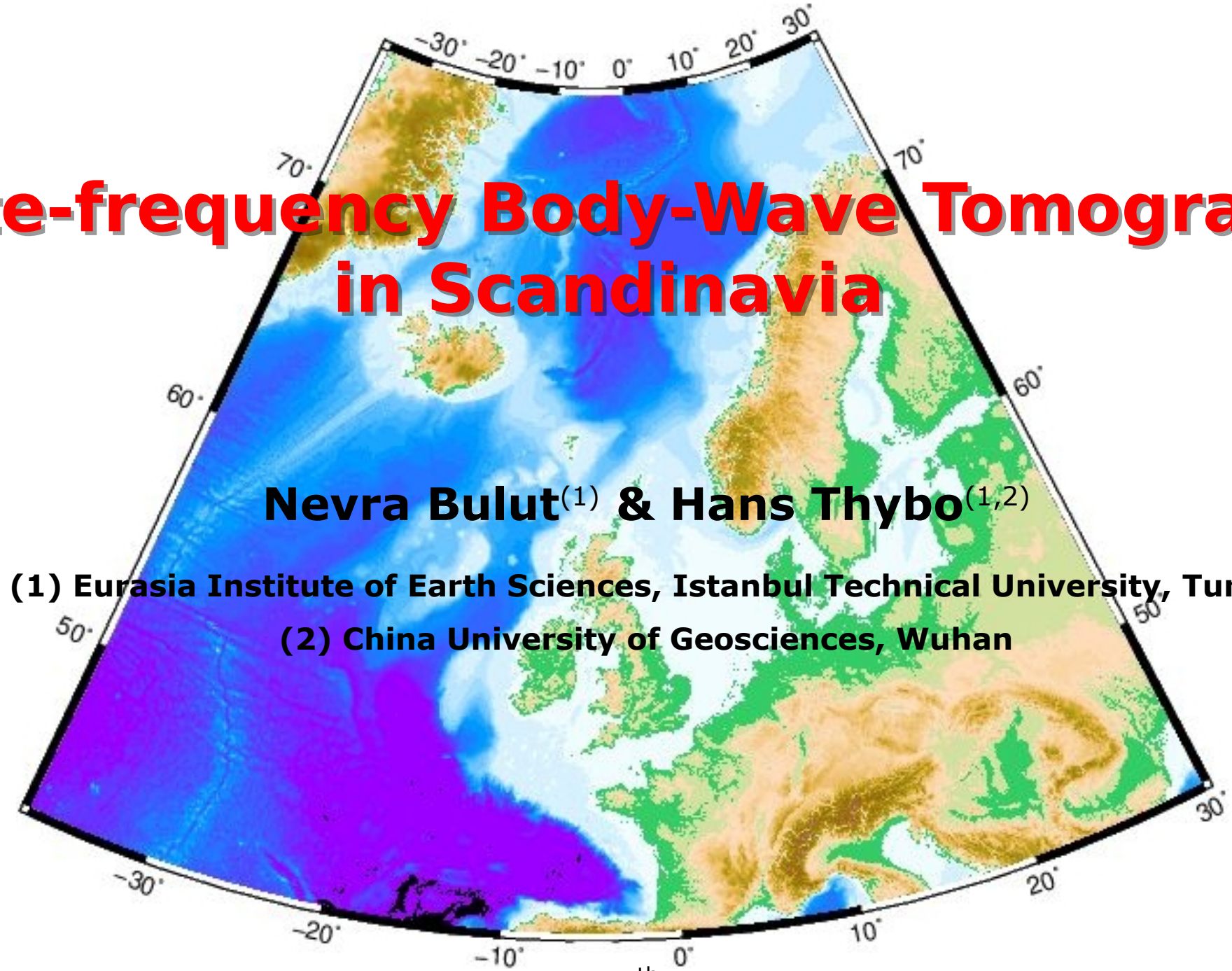
Finite-frequency Body-Wave Tomography in Scandinavia



