

Professor Aleksander Guterch's Cooperation with the Faculty of Geology, Geophysics and Environmental Protection at the AGH University of Krakow¹

Jadwiga JARZYNA and Teresa GRABOWSKA

Department of Geophysics, Faculty of Geology, Geophysics and Environmental Protection,
AGH University of Krakow, Poland

✉ jarzyna@agh.edu.pl; tgrabow@agh.edu.pl

Professor Aleksander Guterch was habilitated in 1978 at the Faculty of Geological Prospection of the Stanisław Staszic Academy of Mining and Metallurgy in Krakow, Poland. The title of his habilitation thesis was: “Structure and physical properties of the crust and upper mantle of the Earth of the Polish area in the light of the results of deep seismic soundings”. The reviewers in the habilitation proceeding were Prof. Jerzy Kowalczyk (AGH, Krakow, Poland), Prof. Roman Teisseyre (Institute of Geophysics, Polish Academy of Sciences, Warsaw, Poland), and Prof. Władysław Pożaryski (Polish Geological Institute – National Research Institute, Warsaw, Poland). The resolution of the Council of the Faculty of Geological Prospection at the AGH was passed on 9 June 1978, and the approval by the Central Qualification Commission was on 30 October 1978. Aleksander Guterch received the Habilitation degree of Geological Sciences in the discipline of seismology.

Two aspects of Prof. Aleksander Guterch's cooperation with the Faculty of Geological Prospection at the Stanisław Staszic Academy of Mining and Metallurgy in Krakow are presented:

1. Comprehensive geophysical research – magnetic and gravimetric, which used the results of seismic studies of teams led by Prof. Aleksander Guterch,
2. Professor's participation in the training of scientific and research staff of geophysicists, as well as the development and acquisition of scientific degrees by faculty members.

Re. 1. The results of seismic surveys performed under the direction of Prof. Aleksander Guterch by teams of employees of the Institute of Geophysics of the Polish Academy of Sciences inspired and were extensively used by potential field specialists to obtain the possibly most accurate structural models of the Earth's crust and upper mantle in the zones covered by

¹previously the Faculty of Geological Prospection of the Stanisław Staszic Academy of Mining and Metallurgy in Krakow, Poland

international seismic surveys. The results of seismic studies of deep lithospheric structures were implemented in the comprehensive geophysical research – gravimetric and magnetic realized by teams headed by Prof. Teresa Grabowska.

The deep structures of the lithosphere recognition, carried out under the international research projects in the 1980s and 1990s, EUROPROBE, POLONAISE'97, and CELEBRATION 2000 by Professor A. Guterch and a team of employees of the Institute of Geophysics of the Polish Academy of Sciences in Warsaw, became the basis for work on the construction of two-dimensional density and magnetic models of the Earth's crust and upper mantle in the area of Poland. This work was carried out at the Interdepartmental Institute of Applied Geophysics and Petroleum Geology, Faculty of Geological Prospection, AGH, later named the Department of Geophysics and now the Chair of Geophysics at the Faculty of Geology Geophysics and Environmental Protection at AGH University of Krakow. The work was carried out within the framework of statutory activities, and in later years as projects financed by the Committee for Scientific Research. Gravimetric and magnetic modeling was carried out by a team of employees of the Department of Geophysics under the direction of Prof. Teresa Grabowska, with the creative participation (development of original software for 2D gravimetric and magnetic modeling) of Dr. hab. Grzegorz Bojdys. Specialists from the Polish Geological Institute in Warsaw, as well as specialists from the Slovak Academy of Sciences and the Slovak University in Bratislava as well as the Ukrainian Academy of Sciences in Kiev and the Belarusian Academy of Sciences in Minsk were also invited to cooperate.

The results of intensive work on density models of the Earth's crust and upper mantle and magnetic models of the Earth's crust were presented at numerous national and international scientific conferences and symposia, as well as published in specialized national and international scientific journals (a list of conference presentations and published articles is attached as References).

The ongoing dissemination of the results of research and modeling work has been served by their presentations at numerous scientific conferences and symposia at home and abroad.

Noteworthy are the conferences jointly organized by the Polish Academy of Sciences, the National Committee of Geophysics and Geodesy, the Commission of Geodynamics, the Committee of Geophysics and the Commission of the Earth's Interior, entitled "Geodynamic Research in the Earth's Interior". "Geodynamic Research in Poland", held periodically in Jabłonna in 1977, 1981, 1983, and 1989, as well as the EUROPROBE International Scientific Symposium entitled "Tectonic evolution of the Tornquist–Teisseyre Zone and adjacent terranes", organized by the Institute of Geophysics of the Polish Academy of Sciences and the European Science Foundation (Jabłonna, 28 September – 4 October 1991).

