitudes have been computed for 231 of the events, and they all fall in the range 0-3, with a peak at around magnitude 1.0.

The total number of located events is 234. About one half of the events are located using 2 stations and the other half with 3 stations. The locations of the latter ones are shown as an epicenter map in Fig. VI.5.1, where a great cluster of events at the west side of Storfjorden appears as the dominating feature. The precisions of the locations are so far not good enough for a closer delineation of this highly active earthquake zone, since the size of the cluster is not much larger than the computed uncertainty ellipse for each event.

The eastern coast of West Spitsbergen in Storfjorden thus appears to be an area of high intraplate seismic activity, since an average of 7.5 events per day with a probable origin in Storfjorden have been recorded by the instrument in Longyearbyen. The work of Mitchell et al (1978) showed most of the epicenters to be confined within a narrow E-W trending zone at 77.7^{O}N about 30 km long and suggested that the fault plane of the 18 January 1976 earthquake (M_s=5.9) in this area (Bungum, 1977) was along this seismic zone. The state of stress in the crust and delineation of active

zones of weakness where faulting may take place are valuable information for present and future industrial development on Spitsbergen. Spitsbergen is cut by major fault zones dating back to Paleozoic with no associated teleseismically recorded activity (Husebye et al, 1975). A future semi-permanent network of microearthquake stations on Spitsbergen would be capable of detecting zones that are tectonically active but have a low level of seismic activity.
A further step towards this end will be taken by installation of a new station (with digital recording) in Svea (S4 in Fig. VI.5.1) in May 1978, while we hope to be able to install two more stations at a later stage (S5 and S6 in Fig. VI.5.1).

H. Bungum
H. Gjøystdal
B. Kr. Hokland
Y. Kristoffersen, Norwegian Polar Institute

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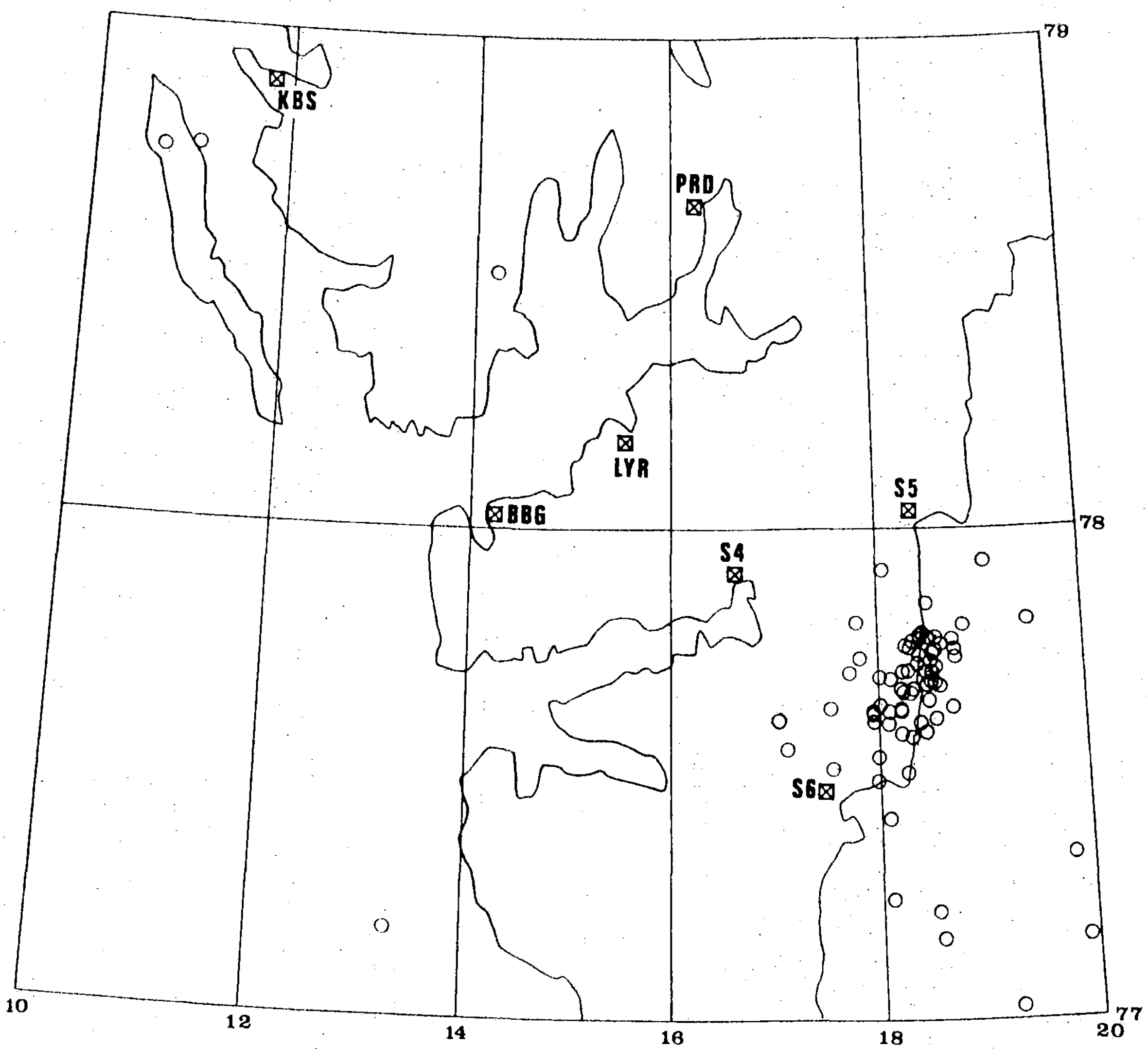

Fig. VI.5.1 Epicenter map of earthquakes located on the basis of the three stations BBG, PRD and LYR. The future station in Sveagruva is also indicated (S4), as well as two possible sites on the west side of Storfjorden (S5 and S6), that if available would greatly improve the array configuration.