

Recent deep reflection seismic surveys in Poland

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The beginning of the second decade of the 21st century has revolutionized the study of the deep structure of the Earth's crust in Poland. After the successes of international seismic projects employing wide-angle reflection/refraction (WARR) methods such as POLONAISE'97 or CELEBRATION 2000 (Guterch & Grad, 2010), the time has come for the implementation of regional deep reflection seismic profiling. Intensification of shale gas exploration indirectly contributed to the acquisition of the first regional deep reflection seismic profiles in Poland: the so-called Transcarpathian profile (POLCRUST-01) and the PolandSPAN™ project. The 240-km long POLCRUST-01 profile ran from the Precambrian platform through the Teisseyre-Tornquist Zone (TTZ) and ended in the Carpathian Mts. in SE Poland. One of the most surprising results was the imaging of the “A-horizon”, which can be partially associated with the crystalline basement and is visible over a 100-km distance (Narkiewicz et al. 2015). Other highlights are related to the identification of the reflective lower crust within the Precambrian platform and the ambiguous definition of the reflective Moho along most of the profile (Malinowski et al. 2013). Shortly after acquisition of the POLCRUST-01 profile in 2012, ION Geophysical company (USA) acquired a net of regional seismic profiles with a total length of about 2,200 km, called PolandSPAN™. Although these profiles were mainly aimed at the regional characterization of the Lower Paleozoic shale basins, the measured data enable imaging of the whole crust. An extended correlation method was used to reprocess the PolandSPAN™ data to image below the nominal record length (12 s TWT) and to obtain reflections from the Moho (Malinowski, 2016). Seismic data from the PolandSPAN project were used as input for potential fields modelling (Mazur et al. 2015, 2016). As a result, a new model for the TTZ was proposed, in which the TTZ constitutes a structure inside the East European Craton, not the platform edge itself. TTZ is also associated with the occurrence of a so-called crustal keel (localized Moho depression). This interpretation concerns central and northern Poland, although results from the southern TTZ segment (Malinowski 2016) seem to confirm the concept of a crustal keel. New interpretations based on PolandSPAN™ and other industrial profiles from SE Poland (Krzywiec et al. 2017ab) question previous interpretations of the results from the POLCRUST-01 profile, assuming Variscan thrusting within the Radom-Kraśnik block and the lack of deeply-rooted, vertical fault zones in the area of the TTZ. Interpretation of PolandSPAN™ data also provided an unequivocal proof that the Precambrian crystalline basement in SE Poland underwent substantial extension in the Neoproterozoic as evidenced by the presence of an extensional half-graben imaged by seismic data and filled by a Neoproterozoic volcano-sedimentary syn-rift succession (Krzywiec et al. 2018).

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