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PETROLOGICAL INTERPRETATION OF GEOPHYSICAL DATA: MIDDLE- AND LOWER CRUST IN THE TRANS-EUROPEAN SUTURE ZONE IN POLAND

Trans-European Suture Zone (TESZ) is located at the contact of the East European Craton with Neoproterozoic(?)-Palaeozoic terranes, that occur in the basement of the Palaeozoic platform of SW Poland (Fig. 1). TESZ consists of a number of minor crustal basement blocks, whose origin and timing of consolidation is still a matter of debate. The evolution of TESZ comprises late Proterozoic-Early Palaeozoic rifting of Pangea, leading to the opening of the Tornquist Ocean and formation of passive continental margin at the SW of newly formed Baltica paleocontinent. The Tornquist Ocean was finally closed in Silurian times. Equivocal geological evidence suggests that the Avalonian terrane was accreted to Baltica in the Polish part of TESZ (Mazur and Puziewicz 2003 and references therein). Trans European Suture Zone is overlain by a sedimentary platform cover, accumulated since Late Carboniferous/Permian. The thickness of the sedimentary cover reaches 10 000 m in the central part of the Mid-Polish Through, being the center of Permian-Mesosoic subsidence along the margin of the East European Craton. For this reason, the middle and lower crustal structure of Polish part of the TESZ can be recognized only by geophysical methods.

Huge amount of seismic refraction data regarding TESZ were accumulated during the POLONAISE 97 experiment as well as during earlier seismic experiments (Grad et al. 2002 and references therein). They are recently interpreted and summarized in the series of P-wave velocity model profiles. Most of them are oriented both NE-SW (i.e. perpendicular to the SW margin of the East European Craton) and some parallel the axis of the Mid-Polish Through. The interpretation of geophysical data in terms of mineral composition of middle and lower crust yields no unique results. Typical problem of this kind of modeling is that various mineral assemblages exhibit similar geophysical properties, especially in terms of seismic wave velocities. Volcanic extrusives, which are the potential source of lower crust/upper mantle derived xenoliths, if present, are hidden under the thick Permo-Mesosoic and Cenozoic sedimentary cover. Thus, the interpretation must be based solely on geophysical data (the seismic profiles and the heat flow, magnetic and gravimetric data compared with laboratory measurements of geophysical parameters of various rocks under appropriate pressures and temperatures). The most probable rock types can be ascribed to the domains with

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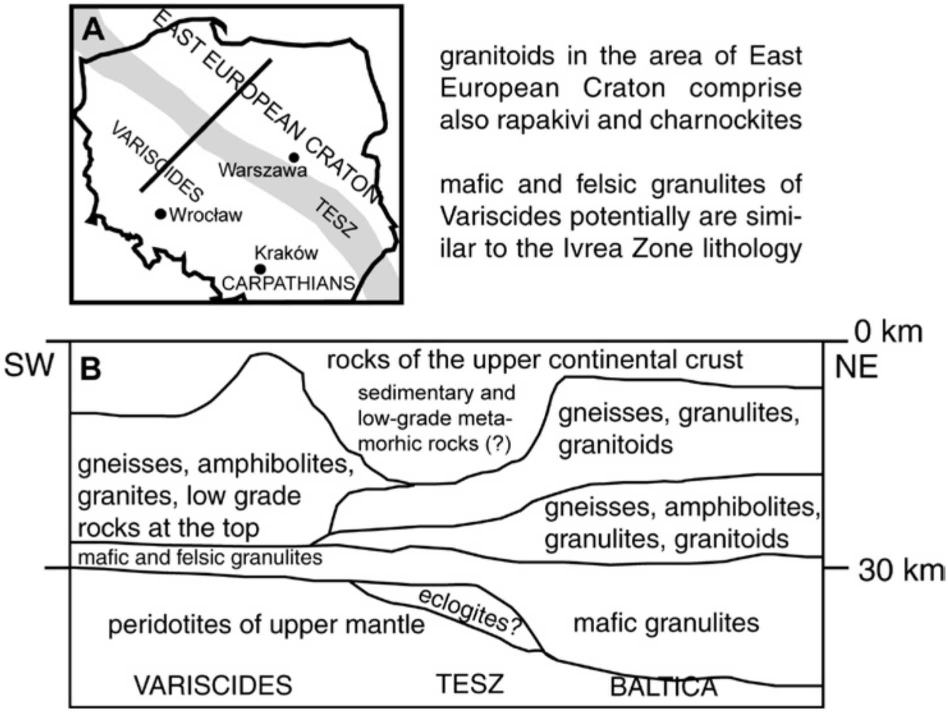

Fig. 1. (A). Location of the Trans European Suture Zone in Poland (after Grad et al. 2002). The line marks the location of the cross-section. (B) Idealized hypothetical lithological cross-section through the TESZ and neighbouring areas in Poland. based on unpublished data of Mazur and Puziewicz (2003).

particular P-wave velocities based on the assumed geological and petrological evolution of the area, enhanced by comparison with the middle- and lower-crust sections exposed at the surface elsewhere in the world. In the following, petrological model of the Polish part of the TESZ, based on the interpretation of seismic data is shown.

The prominent feature of part of the East European Craton located close to the TESZ is south-eastwards increase of P-wave velocities in the lower crust and their decreasein the middle crust. Assuming essentially granulitic composition of the lower crust, this suggests increase of pyroxene contents and/or increase of the Mg/(Mg+Fe) ratio of pyroxene, and/or appearance of another "high-velocity" component in the lower crustal granulite. All those features are indicative of post-melting restite component in the lower crust. The intrusive rocks produced by that melting are probably emplaced in the overlying middle crust. This enriches that part of the crust in "low velocity" components, such as low- to medium anorthitic plagioclase and K-feldspar, and leads to the observed south-westward decrease of P-wave velocities.

The thickness of the crust decreases by ca. 10 km in the TESZ relative to that of the East European Craton. The P-wave velocities in the middle- and lower crust are similar to those of the East European Craton middle- and lower crust, but the layers defined by them are much thinner (Fig. 1). The middle-to lower crust of the TESZ is interpreted as a continuation of crust of the East European Craton (Grad et al. 2002). The thinned crust of TESZ must have originated during extension that preceded the opening of the Tornquist Ocean. Therefore, the mineral assemblages forming the middle- to lower crust in the TESZ are similar to those forming the neighbouring parts of the East European Craton, although the rock fabric might have been strongly reworked during successive extensional and strike-slip events.

The crystalline rocks of the middle- and lower crust of the TESZ are overlain by 6 – 10 km thick assemblage of rocks of P-wave velocities ranging from ca. 5.70 km/s at the bottom to ca. 5.20 km/s at the top. This is interpreted to be an Avalonian accretionary prism, consisting of low grade metasedimentary and metavolcanic rocks (Grad et al. 2002). Mazur and Puziewicz (2003) proposed that the rocks forming the prism are of greenschist to subgreenschist facies in its lower and middle parts, and possibly unmetamorphosed in the upper parts. An Alternative interpretation of Jarosiński et al. (2002) suggests that the upper crust (similarly as the middle and lower ones) is of the Baltica origin. If this is the case, the relatively low P-waves velocities result from anisotropic fabric of the medium- and high grade metamorphic rocks and granitoids. This possibility is supported by gravimetric and tectonic data suggesting that the TESZ is a mega-shear zone with steeply dipping faults in the upper crust.

The SW border of TESZ is marked by a thin, seismically well-layered lower crust typical of Variscan areas, overlain by thick middle crust consisting of various metamorphic and igneous rocks.

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