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Crustal blocks in the Variscan and Carpathian foreland area of southern Poland – results of the CELEBRATION 2000 seismic experiment

M. Narkiewicz (1), M. Grad (2,3), A. Guterch (3), and T. Janik (3)

(1) Polish Geological Institute, Warszawa, Poland (marek.narkiewicz@pgi.gov.pl), (2) Institute of Geophysics, University of Warsaw, Warszawa, Poland (mgrad@mimuw.edu.pl), (3) Institute of Geophysics, Polish Academy of Sciences, Warszawa, Poland (aguterch@igf.edu.pl)

Dense network of deep refraction seismic profiles in SE Poland, performed in the framework of the CELEBRATION 2000 experiment, allowed to recognize velocity (Vp) structure of the Earth's crust in the area of SW margin of the East European Platform (EEP). The geology of the Middle Palaeozoic to Cenozoic structural complexes is well-constrained here, owing to previous investigations of hundreds of deep boreholes, numerous exposures, including those in the Holy Cross Mts., and hundreds of reflection seismic sections. Nevertheless, the pre-Variscan development, most probably comprising accretion of variously defined crustal fragments, is still poorly recognized and therefore debatable. This is partly related to divergent interpertations of an extent of different crust-types, particularly that of the pre-Ediacaran EEP crystalline crust.

The CELEBRATION 2000 data indicate that the typical three-layer, 40-45 km-thick EEP crust, modified in its marginal part (thinning, high-velocity bodies, intracrustal reflectors), extends to the Nowe Miasto Zawichost Fault in SW. The fault, well-reproduced by the pattern of gravity and magnetic anomalies, corresponds to the NE boundary of the Mid-Polish Swell (latest Cretaceous-Paleogene inversion structure), and appears to have controlled the Devonian-Carboniferous palaeogeography and structural development. In the opposite, south-western part of the area, the crust of the Upper Silesian Block is 35 km thick, displaying variable two- or three-layer structure of the crystalline part. The area located between USB and Holy Cross Mts., corresponding to the Małopolska Block, is distinguished by two-layer crystalline crust, whereas Moho is generally shallower than in the EEP. In the Łysogóry Block to NE, the Moho depth is similar to that of the EEP, although the crystalline crust is thinner and shows velocity structure intermediate between that of the EEP and Małopolska. In the SE corner of the study area, near the Polish-Ukrainian border, the crust thins to less than 40 km, while displaying the velocity structure comparable to EEP. The NW boundary of this tentative Narol Unit corresponds roughly to the Fennoscandia-Sarmatia Suture but its nature and extent remain hypothetical.

According to our interpretation, the area south-west of the Teisseyre-Tornquist Zone (corrresponding approximately to the Nowe Miasto-Zawichost Fault) comprises the tectonic blocks accreted during pre-Variscan times. Final stages of accretion were most probably connected with dextral strike-slip displacement on the order of few hudreds of kilometres (Łysogóry Block) or more (Upper Silesian and Małopolska blocks). The mapped tectonic boundaries between the blocks, although representing nearly vertical zones of repetitive, partly strike-slip deformations and, in some cases, also bimodal magmatism, are not clearly expressed in the velocity structure of the crust. This may be related to : (1) limited resolution of the refraction seismic method in tracing vertical or steeply inclined discontinuities; (2) possible thin-skinned detachments in the sedimentary crust and horizontal decoupling in the lower crystalline crust; (3) later, post-accretionary tectonic and/or magmatic overprint.