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Korja, Annakaisa

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## BABEL7: Crustal-Scale Extension Associated with the Formation of the Baltic Sea Paleorift, Fennoscandian Shield

*Annakaisa Korja\* and Pekka Heikkinen*

*University of Helsinki, Finland*

*\* annakaisa.korja@helsinki.fi*

BABEL profiles image the crustal structures of the Fennoscandian Shield (BABEL Working Group, 1993; Korja *et al.*, 2006). BABEL7 (Figure 39.1a) images crustal-scale extension associated with formation of the Baltic Sea paleorift and intrusion of the Åland rapakivi granite batholith (Korja and Heikkinen, 1995; 2005). The Baltic Sea is a Mesoproterozoic failed rift associated with thinning of the crust, voluminous bimodal magmatism (rapakivi granites and gabbro-anorthosites) and continental type sedimentary basins. Rapakivi granite plutons are characteristically multiple intrusions emplaced in an extensional tectonic setting as relatively shallow-level plutons (Kohonen and Rämö, 2005).

The near vertical seismic reflection data are the final stacks from BABEL7 (Figure 39.1b). 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.

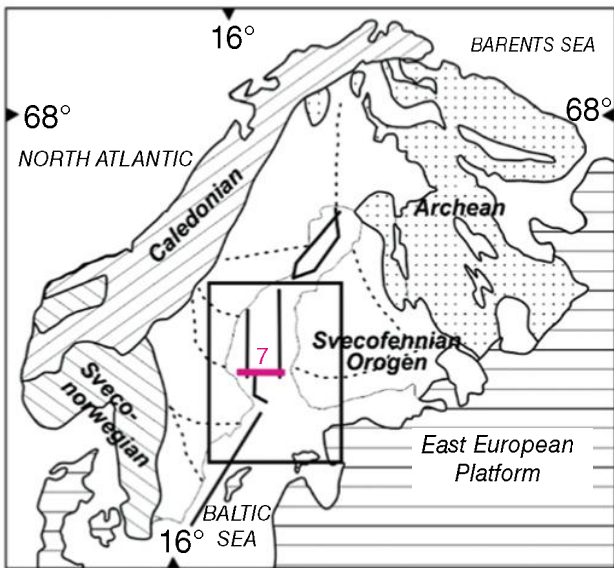
Geological interpretation presumes that reflections image mainly primary igneous or secondary tectonic contacts formed during deformation. Weak reflectivity generally indicates monotonous intrusions and older crustal pieces in which the internal structure has been homogenized in the scale of reflectivity before deforming.

BABEL7 profile images three major blocks with distinct reflectivity patterns. The upper crust of the eastern

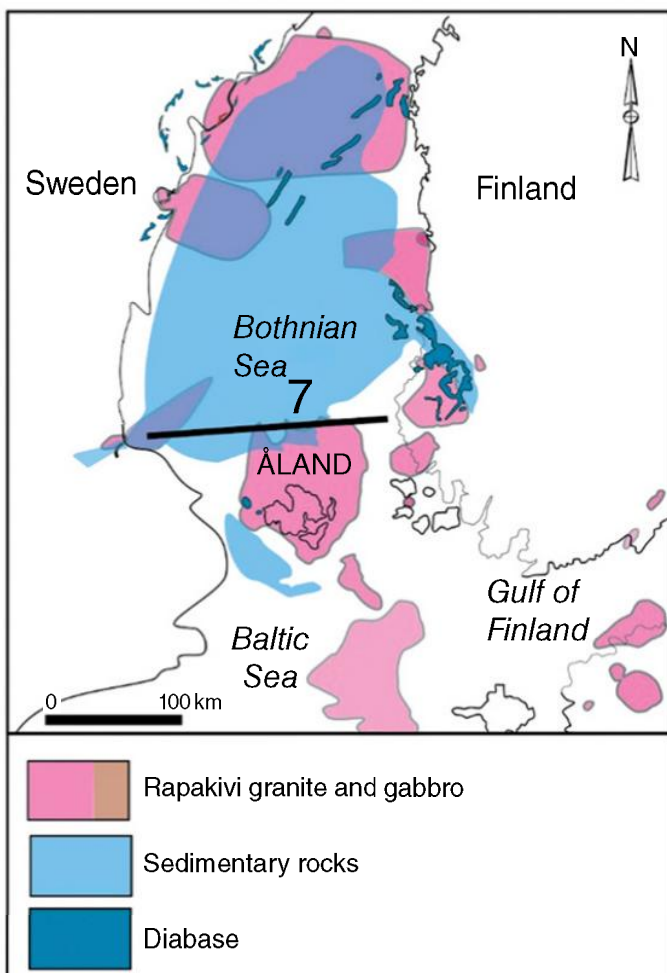
part is weakly reflective but it hosts some minor reflections mimicking graben–horst and diamond-shaped structures. The western upper and middle crust is characterized by strong southeast-dipping bands of crustal-scale listric reflections flattening at the middle-lower crust boundary. The lower crust is highly reflective and bulges upwards in the east. The reflection Moho, defined as base of the reflective lower crust, is distinct and can be correlated with the Moho derived from the wide-angle data.

