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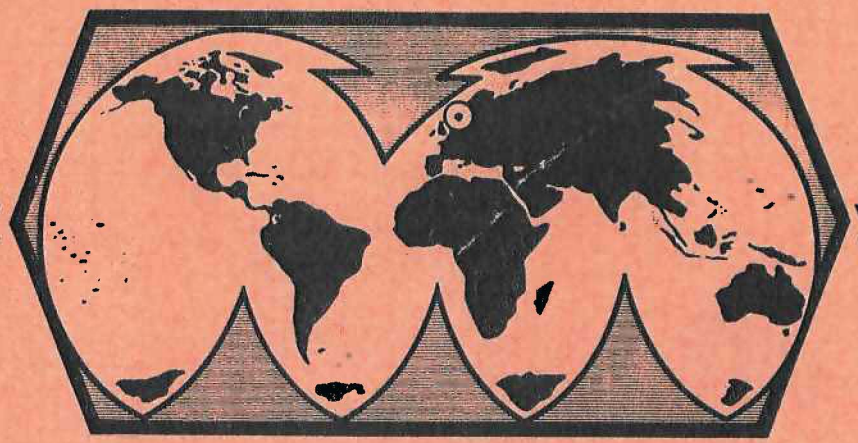

VI.9 The Seismicity of Svalbard

Our investigation of the seismicity of Svalbard has continued as outlined in the previous Semiannual Technical Summary (STS). Extensive and detailed analysis of the recorded data have been completed up to the end of May 1978, giving us almost 6 months altogether. The stations BBG, LYR and PRD have been in operation most of the time, the WWSSN station KBS has been in operation (and available to us through the University of Bergen) all of the time, and a new station SWE became operational in the beginning of May 1978.

Some figures on the detectability of the stations are given in Table VI.9.1, where it is seen that 1258 events have been reported altogether. 878 or about 70% of these are local events from Svalbard and vicinity (including the mid-Atlantic Ridge west of Svalbard), while the rest are teleseismic. With the exception of SWE (where there have been severe problems with local noise from the mines) we see from Table VI.9.1 that the teleseismic detectability is around 2 events/day for all stations, while it is LYR which is the best station so far as local events are concerned. A breakdown of the detectability statistics on a weekly basis is shown in Fig. VI.9.1, where we see that about 30-60 events have been detected every week. The figure also shows the division between teleseismic and local events, and the number in the latter group which have been located. Altogether 566 of the earthquakes have been located, which amounts to 64% of the local ones and 45% of the total number.

Since our report in the previous STS, two important improvements have been added to our location procedure. First, a crustal model for the area has been developed using our recordings of the signals from a profiling survey performed last summer by the University of Bergen (Prof. Sellevoll, personal communication) in cooperation with the University of Hamburg and the Polish Academy of Sciences. Our preliminary model derived from these data consists of layers with P velocities of 5.7, 6.7 and 8.2 km/s, starting at depths of 0, 16 and 32 km, respectively. The P to S velocity ratio is 1.80. The second improvement in our locations is connected to the location method itself. We have tried to use location programs such as HYPO71 (from USGS) but cannot obtain satisfactory convergence because of the poor station

configuration with respect to the epicenter locations. A new method has therefore been developed which is based on the modified S-P method described in the previous STS, using the S-P location as a starting point and then refining the estimate using the absolute P times for the station for which reliable time corrections are available. Although the method in principle is similar to the one in HYP071 (using the same information), it differs in the iterative procedure; our method has much stronger convergence properties for poor station configurations. The method is still being developed, and will be properly documented at a later stage.

An epicenter map from Svalbard using the new location method is given in Fig. VI.9.2, where only our most precise locations are plotted. 133 of our 566 located events are shown on this figure, and the number of phases used in each location ranges between 4 and 8 (S-P with no time correction counts as one phase). Reliable time corrections are available for at least one station for all of the events. The prominent feature is the now well-known Heerland earthquake zone, where any possible lineation still cannot be discerned, while it cannot be excluded either because of the precision of our epicenters. In comparing with the epicenter map in the previous STS, we see that the cluster of events now has been moved a little to the north-west, this is because of the new and imporved crustal model.

Besides the seismic activity along the mid-oceanic (Knipovich) ridge, there is one other feature in Fig. VI.9.2 which deserves attention, namely, the activity along the coast southwards from the WWSSN station KBS. Seven earthquakes are plotted in Fig. VI.9.2 along this (Forlandsundet) seismicity zone, which is reported here for the first time.