In the 1980s, important from the point of view of the exchange of research results on deep geological structures of Central Europe was the participation of the Polish team in international scientific symposia entitled "Problémy Současné Gravimetrie" [Problems of Contemporary Gravimetry], organized by the Institute of Geophysics of the Czechoslovak Academy of Sciences in Prague and Brno Geophysics in Liblice in 1982, 1984, 1986.

Over the years 1970–1980, equally important for the exchange of research results on deep geological structures of Central and Eastern Europe was the participation in the meetings of the Commission of the Academy of Sciences on Planetary Geophysics in Eastern Europe (KAPG), organized by the Interdepartmental Geophysical Committee under the Presidium of the Academy of Sciences of the USSR, and the opportunity to present the results of the Polish team's research at international geophysical conferences and symposia, such as:

- a. International Geophysical Conference entitled "Geophysical and Geodynamic Model of the Central and Eastern European lithosphere" organized by the USSR Institute of Geophysics, Yalta, 15–25 December 1983, paper: "Predvaritel'ni rezul'tati issliedovaniia

- gravimetricheskoi i magnitnoi modeli zemnoi kori vdol VI Geotraversa na territorii Pol'shi" (not published),
- b. International Symposium entitled "Comprehensive Geophysical Research of the Lithosphere of Central and Eastern Europe" organized by the Commission for Multilateral Scientific Cooperation of the Academy of Sciences of the Socialist Countries, KAPG, S.I. Subbotin Institute of Geophysics AN USSR, Yalta, 21–28 December 1987, paper: "Comprehensive model of the crust and upper mantle in the area of the Polish Lowlands" (not published),
 - c. XVIII Meeting of the Academy of Sciences Commission on Planetary Geophysics in Eastern Europe (KAPG), organized by the Interdepartmental Geophysical Committee under the Presidium of the Academy of Sciences of the USSR, Sochi, 18–24 April 1985, Communiqué: "Rezultati issledovaniia glubokoi strukturi ziemnoi kory na territorii Pol'shi" (not published).

In the 1990s, the results of research in potential fields were presented at conferences and workshops organized within the framework of the EUROPROBE project by the Chief National Geologist of Poland, the Institute of Geophysics of the Polish Academy of Sciences in Warsaw, the National Geological Institute, also the Association for Deep Geological Research.

Noteworthy is the participation and presentations in the form of posters of the work of the AGH team at conferences organized by the European Geophysical Society (EGS) in Wiesbaden (1993), Grenoble (1994), Hague (1999), Nice (2000), and also participation in conferences organized by the European Union of Geosciences EUG 7, EUG 8 in 1993 and 1997 in Strasbourg, and later by the European Geosciences Union (EGU) in Nice (2004, 2005).

We should also mention the establishment of cooperation with Slovak geophysicists (Bielik et al. 2006) and participation in Conference and 2nd Workshop on International Gravity Field Research, 2006 (WIGRFR 2006), Smolenice, Slovak Republic.

As an example of international cooperation in the field of comprehensive geophysical research of deep lithospheric structures, selected excerpts from the article entitled "Density and magnetic models of the lithosphere along CELEBRATION 2000 Profile CEL01" by T. Grabowska, G. Bojdys, and geophysicists from Comenius University in Bratislava – M. Bielik and K. Csicsay – can be presented. This article, published in *Acta Geophysica* (Grabowska et al. 2011), presents the results of the application of potential field methods in deep crustal and upper mantle studies, taking into account broadly the information from deep seismic and geological surveys carried out under the direction of Prof. Aleksander Guterch. This paper shows two-dimensional (2D) density and magnetic models of the crust and upper mantle along the CEL01 deep seismic sounding profile, carried out as part of the CELEBRATION 2000 international project. This profile crosses the most important geological units of Central Europe. These are the Alps-Carpathian-Pannonian region (ALCAPA), the southeastern part of the Paleozoic Plateau (PLZ), the Trans-European Suture Zone (TESZ), and a section of the southwestern part of the East European Craton (EEC).

Density and magnetic models were constructed based on a 2D velocity model transformed into a density model, while taking into account geological as well as geothermal data and geophysical modeling results for the lithosphere-asthenosphere boundary (LAB). This allowed the construction of a consistent 2D geophysical model of the crust and the extension of the geophysical-geological characterization of the lithosphere in the Pannonian basin, the Carpathian orogen, and the transition zone (a fragment of the Paleozoic PLZ platform) between the ALCAPA region and the East European Craton (EEC).

