



report  
2007 - 2008



Polish Geological Institute  
National Research Institute

report  

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Polish Geological Institute  
National Research Institute



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(on the basis of Annual Reports of the Polish Geological Institute)

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Photos by Michał Kowalski and Bogusław Bagiński and from General Directorate for National Roads and Motorways, Podhale Geothermal District Heating Enterprise S.A., Polish Energy Group Bełchatów Lignite Mine S.A. and other archives

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Printed and bound by:



Argraf Sp. z o.o.  
03-301 Warszawa, ul. Jagiellońska 76  
[www.argraf.pl](http://www.argraf.pl)

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MINISTRY  
OF THE  
ENVIRONMENT



The National Fund  
for Environmental Protection  
and Water Management



Ministry of Science  
and Higher Education



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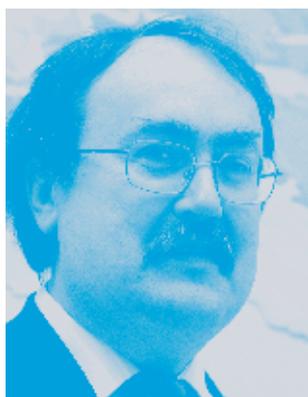
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## FOREWORD BY THE DIRECTOR

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We are after another year of intense work in the long history of the Polish Geological Institute (PGI). Among other things, this was the time of dynamic development of international contacts confirmed by numerous official visits of the heads of geological surveys of Great Britain, Germany, Finland and the Republic of South Africa. Special attention should be paid to the visits of heads of their equivalents from Belarus and Ukraine as cooperation with the Eastern European countries becomes a priority in our international activity. PGI was also visited by the Secretary General of the EuroGeoSurveys and Cracow hosted the Central European Initiative Meeting of Directors of seven geological surveys. Numerous lower level meetings were also organized to discuss transboundary cooperation and other issues and to continue consultations during visits and at conferences, seminars and workshops. Our research staff participated in about 120 conferences, including 25 conferences organized by the Institute or together with other research institutions. The most significant of the latter were: *Geo-Pomerania, Szczecin 2007 – Geology cross-bordering the Western and Eastern European Platforms*, *EUROGRANITES Conference and Workshops*, *First Polish Geological Congress in Cracow*, *Ichnia 2008 – Second International Congress on Ichnology in Cracow* and conference of INQUA Peribaltic Group in Frombork.

PGI actively participated in numerous international research projects. The most significant are *OneGeology–Europe* and AEGOS projects initiated in the course of two years covered by this Report. Projects accomplished in these years include MELA, GEOMIND and GAJA, coordinated by PGI, and ENCOR, PROMOTE, ENGINE, ASTRA and MAGIC, in which PGI acted as a partner of international consortia.

It is hardly possible to enumerate all projects accomplished by PGI in the years 2007-2008. To mention just a few the most significant, we should start with an innovative interdisciplinary study of geodynamics of recent horizontal movements of the Earth crust in Poland. The results of this study may be used for determinations of stress factor of mine tectonic shocks, for finding optimum orientation for directional drillings and for identification of casual factors in natural seismic earthquakes. Another study initiated in 2008, essential not only for our country but also for Europe, is the national programme of identification of geological formations and structures most suitable for safe geological storage of CO<sub>2</sub>. This endeavour planned for the next four years is implemented by a consortium led by PGI.

A number of the accomplished projects were significant for the domestic raw materials policy. Among them are studies concerning perspectives for the occurrence of hydrocarbons in various oil systems, including deposits of the shale gas and tight gas types, a search for polymetallic ores in Cracow-Lubliniec region and geological-geophysical studies aimed at evaluation of possibilities of occurrence of brown coals in proximity of salt domes in the Polish Lowlands. Essential for domestic safety were the studies carried out within the frame of SOPO Landslides Counteracting System, geochemical mapping of the Upper Silesian region in the scale 1:25,000 and identification of geohazards zones in the Upper Silesian Coal Basin on the basis of satellite interferometry data.

The studies on Baltic Sea geology focussed on issues important for the management of offshore areas, especially sustainable use of natural resources and protection of the environment and cultural heritage. Geochemical studies of the southern Baltic, with the special emphasis on geogenic pollution, may serve here as an example. Some projects, for example geological studies of archeological sites related to roadsteads off the Gdańsk, Puck and Ustka harbours (MACHU Project), were carried out by large interdisciplinary research teams.

Much attention was traditionally given to cartography. In 2008, there were completed the last 72 sheets of *The Detailed Geological Map of Poland*, that is the map of fundamental importance for the Polish geology. Completion of this series of maps is planned for 2009. Editorial work on another important map, *The Geological-Economic Map of Poland*, has been completed in 2007. Here it would

be worth to mention an innovative endeavour – preparation of a detailed digital model of deep geological structure of a part of the Warsaw area to serve as a pilot of such models for other urban agglomerations.

In the years 2006-2008, the Polish Hydrogeological Survey, apart from routine works connected with management and protection of groundwater resources, completed a large project aimed at assessment of chemistry of groundwater bodies in individual drainage basins. Moreover, there were completed two projects aimed at creation of informative layers for the first water horizon for GIS database of *The Hydrogeological Map of Poland*.

The Institute was also a partner in a consortium working for the government programme of construction of motorways and expressways. Our role was to prepare geological-engineering and hydrogeological documentations for two sections of A1 motorway under construction, 180 km in length.

It should be emphasized that in the works of the Institute more and more attention is paid to protection of abiotic environment, treated in accordance with the ideas of the International Year of the Planet Earth proclaimed by UNESCO and IUGS as our common heritage which connects all citizens of planet Earth. Within these tasks, works were carried on documentation for geoparks such as *Góra Świętej Anny (Mt. St. Anna)*, *Dolina Kamiennej (Kamienna River Valley)* and *Land of the Glacier Epoch on the Odra River Banks* as well as Polish-Lithuanian *Jaćwież (Yotvings)*. The first geotourist educational trail designed by the Institute, the *Kielniki Quarry*, was opened in 2008 and the next eight trails began to be designed in various parts of Poland. Moreover, works on geotouristic maps for the Wigry, Białowieża, Roztocze, Polesie and Babia Góra National Parks were initiated.

Support for regional geological administration is one of the priorities of the Institute entrusted with the tasks of the Polish Geological Survey. As examples of such support may serve *Geology for the counties (powiats)* websites and discussion forum, educational courses for self-governments staff and some questionnaire studies.

It is a real pleasure to see that the works of our Institute are appreciated. In the period under the Report, the Minister of the Environment presented the Lifetime Achievement Awards to Professor Stefan Kozłowski and Assistant Professor Andrzej Ber and the Award in the Teamwork Category to the authors of *The Geological-Economic Map of Poland*. Moreover, PGI teams got Green Laurel Award for compilation of geochemical maps and atlases and the Award of Innovation of the Year 2008 competition for creation of application for data processing in SOPO Landslide Counteracting System and Award of Geologia 2007 Contest of Minister of the Environment for working out *The Integrative Platform of the Polish Hydrogeological Survey, e-PHS and Groundwaters Monitoring*.

Looking back at those two years, we can also see new challenges the Institute has to respond to and adapt. Among them the most important are challenges connected with domestic energy security, that is support for search for deposits of classic fossil fuels, works on energy supply from alternative sources such as classic geothermal energy and that related to hot dry rocks (HDR), studies on safe geological storage of CO<sub>2</sub> and hydrocarbons and geological analysis of sites for location of nuclear power plants and radioactive waste disposal facilities. Our works on identification and mitigation of geohazards, geochemical pollution and revitalization of post-industrial areas and protection of soils should also appear very important from the point of view of life conditions of individual communities. Efforts will be made to implement the ideas of the Aarhus Convention, that is opening the archives and providing access to environmental data to the whole community.

In 2008, the structure of the Institute was subjected to significant changes. First of all, more clarity was secured by clear differentiation and placing the Geological and Hydrogeological Surveys under direct supervision of Deputy Directors. After these changes the Geological Survey comprises divisions of cartography, geoinformation, as well as environmental geology and geohazards. A division of marine geology was also formed. In this area, besides continuation of works in Polish offshore areas we are planning in the near future to go out into farther waters, including oceanic.

Assistant Professor Jerzy Nawrocki



Director of the Polish Geological Institute  
National Research Institute

## BASIC INFORMATION

The Polish Geological Institute (PGI) was founded on the 7th of May 1919 on the strength of the Resolution of the Parliament of the Republic of Poland. It is the oldest Polish nation-wide scientific institution. It is involved in comprehensive studies of geological structure of the country for practical use in national economy and environmental protection. In addition to scientific activities in all fields of modern geology the Institute was entrusted with the tasks of the Polish Geological Survey and the Polish Hydrogeological Survey. Moreover, it is responsible for the country's security in supply of mineral resources, the groundwater management, for monitoring of the geological environment and warning against natural hazards and risks.

In February 2009, the Council of Ministers bestowed the Polish Geological Institute the status of National Research Institute in recognition of the achievements and contribution to the developments in science and national economy during the last 90 years.

Legal Status: Research & Development Unit, National Research Institute

Supervising Institution: Ministry of the Environment

The legal acts which constitute the basis for the activities of the Institute:

- The Act on Research and Development Units of the 25<sup>th</sup> of July 1985
- The Geological and Mining Law of the 4<sup>th</sup> of February 1994
- The Water Law of the 18<sup>th</sup> of July 2001
- Regulation of the Council of Ministers of the 24<sup>th</sup> of February 2009 – Dziennik Ustaw (Journal of Laws), No. 45, Item 363

### SCOPE OF ACTIVITIES OF THE INSTITUTE

- Comprehensive studies of the geological structure of Poland.
- Geological, geoenvironmental and hydrogeological mapping.
- Evaluation of national mineral resources potential.
- Evaluation of quality and resources of groundwaters, including mineral and thermal waters.

- Monitoring and analysis of wide spectrum of geological issues of the natural environment, including groundwaters.
- Acquisition, storage, processing and dissemination of geological and geoenvironmental information on the entire territory of Poland, including the marine area.
- Expertise on a wide array of geological issues for the state administration and self-governments.
- Cooperation with geological surveys and organizations involved in geological research in other countries.
- Editing and publishing maps, atlases, periodicals and series of publications in geology.

