compression), both these explanations do not fit well to the conception of blastesis of the Ca-rich garnets within the investigated gneisses in UHPM conditions.

The ambiguity of the UHPM genesis of Grs-Alm garnets in the orthogneisses is emphasized by different composition of garnets appearing in ultra-high pressure granulites from the ŚMC. The bimodal granulites build here several km long belt called the Stary Gierałtów Granulitic Complex. The garnets in the felsic granulites display significantly higher amount of magnesium, typical for HP metamorphism (*Alm 48–53, Prp 19–23, Grs 25.5–29.5, Sps 0.5–1, And 0–0.5*). On the other hand, the whole rock chemical composition of the orthogneisses and felsic granulites is analogous. Also the garnets from thin intercalations of felsic high-pressure rocks in the ŚMC eclogites contain more Mg than the ones from eclogite-bearing gneisses (*Alm 37–62.5, Prp 8–35, Grs 4.3–37.5, Sps 0.5–13.5, And 0–2*).

In conclusion, the high-Ca composition of garnets occurring in part of the eclogite-bearing gneisses may not be a sufficient evidence for common, in situ (ultra-)high pressure metamorphism of the eclogites and their host orthogneisses in the Śnieżnik Metamorphic Complex. Origin of these Grs-Alm garnets can be connected not with the burial to the mantle depths, but with migmatisation, possibly in the upper amphibolite-facies conditions.

References

BAKUN-CZUBAROW N., 1992. Quartz pseudomorphs after coesite and quartz exsolutions in eclogitic clinopiroxenes of the Złote Mountains in the Sudetes. *Arch. Mineral.*, 48(1-2): 3-26.

BORKOWSKA M., ORŁOWSKI R. and BACHLIŃSKI R., 2003. Próba wykazania zróżnicowania ortognejsów metamorfiku Lądka-Śnieżnika na podstawie badań geochemiczno-izotopowych. Research Report, Polish Acad. Sci., Warsaw, Poland.

BRÖCKER M. and KLEMD R., 1996. Ultrahigh-pressure metamorphism in the Śnieżnik Mountains: P-T constraints and geological implications. *Journ. of Geol.*, 104: 417-433.

CARSWELL D.A., WILSON R.N. and ZHAI M., 2000. Metamorphic evolution, mineral chemistry and thermobarometry of schists and orthogneisses hosting ultra-high pressure eclogites in the Dabieshan of central China. *Lithos*, 52: 121-155.

GORDON S.M., SCHNEIDER D.A., MANECKI M. and HOLM D.K., 2005. Exhumation and metamorphism of an ultrahigh-grade terrane: geochronometric investigations of the Sudete Mountains (Bohemia), Poland and Czech Republic. *Journ. Geol. Soc. Lond.*, 162: 841-855.

STAWIKOWSKI W., 2005. Historia deformacji i metamorfizmu w strefach kontaktów eklogitów z gnejsami w metamorfiku Śnieżnika. Ph.D. Thesis, Adam Mickiewicz Univ. Poznań, Poland.

The Basement of Eastern Part of the Polish Carpathians in the Light of Geophysical Data Interpretation

Michał STEFANIUK

AGH – University of Science and Technology, al. Mickiewicza 30, 30-059 Kraków, Poland

The study area is located in the eastern part of the Polish Carpathians, east of the Wisłoka River valley, and includes a transition zone between the Western and Eastern Carpathians. The structural rebuilding of the Carpathian orogen and its basement characteristic of that zone reflects in changes of geophysical fields, e.g. in the distribution of gravity anomalies (Bojdys and Lemberger 1986). Specific 3-D deformations of the flysch cover observed in the area suggest strike-slip faults in the basement. In the western part of the area, there probably occur a major tectonic zone in the basement that separates zones of different tectonics (Żytko 1997).

The recognition of the basement in that zone is not complete, generally because of the complex structure of the Carpathian overthrust and lack of deep boreholes, making interpretation of geophysical data difficult. As only a few boreholes located in the marginal zone of the overthrust reached the sub-Paleogene basement, its recognition is based on surface geophysical investigations. As a result of the complex structure of the orogen, the efficiency of the reflection seismic method is lesser. Hence, magnetotellurics, gravity method, geomagnetic soundings and refraction seismics are of greatest importance to investigations in that area.

Deep geomagnetic and magnetotelluric suondings have been made in Polish Carpathians since 1960s (Jankowski et al. 1991). Since then, wide regional surveys applying equipment of two different technological generations were made and different geological interpretations were presented (Woźnicki 1985, Ryłko, Tomaś 1995, Żytko 1997, Stefaniuk 2001). During the period of 1997–2002, a regional survey with the use of high-frequency MT system was made in the framework of "The project of magnetotelluric survey in Carpathians" (Stefaniuk 2003). Seven profiles crossing transversally the orogen and two profiles paralell to the general strike of Carpathian outocrops were located in the eastern part of the Polish Carpathians. Results of MT data interpretation enabled the structural map of the top of high-resistivity basement and maps of horizontal resistivity distribution for selected depths to be constructed. Resistivity cross-sections including elements of geological interpretation were made along measurement lines.

