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Architecture and depth to crystalline basement of the westernmost Polish Outer Carpathians

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The Precambrian crystalline basement of the westernmost Polish Outer Carpathians is one of the least-recognized aspects of the structure of these mountains. Generally, archival boreholes do not reach the top of the crystalline basement, and geophysical surveys have rarely been focused on identifying the basement architecture. Therefore, the main purpose of the study is to use good gravity and magnetic data coverage to map basement structure and depth, and identify possible fault patterns in the potential field data.

The regional cross-section, hereinafter called Carpathica 2018, was constructed based on public-domain wells data and geological maps. For southernmost part of the cross-section a seismic profile was also available. Above mentioned data allowed to plausibly resolve the structure of the deformed sedimentary sequence of the Carpathian Fold and Thrust Belt, while the architecture of the basement remains poorly understood.

The integrated qualitative and quantitative analysis of gravity and magnetic data along the Carpathica 2018 cross-section revealed several normal faults rooted in the crystalline basement. These basement 'steps' can be associated with the evolution of geological units of the Carpathian Fold and Thrust Belt. The frontal thrusts of the Silesian, Magura, Fore-Magura and Dukla units correlate well with interpreted faults visible in the crystalline basement. Our results suggest that basements faults might have had significant influence on the evolution and present day geometry of the Outer Carpathians.

A three-dimensional inversion of gravity data based on the method published by Barnes and Burraud (2012) was also used. As a result, we obtained a depth to crystalline basement map for the entire study area. Depth to basement decreases from nearly 7000 m u.s.l. in the south to around 1000 m u.s.l. in the north of the research area. The maps are supplemented with the results of quantitative structural interpretation based on gravity and magnetic anomaly maps and their derivatives.

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