Some data on the measured local magnitudes are given in Fig. VI.9.3, which shows the incremental and cumulative distributions of magnitudes as measured from amplitudes. It is seen that the slope follows a value of b=1 down to a value of M=2.0, while the deviation below this value may be due to a combination of decreasing detectability, imprecise attenuation parameters in the magnitude formula, imprecise locations and the mixing of several

epicentral areas in one distribution. It is important to notice, moreover, that our Svalbard magnitude scale has so far not been calibrated with respect to absolute level, this may cause a later shift of all the magnitudes by a constant value.

The Svalbard microearthquake network is operated by the Norwegian Polar Research Institute in cooperation with NTNF/NORSAR and the Russian mining trust Arktikugol.

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	BBG	PRD	LYR	SWE	KBS	Total
Teles.	291	291	229	18	310	380
-Daily	1.8	2.1	1.9	1.2	1.7	
Local	640	511	653	58	363	878
-Daily	3.8	3.8	5.4	4.0	2.1	
Sum	931	802	882	76	673	1258
-Daily	5.6	5.9	7.3	5.2	3.8	

TABLE VI.9.1

Detectability figures for the Svalbard microearthquake stations during the time period 8 Dec 1977 -31 May 1978. The daily averages are computed on the basis of the actual uptime for each station, which has been 95% for BBG, 77% for PRD, 67% for LYR, 8% for SWE (only part of May 1978) and 100% for the WWSSN station KBS. The locations of the stations are given in Fig. VI.9.2.