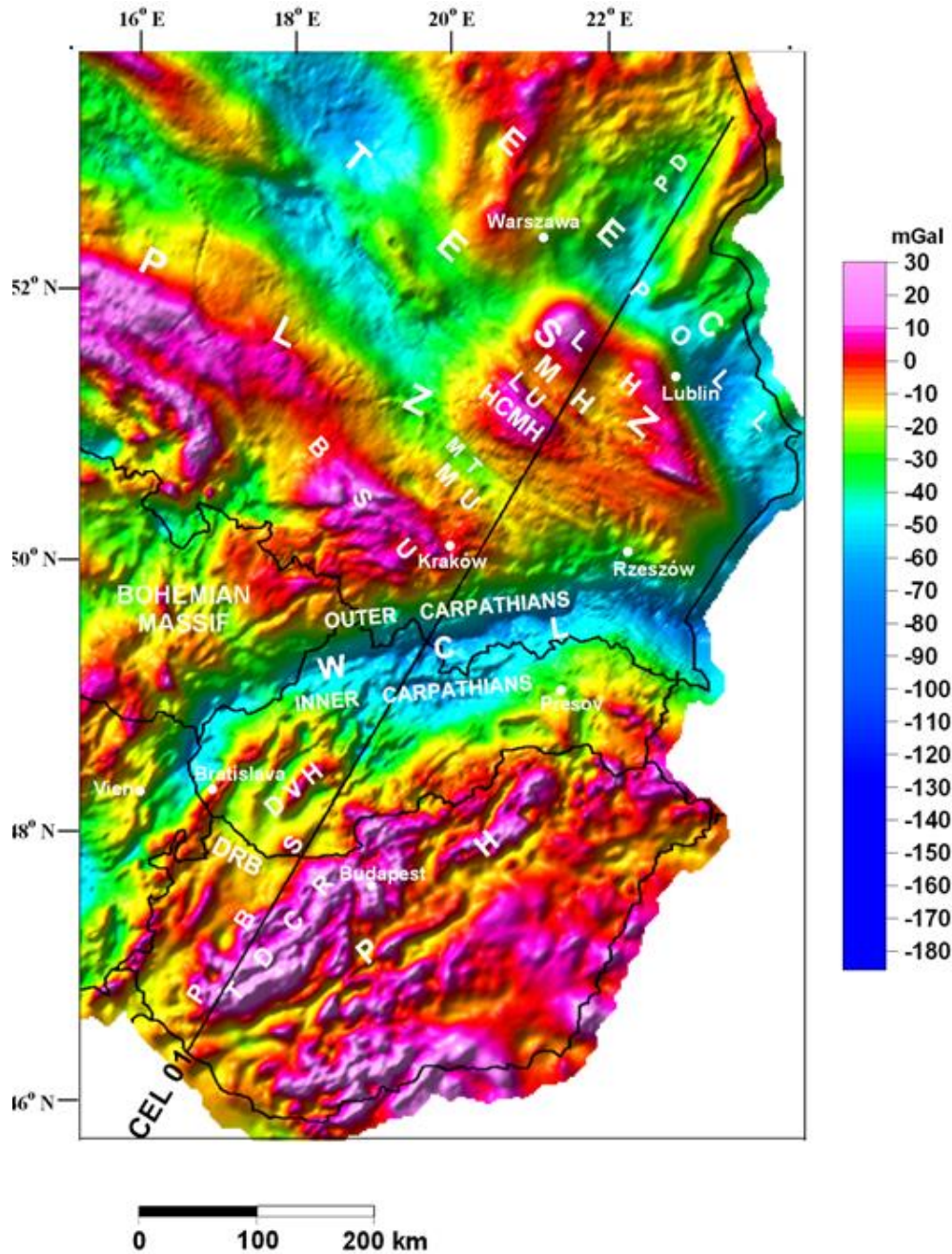


Fig. 1. The Bouguer gravity anomaly map of the CELEBRATION 2000 region (Bielik et al. 2006). The Bouguer gravity anomaly and terrain corrections were calculated for the reduction density of 2.67 Mg/m^3 . Constructed on regularly distributed data (grids): Austria – $1 \times 1 \text{ km}$, Czech Republic – $2.5 \times 2.5 \text{ km}$, Hungary – $2 \times 2 \text{ km}$, Poland – $1 \times 1 \text{ km}$, and Slovakia – $1 \times 1 \text{ km}$. Abbreviations: ALCAPA – Alpine–Carpathian–Pannonian microplate, BSU – Bruno Silesian Unit, CF – Carpathian Foredeep, DB – Danube Basin, DRB – Danube–Raba Basin, DVH – Danube Vah High, EEC – East European Craton, HCF – Holy Cross Fault, HCM/HCMH – Holy Cross Mts. / Holy Cross Mts. High, IGRF – International Geomagnetic Reference Field, JA – Jordanów anomaly, KF – Kock Fault, KLZ – Krakow–Lubliniec Zone, LAB – Lithosphere/Asthenosphere hypothetical boundary, LH – Lublin High, ŁU – Łysogóry Unit, MH – Małopolska High, MT – Miechów Trough, MU – Małopolska Unit, PBS – Pannonian Basin System, PD – Podlasie Depression, PH – Pannonian High, PKB – Pieniny Klippen Belt, PLZ – Paleozoic Platform of Central and Western Europe, POLL – Podlasie–Lublin Low, TDCR – Transdanubian Central Range, TESZ – Trans-European Suture Zone, TTZ – Teisseyre–Tornquist Zone, WCL – Western Carpathians Low, ZB – Zala Basin.

