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The Teisseyre-Tornquist Zone – early Palaeozoic strike-slip plate boundary or Ediacaran rifted margin of Baltica?

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The Teisseyre-Tornquist Zone (TTZ) is the longest European tectonic and geophysical lineament extending from the Baltic Sea in the northwest to the Black Sea in the southeast. This tectonic feature defines a transition between the thick crust of the East European Craton (EEC) and the thinner crust of the Palaeozoic Platform to the southwest. Being a profound zone of crustal and lithospheric thickness perturbation, the TTZ has usually been considered a Caledonian tectonic suture formed due to the closure of the Tornquist Ocean. The suture was hypothesised to originate from the collision between Baltica and Avalonia or large-scale strike-slip displacement along strike of the Caledonian Orogen. However, some minority views postulated the continuation of Baltica crystalline basement farther to the southwest up to the Elbe Lineament and the margin of the Variscan Belt.

We studied the ION Geophysical PolandSPAN survey that consists of 10 regional, seismic depth profiles covering the SW margin of the EEC and the TTZ in Poland. Since the PolandSPAN profiles image to $\sim$30 km depth their interpretation was integrated with the potential fields data and earlier results of refraction sounding to better image the deep structure of the TTZ. Our data show that the NW and central sections of the TTZ correspond, at the Moho level, to a relatively narrow crustal keel and a significant Moho step at the transition from the EEC to the Palaeozoic Platform. However, top of basement above the TTZ is smooth and moderately sloping towards the southwest. In the central part of the TTZ, top of Precambrian is covered by undisturbed lower Palaeozoic sediments. In contrast, the lower Palaeozoic sediments are involved in a latest Silurian, thin-skinned fold-and-thrust belt along the NW section of the TTZ, where the sharply defined Caledonian Deformation Front adjoins a rigid basement buttress above the TTZ. Finally, the crustal keel is mostly missing from the SE section of the TTZ. Instead, this area is dominated by high density lower crustal bodies similar to those that are found along present-day passive continental margins. Moreover, an extensive succession of the uppermost Neoproterozoic sediments is emplaced outboard of the southeastern section of the TTZ.

These results obtained do not support the occurrence of a Palaeozoic terrane boundary along the TTZ. Instead, it is suggested that the crystalline basement of the EEC extends westward beyond the TTZ and continues in the substratum of the Permo-Mesozoic basin of central and western Poland. If the crustal keel underneath the TTZ indeed represents a fossil plate boundary, it must have formed in the Precambrian during the amalgamation of the Rodinia supercontinent. However, the contrast of crustal thickness across the TTZ between the EEC and the adjacent Palaeozoic Platform may have formed later during the Ediacaran rifting and subsequent break-up of the Tornquist Ocean. The Caledonian collisional suture must be located farther southwest in western Poland or NE Germany and deeply concealed beneath a thick cover of Palaeozoic and younger sediments.