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VII.5 Seismicity and Crustal Structure in the Svalbard Area

The seismicity of the Svalbard area, characterized by a definite continental structure, is interesting on account of its proximity to the active Knipovich spreading ridge and also in view of the complicated tectonic history of the area in question. We have re-examined the seismic activity here, resulting in the seismicity map presented in Fig. VII.5.1. The map covers the time period 1957-1975, the epicenters are from ISC, PDE and Sykes (1965) (and in that order of priority if more than one of these have reported the event), and only events with at least 6 reporting stations are accepted. The map also contains seven fault plane solutions from the area. The area covered in Fig. VII.5.1 includes the northern part of Mohns Ridge (MR), Knipovich Ridge (KR), Spitsbergen Fracture Zone (SFZ) and the southern part of Nansen Ridge. The seismic activity along Mohns Ridge east of the Greenwich meridian follows the ridge fairly closely, and the normal faulting of Event 5 also confirms this typical behavior for an active spreading axis (Sykes, 1967). The well-organized earthquake pattern extends through the area where the axis 'bends' into the Knipovich Ridge, which is in accordance with the observed continuity between the two ridges (Talwani and Eldholm, in press). The seismicity along Knipovich Ridge is more uneven and dispersed, and the strike-slip solution of Event 1 may suggest movements along a very local fracture zone. The earthquake activity around the Spitsbergen Fracture Zone is also quite dispersed, which has been used as indication for an én-echelon structure of this transform fault (Husebye et al, 1975). It is noticeable that the 3 events for which focal mechanism solutions are available (Events 2-4 in Fig. VII.5.1), have strike directions coincident with those of the fracture zone.

The intraplate seismicity in Fig. VII.5.1 is confined to two areas, the north-east coast of Greenland (with the normal faulting of Event 6) and the Svalbard region. It is seen from

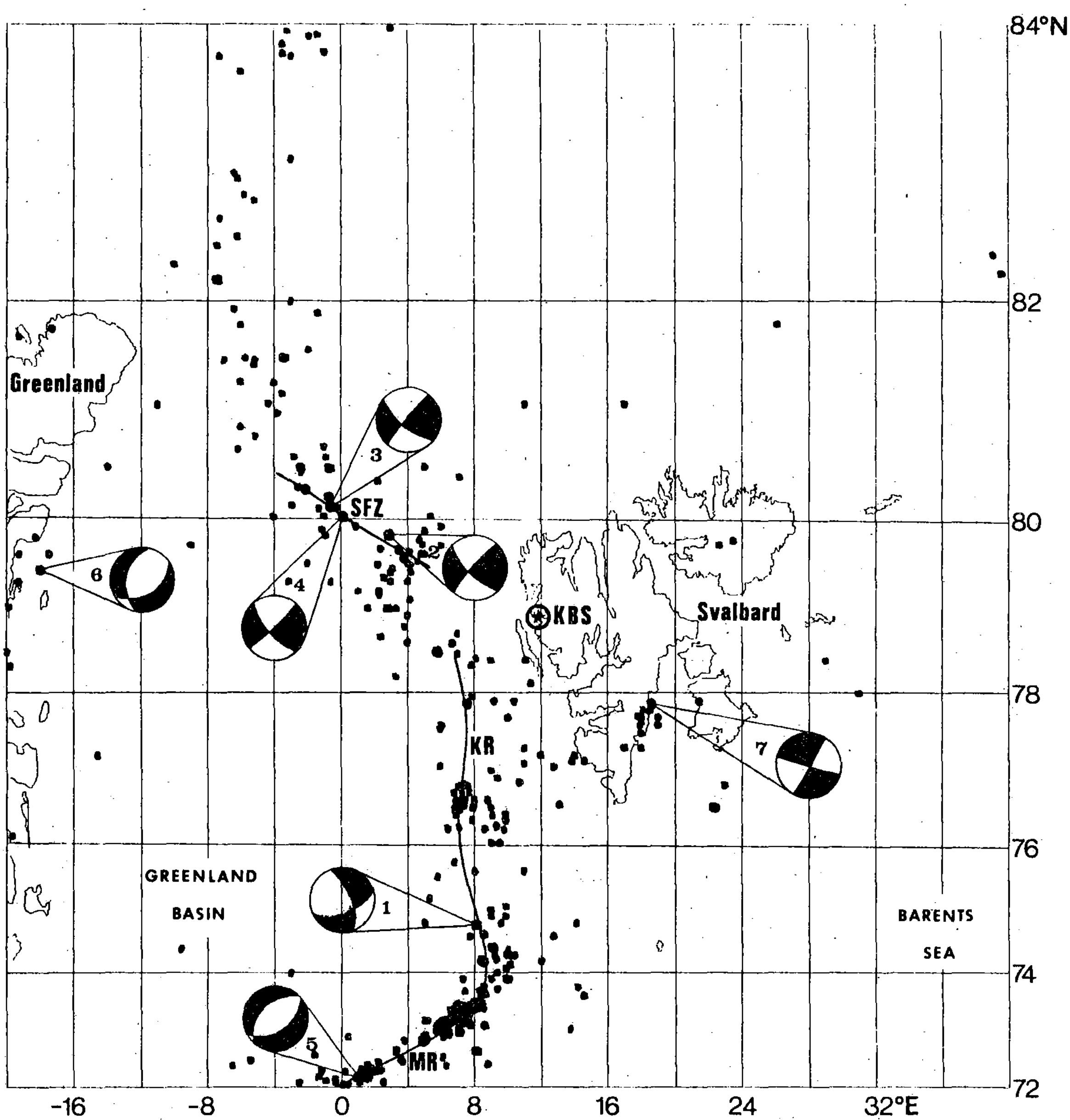

Fig. VII.5.1 Earthquake occurrence in the Greenland/Svalbard region. Only epicentral solutions based on at least 6 stations are used, and the larger symbols indicate a magnitude of at least 5.0. Black and white areas for the seven focal mechanism solutions indicate areas of compression and dilatation, respectively. The structural information on Mohns Ridge (MR), Knipovich Ridge (KR), and the Spitsbergen Fracture Zone (SFZ) is taken from Talwani and Eldholm (in press).

Fig. VII.5.1 that the earthquake activity in the latter area is weak, with the exception of a cluster of events along the southeastern coast of the Spitsbergen island, where a NE-SW trend is observed. A puzzling feature of the seismic activity here is the focal mechanism solution for Event 7, presented in Section VII.4. The available tectonic information cannot resolve the ambiguity of the solution, as the main trend of the Spitsbergen geology is NNW-SSE and thus just between the directions of the two nodal planes. However, the seismicity information give some support for suggesting that the focal plane is the one trending NE-SW, since that direction coincides with the lineation of the earthquake epicenters in the area.

In the second part of this study we have used data from the WWSSN station KBS (see Fig. VII.5.1) in an investigation of the lithospheric structure in the Svalbard area. To this end the spectral ratio method has been employed for estimating local crustal thickness (Phinney, 1964; Berteussen, in press). We scanned all the KBS data for the years 1972-73 and found 8 events suitable for analysis. The observed spectral ratios for these events (calculated for frequencies up to 0.2 Hz) were found to fit the theoretically expected values best for Moho depths around 27 km. In fact, there were two events with 26, one with 27 and five with 28 km. However, since the spectral ratio is also dependent on factors which are kept constant in our calculations (in particular the signal window length and the velocity-depth function), we cannot claim a precision any better than ± 2 km in our determination of the depth to Moho under the station KBS at Svalbard.

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