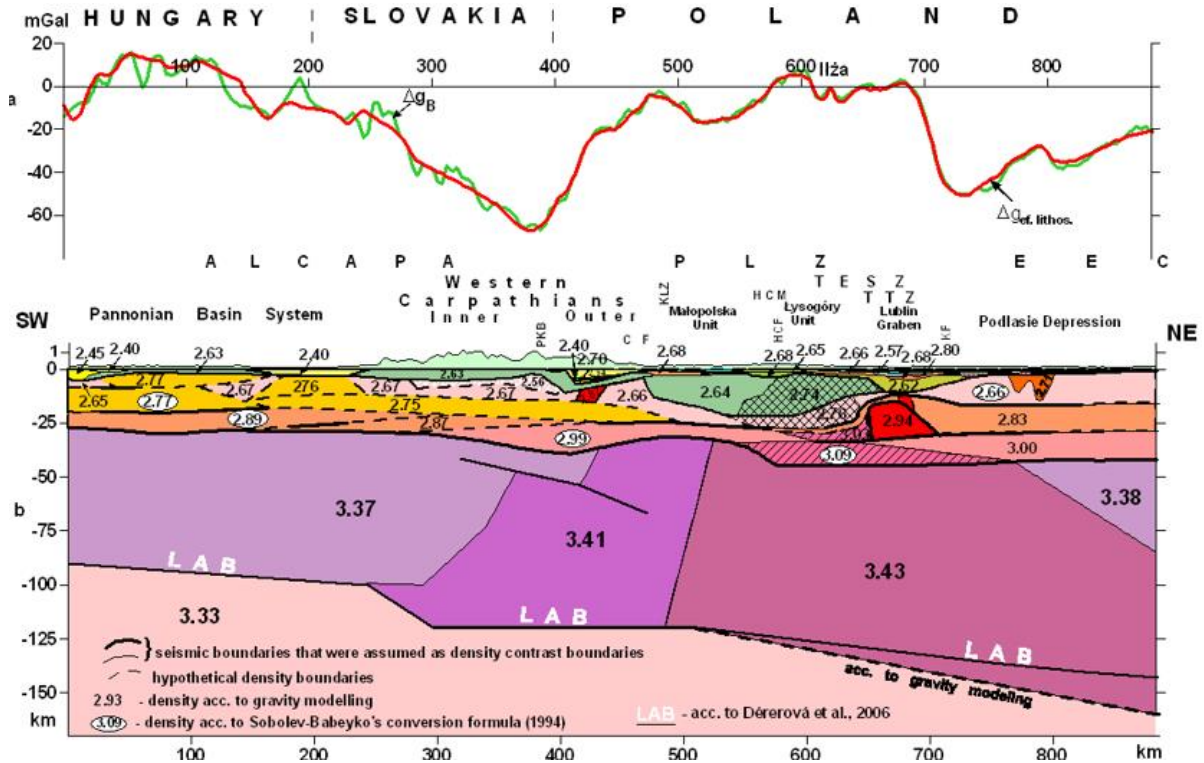


Fig. 2. A 2D density model of the crust and the upper mantle along profile CEL01 constructed on the basis of geological data (sedimentary cover), seismic and geothermal data (crystalline crust and upper mantle), and gravity modeling. Panel a) Δg_B – Bouguer gravity anomaly, $\Delta g_{ef.lithos.}$ – 2D total gravity effect calculated for the density model of the lithosphere which comprises the sedimentary cover, crystalline crust, and upper mantle; Panel b) Density model of the lithosphere. For abbreviations see Fig. 1.

