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The SHIELD'21 deep seismic profile across Ukraine

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Carried out in 2021, the wide-angle reflection-refraction (WARR) SHIELD'21 profile crosses, from SW to NE, the main tectonic structures of Ukraine. It has targeted the crustal and uppermost mantle structure underlying the Archaean and Paleoproterozoic crystalline complexes of the Ukrainian Shield and the adjacent platformal areas. To the SW of the Ukrainian Shield, the crystalline basement is overlain by Vendian through Paleozoic strata of the Volhyno-Podolian Homocline, plunging at its SW end below the Carpathian belt and its Neogene foredeep. To the NE, the crystalline cratonic basement is covered by Devonian and Carboniferous successions of the Dnieper-Donets rift basin. The ~650 km long SHIELD'21 profile is a northeasterly extension of the RomUkrSeis profile carried out in 2014 and running from Romania to the southwestern part of the Ukrainian Shield (Starostenko et al., 2020). The WARR study along the SHIELD'21 profile provided high-quality seismic records. The main recorded seismic waves are refractions of P- and S-waves in the sedimentary layer, crystalline basement, middle and lower crust and uppermost mantle, as well as reflections from crustal boundaries, the Moho interface and boundaries in the uppermost mantle. The correlation picking of their arrival times allowed us to build a velocity model not only for the P-, but also for S-waves and Vp/Vs ratio. The model reveals that over the entire thickness of the crust, the Vp in the crystalline basement nowhere exceeds 6.85 km/s, which – particularly in the context of the lower crust – represent low values, but similar to those known from the other nearby deep seismic profiles (e.g. TTZ-South, and DOBRE-4). Patterns of crustal boundaries combined with velocity differences across them, permit hypothesizing on Proterozoic large-scale subhorizontal extensional faulting in the crystalline upper crust. A prominent dome-like structure in the lower crust may represent a longitudinal section of a major duplex resulting from Paleoproterozoic overthrusting to the NW, comparable to those interpreted on the TTZ-South profile (Janik et al., 2022). The Moho shows strong variability of a depth (~32-50 km), and is underplated by lenticular horizontal ca. 10 km thick high velocity mantle bodies with Vp>8.36 to 8.40 km/s, also present deeper in the upper mantle of Vp between 8.15 and 8.25 km/s. The Moho is prominent and marked by the Vp velocity contrast of c. 1.4 to 1.8 km/s between the upper mantle and lower crust. It is characteristically undulated with successive downward and upward

bends, with the amplitude locally exceeding 15 km and wavelength of the order of 150 to 250 km. A similar Moho undulation form was described along the DOBRE-4 profile and was interpreted as Mesozoic(?) buckle mega-folds (Starostenko et al, 2013).

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