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BABEL4: Crustal Structures of the Precambrian Svecofennian Accretionary Orogen in the Fennoscandian Shield

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BABEL profiles image the crustal structures of the Precambrian Svecofennian accretionary orogen in the Fennoscandian Shield (BABEL Working Group, 1993; Lahtinen *et al.*, 2005) (Figure 38.1a). BABEL4 profile images, for the first time, a Paleoproterozoic subduction zone suggesting modern plate tectonics (BABEL Working Group, 1993) and collision tectonics (Beaumont and Quinlan, 1994; Korja and Heikkinen, 2005).

The near vertical seismic reflection data are the final stack from BABEL4 (Figure 38.1b). Acquisition parameters and the full processing sequence have been described by the BABEL Working Group (1993). Migrated sections are displayed as instantaneous amplitude sections overlain by automatic line drawings (Korja and Heikkinen, 2005). The section is plotted without normalization, that is, the amplitudes of the different areas in each section are comparable. The large-scale reflectivity changes are pronounced, whereas the details of individual reflections are obscured.

In the geological interpretation it is assumed that reflections image mainly primary igneous or secondary tectonic contacts formed during folding/faulting. Weak reflectivity generally indicates monotonous intrusions and older crustal pieces in which the internal structure has been homogenized in the scale of reflectivity before deforming. Near vertical strike-slip zones are observed indirectly, as they are associated with transparent zones with decreased reflectivity and displacement of continuous reflections.

BABEL4 profile images five major blocks with distinct reflectivity patterns. The lower crust of the northern part is a reflective homogenous block. The upper and lower boundaries are reflective. The block is interpreted

as an older continental fragment/crustal indenter with tectonic contacts. The middle crust of the northern part is highly reflective comprising a set of southwest dipping listric reflections, correlated with the volcano-sedimentary sequences of the Savo/Skellefte belt onshore. The lower crust of the southern part is highly reflective and hosts high amplitude, northeast-dipping reflections. The block has seismic P-wave velocities $> 6.8 \text{ km s}^{-1}$ suggesting mafic granulites. The high amplitude reflections may originate from the interlayering of oceanic crust and metasedimentary rocks. The upper and middle crust of the southern and central parts is weakly reflective. It hosts a package of steeply northeast-dipping reflections bound by low-angle (8°) unreflective bands. The bands are disturbed and reminiscent of large-scale breccias in the central part. The southern and central parts are correlated with the migmatitic and granitoid rocks of the Bothnia Basin and Vaasa complex respectively. The seismic image suggests that the block is separated from the blocks below along a tectonic contact/detachment.

Seismic profile BABEL4 images a frozen paleosubduction zone, where northeast subduction of the lower plate below the upper plate has ceased and collision has started (Beaumont and Quinlan, 1994). A retrowedge comprises remnants of the Savo arc (Savo belt, SB) that have been accreted to the upper plate. The accretionary wedge (Bothnian Basin, BB) is part of the prow edge. Thickening of the crust induced high T – low P regional metamorphism, partial melting and formation of granites (unreflective parts of the upper and middle crust) within the prow edge and uplifted plug (Bothnian Basin and Vaasa complex).

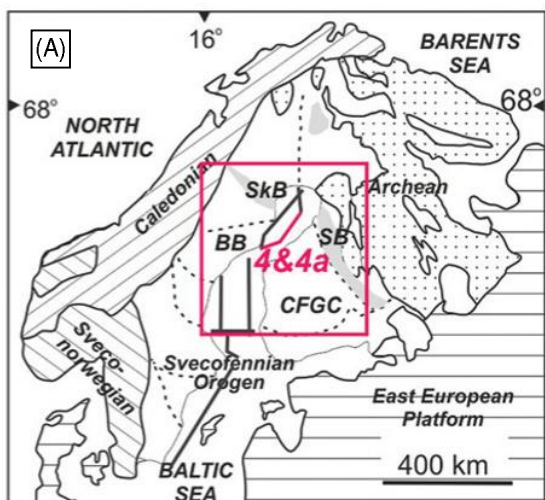
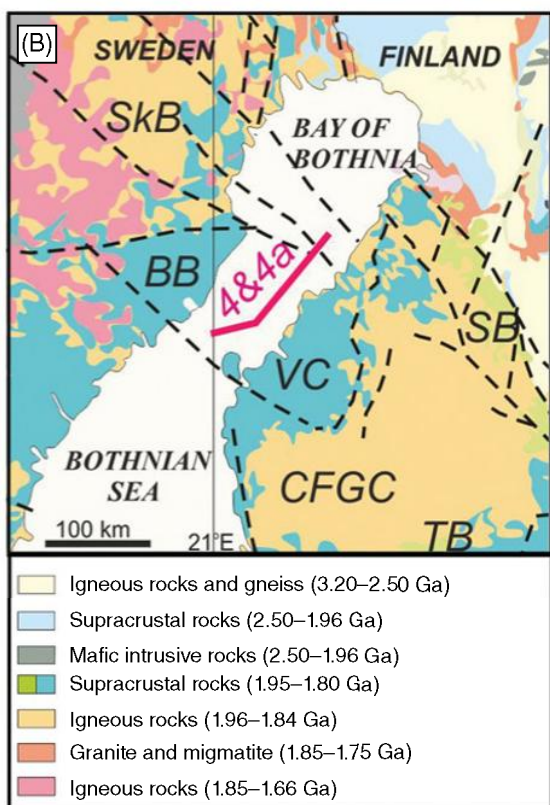