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Introduction

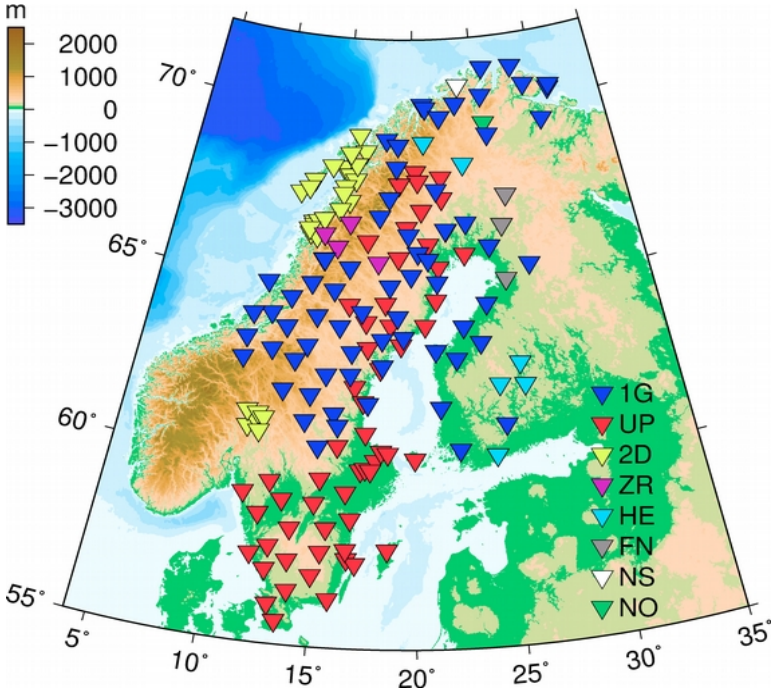
Aim: Determining the seismic velocity structure of the upper mantle by finite-frequency tomographic inversion.

Network: 178 broadband seismic stations installed through Norway, Sweden and Finland, between 2012-2017.

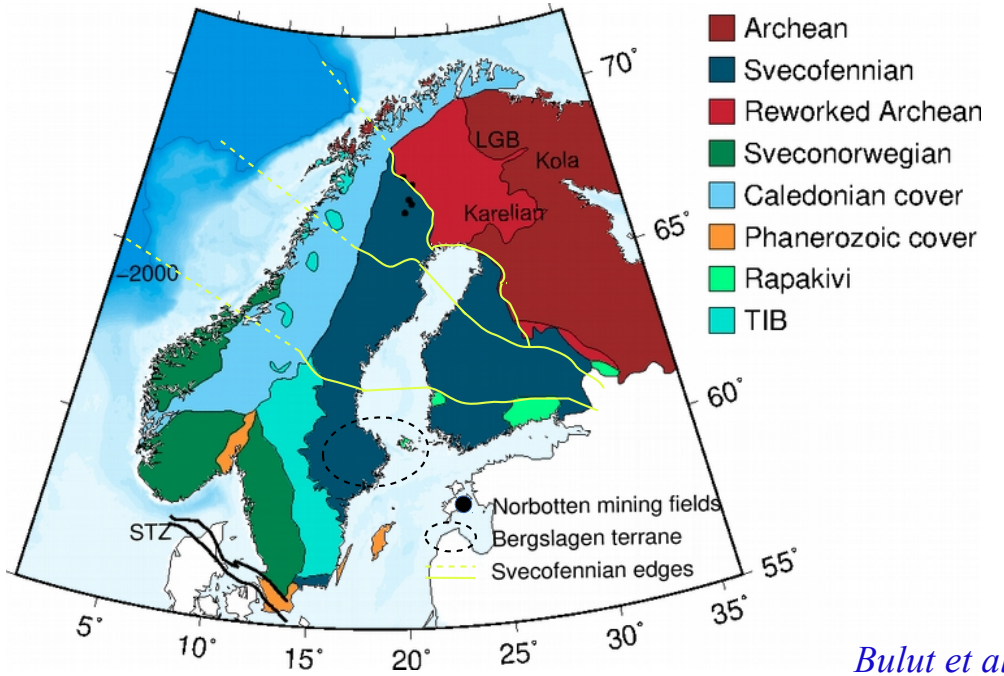
Data: P- waves from teleseismic earthquakes at epicentral distances 30° to 100° with magnitudes > 5.5.

- The broadband seismologic array extends spatially over 2000x800 km² and the model extends to 800 km depth.

