

**CELEBRATION 2000: CONTRASTS AT LITHOSPHERIC STRUCTURE IN THE
TESZ (FROM NE TO SE POLAND)
ALONG TTZ & C03 SEISMIC PROFILES**

CELEBRATION 2000 Working Group (*Reporter T. Janik*)

Institute of Geophysics, Pol. Acad. Sc., st. Ks. Janusza 64, 01-452 Warsaw, Poland; janik@igf.edu.pl

Introduction

New deep seismic sounding experiment (DSS), called Central European Lithospheric Experiment Based on Refraction, or CELEBRATION 2000, was made in June 2000 as an international cooperation of 28 European and North American institutions. It targeted the structure and evolution of the complex collage of major tectonic features in the Trans-European Suture zone (TESZ), as well as the southwestern portion of the East European craton (southern Baltica), the Carpathian Mountains, the Pannonian basin, and the Bohemian massif. The TESZ region (Caledonides – Teisseyre-Tornquist zone area) can be thought of as a broad zone of deformation that extends across Europe from British Isles to the Black Sea region. In 1960s and 1970s the Teisseyre-Tornquist zone (TTZ), the NE-most part of TESZ, was crossed by a net of DSS profiles, modelled using 1-D technique (Guterch et al., 1986). Next investigations of NW part of Polish TESZ were made in the framework of the following projects: LT-7 (Guterch et al., 1994), TTZ (Grad et al., 1999), and POLONAISE (Guterch et al., 1998, 1999; Janik et al., 2002; Grad et al., in preparation) using 2-D and 3-D technique of modelling. One of the profiles of CELEBRATION 2000 experiment, profile C03, about 300 km long, was located in the Teisseyre-Tornquist zone in central and SE Poland. Twelve shot points, with charge from 200 kg to 1000 kg of TNT, were detonated at intervals of about 30 km along the profile. Location of the NW-most shot was in coincidence with the position of shot point 05 from TTZ profile on which measurements were carried out in TTZ (NW and central Poland) in 1993 (Grad et al., 1999). NW part of the TTZ profile, up to SP05 (with 13 shot points, 90–1000 kg of TNT), 294 km long, and profile C03 with a total length of 720 km, were interpreted together. Also, record sections from six southern shots of TTZ profile (up to 450 km) were additionally used for modelling. This line runs along TTZ/TESZ parallel to the edge of the East European craton (EEC) through the whole territory of

Poland. Acquisition was undertaken using about 130 mobile geophones deployed at a station spacing of 3–3.5 km on C03 profile, and 135 equipments were used at two deployments (spacing of ca 1.7 km) on TTZ profile. Clear reflected and refracted P-waves and phases were recorded from the crust and upper mantle. Raytrace modelling for P-waves was then undertaken using SEIS83 (Červený, Pšenčík, 1983) and ZPLOT (Zelt, 1992) seismic program packages. This modelling established a 2-D (quasi 3-D) P-wave velocity lithospheric model. The thickness of the crust varies from 35 to 50 km. We discussed the results together with other seismic results of this region.

P- wave field and 2-D modelling

A total of 31 seismic record sections form the basis for interpretation of the crustal structure beneath the TTZ&C03 profiles. The data are of good quality, with generally clear first arrivals of P waves up to 150-400 km.

Profiles TTZ&C03 are the spine of the net of profiles which cross TTZ from NW to SE: LT-7, P2, P4, C04, C10, C01, C02, and C05. Realisation of so huge experiment gives opportunity to make a common interactive 2-D modelling along the profiles crossing each other. If the crossing profiles have same quality of data, model solutions could be verified at crossing places. If the crossing profiles have different quality of data, information and details well documented on one profile could be implemented to solution of the model on other profile in which details are not so well expressed. Since the net of crossing profiles used for verification is very dense, the modelling is quasi 3-D. It displayed much more details than the ordinary 2-D modelling. Model of C03 profile was calculated jointly with profiles C04, C01, C02, C05, but the TTZ part was remodelled using the results of modelling along profiles P2 (Janik et al., 2002) and P4 (Grad et al., in preparation). What worsen the quality of comparison of the information at crossing places is the fact that shot points are located not exactly at the same places, being sometimes up to 12 km far from lines of the profiles.