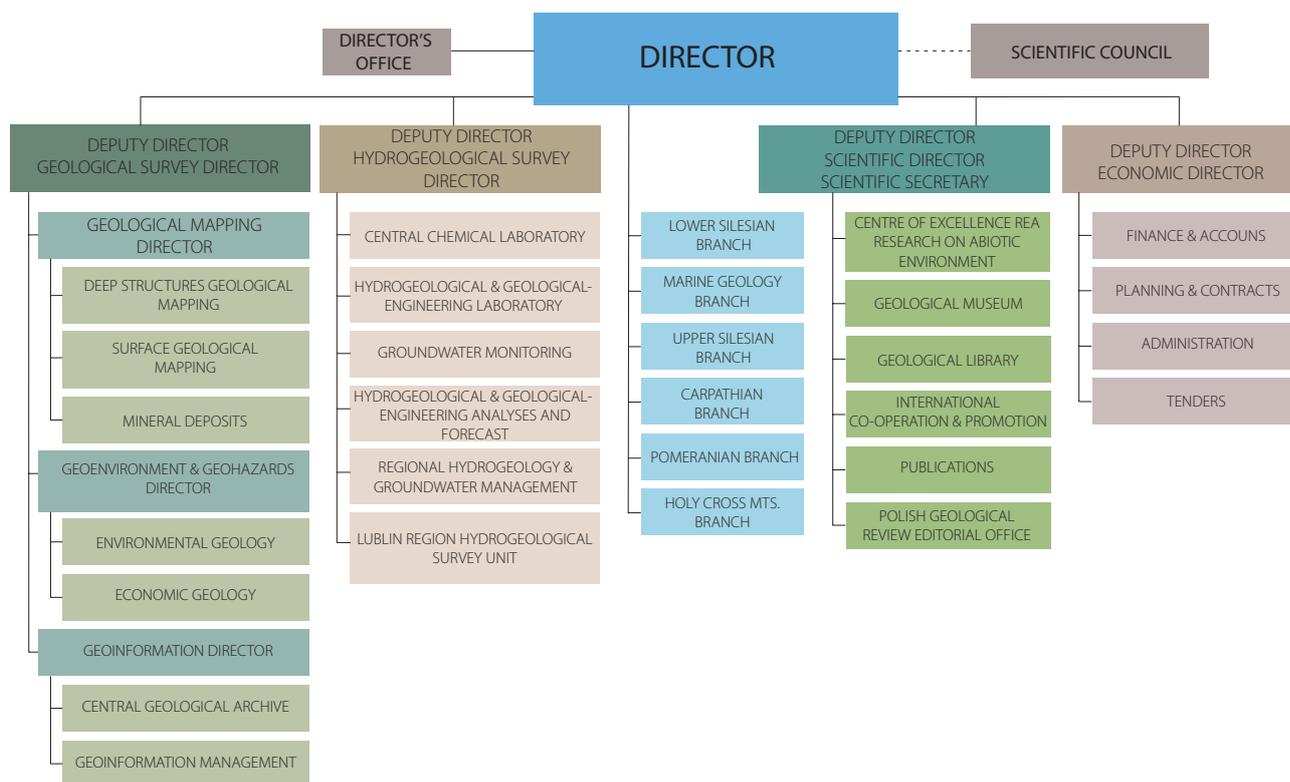
### NEW CHALLENGES

**Care for sustainable development of the country:** elaboration and presentation of methods of optimal sustainable use of the natural environment and management of its resources.

**Ensuring energy security for the country:** assessments of perspective resources of lignite and the Lublin region coal, further search for hydrocarbon deposits and sources of geothermal energy, studies aimed at finding optimal locations for nuclear power plants and potential sites for radioactive waste disposal facilities.

**Mitigation of effects of global climate changes:** identifying geological formations and structures as potential sites for safe storage of CO<sub>2</sub>.

**Risk analysis and monitoring of natural hazards:** SOPO Landslide Counteracting System, that is the system of surveying and registering all the major landslides and areas of potential threat from mass movements in Poland and establishing a network for monitoring of surface and subsurface movements at selected landslides.



Organizational Chart of the Polish Geological Institute as of 31<sup>st</sup> December 2008

## THE SCIENTIFIC COUNCIL

The Scientific Council is a decisive, initiative and consulting body of the Polish Geological Institute acting with respect to the statutory tasks and development of the scientific and scientific-technical staff.

### The Scientific Council elected for the 2008-2012 term

Chairman of the Scientific Council:

Prof. Dr. Krzysztof Jaworowski, Polish Geological Institute, Warsaw

Deputies of Chairman of the Scientific Council:

Prof. Dr. Stanisław Speczik, Polish Geological Institute, Warsaw

Prof. Dr. Andrzej Szczepański, AGH University of Science and Technology, Cracow

Members:

Prof. Dr. Izabela Bojakowska, Polish Geological Institute, Warsaw

M.Sc. Paweł Brański, Polish Geological Institute, Warsaw

Dr. Eng. Zbigniew Buła, Polish Geological Institute, Sosnowiec

Dr. Eng. Józef Chowaniec, Polish Geological Institute, Cracow

M.Sc. Ryszard Dobracki, Polish Geological Institute, Szczecin

Prof. Dr. Józef Dubiński, Central Mining Institute, Katowice

Dr. Zbigniew Frankowski, Polish Geological Institute, Warsaw

M.Sc. Waldemar Gogołek, Polish Geological Institute, Warsaw

Prof. Dr. Marian Harasimiuk, Maria Curie-Skłodowska University, Lublin

M.Sc. Gertruda Herman, Polish Geological Institute, Kielce

Ass. Prof. Dr. Katarzyna Jarmołowicz-Szulc, Polish Geological Institute, Warsaw

Ass. Prof. Dr. Marek Jarosiński, Polish Geological Institute, Warsaw

Prof. Dr. Eng. Jadwiga Jarzyna, AGH University of Science and Technology, Cracow

Dr. Jacek Kasiński, Polish Geological Institute, Warsaw

M.Sc. Hubert Kiersnowski, Polish Geological Institute, Warsaw

Prof. of Szczecin University, Dr. Ryszard Kotliński, Interoceanmetal, Szczecin

Prof. of Silesian University, Dr. Andrzej Kowalczyk, Silesian University, Katowice

Prof. of Warsaw University, Dr. Ewa Krogulec, Warsaw University, Warsaw

M.Sc. Dariusz Lech, Polish Geological Institute, Warsaw

Prof. Dr. Marek Lewandowski, Institute of Geological Sciences, Polish Academy of Sciences, Warsaw

Prof. Dr. Ryszard Marcinowski, Warsaw University, Warsaw

Prof. of Warsaw University, Dr. Bronisław Matyja, Warsaw University, Warsaw

Prof. of AGH, Dr. Eng. Jacek Matyszkiewicz, AGH University of Science and Technology, Cracow

Prof. Dr. Eng. Eugeniusz Mokrzycki, Mineral and Energy Economy Research Institute, Polish Academy of Sciences, Cracow

M.Sc. Teresa Mrozek, Polish Geological Institute, Cracow  
 M.Sc. Eng. Andrzej Pacholewski, Polish Geological Institute, Sosnowiec  
 Ass. Prof. Dr. Anna Pasieczna, Polish Geological Institute, Warsaw  
 Prof. Dr. Krystyna Piotrowska, Polish Geological Institute, Warsaw  
 Prof. Dr. Jan Przybyłek, Adam Mickiewicz University, Poznań  
 Dr. Paweł Rowiński, Institute of Geophysics, Polish Academy of Sciences, Warsaw  
 Ass. Prof. Dr. Magdalena Sikorska-Jaworowska, Polish Geological Institute, Warsaw

Prof. Dr. Eng. Tadeusz Słomka, AGH University of Science and Technology, Cracow  
 Prof. Dr. Stanisław Staško, Wrocław University, Wrocław  
 Prof. Dr. Alfred Uchman, Jagiellonian University, Cracow  
 Prof. Dr. Andrzej Wierzbowski Warsaw University, Warsaw  
 Prof. Dr. Andrzej Witkowski, Szczecin University, Szczecin  
 Prof. Dr. Andrzej Żelaźniewicz, Institute of Geological Sciences, Polish Academy of Sciences, Wrocław

## BUDGET

	2007	2008
Income (in million EUR)	34.97	28.81
Costs and expenditures (in million EUR)	34.06	28.28
Gross profit before taxation (in million EUR)	0.91	0.53
Legal entity income tax (in million EUR)	0.04	0.04
Net profit (in million EUR)	0.87	0.49
Net profitability (in %)	2.5	1.7

The Institute's income from individual sources of financing remained generally similar in proportions as in previous years. The National Fund for Environmental Protection and Water Management invariably continued to be the major source of financing of services contracted by the Ministry of the Environment, with the share equal 58.3% of the income of the Institute in the year 2007 and 60.95% in 2008. The Ministry of Science and Higher Education was the second largest source of financing with the share equal 15.2% in the year 2007 and 16.6% in 2008.

Since 2007 a special attention was paid to differentiate income and costs of the Polish Geological Survey and the Polish Hydrogeological Survey in the Financial Reports of the Institute. The Report for the fiscal year 2008 shows that contribution of the Polish Hydrogeological Survey to the total income was 18.0%, and that of the Polish Geological Survey – 9.7%.

Compared to the year 2006, total costs increased for about 8.9% in 2007. Labour costs and related ones were the major position here. The total costs declined by about 5% in 2008 whereas the labour costs remained at the same level. The year of 2007 was the time of significant investments and purchases. The sum assigned for these purposes was 14.1 million Polish zlotys (~3.92 M EUR) compared to about 2.8 million PLN (~0.67 M EUR) in the year 2008. The major investments of the year 2007 were the purchase of a plot of land with an office building at Jagiellońska Street in Warsaw for 11.2 million PLN (~3.12 M EUR) and a lease of passenger cars and trucks for about 1.8 million PLN (~0.5 M EUR).

Moreover, funds guaranteed in service contracts for the years 2007-2008 made it possible for the Institute to purchase and order a new specialist equipment for about 3,0 million PLN (~0.8 M EUR) as well as software for 4.5 million PLN (~1.25 M EUR).

The Institute Financial Reports for the fiscal years 2007 and 2008 have been approved by external licensed auditors.

## STAFF

The years 2007–2008 witnessed a moderate net increase in number of employees in relation to the previous ones. The total number of employees initially decreased to 726 in the end of 2007 to increase up to 746 by the end of 2008, which corresponds to 713.43 and 730.63 full-time equivalent positions, respectively. The number of employees holding academic degrees is over 75% of the staff. It includes:

12	professors
27	assistant professors
116	Ph. Ds

The employment in three principal groups remained at a similar level as in previous years. Employees involved in basic activities of PGI represented almost 85% of the staff, those responsible for administration and office work – 12%, and those responsible for services and maintenance – the remaining 3%.

In 2007-2008, the Minister of the Environment promoted 4 researchers to the post of Assistant Professor. Moreover, the Scientific Council of PGI conferred the scientific title of Ph.D. to 10 persons and the title of Dr. Sc. to 4 persons.

## AWARDS AND DECORATIONS

### State Awards

The President of the Republic of Poland presented high state awards to the following honorees:

**The Golden Cross of Merit** to: Jacek Kasiński and Marek Narkiewicz

**The Silver Cross of Merit** to: Janusz Badura, Andrzej Gąsiewicz, Marek Jarosiński, Alicja Kasprzyk, Hubert Kiersnowski, Krzysztof Krupiński, Janina Małecka, Hanna Matyja, Piotr Pasłowski, Barbara Radwanek-Bąk and Adam Tomasz

**The Bronze Cross of Merit** to: Jacek Grabowski, Monika Jachowicz, Piotr Krzywiec, Jerzy Nawrocki, Jolanta Paczeńska, Lidia Razowska-Jaworek, Elżbieta Sarnecka and Ilona Śmietańska

### Ministry Awards and Decorations

**Minister of the Environment conferred Decorations for Merit to Polish Geology to:** Marek Adamski, Andrzej Biel, Joanna Bil, Jolanta Cabalska, Maria Dobroszycka, Anna Feldman-Olszewska, Agnieszka Felter, Piotr Freiwald, Dariusz Gałązka, Tomasz Gliwicz, Olga Głowacka, Dariusz Grabowski, Ryszard Habryn, Lilia Herda, Irena Jaroń, Edyta Jaśkaczek, Elżbieta Jeleńska, Waldemar Józwiak, Barbara Kielkiewicz, Ewa Klimuszko, Wojciech Komorowski, Monika Koniecznyńska, Dorota Koszka-Maróń, Włodzimierz Krieger, Jarmila Krzemińska, Jarosław Kucharzyk, Krystyna Kupiszak, Krzysztof Leszczyński, Marek Maćkowiak, Tomasz Malata, Lesław Mil, Grażyna Miotk-Szpiganowicz, Magdalena Mizerska, Barbara Mrowiec, Joanna Muras, Wanda Narkiewicz, Bogumiła Pisaniec, Katarzyna Pochocka-Szwarc, Małgorzata Połońska, Marek Rumiński, Mirosław Rutkowski, Sylwester Salwa, Katarzyna Sawicka, Krzysztof Seifert, Tadeusz Smakowski, Krzysztof Sokołowski, Katarzyna Strzezińska, Małgorzata Such, Anna Szelewicka, Marta Szunke, Andrzej Szydło, Jacek Śniegowski, Mirosława Tiałowska, Anna Tomasz, Wiesław Trela, Jan Turczynowicz, Krzysztof Urbański, Maria Waksmundzka, Bożena Walowska, Dorota Węglarz, Ewa Włodarczyk, Paweł Woźniak, Leszek Zaleszkiewicz, Elżbieta Zdrojewska, Anna Zybura, Zbigniew Żółtowski, Halina Żuczek.

