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Imaging East European Craton margin in Northern Poland using extended-correlation processing applied to regional seismic profiles

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Detailed image of the entire crust and Moho discontinuity in the area of the Baltic basin, N Poland, were derived from reprocessing several 2D Vibroseis industry seismic reflection profiles with the use of the extended-correlation technique. We apply this method to a subset (5 profiles of 950 km total length) of ION Geophysical PolandSPAN™ regional seismic program covering the marginal region of the East European Craton (EEC) and originally aimed at imagining Lower Palaeozoic shale play over entire country.

Given the raw, uncorrelated seismic data, acquired with a 28-s listening time and 16-s long sweep, we were able to extend the nominal record length up to 22 s two-way-time (TWT) ($\sim$ 60 km depth). For the recorrelated dataset, we designed a special processing workflow including denoising, cascade deconvolution, signal enhancement, frequency filtering and post-stack migration. In order to boost signal coherency, the novel form of stacking seismic traces along common-reflection surface (CRS) was also tested here and compared with well-known common-midpoint stacking. The CRS method is based on summing traces that are collected not only along offsets but also in a midpoint direction. In that way, the multidimensional stacking tends to output image with improved signal-to-noise ratio and more stable continuity of reflections, especially in low fold zones. In order to support interpretation of the final results, we performed a time-depth conversion of the post-stack migrated sections using velocity model compiled from the available pre-stack depth migration velocity models for the section above the basement and the velocity field based on a recent compilation of the wide-angle reflection/refraction (WARR) profiles for the deeper section below the basement.

Processing of the strike lines (i.e. perpendicular to the Teisseyre-Tornquist Zone, TTZ) revealed a very reflective lower crustal domain. Previously, reflective lower crust was noted in the legacy deep reflection seismic data from the Pomerania region, as well as in the new reflection seismic profiles further south along the TTZ in Poland (profiles from the same PolandSPAN™ family as well as the POLCRUST profile). We tentatively link this reflectivity with the passive-margin stage of Baltica. Moho reflectivity varies in strength and quality, but is observed across the profiles at a consistent depth level of ca. 35-40 km, which is compatible with the observations from WARR data. Our extended-correlation processing of the PolandSPAN™ data provides a new source of information that will undoubtedly shed some light on the evolution of the EEC in the upcoming tectonic model creation.

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