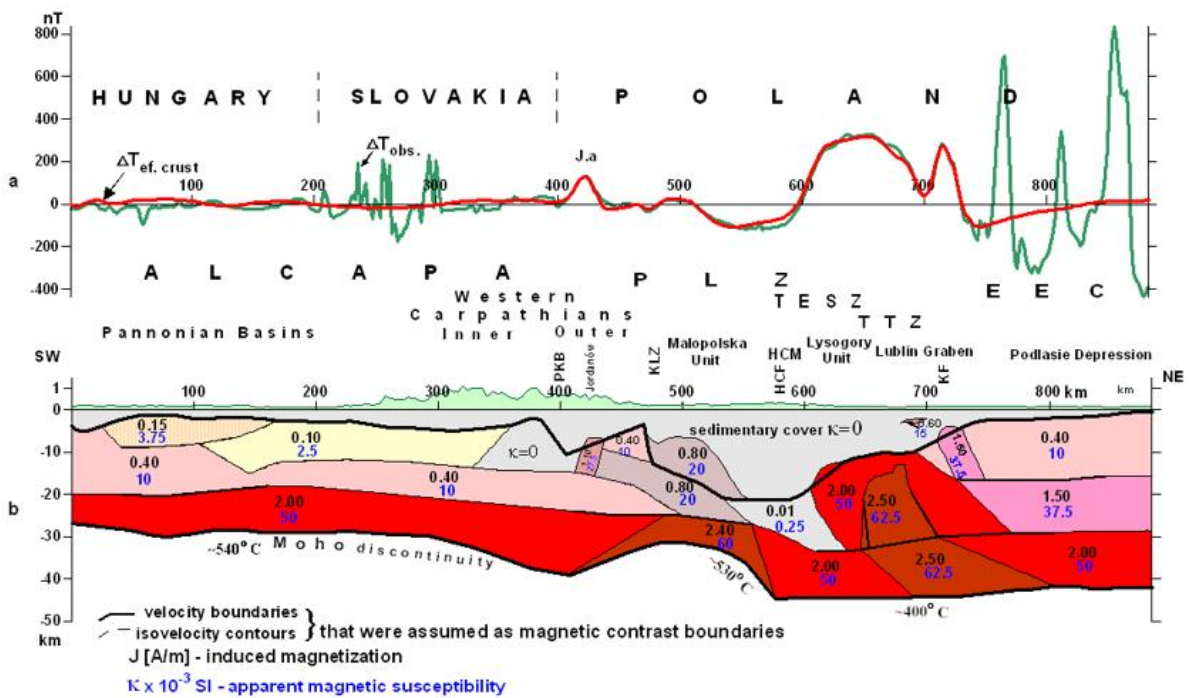


Fig. 3. A 2D magnetic model of the crystalline crust along profile CEL01. Panel a) ΔT_{obs} – a magnetic anomaly of the total intensity of the geomagnetic field, $\Delta T_{ef.crust}$ – 2D magnetic effect calculated for the model. Panel b) Magnetic model constructed on the basis of seismic data, gravity data, and 2D magnetic modeling. The top and the bottom of the layer with the magnetic susceptibility correspond to crystalline basement and Moho discontinuity. Other abbreviations and explanations as in Fig. 1.

In Fig. 1, the Bouguer gravity anomaly map of the CELEBRATION 2000 region is presented. In Fig. 2, a 2D density model of the crust and the upper mantle along profile CEL01 constructed on the basis of geological data (sedimentary cover), seismic and geothermal data (crystalline crust and upper mantle), and gravity modeling is shown. The modeling performed provided evidence for density differentiation in the lithospheric mantle, the terrane concept of the EEC foreland, and confirmed the possibility of rift phenomena along the SW boundary of the Precambrian craton in SE Poland.