### Awards of the Minister of the Environment

The Minister of the Environment presented the Lifetime Achievement Awards to Professor Dr. Stefan Kozłowski and Ass. Professor Dr. Andrzej Ber for scientific research activities in geology and environment protection.

The award in the Teamwork category was won by PGI team comprising Małgorzata Sikorska-Maykowska, Tomasz Gliwicz, Paweł Lewandowski, Olimpia Kozłowska, Ryszard Strzelecki, Sylwia Tarwid-Maciejowska and Iwona Walentek, for compilation of *The Geological-Economic Map of Poland in the scale 1:50,000*.

Award in *Geology 2007* Contest of Minister of the Environment was won by a team of PGI authors comprising Jolanta Cabalska, Agnieszka Felter, Mateusz Hordejuk and Anna Mikołajczyk, for creation of *The Integrative Platform of the Polish Hydrogeological Survey, e-PHS and Groundwater Monitoring*.

### Other awards and decorations

**The Golden Badge of the Polish Geological Institute was conferred to:**

Eugeniusz Cieśla, Grzegorz Czapowski, Iwona Duliban, Magdalena Jakóbczak, Tomasz Janicki, Jacek Kasiński, Barbara Kerber, Aleksandra Kozłowska, Zofia Krysiak, Jerzy Nawrocki, Radosław Pikies, Barbara Radwanek-Bąk, Andrzej Sokołowski, Zbigniew Sowiński and Hanna Tomassi-Morawiec.

### Innovation of the Year 2008

The jury of *Innovation of the Year 2008* Contest organized under auspices of the Ministry of Regional Development, Information Processing Centre and FIRE Innovation Centre Foundation together with organizers of Business Forum Contest awarded the Polish Geological Institute for creation of application for data processing in registering landslides within the frame of SOPO Landslide Counteracting System.

### Green Laurel

In III<sup>rd</sup> Edition of *Green Laurel* Competition organized by the EcoDevelopment – Polish Chamber of Commerce in 2007, the award was won by the PGI team comprising Józef Lis, Anna Pasiczna and Tomasz Nałęcz for compilation of geochemical maps and atlases for individual parts of the country.

## MAJOR EVENTS

### 2007

- 15-19.01. Visit of Dr. Patrice Christmann, Secretary General of EuroGeoSurveys, in PGI Warsaw headquarters and the Lower Silesian Branch in Wrocław
- 17-18.05. Celebrations of 88<sup>th</sup> anniversary of the Polish Geological Institute in Warsaw – Scientific session and exhibition commemorating scientific achievements of Professor Zbigniew Kotański and opening of open-air photographic exhibition *Our Earth*
- 17-18.05. Visit of Professor Elias Ekhdal, Director of Geological Survey of Finland (GSF), in Warsaw headquarters of PGI
- 22.05. Lifetime Achievement Award of Minister of the Environment for Professor Stefan Kozłowski
- 5-6.06. Meeting of directors of geological surveys of member states of the Central European Initiative (CEI) in the Carpathian Branch of PGI in Cracow (Photo 1)
- 20-23.08. Visit of Professor John Ludden, Director of the British Geological Survey (BGS) in PGI Warsaw headquarters and the Marine Geology Branch in Gdańsk
- 1-6.09. International EUROGRANITES Conference and Field Workshop (Wrocław, Karpacz, Szklarska Poręba, Strzegom, Strzelin, Kraków, Wieliczka, Zakopane) (Photo 2)
- 4-5.10. Conference on Geoenvironmental Data in Poland and Implementation of INSPIRE Directive, Warsaw (Photo 3)
- 25.10. *Green Laurel Prize* for PGI team for geochemical maps and atlases of individual regions of the country
- 29.10. Visit of Thibedi Ramontja, Director of Council for Geoscience, geological survey of the Republic of South Africa, in PGI Warsaw headquarters
- 22.11. Prize of *Geologia 2007 Competition Prize* for PGI team for achievements in development of databases of the Polish Hydrogeological Survey
- 27.11. Conference *Quaternary Studies in Poland and Protection of Geoenvironment*, organized to celebrate 45 years of research work of Assistant Professor Andrzej Ber, Warsaw
- 19.12. Visit of Professor Hans-Joachim Kümpel, Director of Federal Geological Survey of Germany (BGR), in PGI Warsaw headquarters



Photo 1



Photo 2



Photo 3

## 2008

- 8.02. Professor Andrzej Sadurski appointed as the President of National Water Management Authority
- 15.04. Minister of the Environment has appointed Assistant Professor Jerzy Nawrocki to the position of Director of Polish Geological Institute
- 15.05. Celebrations of 89<sup>th</sup> anniversary of the Polish Geological Institute in Warsaw – Scientific session and exhibition commemorating scientific achievements of Professor Stanisław Doktorowicz-Hrebniicki and opening of open-air photographic exhibition *Geology in Profile and En Face*
- 22.05. Prizes of Minister of the Environment for Assistant Professor Andrzej Ber for his life time achievements and for the team of PGI authors of the Geological-Economic Map of Poland in the scale 1:50,000 (Photo 4)
- 25.06. Elections to the Scientific Council of the Polish Geological Institute
- 11.06. Signing agreement on cooperation between PGI and the State Geological Institute of Dionýz Štúr (geological survey of Slovakia) for the years 2008-2013
- 23.06. Conference *The Future of Lignite-based Mining and Energy Production in Poland and Europe* and press briefing by the Chief National Geologist Dr. Henryk Jacek Jezierski in Warsaw PGI headquarters (Photo 5)
- 26-28.06. First Polish Geological Congress in Cracow – PGI exposition and Conference on *Mineral Raw Material Deposits – Current Issues in Prospecting, Research and Documentation*
- 29.08. Opening of Kielniki Quarry Educational Trail designed and organized by PGI, Olsztyn near Częstochowa (Photo 6)
- 7.10. Signing Memorandum of Understanding between PGI and the Corporation of the International Year of Planet Earth
- 13.11. Prize *Innovation of the Year 2008* for creating an application for registering landslides within the frame of SOPO Landslide Counteracting System (Photo 7)
- 14.11. Inauguration meeting of the PGI-led consortium for implementation of CO<sub>2</sub> geological sequestration programme
- 21.11. Signing agreement on cooperation in the field of geology between PGI and the Geological Institute of Angola (IGEO)
- 24.11. Signing agreement on cooperation between PGI and the Institute of Geological Sciences of the National Academy of Sciences of Ukraine
- 1-4.12. Visit of representatives of the State Geological Survey of Ukraine, Ukrainian State Geological Research Institute, Enterprise "Belgeologia" and the State Research Institution – Institute for Natural Management of the National Academy of Sciences of Belarus in PGI headquarters, Warsaw
- 9.12. Meeting of representatives of the Ministry of the Environment and scientific institutions and enterprises on new raw material policy of the European Union, PGI headquarters, Warsaw



Photo 4



Photo 5



Photo 6



Photo 7

## REGIONAL GEOLOGY

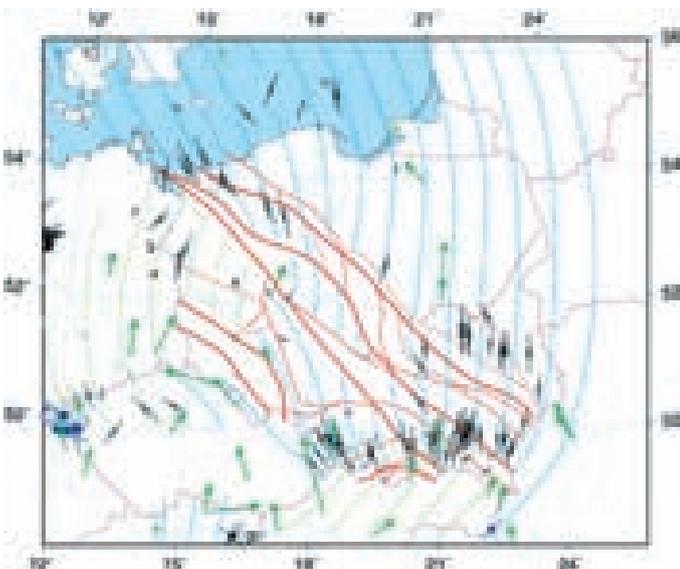
Earth history without secrets



## GEODYNAMICS

### Geodynamics of Recent Horizontal Movements of the Earth's Crust in Poland

An interdisciplinary synthesis of recent geodynamics of the area of Poland has been completed by a consortium formed by PGI and the Institute of Geodesy and Geodetic Astronomy of the Warsaw University of Technology. Results of measurements of recent stresses and deformations and geophysical surveys were used to create mechanical models of the lithosphere which, in turn, made it possible to construct numerical models of propagation of tectonic stresses. The studies showed that the area of Poland is under equalizing influence of stresses transmitted from the Mediterranean collisional zone and the Mid Atlantic Ridge. The mode of transmission and compensation of these stresses between tectonic blocks separated by zones of mechanical discontinuities was reconstructed. Moreover, outline proposals of further interdisciplinary research on the recent dynamics of the area of Poland were given.



Map of the present-day maximum horizontal stress directions (black arrows), their interpolated trajectories (blue lines) and vectors of horizontal intra-plate motions (green arrows) with major fault zones (red lines) in the background

## TECTONICS

### Morphotectonic Map of the European Lowlands

The first sheet of morphotectonic map of a model transboundary area in the Lower Odra River region in the scale 1:250,000 shows the results of studies carried out within the frame of MELA Project. The Project made it possible to systematize the knowledge of this area with reference to the newly obtained geophysical, geothermal, geochemical, SAR interferometric and other data. The obtained results were subsequently synthesized in the form of geological models. The Project was done in ESRI (ArcInfo ver. 9.2) environment with extraction of topographic features from Digital Terrain Model (DEM). Individual phenomena and processes were presented as vectors or rasters or spatial digital models. The input data were inserted to geobases by grouping in accordance with a set of domains and relationships. 3D presentation of the data was made with ArcScene and 2D – with ArcMap and ArcReader. Moreover, there were compiled latitudinal and longitudinal cross-sections through the studied area.

