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VII.9 The Seismicity of Fennoscandia

A critical parameter in seismicity studies is the space-time relationship between the largest occurring earthquakes within the region under investigation. An interesting feature here is that most of the largest shocks ($M \geq 6$) are restricted to the period 1863-1913, while 3 other strong earthquakes took place between 1819 and 1836. There is no indication of spatial migration in the distribution of the largest earthquakes and neither do we find any clear regularity in occurrence of large events in specific areas. In other words, the very largest earthquakes observed seem to be isolated phenomena. This points towards exceptionally long recurrence intervals, i.e., a large time lag between two large events occurring within a tectonically uniform area. As it is considered unlikely that any major earthquake occurring after 1600 are left unreported, the recurrence interval is probably larger than 350 years for earthquakes with magnitude M larger than 6.

The seismicity pattern of Fennoscandia is somewhat diffuse, which is normal for intraplate earthquake occurrence (Sbar and Sykes, 1973). We found it convenient to subdivide the Fennoscandian earthquakes in 3 primary zones: namely, the western Norway zone, the Telemark-Vänern zone and the Bothnian zone; plus a weaker one called the Lappland zone (Fig. VII.8.1).

The western Norway seismicity belt is in northern Norway confined to the coastal area while the epicenters become more dispersed south of 64°N. The west coast area of Norway is relatively prominent seismically and also geophysically (Husebye et al, 1975). A characteristic feature here is that this zone is within the Caledonides and its strike direction is parallel to the folding axis; this can be taken as evidence for the importance of remnant or locked-in stresses from the above mountain folding period. Another feature is that the epicenters are mainly confined to the coastal areas where the relief is very pronounced, which in turn may indicate additional loading stresses and/or zones of weakness.

The Telemark-Vänern seismicity zone which represents a geographical envelope of earthquake epicenters in this area is typified by graben structures and the most prominent one is the Oslo Graben. A slight clustering of epicenters can be found around the mentioned graben structures, pointing towards a causal connection between these structures and earthquake occurrence, possibly through release of locked-in stresses. An alternative explanation is, however, that the orientation of the Telemark-Vänern belt is in fact tectonically significant.

The Bothnian seismicity belt, parallel to the Caledonian folding axis, goes from Lake Vättern to the northern end of the Gulf of Bothnia. The latter area has the most pronounced earthquake activity, and there may be a correlation between the relatively strong glacial uplift and the earthquake occurrence in this particular area (Båth, 1953). ALso, this zone is characterized by faulting.

The Lappland seismicity zone is only weakly defined by the data available to us, but a series of earthquakes in 1973/74 was entirely within this zone. As this area always has been thinly settled, the macroseismic information available would necessarily be scarce.

The above seismic zones account for most of the seismic activity in Fennoscandia during the last five hundred years. The seismic activity is typical for intraplate earthquake occurrence, by neither exhibiting a too clear spatial zoning nor an obvious correlation with geological and geophysical information pertinent to the area. The likely reason for this is that Fennoscandia has been through several tectonic cycles, which in turn is reflected in the present complex stress distribution. Consequently, an improved understanding of the on-going seismic activity here and at the same time a better assessment of dominant stress sources requires more in-situ stress measurements. Equally important would be focal mechanism solutions for earthquakes occurring within Fennoscandia.

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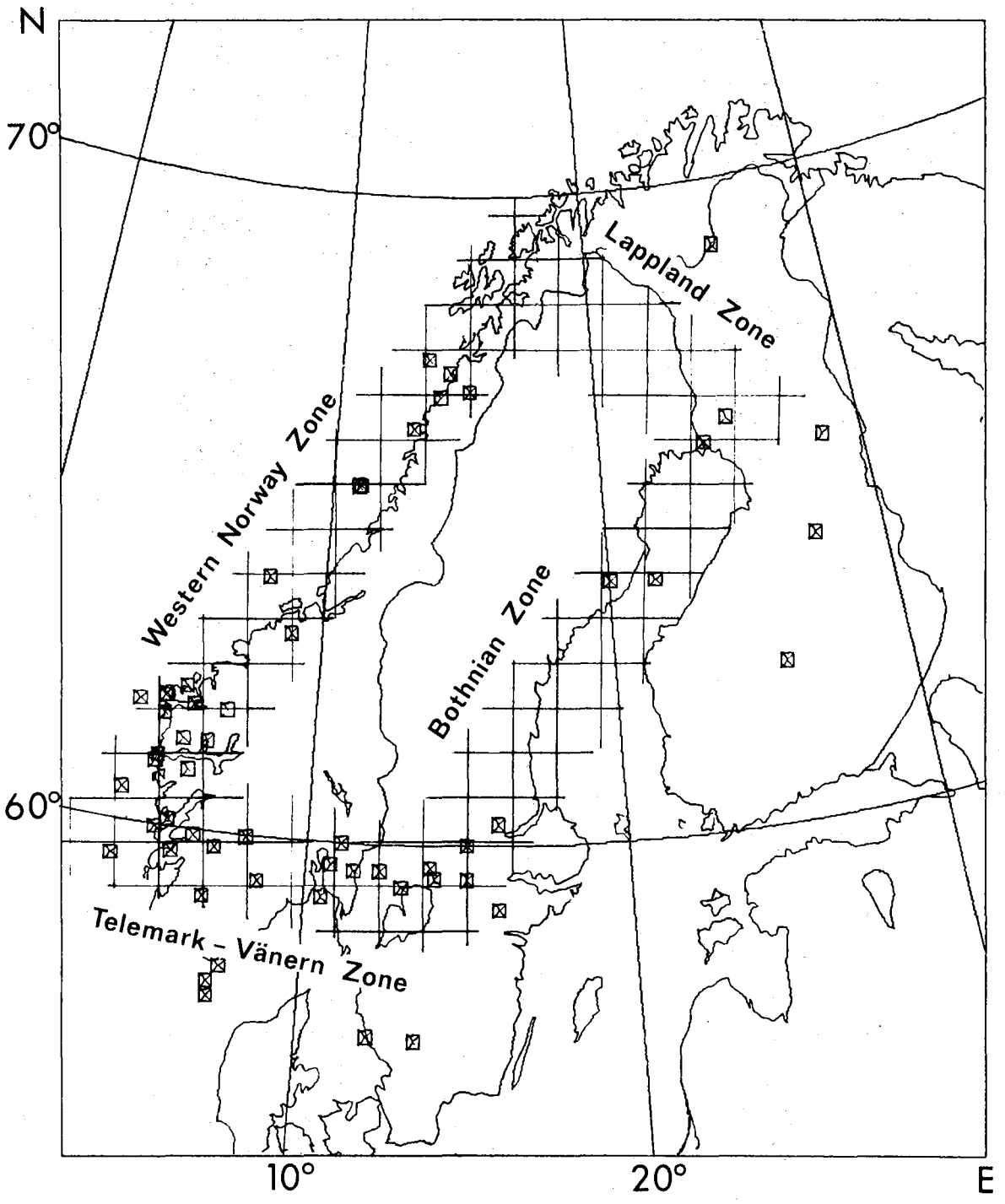

Fig. VII.9.1 Fennoscandian earthquakes for the time period 1497-1973 and with a magnitude M greater than 4.5. An outline is also given of the 4 seismicity zones defined in this paper. Note that the definition of the zones is based on much more seismicity data than is actually displayed in this figure.