TECTONIC MODELLING OF SOUTH WEST SCANDINAVIA BASED ON MARINE REFLECTION SEISMIC DATA

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Abstract

A series of structures related to the Proterozoic and Phanerozoic tectonic evolution of the SW Scandinavian crust is investigated using marine reflection seismic data from Skagerrak and Kattegat, which are the seas that separate western Sweden from Norway and Denmark. The seismic data are correlated with available geological and geophysical data from the region. The first part of the thesis is committed to the study of large deep crustal seismic structures in eastern Skagerrak, and their relation to signs of large scale tectonics on the exposed shield onshore western Sweden. The seismic structures are correlated to each others and put into a tectonic model where the major component is a late Sveconorwegian Wernicke-type simple shear extension of the crust beneath NE Skagerrak. The tectonic model includes a high angle crustal penetrating fault which links the Bohus Moho Offset with the Hakefjord on the Swedish west coast. Analyses of topography, precision levellings, rock distribution, earthquakes, and reflection seismic data indicate a fault in the fjord, and is consequently named the Hakefjord Fault.

The second part of the study focuses on the crustal transition zone between the Baltic Shield and the Norwegian-Danish Basin in Kattegat. The crustal transition zone evolved during the Palaeozoic as a response to crustal stretching. Eventually, parts of the transition zone were inverted, which created the Sorgenfrei-Tornquist Zone. The inversion took place along a few of the old extensional faults which were rejuvenated. The reason why not all the old extensional faults became rejuvenated, despite their common appearance and age, is discussed on a geodynamical basis. A tectonic model is presented that takes in consideration both the mechanisms and the chronology of the crustal transition. The tectonic model favoured for the crustal structure beneath Kattegat, is a Silurian Wernicke-type simple shear system with a south-west dipping listric detachment. The Sorgenfrei-Tornquist Zone is interpreted as the heavily faulted "toe" of the old simple shear system's hanging wall block, and hence as a comparatively shallow feature. The large normal faults that separate the Baltic Shield from the Norwegian-Danish Basin are interpreted to represent the proximal zone of the simple shear system, while the Ringkøbing-Fyn High is interpreted as a discrepant zone. Also, a hitherto unrecognised stratigraphic unconformity in the Sorgenfrei-Tornquist Zone challenges the traditional opinion that the major part of the inversion took place in late Cretaceous - early Tertiary. Instead, the new seismic data point toward a Jurassic (Kimmerian?) major inversion phase. A structural depression in the crystalline basement just north of the Sorgenfrei-Tornquist Zone has been discovered. The depression contains rocks that based on their stratigraphic level, shape and seismic velocity are interpreted to be of Late Palaeozoic volcanic origin. This is taken as an evidence that the faults in the Precambrian basement of Kattegat are of at least two generations separated by a mid-late Palaeozoic erosional phase, which would explain the Palaeozoic differences between the Palaeozoic stratigraphy of the Norwegian-Danish Basin, the Sorgenfrei-Tornquist Zone and the Skagerrak-Kattegat Platform. The Skagerrak-Kattegat Platform is found to be geodynamically reclaimed by the Baltic Shield, although the Precambrian crust beneath the platform is characterised by many large normal faults, that have remained unaffected by the very intense Mesozoic and Cainozoic tectonics that caused the evolution of the Sorgenfrei-Tornquist Zone. Furthermore, it is found that the Baltic Shield's margin of crustal stability has moved considerable distances back and forth during the Phanerozoic. However, the present margin of crustal stability is the Sorgenfrei-Tornquist Zone.