Because of a very wide spectrum of phenomena and processes taking place at and beneath the terrain surface, it was decided to present the obtained results in two separate plates of the map. Plate I, compiled for specialized users, shows the recorded geological phenomena, elements of palaeorelief, tectonic features, geophysical and geothermal anomalies, hydrological and hydrogeological indices and other features. In turn, Plate II was designed for the users such as town-planners, land-use planners and local and regional administration so it shows the studied areas from the point of view of advantageous and disadvantageous conditions and constrains for habitation and location of new settlements and economic activities. The studies carried out within the frame of MELA Project also included comparative analyses of reference areas. The studies made it necessary to elaborate a methodology for compilation of the map and its explanatory note.

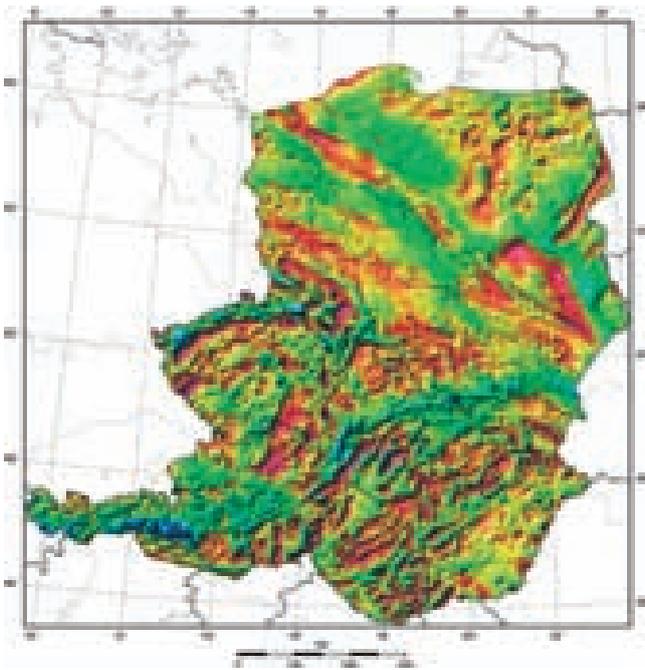


Image of residual gravity anomalies in area of CELEBRATION'2000 Project

## GEOPHYSICS

### Interpretation of Potential Field Anomalies in Area Covered by CELEBRATION'2000 Project

A new integrated interpretation of geophysical data collected by CELEBRATION'2000 Project greatly contributed to our knowledge of physical properties of deep-seated geological structures in Central Europe. The interpretation made it possible to compile uniform maps of potential field anomalies as well as a new map of heat flow. The latter map was prepared taking into account the influence of climate changes as shown by data from areas adjacent to those covered by the Project. Moreover, there were

created density distribution and magnetic models. The digital models cast new light on temperature distribution and heat flow density in the Earth's crust and lithosphere. It should be added that models created for selected CELEBRATION'2000 profiles made it possible to analyse rheological structure of the lithosphere.

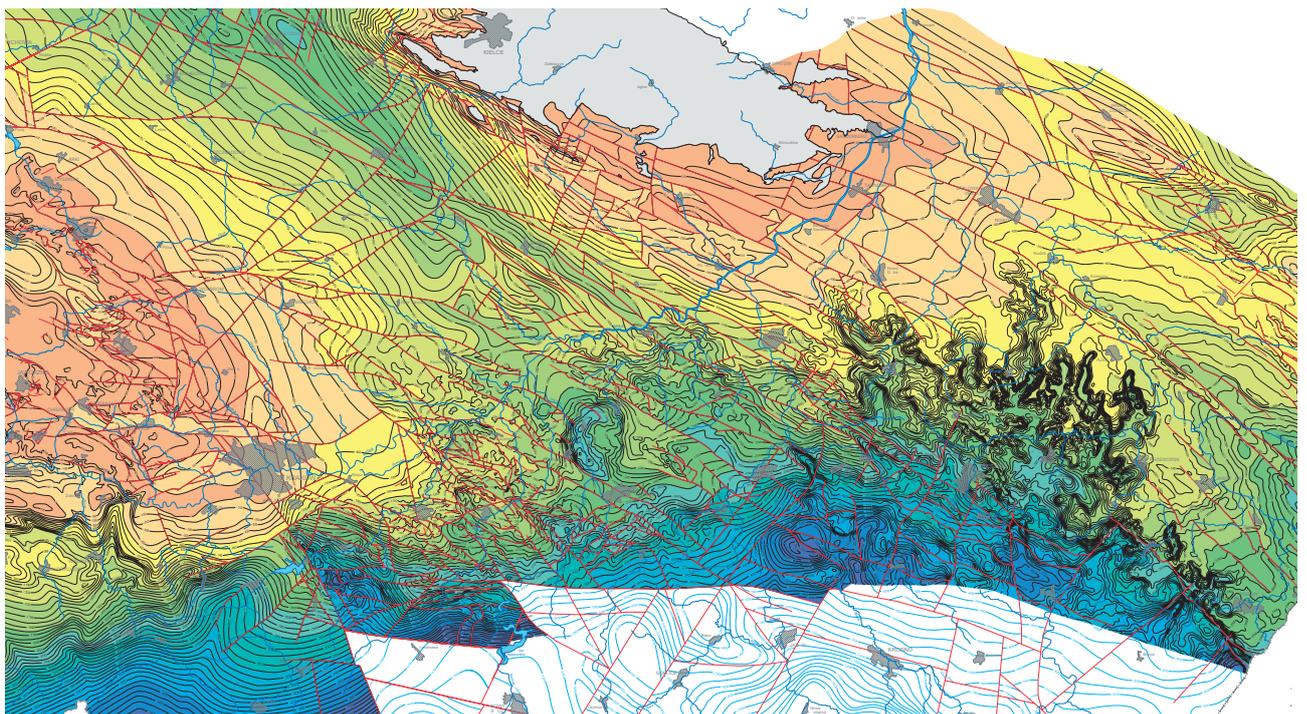
## STRATIGRAPHY

### Palaeogene and Neogene of North-Eastern Poland – Correlation and Synthesis for the Needs of Geological Cartography

Correlation and synthesis of archival geological, palynological and microfaunal data were supplemented with results of new studies carried out in connection with compilation of a few dozen sheets of *The Detailed Geological Map of Poland in the scale 1:50,000*. The obtained results made it possible to elaborate bio- and lithostratigraphic subdivisions which should be useful as the reference in further studies on the Palaeogene and Neogene successions in the region covered by currently reambuluted Gdańsk and Pisz sheets of *The Geological Map of Poland in the scale 1:200,000*. The analysis of pollen-phytoplankton assemblages and co-occurring microfossils gave the basis for correlations as well as palaeofacies and palaeogeographic and palaeoclimatic reconstructions for these sediments. The method of nannoplankton analysis of marine sedimentary series of the Lower Palaeogene in areas of successive sheets of *The Detailed Geological Map of Poland in the scale 1:50,000* made possible their palaeontological documentation and dating at the upper part of the Danian Stage.

### Geological-Structural Atlas of the Palaeozoic Basement of the Outer Carpathians and Carpathian Foredeep

This atlas presents the summary of several years of studies carried out by PGI and the Krosno Branch of Polish Oil and Gas Company.



Geological-structural map of top surface of pre-Permian Palaeozoic and Precambrian – relief of Palaeozoic and Precambrian surface (Geological-Structural Atlas of the Palaeozoic Basement of the Outer Carpathians and Carpathian Foredeep)

Revision of stratigraphic position of Palaeozoic and/or Precambrian rocks along with reinterpretation of seismic and magnetotelluric data from a few thousand boreholes made it possible to work out a new cartographic version of a model of geological structure of these strata in areas of southern and south-eastern Poland. Eight maps of the Atlas present results of the reinterpretation of geological structure of eastern part of the Upper Silesian and Małopolska Blocks, clearly showing different tectonostratigraphic evolution of these tectonic units in the Precambrian and Palaeozoic times. The maps give good basis for analyses and evaluations of hydrocarbon potential of Palaeozoic successions. They may be also useful for oil companies in making decisions concerning applications for concessions for prospecting and exploration of oil and gas fields and in defining conditions for geological CO<sub>2</sub> storage in this region.

## PETROLOGY

### Diagenesis and Reservoir Properties of Upper Carboniferous and Lower Permian Sandstones

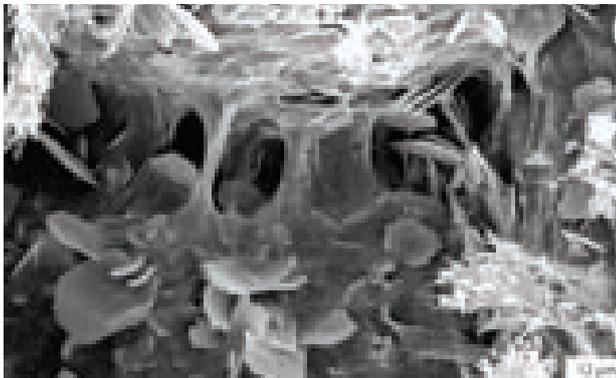
Sandstones from 32 borehole columns in Baltic part of the Western Pomerania were covered by studies carried out in cooperation with the Piła Branch of Polish Oil and Gas Company and the Institute of Oil and Gas. The studies made it possible to identify diagenetic processes which affected these sediments. Moreover,

temperatures affecting these rocks were approximated and attempt was made to establish time and reasons why pore space has become closed off for flow of reservoir fluids. The studies also showed the presence of secondary porosity. Sandstones of the Upper Carboniferous and those from the Carboniferous and Permian passage beds were found to be characterized by the best reservoir properties.

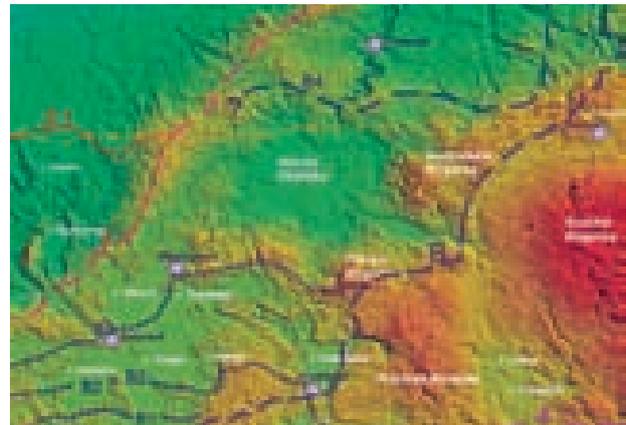
## QUATERNARY GEOLOGY

### Deglaciation in Northern Part of the Mazurian Lake District at the End of the Last Glaciation

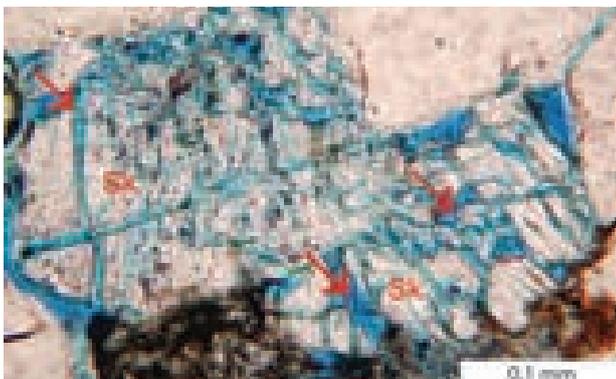
Results of many years of cartographic works and interdisciplinary palaeogeographic and palaeoenvironmental studies made it possible to reconstruct Late Glacial history of the area adjacent to the Polish-Russian border. The direction of movement of the last ice sheet was reconstructed on the basis of results of analysis of orientation of post-glacial morpholineaments as revealed by radar imagery and digital model of terrain surface. The obtained NNW direction appears consistent with that of an advance of the Mazurian ice sheet lobe in the Main Stadial of the Vistulian Glaciation. Ice sheet extents were correlated with those established in neighbouring areas. On the basis of the archival data, the bedrock apparent exposure ages of about 14.5–12.0 ka were accepted.