Study Region



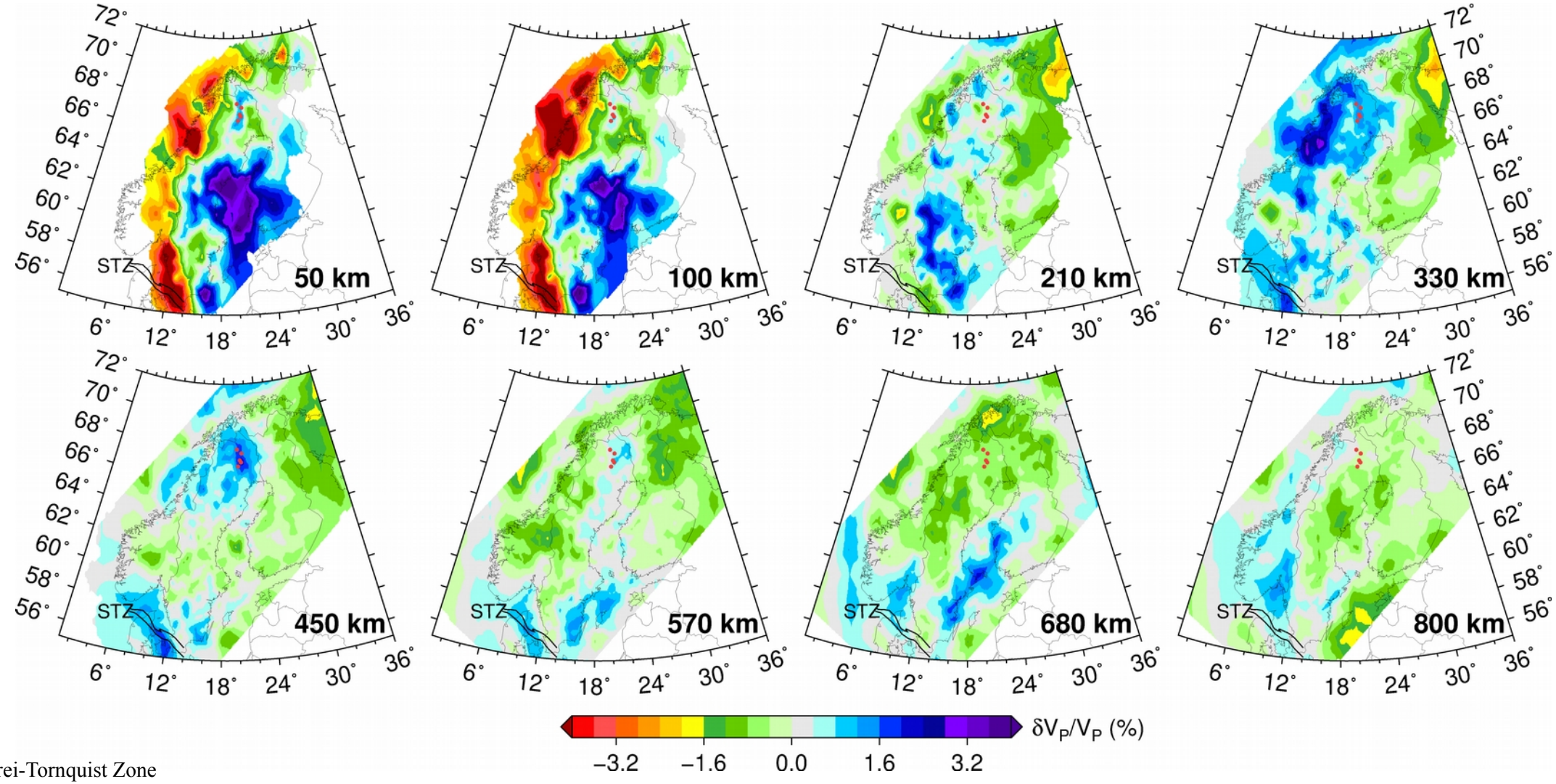
Surface Geology in the Baltic Shield



Bulut et al. (2022), GJI.