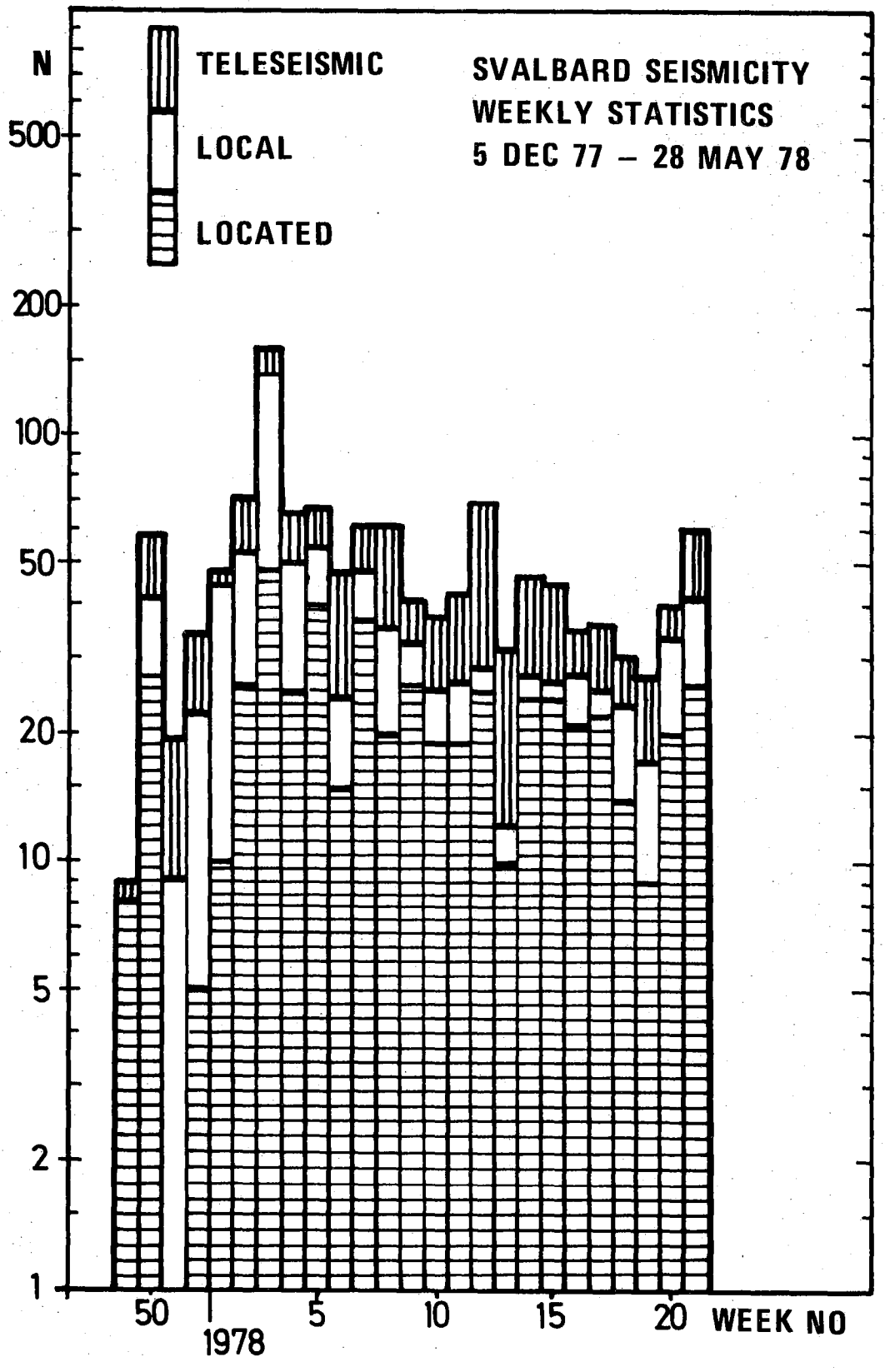

Fig. VI.9.1 Weekly breakdown of the number of earthquakes reported by the Svalbard microearthquake network in the 6 months between December 1977 and May 1978. The number of teleseismic, local and located (all local) events are shown separately. The peaks are due to swarms from the Knipovich Ridge and/or the Heerland earthquake zone (see Fig. VI.9.2).

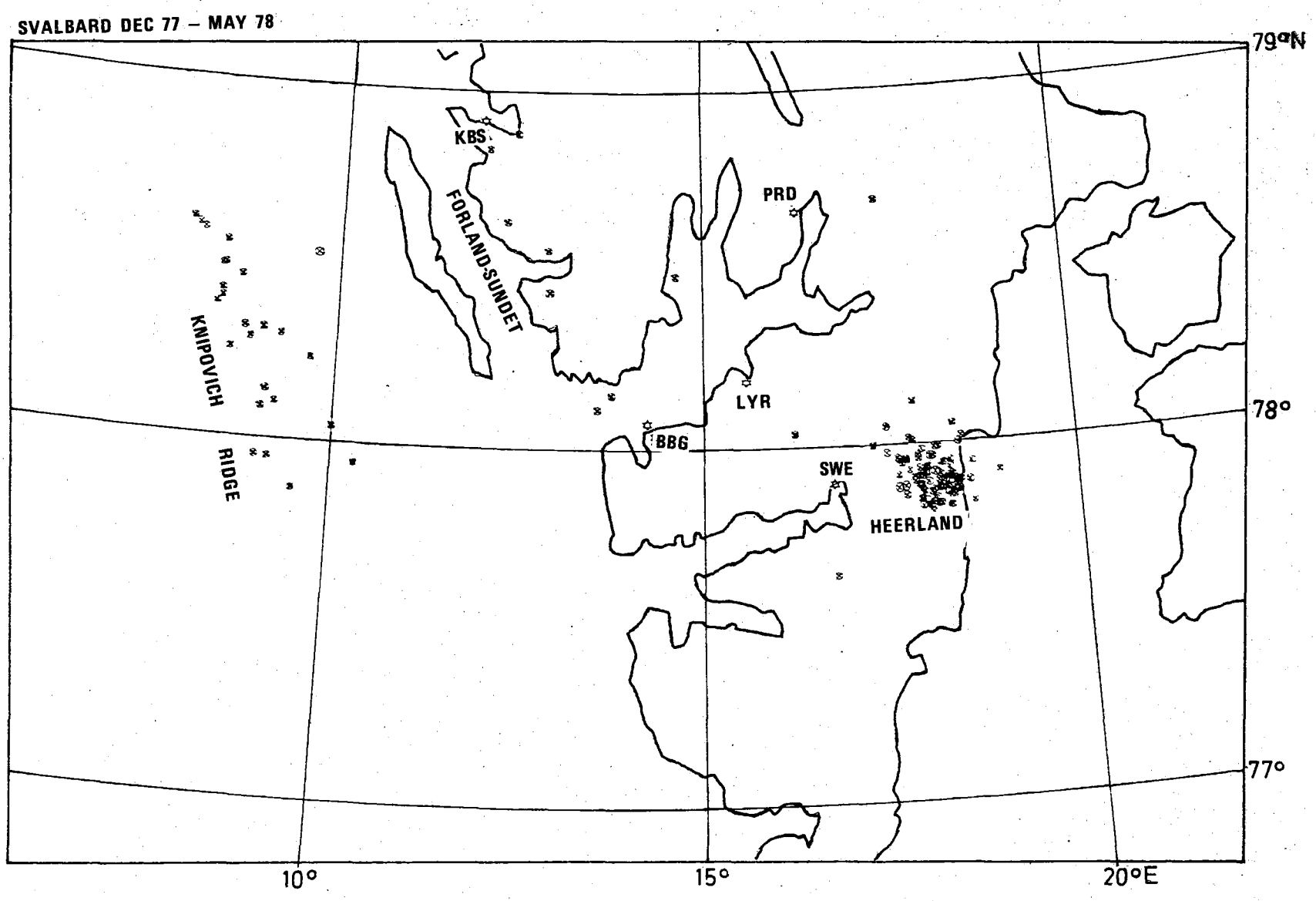

Fig. VI.9.2 Epicentral locations for the 133 most precisely located earthquakes from the Svalbard microearthquake network from December 1977 to May 1978.