Lithospheric model

The TTZ&C03 profiles run along the axis of TTZ. Densely spaced shots and receivers along this 720-km long profile produced data of high quality which together with a large number of crossing profiles enabled quasi 3-D modelling, yielding a seismic model of the crust in the contact zone between the Precambrian Platform and the

EEC. In this area, the depth of the consolidated basement, with a P-wave velocity of about 5.8 km/s, is from 8 to 10 km. However, down to a depth of 15-20 km, the P-wave velocity is very low, not greater than about 6.0 km/s. The middle crust is divided along the profile, at distances of 210 km and 600 km, into three parts, approximately 10 km thick each, with velocities of 6.5-6.6 km/s, 6.2-6.3 km/s and 6.4-6.5 km/s, going from NW to SE. Two high velocity bodies (HVB) were detected: the one with velocity ~6.35 km/s at 11-13 km depth in the distance range of 130-170 km, and the other, with velocity ~6.9 km/s at 12-18 km depth in the distance of 480-600 km. In the lower crust, the velocities of 7.0 km/s and 7.2-7.3 km/s were found in two layers, with thickness of about 4-7 km each, up to a distance of 600 km. In the SE part of the profile, the lower crust with a velocity of 6.8-6.9 km/s is 15 km thick and is thinning toward the central part of the profile, going over the layers with velocities 7.0 km/s and 7.2 km/s and a "body with velocity of 7.8-7.9 km/s at a depth ca 45 km at distances 410-520 km. The depth of Moho boundary strongly changes along the profile: from 37 km at NW side, through ~50 km at distances of 400 km and 550 km, and jumps to 43 km in the SW part. Sub-Moho velocities vary from ~8.2 km/s in NW part (0-150 km), through 8.35-8.45 km/s in the central part (150-400 km), to ~8.15 km/s in the SE part (400-720 km). Ca. 15 km thick lower lithosphere layer with velocity ~8.2 km/s was detected below the mantle intrusion with a velocity of 8.4 km/s, at distances of 350-450 km up to 720 km. At distance of 600 km, the shape of the layer has the same jump as the Moho boundary.

Model of TTZ&C03 profiles can be divided by two sloped lines (faults?) into three parts. The first line runs from distance ~200 km of the profile, on the surface, to ~160 km at 40 km depth, and the second line runs from distance ~600 km to ~380 km, respectively. Distribution of velocities in these parts has been described earlier in the text. Strong differentiation of all parts suggests difference in origin and complex processes which had an influence on tectonic history of the area. The previously calculated crossing profiles: LT-7 (Guterch et al., 1994), P2 (Janik et al., 2002) and P4 (Grad et al., in preparation). The interactive modelling of profile TTZ&C03 with other, crossing profiles is still under way and we expect to established final models in greater detail.

References

- Červený P., Pšenčík I., 1983. SEIS83 - seismic program package
- Guterch, A., Grad, M., Keller, R.G., 2001. Seismologists celebrate the new millennium with an experiment in Central Europe. *EOS*, 82 (45), 529, 534-535.
- Guterch, A., Grad, M., Thybo, H., Keller, R.G., POLONAISE Working Group 1999. POLONAISE'97 – International Seismic Experiment between Precambrian and Variscan Europe in Poland. *Tectonophysics*, 314, 1-3, 101-122.
- Guterch A., Grad M., Janik T., Materzok R., Luosto U., Yliniemi J., Lück E., Schulze A., Förste K., 1994. Crustal structure of the transition zone between Precambrian and Variscan Europe from new seismic data along LT-7 profile (NW Poland and eastern Germany). *C.R. Acad Sci. Paris*, 319, serie II: 1489-1496.
- Guterch, A., Grad, M., Materzok, R., Perchuc, E., 1986. Deep structure of the earth's crust in the contact zone of the Palaeozoic and Precambrian Platforms in Poland (Teisseyre-Tornquist Zone). *Tectonophysics*, 128, 251-279.
- Guterch, A., Grad, M., Thybo, H., Keller, G.R., Miller, K., 1998a. Seismic experiment spread across Poland. *EOS*, 79 (26), 302, 305.
- Grad M., Janik T., Yliniemi J., Guterch A., Luosto U., Komminaho K., Środa P., Höing K., Makris J., and Lund C-E. 1999. Crustal structure of the Mid Polish Trough beneath TTZ seismic profile. *Tectonophysics*, 314, 1-3: 145-160.
- Janik, T., J. Yliniemi, M. Grad, H. Thybo, T. Tiira, and POLONAISE P2 Working Group, Crustal differentiation across TESZ along POLONAISE'97 seismic profile P2 in NW Poland, *Tectonophysics*, 2002 (*in press*).
- Jensen S. L., Janik T., Thybo H. and POLONAISE Working Group, 1999. Seismic structure of the Palaeozoic Platform along POLONAISE'97 profile P1 in NW Poland. *Tectonophysics*, 314, 1-3: 123-144.
- POLONAISE Workin Group, (at preparation) Crustal Structure and Tectonic Interpretations of the Trans-European Suture Zone Region Beneath the POLONAISE'97 Seismic Profile P4
- Zelt, C.A., 1992. Seismic program package ZPLOT