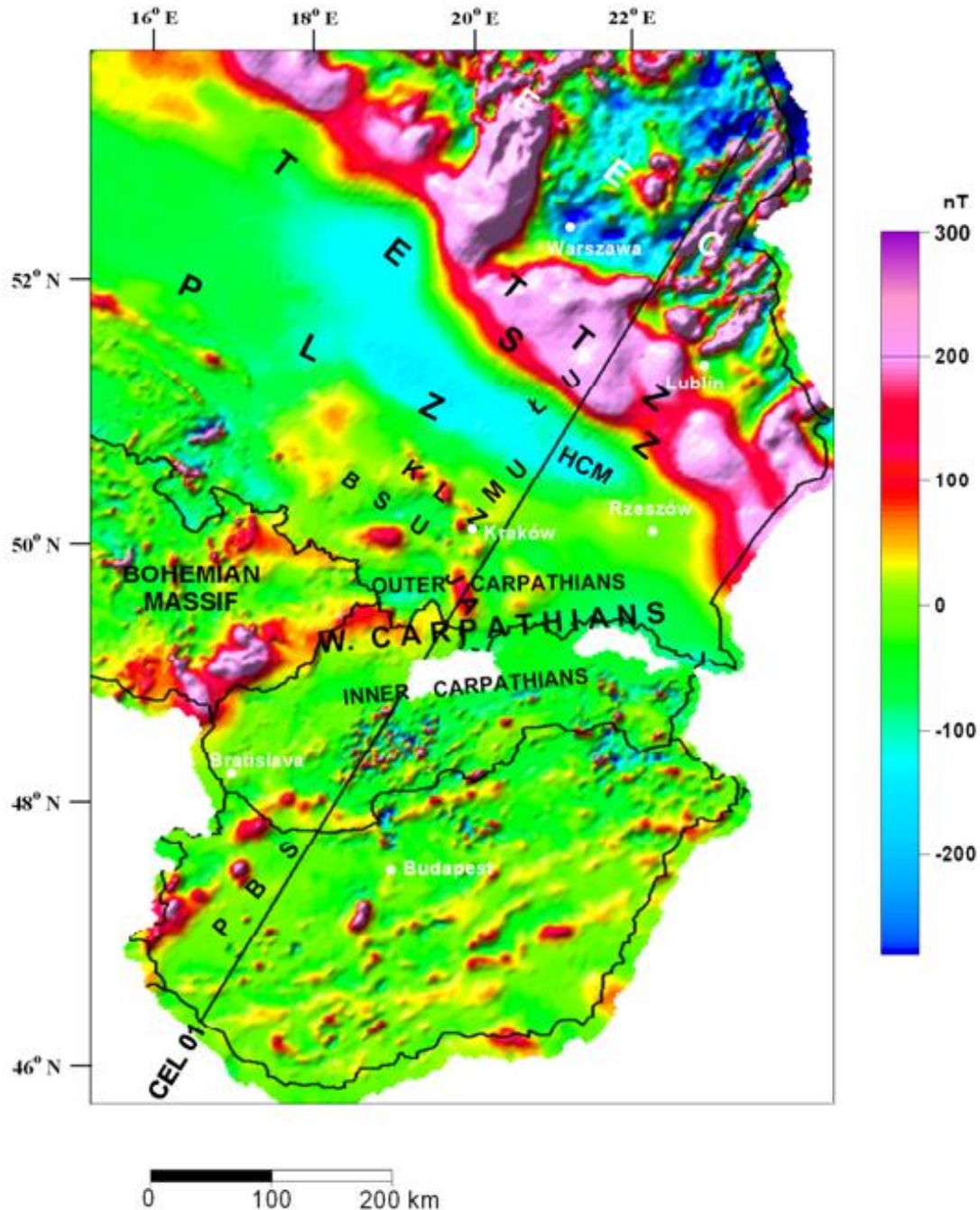


Fig. 4. A magnetic anomaly map of the total intensity of the geomagnetic field of the CELEBRATION 2000 region (reproduced from the unpublished map by Wybraniec and Bielik from 2006, courtesy of authors), constructed on a regularly distributed data with 1×1 km grid. IGRF – 1982,5. For abbreviations see Fig. 1.

In Fig. 3, a 2D magnetic model of the crystalline crust along profile CEL01 is presented and in Fig. 4 a magnetic anomaly map of total intensity of the geomagnetic field of the CELEBRATION 2000 region (reproduced from the unpublished map by Wybraniec and Bielik from 2006, courtesy of authors) is included.

Some selected publications illustrating the work of Prof. Teresa Grabowska and colleagues from the Chair of Geophysics at the Faculty of Geology, Geophysics and Environmental Protection, AGH University of Krakow, through the years 1985–2011 are attached in References (Grabowska and Perchuć 1985; Guterch et al. 1988; Grabowska et al. 1992, 1993, 1998, 2011; Grabowska and Koblański 1992; Chekunov et al. 1993; Grabowska and Dolnicki 1994; Grabowska and Bojdys 2001, 2004). **Their purpose was to show that the results of seismic surveys conducted by Prof. Aleksander Guterch inspired and were used by specialists in potential fields to obtain the most accurate structural models of the Earth's crust and upper mantle in the zones covered by international seismic surveys.** Similarly, selected conference abstracts are also presented in References (Grabowska and Dolnicki 1993; Thybo et al. 1993, Grabowska et al. 1994; Grabowska and Bojdys 1997, 2004; Bojdys and Grabowska 1999, 2000; Bielik et al. 2006).

Re. 2. Professor Aleksander Guterch actively participated in the development and qualification of the scientific and research staff of applied geophysics at the Faculty of Geological Prospection at the AGH. Table 1 includes lists of reviews performed by the Professor in doctoral and postdoctoral dissertations conducted at AGH in 1975–1991. Professor contributed to the doctoral degrees of seven seismic scientists who have joined research teams at the AGH Faculty of Geological Prospection (pos. 3, 4, and 6), at the Oil and Gas Institute – National Research Institute (pos. 2 and 7), as well as at the enterprise Geofizyka Krakow, where Andrzej Marian Ptak, Ph.D., was the long-time head of the seismic group, then head of the Exploration Geophysics Department. One review concerned the doctoral thesis of the employee of the Geophysical Research Company in Warsaw – Adolf Mikołajczak, Ph.D., who worked at the institution for many years. A doctoral student from Mongolia (pos. 8) completed his doctoral internship at the AGH and prepared his dissertation under the supervision of Prof. Teresa Grabowska.

