Chapter V

Concluding Remarks

The results of the present study show once again the effectiveness of the receiver function analysis methods in probing into the crust and upper mantle. Taking advantage of network data it became possible to produce detailed imagery of the crust and upper mantle both in time and space domains which helped to draw the following thematic conclusions:

5.1 Crust and crust−mantle boundary along TOR profile

More than 2400 computed receiver functions from over 140 stations of TOR, GEOFON and GRSN were used to map the Moho topography and picture large scale crustal features associated with main tectonic elements in northern Europe.

Across the North German Basin more than 10 km of sedimentary deposits cover the metamorphosed Caledonian basement from which strong P−to−S conversions were observed. The crust−mantle boundary in this region is bent downwards and reaches 35−40 km depth north of the Elbe Lineament. North of the Elbe Line towards the Trans−European Suture Zone (TESZ) the transition from the Central European to the Baltic Shield crust begins in a gradual manner. While the Central European Moho continues up to the Caledonian Deformation Front (CDF) at the depth of 35−40 km a second branch of Moho, apparently belonging to the Baltic Shield appears which underneath the Tornquist Zone bulges to reach the depth of 30−35 km. The elevated Moho has been attributed to large scale tectonic inversions which occurred during Cretaceous−Tertiary and formed the Tornquist Zone in its present shape. North of the Tornquist Zone and into the Baltic Shield the crust thickens steadily so that in the northern end of the TOR profile the Moho is traced at depths more than 45 km. The abrupt change in the Moho depth is accompanied by an increase in values of

Vp/Vs and positive Bouger anomaly northwards across the TESZ. Additional conversion zones and north dipping intracrustal features are also to be seen which extend deep into the lower crust. They could collectively be interpreted as remnants of different phases of the collisional tectonics which included subduction of the Avalonia underneath the Baltica back in Paleozoic time.

5.2 Crust and the crust–mantle boundary across the SVEKALAPKO

Analysis and interpretation of over 6400 computed receiver functions from the stations of the SVEKALAPKO network led to detailed mapping of the crustal thickness across southern and central Finland.

A crust of at least 40 km thick is observed throughout the region in obvious contrast to rather flat surface topography and lack of adequate Bouger anomalies. A phenomenon that can be explained by the presence of dense materials in the upper and lower crust which are genetically related to the long history of amalgamations and accretions of different crusts in the Baltic Shield.

Along a profile centered at 27°E , just south of the Archean–Proterozoic Suture Line (APSL), the Moho drops by more than 20 km into a trough with thickness of the crust exceeding 60 km. It is accompanied by a north dipping intracrustal structure which can be associated with the collision of the Proterozoic and Archean provinces in Proterozoic. North of the APSL the Moho rises to a depth of 45 km marking the boundary of the Moho depression.

5.3 The 410 and 660 discontinuities across the TOR and SVEKALAPKPO

The 410 and 660 discontinuities detected under the TOR and SVEKALAPKO networks have provided information on the overall velocity structure of the upper mantle across the North German Basin and the Baltic Shield. Along the TOR profile, the two discontinuities were hard to detect. However, manyfold stacking of mainly broadband receiver functions in gridded space showed that along TOR, the 410 conversions arrive more or less according to the predicted time by the IASP91 velocity model. The 660 discontinuity on the other hand shows signs of up to 3 sec of early arrival underneath the North German Basin. In the presence of thermal variations in the upper mantle transition zone the opposite Clapeyron slopes of 410 and 660 require that a bulge of one discontinuity be coincided with a depression of the other, which is not the case here. And, therefore it must be regarded as an artifact of stacking rather than a genuine signal.

Across the extent of the SVEKALAPKO network and specially underneath the Archean province both discontinuities are to be seen in time and space domain sections. Specially in the Archean province 410 and 660 conversions arrive 1−2 sec earlier than the predicted time of IASP91 velocity model. Besides, since the differential time between the two discontinuities is in accordance with IASP91 model, the early arrival of the conversions from both discontinuities is an evidence for faster upper mantle above 410 km depth.

According to observations made in this study there have been no conversions originating from the lithosphere−asthenosphere boundary. This could be owing to the gradational nature of the boundary in studied area and/or the masking effect of multiples of the Moho conversions.