Two-dimensional models of petrophysical parameter distribution in structural-facies units of Polish Outer Carpathians in the Łupków–Jarosław profile

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The tectonics of the Cretaceous and Palaeogene flysch formations in the Łupków–Jarosław profile is characterised by elevated asymmetric folds and thrust sheets that are cut by overthrusts. Their deep geological structure was interpreted to obtain the best coincidence of the surface cartographic

data and borehole logs with the trends of thickness changes of stratigraphic complexes and the morphology of the pre-Alpine basement. The geometric model of folds and overthrusts was verified using a method of cross-section balancing.

The bulk density, resistivity and seismic wave velocity data from boreholes were set along the study profile. Bulk density data were supplemented by the results of density measurements in surface outcrops. Models of distribution of bulk density, resistivity and seismic velocity along the profile were constructed using the above mentioned data set, as well as data obtained from a structural-lithofacies cross-section. Two modes of petrophysical parameter evaluation were applied. The distribution of density, porosity and shaliness in cells of a finite-element net was determined in the central part of the profile by interpolating and extrapolating borehole data and using the STRATAMODEL program. Resistivities and seismic wave velocities for each cell were calculated using empirical relations between density, porosity and shaliness, and those parameters. Lithological differentiation along the profile was taken into account. The correctness of calculation results was verified using well logging data. Petrophysical data distribution was then averaged for respective lithostratigraphic complexes. The distribution of physical parameters of rocks was obtained directly from interpolation and extrapolation of well logging and surface data for lithostratigraphic complexes in the outer parts of the profile.

As a result of calculation, cross-sections illustrating two-dimensional distribution of petrophysical parameters in structural-facies units were obtained. The flysch cover is characterised by great variations of physical parameters, caused by the variability of the flysch lithology. In general, the flysch formations are built of sequences of sandstone and shale layers of contrasting physical properties. A proportion between the volumes of these lithotypes determines averaged values of physical parameters and anisotropy coefficients. The presence of other lithotypes, i.e. carbonate and siliceous rocks, strong tectonic deformation and lateral lithological alteration complicate the situation. Under such circumstances, the evaluation of trends of petrophysical parameter changes and establishing its connection with lithostratigraphic data is difficult. However, some general relationships could be observed.

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