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Two-dimensional gravity and magnetic model along a new WARR profile in the transition zone from the Precambrian to Palaeozoic platform in the southern Baltic

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Defining a transition zone between the Precambrian East European Craton (EEC) and the Palaeozoic West European Platform (WEP) is still a matter of discussion despite a large body of geophysical and geological data. The main tectonic feature of the transition zone is the Teisseyre-Tornquist Zone (TTZ), which has been variously interpreted over the past decades mainly because of a thick (c. 10 km) Palaeozoic and Mesozoic sedimentary cover masking its crustal architecture. We investigated the crustal structure of the TTZ using a 270-km long wide-angle reflection/refraction profile (WARR) measured along 15 ocean-bottom seismometers and 2 land stations during the course of the RV MARIA S. MERIAN expedition 'MSM52'. This NE to SW profile is oriented nearly parallel to the Polish coast, located ~ 48 km south of the Danish island of Bornholm. We prepared a two-dimensional gravity and magnetic forward model along this profile, using the Geosoft GM-SYS software with layers of infinite length. The basis for the potential field modelling is a seismic velocity model that has been prepared through trial-and-error forward modelling.

The seismic velocity model shows a continuity of the lower and middle crust of the EEC towards the basement of the WEP. The synthetic magnetic profile is smooth and indicates that the seismic data accurately revealed the geometry and depth of the magnetic (crystalline) basement. However, the model was unable to replicate short-wavelength, high-amplitude magnetic anomalies in the ENE section of the profile, probably representing iron oxide mineralisation in the crystalline basement of the EEC. The gravity model shows 3 areas of misfit between the synthetic and observed gravity profile. The most prominent misfit coincides with the NE boundary of the TTZ. To remedy the misfit, we produced two alternative gravity models that deviate from the seismic velocity model in the problematic area. One model postulates a crustal keel underneath the NE section of the TTZ and the other suggests the presence of a middle crust magmatic intrusion. Both models equally and adequately reduce the misfit of the gravity model.

Our models suggest a SW-ward continuation of the Baltica middle and lower crust through the TTZ and seem to preclude the coincidence of the Caledonian Thor suture with the TTZ. An important perturbation of the upper crust and sedimentary cover within the latter is mostly associated with the superimposed effects of Devonian-Carboniferous and Permian-Mesozoic extension. The only conspicuous compressional event confirmed by our data is the Late Cretaceous-Paleogene inversion of the Permian-Mesozoic basin. Due to limited resolution, our models did not reveal the effects of Caledonian nor Variscan shortening, including the Caledonian Deformation Front.

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