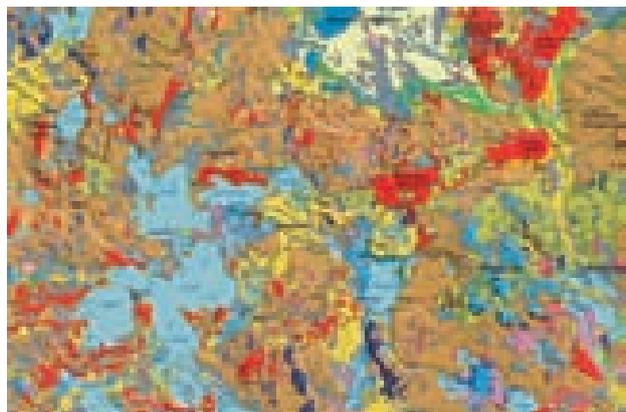
*Illite bridges overgrowing pore space in sandstones; electron micrograph; Ciechnowo 1 borehole, depth of 3,807.5 m*



*Extents of ice sheet during its recession in the Pomeranian phase (Main Stadial of the Vistulian Glaciation): A – extent of ice sheet in the Pomeranian phase; B1-B4, C-C1 – recessional stops of the ice sheet*



*Secondary porosity (arrows) in potassium feldspar grains (Sk) subjected to dissolution; sample impregnated with blue resin; polarized light image with analyzer moved out; Sarbinowo 1 borehole, depth of 2,390.1 m*



*Geological map of surface sediments in northern part of the Mazurian Lake District*

### Assessments of Formations and Structures for Safe CO<sub>2</sub> Storage and Programme of Monitoring

In order to limit greenhouse effect and mitigate anthropogenic climate change, the European Union made obligations to reduce CO<sub>2</sub> emissions from the combustion of fossil fuels. To meet these obligations, all the member states including Poland have to develop the necessary technical, economic and legal framework relevant to the consideration of carbon dioxide capture and storage in deep-seated geological structures.

In order to meet the above mentioned tasks, in 2008 the Ministry of the Environment commissioned PGI to lead launching and implementation of the national research project *Assessments of Formations and Structures for Safe CO<sub>2</sub> Storage, Including Monitoring Plans*.

This four-years project is carried out by a consortium formed by the Polish Geological Institute as the leader, AGH University of Science and Technology, Central Mining Institute, Polish Academy of Sciences Mineral and Energy Economy Research Institute, Oil and Gas Institute and PBG Geophysical Exploration Company. The major goal of this project is evaluation of geological formations in the whole area of Poland including the Polish economic zone of the Baltic Sea, from the point of view of their usability for storage of carbon dioxide from large industrial sources of emission.

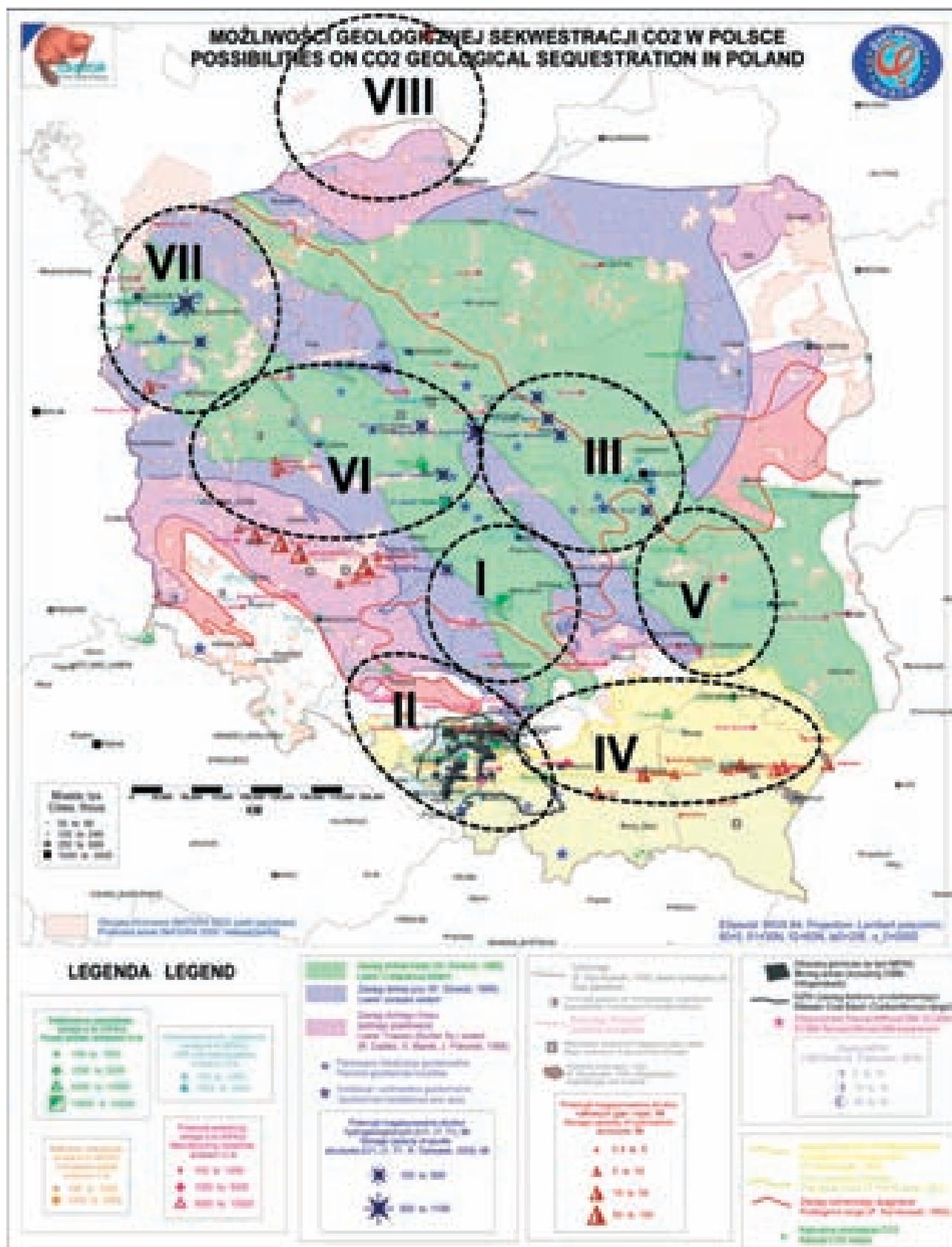
Taking into account the needs of national economy and the already existing knowledge of potential for the geological storage, 8 regions were selected for detailed assessments of possible sites for CO<sub>2</sub> storage in deep saline aquifers, depleted oil and gas reservoirs and unexploited methane-rich coalbeds.

Implementation of the project began in the last quarter of 2008. The works started with detailed assessment of possible storage sites in deep saline aquifers in the Bełchatów area (region I). One such site was identified as promising and now its usability is being analysed in accordance with recommendations of the European Commission's Directive on the geological storage of CO<sub>2</sub>. The works are being conducted for the needs of a demonstration project of a reduced CO<sub>2</sub> emission power plant, an investment for which the PGE Polish Energy Group *Bełchatów* is applying for co-financing from the so-called UE Flagship Programme. The studies should make it possible to find location for optimal potential storage site for the sequestered CO<sub>2</sub>.

In 2009, similar works will be initiated in two other regions. In one of these regions PKE Southern Energy Concern and *Kędzierzyn* Nitrogen Plant are planning to locate demonstration reduced CO<sub>2</sub> emission power plant, which would be the second project of that type in Poland.



Studies carried out in the Bełchatów region



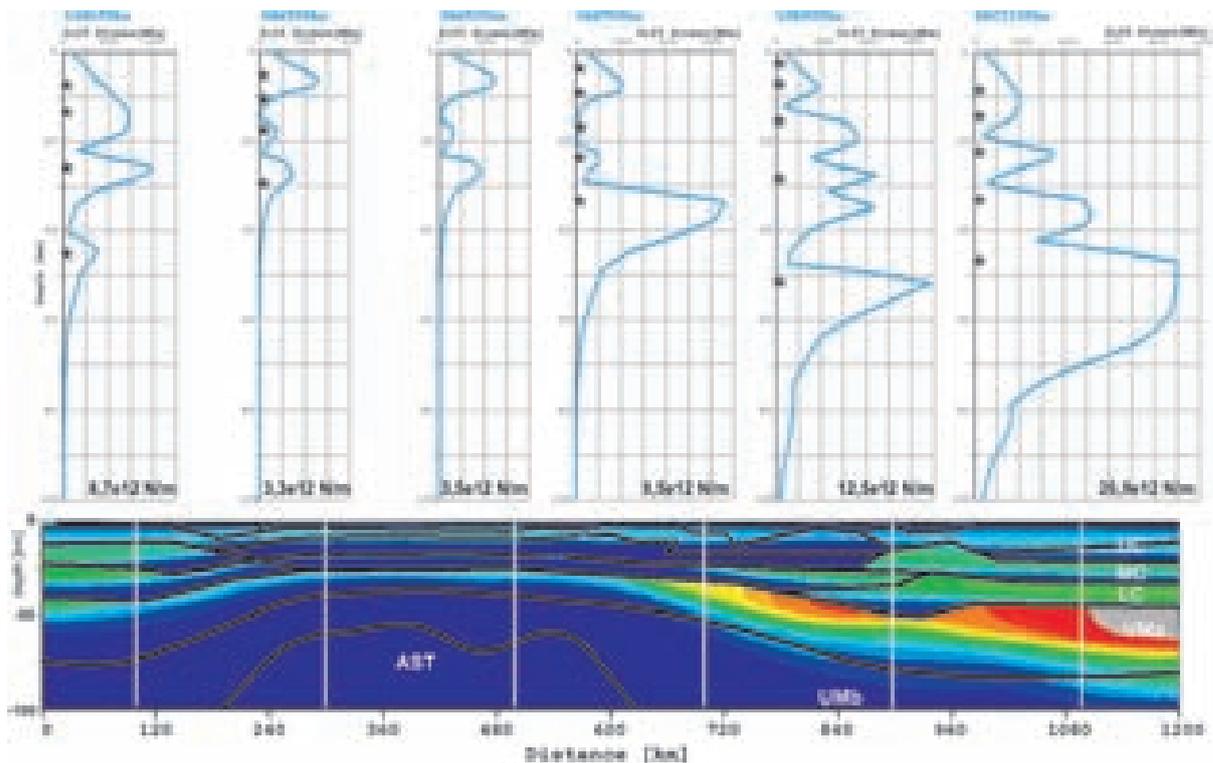
Possibilities of geological sequestration of CO<sub>2</sub> in Poland  
 Tentative location of regions I-VIII of detailed assessments of potential CO<sub>2</sub> storage sites in saline aquifers at the background of results of preliminary studies on the storage potential (A. Wójcicki, 2004-2008)

