THICKNESS RECONSTRUCTION OF LAYERS BY 3D GEOMETRICAL MODEL TO CHARACTERIZE CALEDONIAN TECTONIC COMPLEX AND DATA IN LATVIA

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1. INTRODUCTION

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 & Konšins 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.

2. DATA AND METHODS

MOSYS modeling system was used for the geological structure modelling, 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.

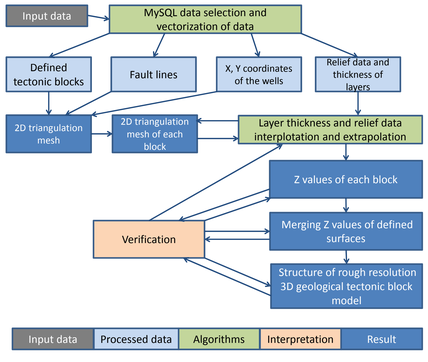

Figure 1. **Tectonic block model establishment, verification and data implimentation scheme.**

Figure 2. **Structual scheme of Ordovician surface.**

As main geological data well logs and fault lines were used which were taken from Geological Survey databases and structual maps. Although maps are interpreted from seismic data, no other seismic data was used.

3. RESULTS

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.

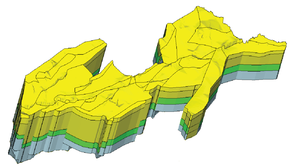

Figure 3. **Tectonic block type model overview.** *3D view from South-West to Nort-East*

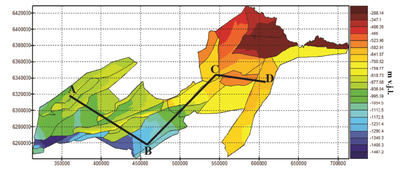

Figure 4. **Middle Ordovician surface.**

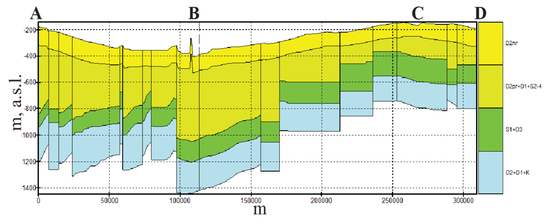

Figure 5. **Cross-section along line A-B-C-D.** *Setting showed at Fig. 4.*

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. Modelling results allowed identifying several new hypothetical local structures associated with the faulting.

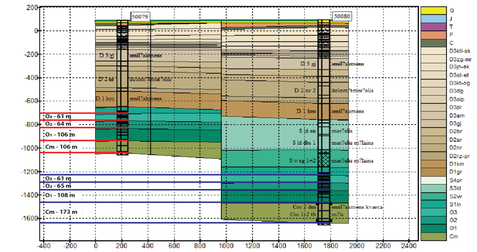

Figure 6. **Cross-section between wells 50079 and 50080.** *Mathematical model of the Baltic artesian basin (Virbulis et al).*

On the other hand thickness analysis in Caledonian tectonic complex showed that the most significant thickness changes between two fault blocks have occured in the Cambrian where difference reaches 80 m (Fig. 6). Although it is not observed everywhere but only in Central-West and North-West Latvia where deformation is the most consistent. Also in most observed cases layers from fault to SW has increased thickness.

4. DISCUSION / CONCLUSIONS

Although research data is sparse and dip angles of fault structures are unknown and fault planes in model are vertical, it still indicates major characteristic of deformation and strata thickness changes which for insight as preliminary study in tectonic evolution is enough to draw first major conclusions.

Established model showed that commonly surface level and of tectonic block is increasing SE and joined with orientation of fault data indicates that deformation occured under compressive regime. By determining direction mean of fault structures was possible to define main stress orientation (NW – SE) and both thickness changes and erosion shows that processes occurred very rapidly and it was major thrusting at the end of Calodenian event and should be linked to Scandian orogeny.

Thickness changes in Cambrian suggest tectonic movements also occured in Early Caledonian and most likely by reactivating older fault structures as lithology in the hangingwall and in the footwall is the same and distance between wells is not large enough to take any abnormal sedimentary process into account.

Acknoledgements

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