Velocity model

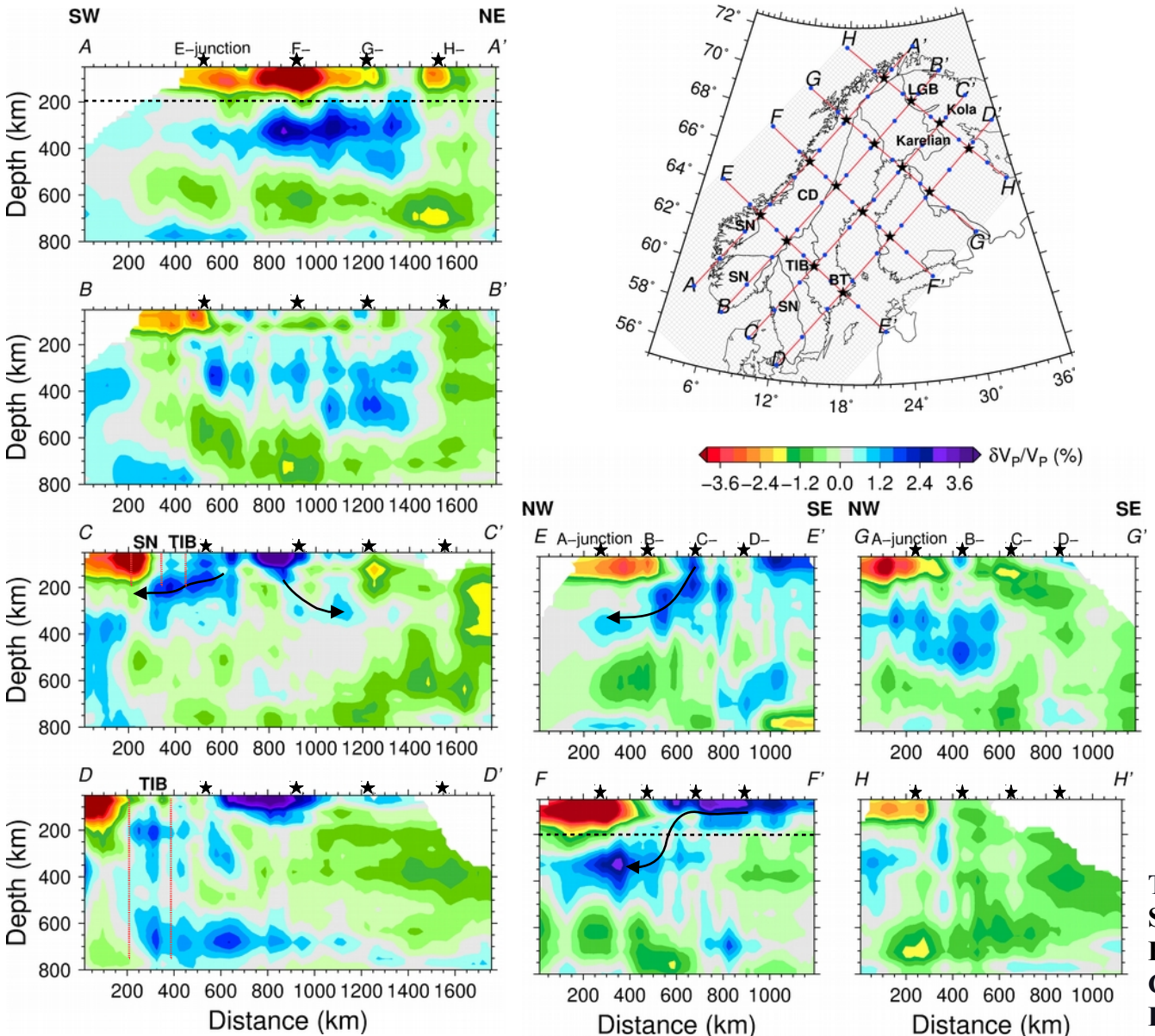
P-wave velocity model in map view at selected depths between 50 and 800 km



STZ: Sorgenfrei-Tornquist Zone

Bulut et al. (2022), GJI.

Strong low- and high-velocity anomalies



- Low velocities;
  - Extend to ~140 km depth
  - Underlain by very high-velocity anomalies
  - May indicate that Caledonian units are thrust over original Svecofennian core

