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Lateral spreading of the Svecofennian Orogen imaged by average lineations and residual velocity anisotropy

A. Korja (1), T. Tiira (1), T. Hyvönen (1), T. Kilpeläinen (2), and T.M. Lammi (2)

(1) University of Helsinki, Department of Geosciences and Geography, Helsinki, Finland (annakaisa.korja@helsinki.fi, +358 9 19151598), (2) University of Turku, Department of Geography and Geology

Lateral spreading of orogen involves active horizontal transportation of bedrock units after collision has taken place. Continuous transportation results in structural anisotropy and lattice preferred orientation (LPO) of growing metamorphic minerals, displayed as mineral lineation and geophysical anisotropy. If the movement direction is consistent it will result in consistent lineation and anisotropy patterns. These patterns can be more effectively studied with the help of technique employing spatially averaged values, where the complicating effects of older deformation is minimized.

We have developed two new techniques to study lateral spreading of orogen and applied these techniques to the Paleoproterozoic Svecofennian orogen, a laterally spreading fossile orogen that froze. In the first technique, Azimuthal residual anisotropy technique (ARAT), the movement directions are searched from residuals of the local isotropic tomographic P-wave velocity model. In the isotropic tomographic velocity models of the crust anisotropic component is embedded in the residual component. In the second technique, the map of average lineations, the directions are searched from the spatial averages (10kmx10km, 30kmx30km) of the prominent stretching lineations (78 000), most likely to have been detected in routine mapping. Both methods indicate consistent regional scale block movements in similar directions.

Large scale seismic reflection profiles across Finland suggest that the bedrock thickened in accretionary processes and that later the bedrock structures were rearranged in post-collisional spreading and/or collapse processes. The exposed bedrock is a compilation of former upper and middle crustal blocks. Seismic images suggest that during spreading the different crustal layers were detached and deformed independently of each other.

A recent three dimensional tomographic seismic velocity model of southern and central Finland suggests that the crust is composed of large scale blocks. Our preliminary results suggest that the Svecofennian orogen hosts residual azimuthal velocity anisotropy consistent over large areas. Because the anisotropy varies with depth, it supports the idea that different layers of the crust have moved independently.

New maps of average lineations also display consistent regional movement directions. The lineation patterns suggest large-scale block-movements and deformation in the upper and middle crust. In those areas where the bedrock shows constant directions of lineations, the residual component of a tomographic velocity model hosts subparallel azimuthal velocity anisotropy (AVA)suggesting that they stem from the same process.