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A Palaeoproterozoic Super-Large Synformal Sheath Anticline: an example from the Keivy Terrane, northeastern Baltic Shield

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The Keivy Terrane is located in the northeastern foreland of the Palaeoproterozoic Lapland-Kola Collisional Orogen in the northeastern Baltic Shield (Daly et al., 2006). The Keivy Paraschist Belt situated in the northeastern margin of the terrane consists of nonmagnetic garnet, staurolite, kyanite, and mica-quartz paraschists of an uncertain age (Neoarchaean or Palaeoprotepozoic) which dip northwards at gentle and intermediate angles. These rocks have been believed to be deformed into a WEW-trending synclinorium 170 km long and up to 12 km wide. There is the Serpovidny Ridge Syncline in the western part of this synclinorium. The syncline core is 8 x 2 km in size and is composed of riftogenic rocks which are correlated with the Umba Formation of the Palaeoproterozoic Imandra-Varzuga Rift-Belt (Belolipetsky et al., 1980) located ca. 50 km south of the Serpovidny Ridge.

Magnetic and geological mapping has shown that the Palaeoproterozoic fold core is isoclinal and consists (from limbs to core) of the nonmagnetic Carbonate-Bearing Schist Sequence, the magnetic Metabasalt Sequence, and the Magnetite-Bearing Schist and Gneiss Sequence metamorphosed under amphibolite-facies conditions (kyanite- and garnet-bearing mineral assemblages). These sequences, like the surrounding Keivy paraschists, dip northwards. The southern limb of the fold core is strongly thinned. The thickness of the Carbonate Sequence is 10-15 m and ca. 700 m in the southern and northern limbs, respectively. The XZ ratio determined at the contact between the Carbonate and Metabasalt sequences in the southern limb is up to 25 whereas in the whole northern limb all rocks are practically undeformed.

A solution of the inverse problem to the modulus of the magnetic field for the study area has revealed that the magnetic Metabasalt and Magnetite-Bearing sequences surrounded by nonmagnetic rocks build up the strongly elongated downward keel of the fold core. It suggests a synformal sheath-like morphology of this core. Taking into account the thickness of the nonmagnetic Carbonate Sequence, the length of sheath is estimated at 4-5 km. Geometrical analysis of orientation data on Keivy paraschists that immediately surround the Palaeoproterozoic fold core directly indicate its sheath-like morphology. The eastern closure of the fold core displays the NW-plunging hinge line, while the western closure has the NNE-plunging hinge line. A north-plunging lineation subdivides the angle between hinge lines (51°) into two nearly equal parts. From these data, the length of sheath is estimated also at 4-5 km. Sedimentary structures indicative of the polarity of bedding (graded and cross-bedding, erosion surfaces) indicate that the Palaeoproterozoic fold core is a synformal anticline, i.e. its northern, undeformed limb is normal, and its southern, strongly thinned one is overturned. Kinematic indicators (sigma and s-c structures, the asymmetric appearance of the Serpovidny Ridge Fold Core and exposure-scale sheath folds in Keivy paraschists) suggest that these structures resulted from north-directed movements.

We conclude that the Palaeoproterozoic Serpovidny Ridge Fold Core is a super-large synformal sheath anticline. This is interpreted as an outlier of a Helvetic-type nappe come from the Palaeoproterozoic Imandra-Varzuga Rift-Belt. This is a contribution to projects RFBR-12–05–00878a and ONZ-6.