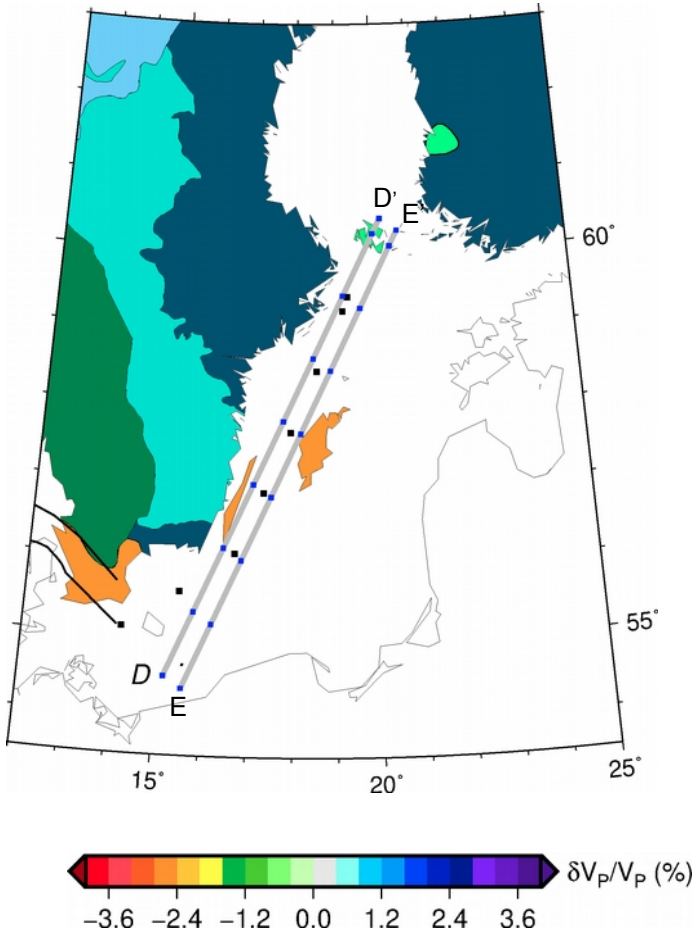
- Extremely strong higher velocities;
  - Up-to +6%, extend to depths of ~200 km around the core of Baltic Shield.
  - May indicate the pristine upper mantle of the present central Fennoscandian cratonic core has been protected

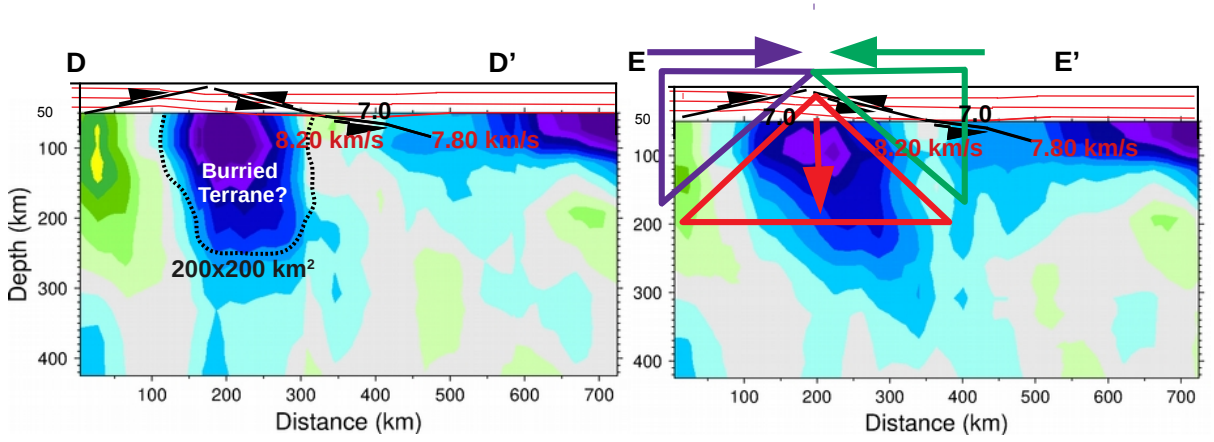
TIB: Transscandinavian Igneous Belt.
SN: Sveconorwegian formation.
BT: Bergslagen terrane.
CD: Caledonian cover.
LGB: Lapland Granulite Belt.

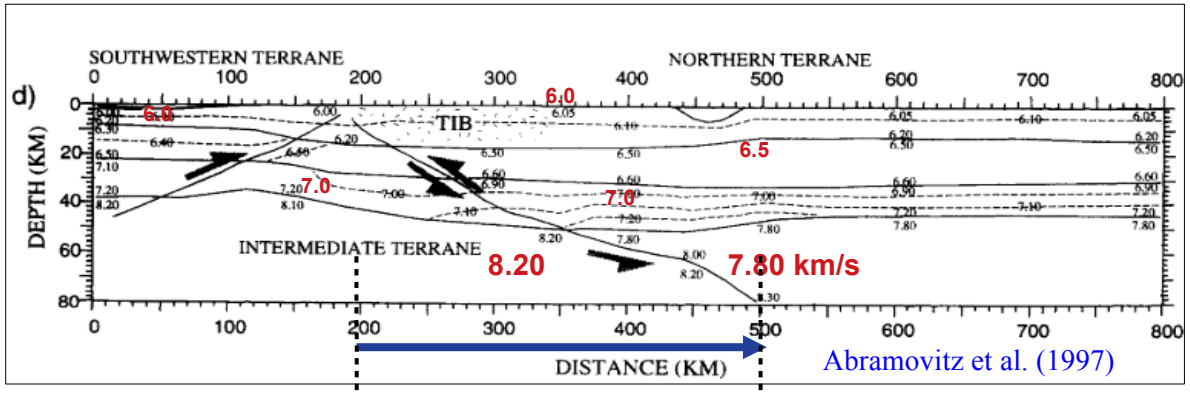
Bulut et al. (2022), GJI.