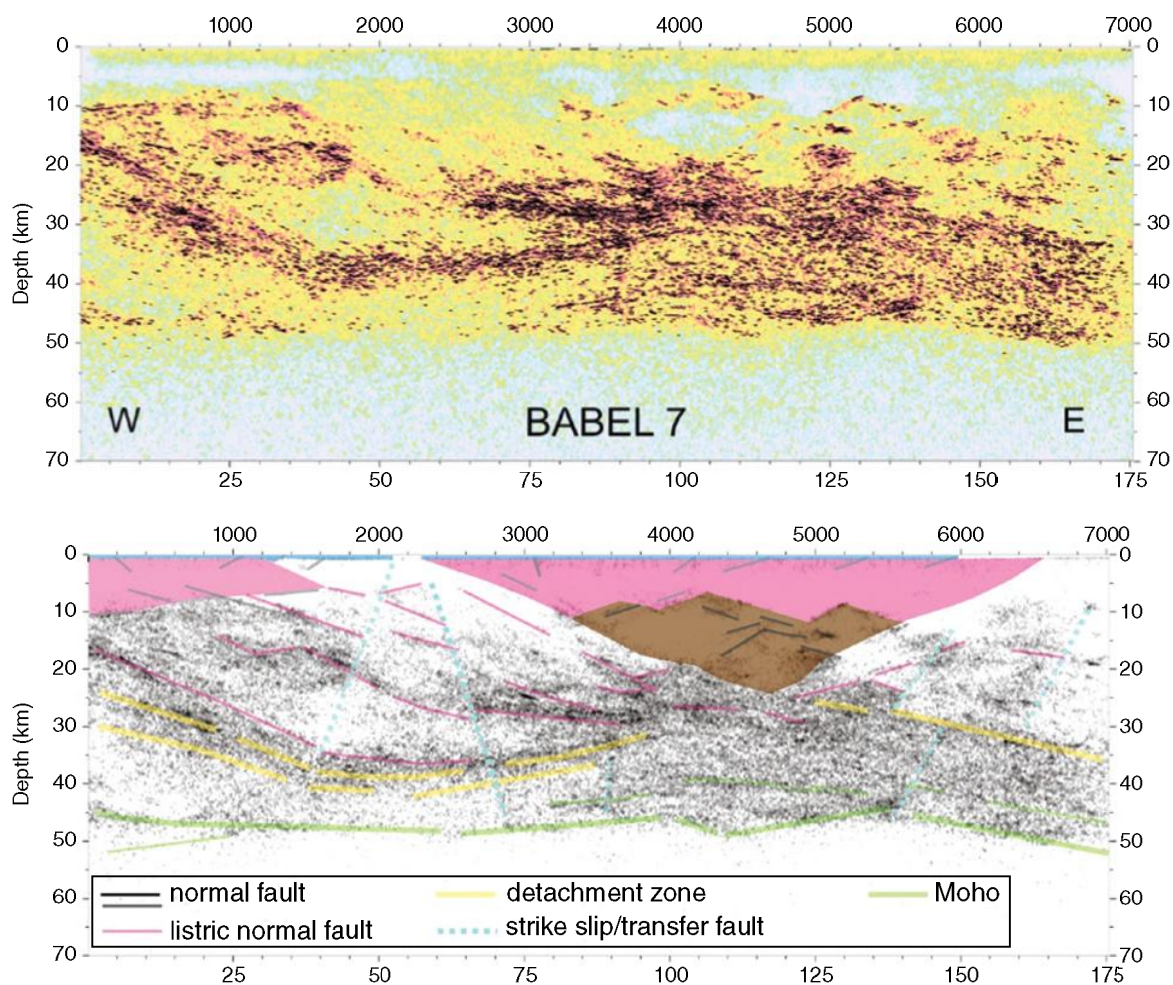
The crustal structure is interpreted to image mostly the latest tectonic extensional event associated with the thinning of the crust and the formation of the Åland and Gävle rapakivi granite batholiths and Bothnian Sea Basin. Some of the extensional normal faults may be inverted stacking surfaces.

The listric reflections are interpreted to image listric normal faults detaching on the mid-lower crust boundary. The offsets of the major reflections can be traced to the surface, where they presumably connect with thin-skin half-grabens of the Bothnian Sea. Thinning of the upper-middle crust counterbalance by bulging and uplifting of the lower crust. Space created by extension is occupied by the Åland batholith: a homogeneous and weakly reflective body. It is composed of an upper granitic part ( $6.15 \text{ km s}^{-1}$ ,  $2625 \text{ kg m}^{-3}$ ) and a lower diamond-shaped gabbro-anorthositic part ( $6.50 \text{ km s}^{-1}$ ,  $2870 \text{ kg m}^{-3}$ ). A reflective graben and horst-structure within the batholith outlines the contact between the granitic and gabbro-anorthositic parts. Breaks in the reflections are interpreted as normal and reverse faults.



**Figure 39.1a** (top) BABEL7 line on a geological index map of Northern Europe. (bottom) BABEL7a lithological map of the study area after Kohonen and Rämö (2005).





**Figure 39.1b** (top) A vertical seismic section along BABEL7 profile shown as an instantaneous amplitude section in colour scale overlain by an automatic line drawing. No vertical exaggeration. (bottom) A schematic geological line interpretation of BABEL7 profile on an instantaneous amplitude section in greyscale modified after Korja and Heikkinen (1995; 2005).

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