The origin of gravity anomalies in zones of folded orogens is connected mainly with thick under-compacted sedimentary series that fill deep basement depressions. The other source of gravity anomalies in the study area is a low-density zone in the upper mantle (Bojdys and Lemberger 1986). The qualitative analysis of residual gravity anomalies computed for selected depth intervals enabled extreme zones of horizontal gradients connected with vertical or steep density boundaries to be evaluated. Such gradient zones are probably related with tectonic contacts.

Based on the above mentioned results of magnetotelluric and gravity data interpretation, a spatial model of the basement was constructed. The model includes a structural map of the top of the Precambrian basement related to main regional resistivity boundary, a structural map of the top of Mesozoic and Paleozoic basement and major tectonic zones. The map of refraction horizon related to the top of sub-Paleogene basement was also used in model construction.

Acknowledgments

This paper was prepared as apart of statutory research of Department of General Geology and Environmental Protection, UST AGH, financed by the Ministry of Scientific Research and Information Technology (project no 11.11.140.159). Results of investigations carried out by the Geophysical Exploration Company for the Polish Oil and Gas Company and Ministry of Environment were used.

References

BOJDYS G. and LEMBERGER M., 1986. Modelowania grawimetryczne jako metoda badania budowy litosfery na przykładzie Karpat. *Zesz. Nauk. AGH Geologia*, 33: 1-106

JANKOWSKI J., PAWLISZYN J., JÓŹWIAK W. and ERNST T., 1991. Synthesis of electric conductivity surveys performed on the Polish part of the Carpathians with geomagnetic and magnetotelluric sounding methods. *Publ. Inst. Geoph. Pol. Ac. Sci*, A-9/236, 183–214.

LEMBERGER M. (ed.), 1998. Kompleksowe modele geofizyczno-geologiczne wgłębnej budowy wschodniej części Karpat zewnętrznych i ich podłoża. Report of project no: 9T12B 020 11. Arch. KBN, Warszawa, 1–324.

RYŁKO W. and TOMAŚ A., 1995. Morphology of the consolidated basement of the Polish Carpathians in the light of magnetotelluric data. *Kwart Geol*., 39, 1, 1–16.

STEFANIUK M., 2001. Główne elementy strukturalne podłoża wschodniej części Karpat polskich w świetle badań magnetotellurycznych. *Kwart. AGH, Geologia*, 27, 1, 127–159.

STEFANIUK M., 2003. Regionalne badania magnetotelluryczne w polskich Karpatach wschodnich. *Kwart. AGH Geologia*, 3-4, 131-168.

WOŹNICKI J., 1985. Low-resistivity element in the Carpathians. *Kwart. Geol*., 29, 153–166.

ŻYTKO K., 1997. Electrical conductivity anomaly of the Northern Carpathians and the deep structure of the orogen. *Ann. Soc. Geol. Pol*. 67, (1), 25–43.

Application of Paleomagnetic Methods for the Tectonic Study of Northern Variscan Thrust Front

Rafal SZANIAWSKI[1], Marek LEWANDOWSKI[1], Jean-Louis MANSY[2], Olivier AVERBUCH[2] and Frederic LACQUEMENT[3]

[1] Institute of Geophysics PAS, ul. Ks. Janusza 64, 01-452 Warsaw, Poland
[2] Univ Lille 1, UMR 8110, F-59655 Villeneuve Dascq, France
[3] Bur Rech Geol & Minieres, F-45000 Orleans, France

Paleomagnetic study has been carried out within a 150 km long segment of the Variscan external fold–and–thrust belt of N France and S Belgium. Main target was about its tectonic development and particularly the origin of its curved shape. The carbonate rocks have been sampled in numerous locations in the Ardennes Massif. The sites have been localized along the fold-belt at the similar distance from its front in order to compare the paleomagnetic records from the tectonic structures characterized by different orientations of the fold axes but with a same age of deformations. Some others carbonate sites has been spotted inside specific tectonic structures in single outcrop (Bettrechies) in order to compare relative age of deformation and remanence acquisition. The sandstones have been collected in the Ardennes and in the Artois Massif. In the Ardennes the sites containing sandstones have been located both in the middle part of the thrust-belt and in its marginal part.

Within magnetite and pyrrhotite bearing Devonian and Carboniferous carbonates, two secondary components were evidenced. Inclination-only tests indicate the synfolding origin of both components: the high temperature component (HT) was acquired during the early stage of deformation while the low temperature component (LT) appears during the late stage. Results from Bettrechies enable to correlate diagenesis events with remagnetizations episodes and progressive folding. Outcomes obtained for the Lower Devonian reddish sandstones indicate presence of a hematite carrier and syn- or post-folding magnetization, depending on the sampling site location.

Paleomagnetic directions from the carbonates display dependence on the local tectonic trend. Declinations of the HT component are similar to the directions known for Laurussia in regions of NE-SW orientation of the fold axis. Conversely, ar-