### Digital Modelling of Lithospheric Deformations Induced by Tectonic Compression

Computer simulations of deformations were carried out to test the influence of rheological delamination on the lithosphere with a mechanically weakened segment comparable to a rift basin. The structure and parameters for this model were determined by analogy to the Pannonian Basin and surrounding areas stretching from the Adriatic Sea to the East European Platform. Horizontal compression of the lithosphere in 2D vertical sections in the period of 10 million years was mathematically modelled by the finite element method. The obtained results in large part turned to be cutting-edge contributions to our understanding of these processes. The studies made it possible to find regularities in mechanical evolution of the lithosphere during compressional inversion of rift basins. There were differentiated three stages of inversion, differing in tectonic regime, distribution of deformations and mechanical delamination of the lithosphere. Topographic effects of inversion were defined and the role of a folding factor and isostatic compensation in creation of topography of the basin and its surroundings were analysed. The results

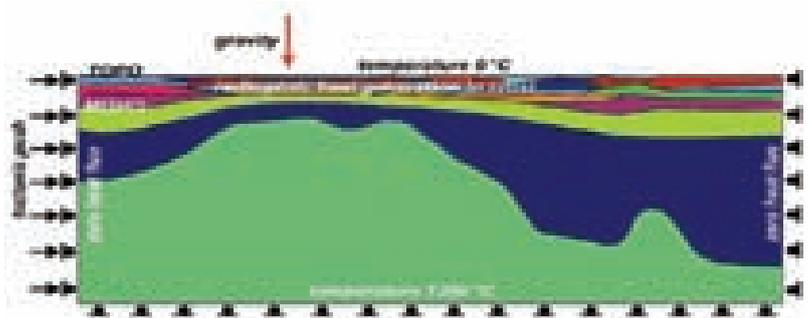
of the modelling univocally show that an elevation of the marginal swell type should originate along the margins of the basin during its inversion. Complex mechanism of growth of intrabasin anticlines, from the stage of folding related to rise of a bulge to uplift resulting from isostatic compensation, was described. Moreover, evolution and mechanism of origin of fold systems of a lower order, initiated due to uneven surfaces of individual layers, were discussed.

Results of modelling appear consistent with phenomena known to accompany neotectonic inversion of the Pannonian Basin. The model gave similar values of length of folds of all the three orders of magnitude as well as realistic rates of vertical and horizontal movements. The performed simulations showed that the present state of compression in the surroundings of the basin is determined by weakness of the lithosphere within this area. Moreover, the majority of mountain ranges surrounding the basin appear to be situated in location characteristic for the marginal swells. It follows that the topographic elevation of the Carpathians and Dinarides may be markedly influenced by the recent compressional stress field in the studied region.



Results of modelling of tectonic compression as distribution of magnitudes of differential stresses in the lithosphere; graphs show variability of differential stresses along vertical profiles

Structure of digital model along seismic line Cel05 (prolongated in direction of the Dinarides) and its loading conditions



# BALTIC SEA AND ITS COAST

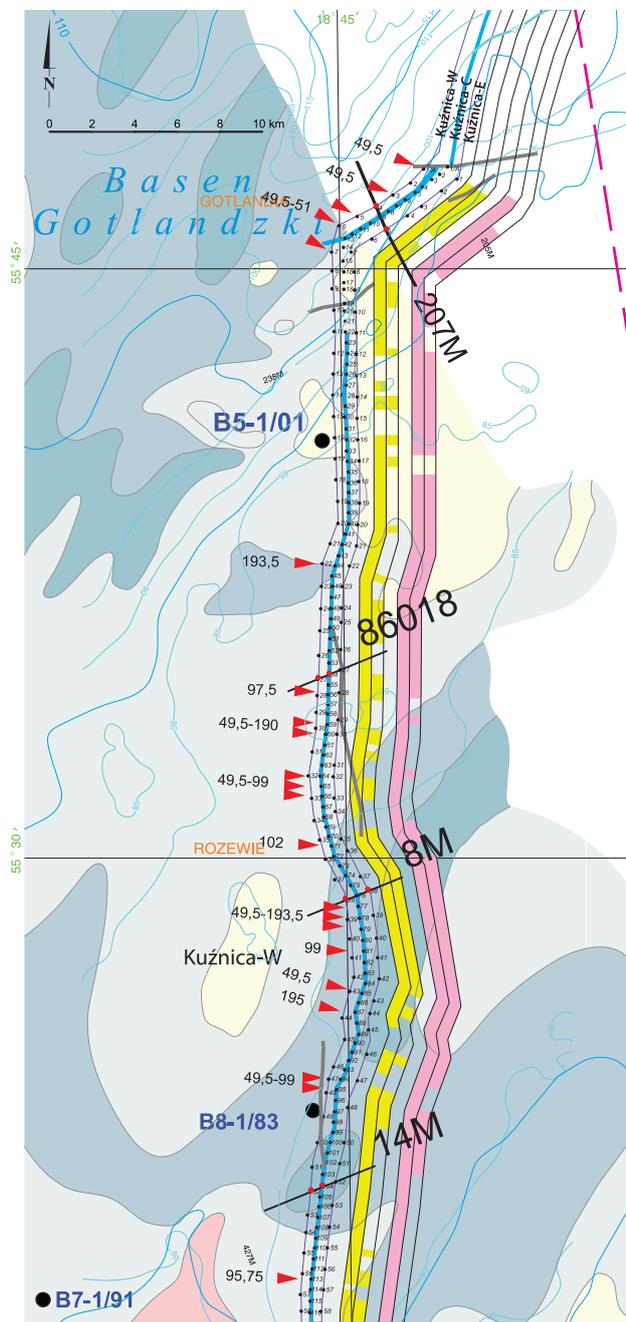
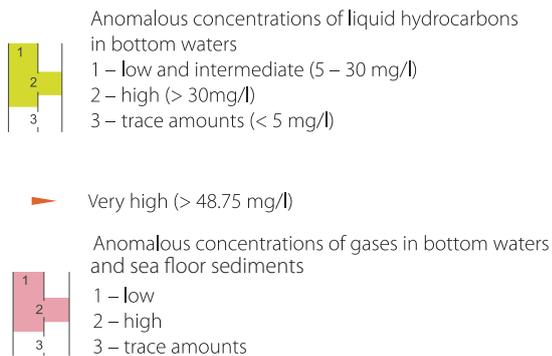
Rational use of advantages and natural resources of the Baltic Sea



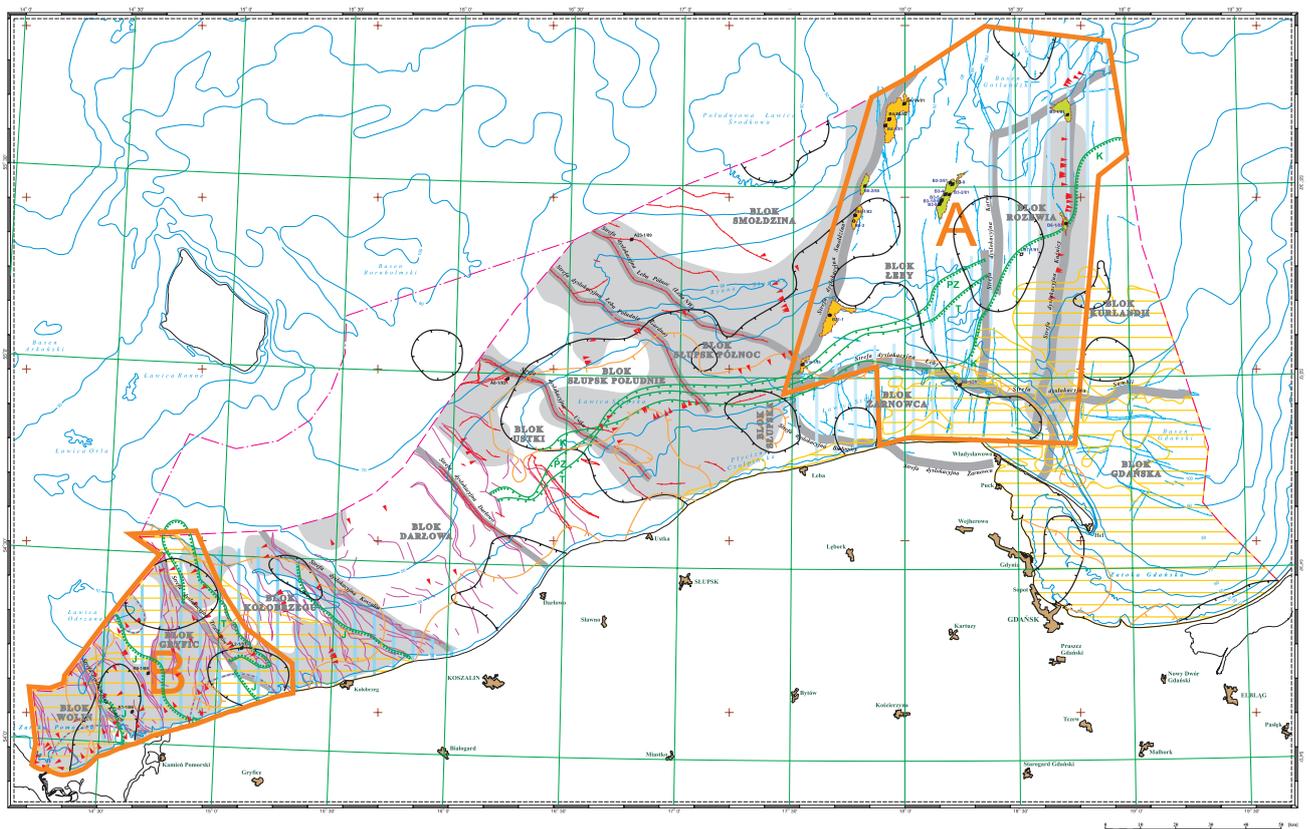
## CONTAMINATION OF SEABED SEDIMENTS

### Geochemical Studies of the Southern Baltic Sediments from the Point of View of Geogenic Contaminations

The whole area of the Polish Exclusive Economic Zone of the Baltic Sea is shown to be prone to contaminations with various types of liquid and gaseous harmful matter, the origin, chemical composition and physical properties of which are the result of geological processes. The risk of contamination is the highest in eastern part of the Polish EEZ, comprising the Kurland, Rozewie and Łeba Blocks (including the Smółdzino Fault Zone) and eastern part of the Żarnowiec Block, and in the west – south-western part of the Kołobrzeg as well as Gryfice and Wolin Blocks. Despite of large thickness of the seal composed of Silurian clay shales and Zechstein rock salt, fault zones can act as fluid and gas conduits making possible escape of significant amounts of hydrocarbons from parent rocks and oil and gas reservoirs. In result, concentrations of liquid hydrocarbons in near-bottom water layer in the Polish EEZ are equal 50–200 mg/l. So high concentrations mean that the environment is strongly polluted and have negative influence on the whole ecosystem of the Baltic Sea.



Fragment of the Map of Geogenic Activity in the Kuźnica Dislocation Zone



Southern Baltic; A, B – areas of the highest risk of geogenic pollution

## STABILITY OF SEA COAST

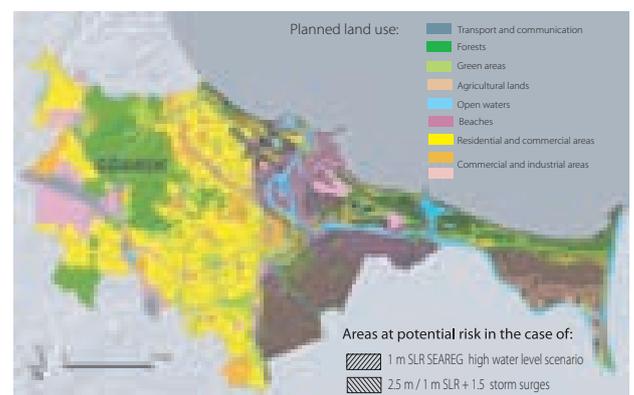
### Geodynamic Map of Polish Coastal Zone of the Southern Baltic Sea in the scale 1:10,000

Data used to compile 32 map sheets in analog form in the years 1994–1997 were updated and supplemented. Each sheet was supplemented with a documentation map and those showing lithology of surface sediments, stability of sea coast, deposits of mineral raw materials, groundwaters, geological-engineering conditions and areas and objects placed under legal protection. The map provides information necessary for implementation of strategy of coastal protection measures in accordance with the Act of the Polish Parliament, introducing many years' *Programme of Sea Coast Protection* (Journal of Laws, No. 67, Item 621, 18 April 2003). At the same time the map is an important source of data usable for such tasks as for example delineation and designation of protection zones for the coastline-encircling "technical belt".