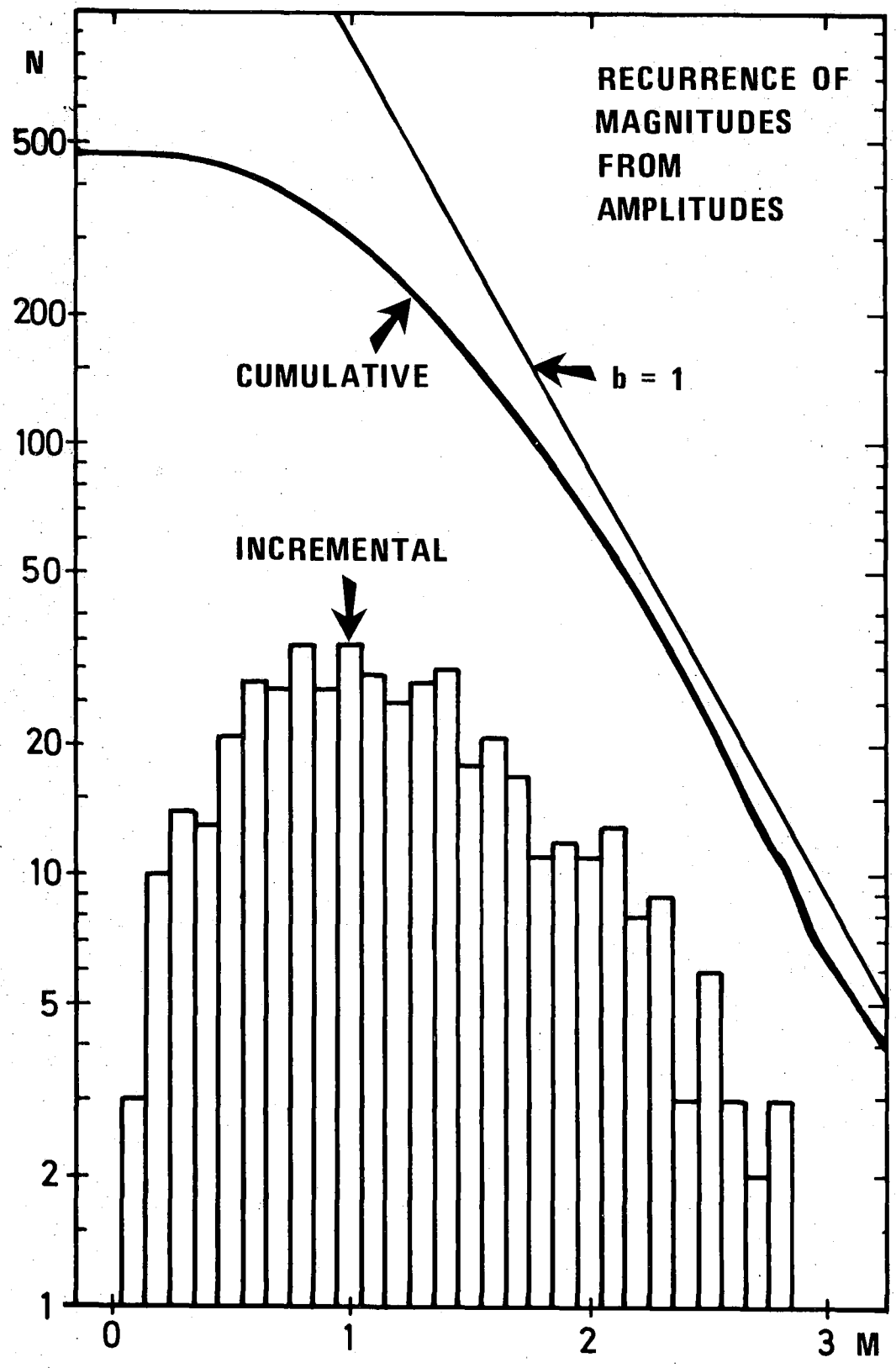

Fig. VI.9.3 Frequency-magnitude distribution for the located earthquakes in and around Svalbard, Dec 77 - May 78. The formula used is

$M=\log(A) - \alpha_1+\alpha_2\log\Delta+C$

where A is maximum amplitude, Δ is epicentral distance, α_1 and α_2 are parameters, and C is a constant.