The teams of geophysicists and geologists from the Faculty of Geological Prospection/ Geology Geophysics and Environmental Protection at the AGH who had the chance to listen to Prof. Aleksander Guterch's lectures, participate in discussions of the results of seismic, gravimetric, and magnetic work, and prepare papers based on his concepts are grateful to fate for this opportunity.

Acknowledgments. Prof. Dr. hab. Teresa Grabowska (Department of Geophysics, Faculty of Geology Geophysics and Environmental Protection, AGH University of Krakow) has reviewed Prof Guterch's extensive publication record and selected representative articles and conference papers on the use of seismic, gravimetric, and magnetic methods, illustrating the cooperation between geophysical teams from the Institute of Geophysics, PAS, and the AGH University of Krakow. Ms. Urszula Godyń of the Dean's Office of the AGH University of Krakow has compiled data on reviews prepared by Prof. Aleksander Guterch in habilitation proceedings. Information about the doctoral dissertations in which Professor A. Guterch prepared reviews was obtained from the AGH Main Library Catalog.

Table 1

Reviews of the doctoral theses and reviews in the habilitation proceedings carried out at the Faculty of Geological Prospecting of the Academy of Mining and Metallurgy, Krakow, Poland², prepared by Prof. Aleksander Guterch

Reviews of the doctoral theses			
No.	Forename and name of Ph.D. student	Title of doctoral thesis	Year of degree conferral
1	Adolf Mikołajczak, M.Sc.	Analysis of refraction waves (with Vg 5.7 km/s – Paleozoic formations) in terms of increasing the efficiency of refraction seismic surveys in the area of Western Pomerania	1975
2	Józef Smolik, M.Sc.	Study of reflection seismic wave dynamics for thin – bedded systems	1976
3	Eng. Ryszard Ślusarczyk, M.Sc.	Kinematic modeling of seismic waves undergoing diffraction in a geological medium	1976
4	Eng. Jerzy M. Szwejkowski, M.Sc.	Theoretical approximation of the disturbance of the seismic wave propagation velocity field around selected tectonic structures	1976
5	Eng. Andrzej Marian Ptak, M.Sc.	Seismic reflection methodology – selected issues in seismic signal generation, reception and recording	1981
6	Eng. Ewa Szabelska-Latała, M.Sc.	New method of stacking velocity transformation into other seismic velocities	1981
7	Anna Pólichłopek, M.Sc.	Analysis of seismic migration modes using the wave equation	1987
8	Dawaagijn Lchagwadorż, M.Sc.	Structure of the Earth's crust of the northern part of the Polish Lowlands in the light of gravimetric studies	1991
Reviews in the habilitation proceedings			
9	Dr. Eng. Zbigniew Kasina	The Problem of Elastic Wave Attenuation in Seismic Prospecting Aspect. Dr. Hab. in technical sciences, applied geophysics	1982
10	Dr. Eng. Grzegorz Bojdys and Dr. Eng. Marek Lemberger	Gravimetric Modeling as a Method of Lithosphere Examinations on Example of Carpathians. Dr. hab. in natural sciences, geophysics	1989

²later Geology Geophysics and Environmental Protection of the AGH University of Krakow