## CLIMATE AND SEA LEVEL CHANGES

### Developing Policies and Adaptation Strategies to Climate Changes in the Baltic Sea Region (ASTRA)

Coastal erosion, floods due to high sea level and those caused by rivers, rise of groundwater table, local floodings and saltwater intrusions to aquifers were recognized as most important potential adverse effects for coastal areas of Sopot and Gdansk and a part of the Pruszcz Gdański commune. The map *Effects of Climate Changes in the Gdansk Region* shows shares of areas of different types of land use in zones susceptible to impact of such changes. It also shows assessments of vulnerability of groundwaters of the Gdansk region to pollution which may result from

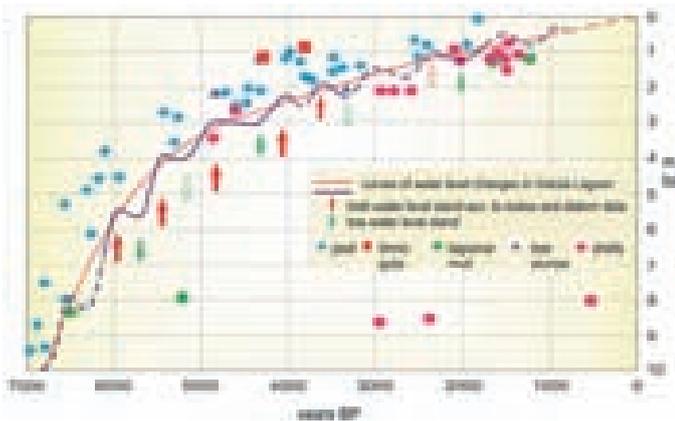


Gdansk; areas prone to floods and local floodings as assessed in model simulations of sea-level rise (SLR) impact

the forecasted climate changes. This project was co-financed by The Baltic Sea Region INTERREG IIIB Neighbourhood Programme and coordinated by the Geological Survey of Finland.

### Sea Level Changes in the Vistula Lagoon in the Middle and Late Holocene

The studies covered the areas of coastal peatlands and bottom of the Vistula Lagoon and comprised diatom, palynological and chemical analyses (including analyses of stable  $^{13}\text{C}$  i  $^{15}\text{N}$  isotopes) and datings by the AMS  $^{14}\text{C}$  method. On the basis of datings of peats, muds, wood and shells and location of these samples in relation to the present sea level it was shown that between 7500 to 5000 years BP the water level rose from  $-15\text{ m}$  to  $-5\text{ m}$  and that 2000 years BP it was still one meter lower than at present. Transgressive-regressive cycles with a duration of from about 500 to 600 years and amplitudes of about 0.5 m were superim-



Curve of relative water level changes in the Vistula Lagoon

posed on this long-lasting trend of slow rise of water level. Ingressions of the Vistula Lagoon waters into peatland areas are dated at 6000–5900, 5400, 4800, 4000, 3600 and 2400 years BP. In turn, regressions are dated at 5700, 4300 and 2000 years BP and less certain signs of low water level – at 6300, 5200 at 3400 years BP. The recorded cyclicality in oscillations of water level in the Vistula Lagoon appears consistent with changes in atmospheric and ocean circulation in the North Atlantic region with a duration of 1650 (1500), 1000 and 550 years.

### Holocene Climatic and Environmental Changes in the Gdańsk Region

On the basis of results of interdisciplinary studies of biogenic sediments representing various sedimentary environments of the Kaszuby Lake District and coastal areas of the Gulf of Gdańsk, an attempt was made to trace environmental changes during the Holocene times. Reconstructions of evolution of climate and local and regional sea level changes and coastal zone development were especially important for in these studies. Sediments of high peat bogs of the Kaszuby Lake District appeared to be a source of valuable information on palaeoclimate and palaeoenvironment. The sediments yield well preserved pollen and microfauna and they provide excellent material for <sup>14</sup>C dating. Lagoon and coastal peat bog sediments also provide information on sea level changes as well as palaeoclimate. Cor-

relation of palaeobotanic, palaeozoological, lithological, palaeomagnetic and geochemical data obtained for sediments representing different sedimentary environments is important for reliability of palaeogeographic reconstructions. The studies made it possible to gather precise information on environmental and climatic changes during the last 1200 years. The data are especially clear in the case of the so-called “Little Ice Age”.

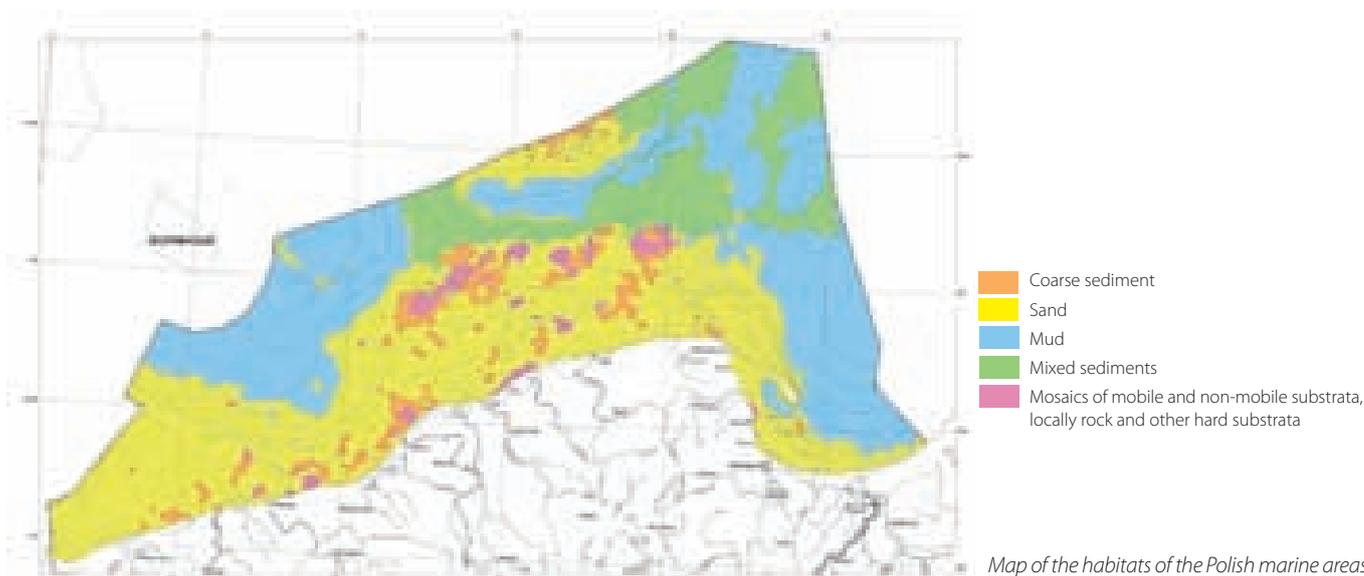
### Climatic and Environmental Changes in the Southern Baltic and Pomeranian Region at the End of the Last Glaciation

Climatic changes from the end of the Last Glaciation were reconstructed on the basis of results of analyses of changes in malacofauna and ostracod assemblages occurring in lacustrine sediments of the Late Glacial age. The studies comprised eastern part of the Pomeranian region, covered by the ice sheet during the Late Vistulian. The obtained results showed that five out of nine areas covered by detail studies (Mukrz, Szlaga-Młyn, Żurawki, Sominy and Czechowo) were situated just behind the line of the maximum extent of the ice sheet of the Pomeranian phase, mostly within limits of sandur fields formed during this phase. The remaining four areas were situated in the front of the ice-sheet or (Boże Pole Szlacheckie) within marginal zone of the ice sheet. The studies on sediments of the Wietcisa and Wierzyca river valleys passing through a young glacial area formed by the Late Vistulian ice sheet, showed that these valleys are of a polygenic origin and use fragments of subglacial channels. These channels were formerly lakes the origin of which was linked to the dead ice melting processes that occurred during the Late Glacial times.

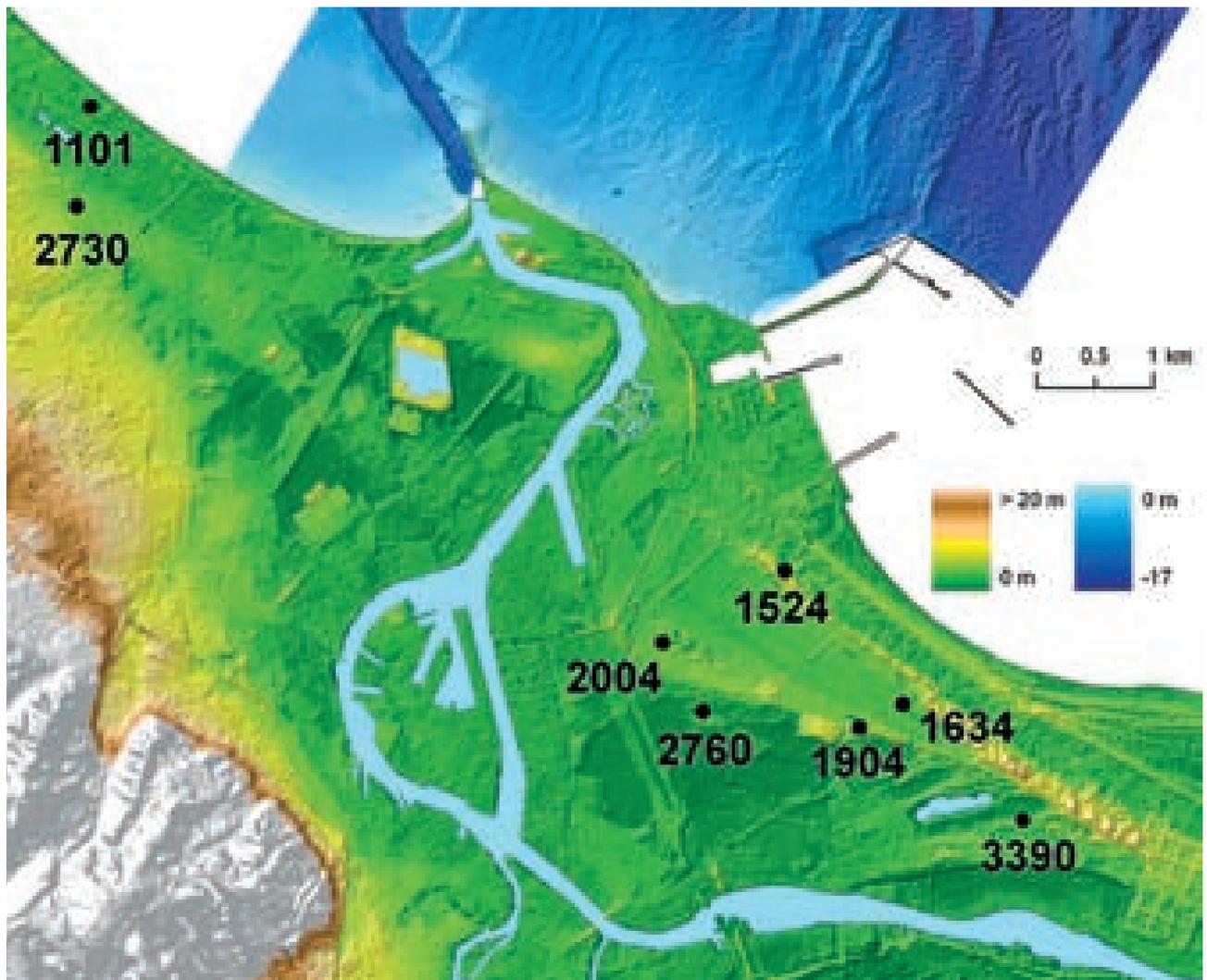
### SPATIAL PLANNING AND PROTECTION OF NATURAL RESOURCES OF THE BALTIC SEA

#### Ecosystem Approach to Marine Spatial Planning – Polish Marine Areas and the NATURA 2000 Network

A methodology of use of results of interdisciplinary studies for compilation of maps of habitats was worked out with reference to areas most vulnerable and at the same time most strongly diversified from the point of view of natural resources, that is the