Figure 38.1a A) BABEL4&4a line on a geological index map of Northern Europe. B) BABEL4&4a a lithological map of the study area after Lahtinen et al. (2005).



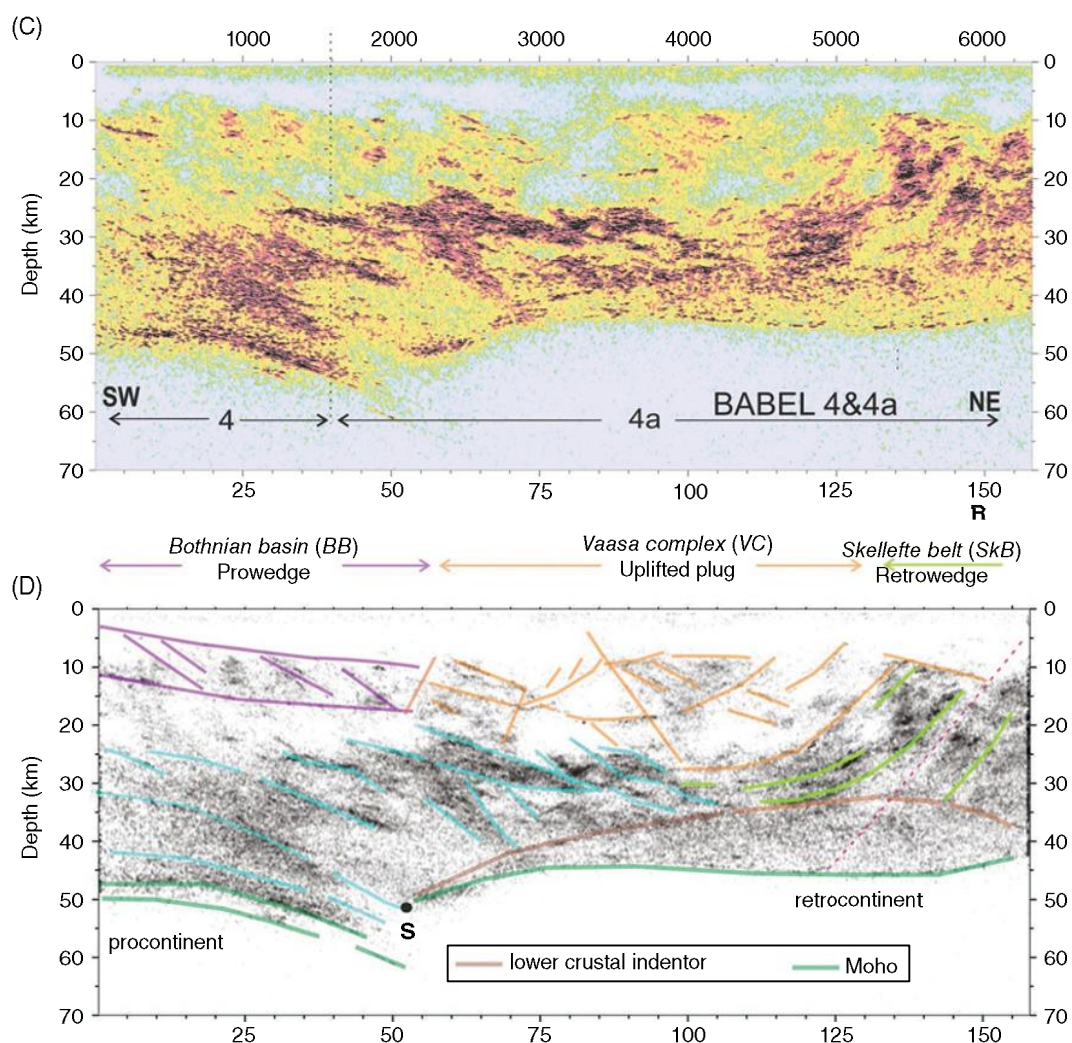


Figure 38.1b C) A vertical seismic section along BABEL4&4a profile shown as an instantaneous amplitude section in colour scale overlain by an automatic line drawing. No vertical exaggeration. D) A schematic geological line interpretation of BABEL4&4a profile on an instantaneous amplitude section in greyscale after Korja and Heikkinen (2005).

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