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Thickness Reconstruction of Layers by 3D Geometrical Model to Characterize Caledonian Tectonic Complex and Data in Latvia

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In present study we attempt to verify the 3D geological model, which has been built on a variety of heterogeneous data sources for the Baltic Basin (BB). Data describing the displacement along the faults and associated thickness changes of the syntectonic strata is sparse and reflects only regional relevance (Brangulis & Konsins 2002). Borehole logs provide most reliable and comprehensive data source for reconstructing the structural geology of the Latvia sedimentary cover as sufficient quality seismic data is available only for the local scale structures. Based on the thickness analysis of the boreholes rough resolution 3D geological tectonic block model was developed to deconstruct the geological structure of the Latvia Caledonian sedimentary sequence.
MOSYS modeling system was used for the geological structure modeling, developed within the PUMA project (Sennikovs et al, 2011). Algorithmic genetic approach was applied to interpolate data of well logs as strata volume and sequentially to reconstruct the post-deformation situation. This approach allows modifying model construction in any step and all processes are fully documented and are repeatable. Geometrical model consists of 33 tectonic blocks bordered by the faults which were distributed by interpreting displacement amount of the blocks along the faults providing an opportunity to characterize common tectonic evolution.
The study results indicate insignificant thickness change of the Ordovician and Silurian strata along the faults suggesting that major slip event along the faults occurred during the late Silurian and early Devonian, and some secondary fault reactivation during the middle Devonian Narva time. Uplift of the territory during this time is confirmed by the presence of the regional unconformity.
Constructed rough resolution 3D geometrical model suggests shortening along the horizontal axis approximately 10 - 20% but most of the shortening has occurred in the central-west part of Latvia where it reaches 30%. About 20 - 25% of the initial stratigraphic units subjected to faulting are estimated to be eroded. The modeling results allowed identifying areas of inconsistently interpreted geology and allowed to significantly reduce the geometrical uncertainties of the structural surfaces. Modeling results allowed identifying several new hypothetical local structures associated with the faulting. Application of a 3D thickness reconstruction can be very useful for characterizing tectonic structures and their evolution.

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