References

ARTICLES

- Chekunov, A.V., V.I. Starostenko, S.S. Krasovsky, R.I. Kutas, J.P. Orovetskiy, I.K. Pashkevich, A.A. Tripolskiy, S.V. Eliseeva, P.J. Kuprenko, F.P. Mitrofanov, H.W. Sharov, V.G. Zagorodny, V.N. Glaznev, R.G. Garetsky, A. Karataev, N.W. Aksamentova, A. Guterch, T. Grabowska, A. Koblański, W. Ryka, R. Dadlez, S. Cwojdzinski, X. Korhonen, Y. Luosto, G. Gaal, W.A. Zhuravlev, and A.S. Sadov (1993), Geotransect Euro-3 (EU-3), *Geofiz. Zhu.* **15**, 2, 3–32.
- Grabowska, T., and G. Bojdys (2001), The border of the East-European Craton in south-eastern Poland based on gravity and magnetic data, *Terra Nova* **13**, 2, 92–98, DOI: 10.1046/j.1365-3121.2001.00321.x.
- Grabowska, T., and G. Bojdys (2004), Analysis of geomagnetic field along seismic profile P4 of the International Project POLONAISE'97, *Tectonophysics* **383**, 1–2, 15–28, DOI: 10.1016/j.tecto.2004.02.002.
- Grabowska, T., and J. Dolnicki (1994), Interpretatsiya magnitnykh i gravitacionnykh anomalii Vostochno-Evropeyskoi Platformy. *Geofiz. Zhu.* **16**, 2, 15–26 (in Russian).
- Grabowska, T., and A. Koblański (1992), Interpretation of magnetic anomalies along the Eu-3 Geotransect in Poland, *Acta Geophys. Pol.* **40**, 2, 175–185.
- Grabowska, T., and E. Perchuć (1985), Gravimetric-seismic model of the Earth's crust in the region of southeastern Poland, *Publs. Inst. Geoph. PAS A-16 (175)*, 43–56.
- Grabowska, T., M. Raczyńska, and J. Dolnicki (1992), Interpretation of gravity anomalies along the Eu-3 Geotransect in Poland, *Acta Geophys. Pol.* **40**, 2, 159–173.
- Grabowska, T., A. Koblański, and J. Dolnicki (1993), Deep structure of the Earth's crust in the Teisseyre-Tornquist zone (TTZ) in Poland, based on magnetic and gravity studies, *Publs. Inst. Geoph. PAS A-20 (255)*, 81–85.
- Grabowska, T., G. Bojdys, and J. Dolnicki (1998), Three-dimensional density model of the Earth's crust and the upper mantle for the area of Poland, *J. Geodyn.* **25**, 1–2, 5–34, DOI: 10.1016/S0264-3707(97)00001-X.
- Grabowska, T., G. Bojdys, M. Bielik, and K. Csicsay (2011), Density and magnetic models of the lithosphere along CELEBRATION 2000 profile CEL01, *Acta Geophys.* **59**, 3, 526–560, DOI: 10.2478/s11600-011-0007-3.
- Guterch, A., M. Grad, R. Materzok, E. Perchuć, and T. Grabowska (1988), Glubinnoje strojenije zemnoj kory po geotraversu IV na territorii PNR. **In:** A.V. Chekunov (ed.), *Litosfera Centralnoj i Vostochnoj Ewropy. Geotraversy IV, VI, VIII*, Kyiv, 13 (in Russian).

CONFERENCE AND WORKSHOP ABSTRACTS

- Bielik, M., T. Grabowska, G. Bojdys, K. Csicsay, and J. Hladky (2006), Density modeling along Transects CELEBRATION 2000. **In:** *Abstract in the 2nd Workshop on International Gravity Field Research 2006 (WIGFR), 8–9 May 2006, Smolenice, Slovak Republic.*
- Bojdys, G., and T. Grabowska (1999), Geological implications of magnetic and gravity anomalies of the southeastern segment of the Tornquist–Teisseyre zone (TTZ) in the area of Poland. **In:** *Abstract in 24th General Assembly EGS, Society Symposium, Solid Earth Geophysics & Geodesy, 19–23 April 1999, Hague, The Netherlands.*
- Bojdys, G., and T. Grabowska (2000), Interpretation of gravity and magnetic anomalies on the POLONAISE'97 seismic experiment area. **In:** *Abstract in Geophysical Research Abstracts, EGS Solid Earth Geophysics and Geodesy, 24–30 April, 2000, Nice, France.*
- Grabowska, T., and G. Bojdys (1997), Results of gravity and magnetic studies of the Trans-European Suture Zone (TESZ) in the Polish territory. **In:** *Proc. European Union of Geosciences Conference (EUG 9), 23–27 March 1997, Strasbourg, France.*

- Grabowska, T., and G. Bojdys (2004), Preliminary density and magnetic models of the lithosphere along seismic profile P4 of the International Project POLONAISE'97 in Poland. **In:** *Geodynamics of Central Europe Workshop, 15–20 May 2004, Nice, France.*
- Grabowska, T., and J. Dolnicki (1993), Magnetic and gravity models of the crustal structure in the Polish territory. **In:** *Proc. European Union of Geosciences Conference (EGU VII), 4–8 April, 1993, Strasbourg, France.*
- Grabowska, T., G. Bojdys, and J. Dolnicki (1994), Crustal structure of Southern Poland in the light of gravity modelling. **In:** *Proc. International Trans-European Suture Zone Workshop EURO-PROBE, 24 September – 1 October 1994, Kielce, Poland.*
- Thybo, H., E. Perchuc, and T. Grabowska (1993), Interpretation of seismic P- and S-wave velocity and density along Eugeno-S profile 4 in Southern Sweden. **In:** *Proc. European Geophysical Society, XVIII General Assembly, 3–7 May 1993, Wiesbaden, Germany.*

Received 12 June 2024

Received in revised form 1 July 2024

Accepted 2 October 2024