A small buried terrane

- High velocity extends to 300 km depth in southern Fennoscandia
- Coincident with a crustal-uppermost mantle terrane identified by seismic reflection and refraction





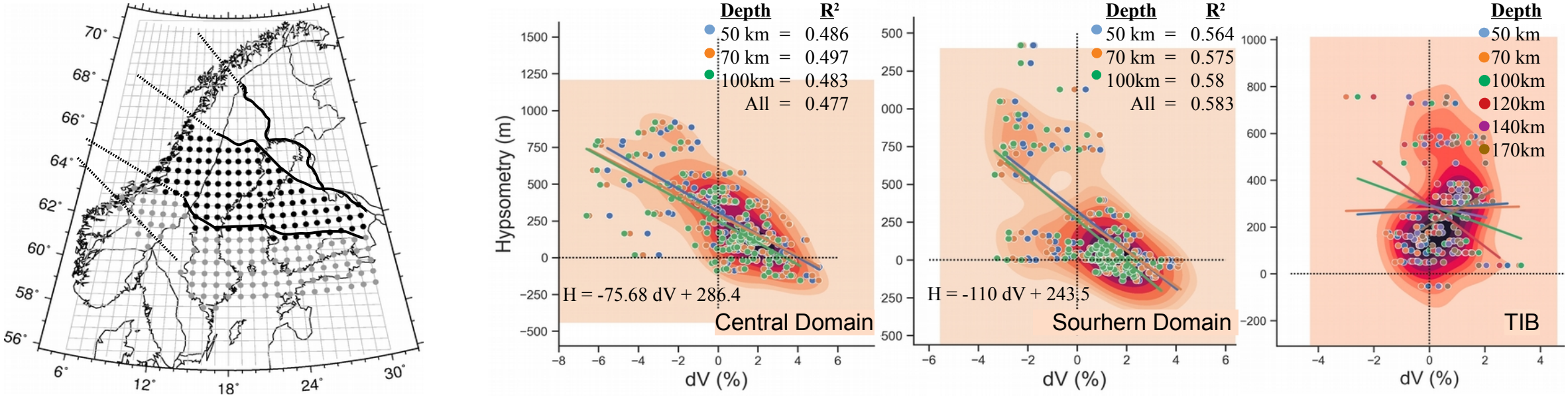


Abramovitz et al. (1997)

Hypsometry and velocity correlation

Test of possible isostatic support of the topography by the uppermost lithospheric mantle by cross plots of relative velocity anomaly (dV %) and hypsometry (m):

- At three depth levels down to ca. 100 km in the central and southern Svecofennian domains.
- An example of noncorrelation and negative correlation of TIB for the depth levels down to 170 km.



Bulut et al. (2022), GJI.

Summary,

- The Fennoscandian upper mantle is characterised by strong velocity contrasts (>6%) over lateral distances 150 km.
- Low velocity anomalies in the upper mantle below the enigmatic high topography in the Scandes indicate that coincident low density material above 200 km depth (uppermost mantle) may isostatically support the high topography.
- Exceptionally high velocity anomalies in the central part of Fennoscandia indicate the pristine upper mantle of the present Fennoscandian cratonic core has been protected over the geological time.
- High velocity anomalies beneath the strong negative anomalies below the Scandes indicate that original Svecofennian and Archaean mantle is preserved throughout Fennoscandia, including the Caledonian and Svenorwegian provinces.
- A strong high velocity north-dipping anomaly in the southern Baltic Sea supports the presence of a buried terrane to 300 km depth.

Detailed results are discussed in *Bulut et al. (2022), GJI.*

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