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VII.5 Source parameter analysis, 8 March 1983 Stord earthquake

Among the events in the data base presented in VII.4, we have the best recorded Norwegian earthquake to date, from March 8, 1983 (M_L = 4.7). The large number of high quality recordings have made it possible to determine the depth to 15 km, with an epicenter at 59.74°N and 5.38°E. Altogether 19 aftershocks were observed and the best ones were located (by master event technique) to within 1 km of each other. It is seen from Fig. VII.4.1 that this event is located to one of the most seismically active areas at the coast of Western Norway.

Using the nearest station with unsaturated data (BLS, Δ = 73 km), an analysis of source-displacement spectra (S-waves) gave a seismic moment of about $2 \cdot 10^{21}$ dynes-cm, but with no clear indication of corner frequency. It was quite clear, however, that very high Q-values (well above 1000) would be needed in the path correction time.

The source dimension was then obtained from the time between the P-wave onset to the first zero crossing following the method outlined by Frankel and Kanamori (1983). Two of the closest stations (BLS and SJD) were used, and assuming a circular fault, a source radius of 0.26 km was obtained. The best agreement between source radii calculated for BLS and SJD was obtained using the NW striking fault from the fault plane solution (see Fig. VII.5.1). A source radius of 0.26 km is comparable to the source dimension of the aftershock area. The stress drop was calculated to 50 bars using the Brune formulation and above values for moment and source radius.

The fault plane solution (Fig. VII.5.1), using first motions from 21 stations, shows a thrust fault with the compressional axis going nearly east-west. Lineation of aftershock epicenters indicates that the nodal plane striking N34°W and dipping 60° could be the fault plane, a solution which is in good compliance with the local faulting pattern in the area.

The two 1954 Stord events (M_b = 4.9) were relocated (59.82°N, 5.33°E) 10 km to the northwest of the 1983 event, and it seems that they could have been on

the same fault. This and the fault plane solution suggest that the active faults in this part of western Norway may follow the north-west striking system of fjords and not the geologically more dominant north-east striking Caledonian folding axis (see Fig. VII.5.2).

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References

Frankel and Kanamori (1983): Determination of rupture duration and stress drop for earthquakes in Southern California. Bull. Seism. Soc. Am., 1527-1551.

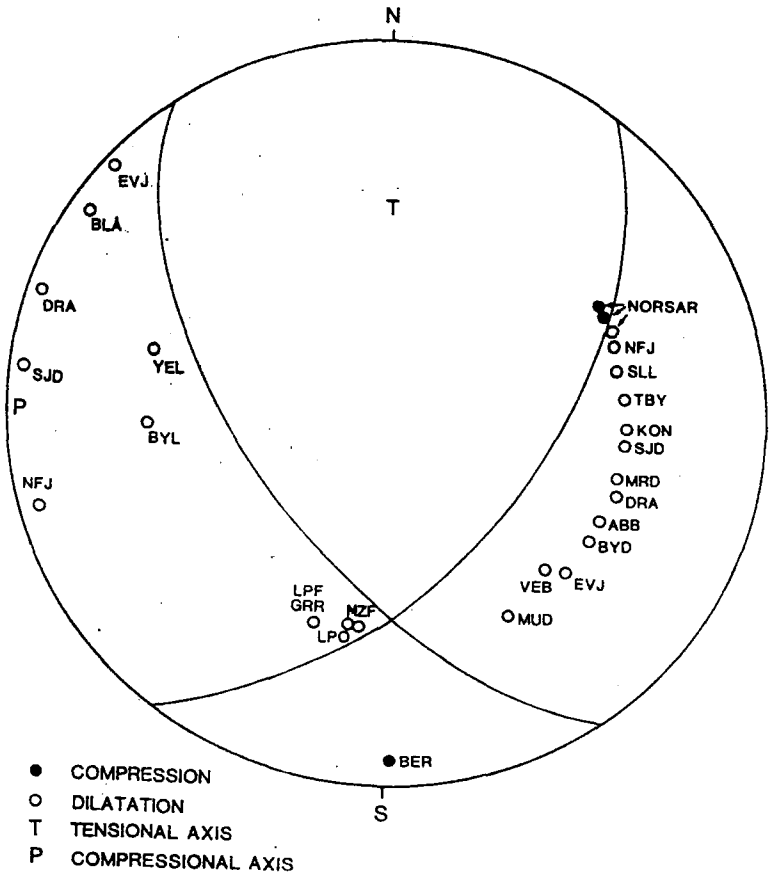

Fig. VII.5.1 Focal mechanism solution for the M_L=4.6 Stord earthquake on 8 March 1983.

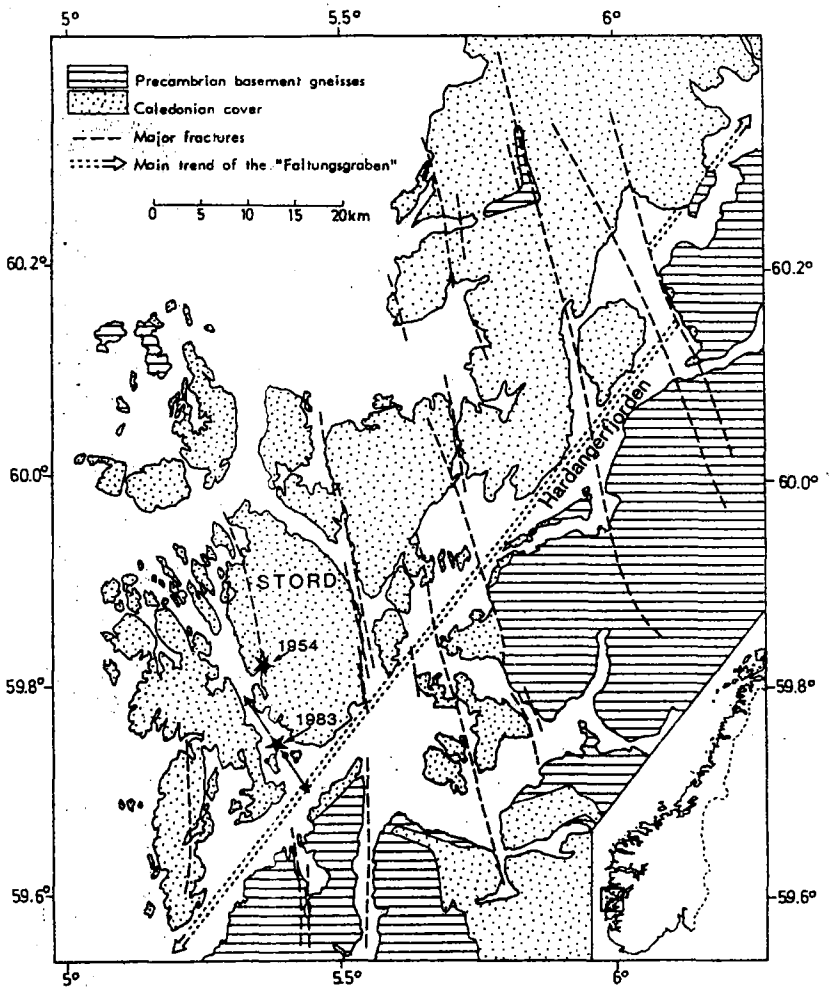

Fig. VII.5.2 Outline of geological features in the general Stord area. The location of the 1984 earthquake is indicated (with the most probable fault orientation) together with a relocalized m_b 4.9 earthquake from 7 July 1954.