Map of the habitats of the Polish marine areas



*Optically Stimulated Luminescence (OSL) datings of dune sands of the Wisła Martwa mouth at the background of detailed model of this area*

Puck Bay, Słupsk Bank with its stony reefs and central Polish coast. Complex approach in studying these environments made it possible to define statistical probability of co-occurrence of geological, hydrological and biological parameters characteristic for individual habitats.

This project was implemented by PGI in cooperation with the Institute of Oceanology of the Polish Academy of Sciences, Gdańsk University, Maritime Institute in Gdańsk, Sea Fisheries Institute in Gdynia, Geoscience and Marine Research & Consulting GEOMOR Ltd. and Norwegian Institute for Water Research.

#### **Managing Cultural Heritage Underwater (MACHU)**

Popularization and wide dissemination of knowledge of underwater archaeological sites are the main goals of the MACHU Project. About a dozen archaeological sites in northern and central Europe have been selected for further studies. Three of these sites are situated in Polish sector of the Baltic Sea: roadstead of the Gdańsk harbour, submerged medieval harbour at Puck and submerged forest in area between Ustka at the Polish coast and Słupsk Bank.

The major tasks in studies in the area of the Gdańsk harbour roadstead include reconstruction of development of mouth of Wisła Martwa river (one of the branches of Vistula, flowing through the city of Gdańsk) in search for antique wrecks, combined with attempts to estimate the rate of the growth of the land part of the outlet fan and corresponding changes in location of the shoreline. The datings of dune ridges in area of the Wisła Martwa river mouth by OSL method provided information on age and rates of growth of the river outlet cone.

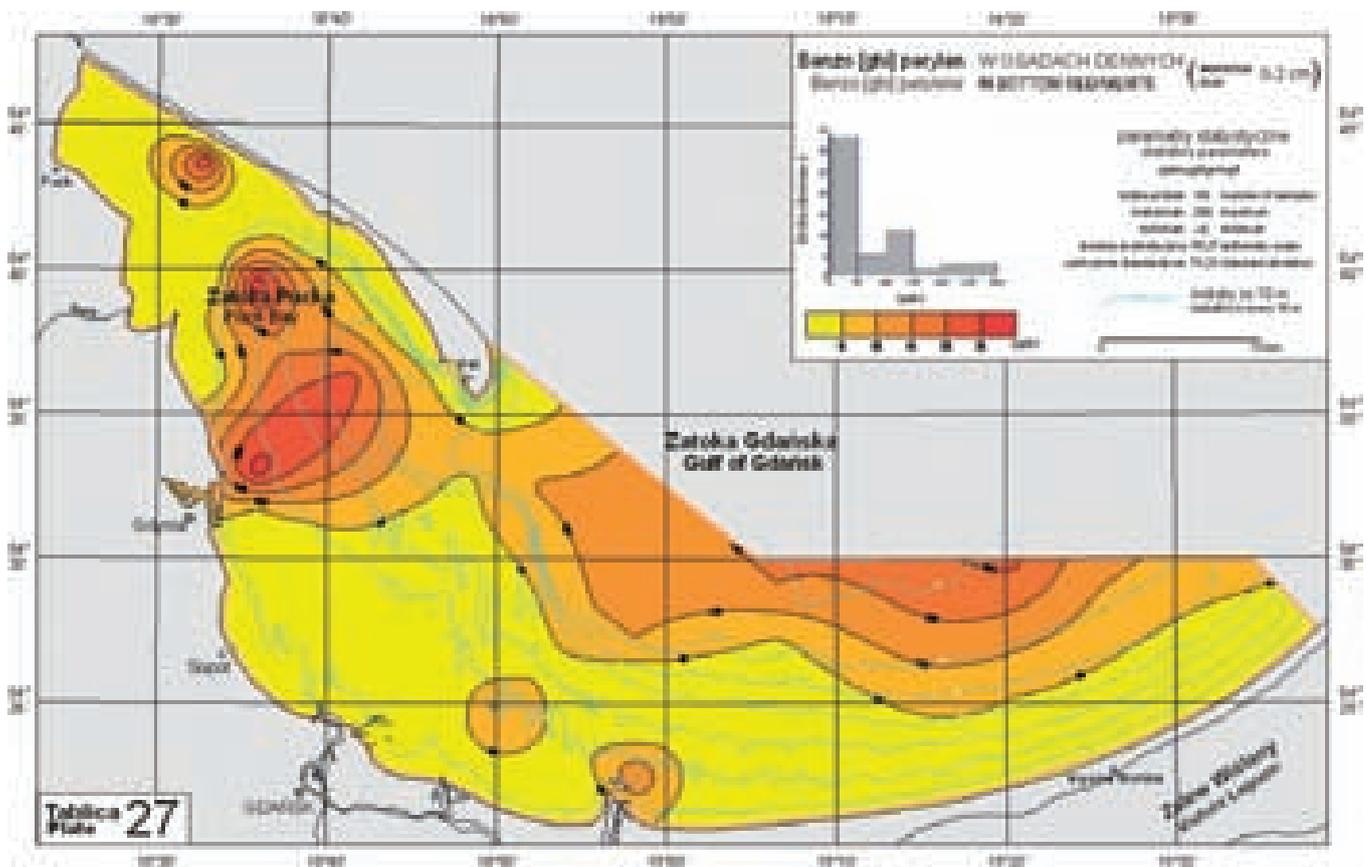
In the case of Puck, the studies are aimed at identification of natural factors which could be responsible for destruction of the harbour. The studies involved recognition of geological structure and palaeoenvironments and dynamics of erosion of the gulf bottom and shores.

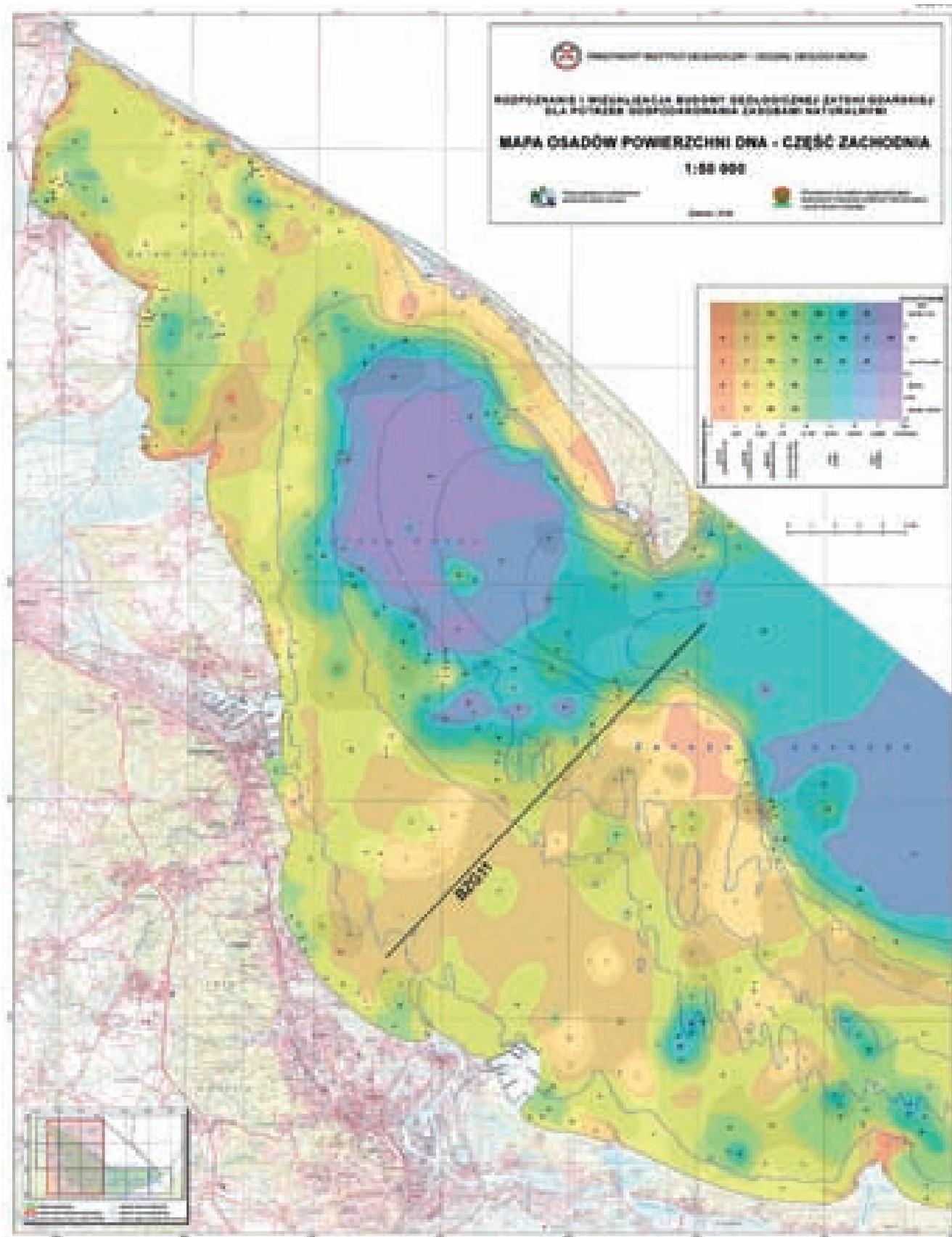
The area of the submerged forest is regarded as a potential archaeological site of Palaeo- or Mesolithic cultures. The studies are currently concentrated on reconstruction of an environment from the Boreal and Atlantic transition.

**Recognition and Visualization of Geological Structure of the Gulf of Gdańsk for the Needs of Management of Natural Resources**

The Gulf of Gdańsk is an intensively used multi-purpose resource. Taking aside shipping and fishing, this is the area with highly diversified infrastructure (pipelines, cables, fairways, roadsteads and anchorages) and with sites for disposal of dredged material. At the same time, some parts of the Gulf are under legal protection as marine and coastal protected areas, landscape parks or areas regarded as of the utmost importance for preservation of plant and animal species known to be very rare or threatened with extinction and characteristic natural habitats important for preservation of nature and biodiversity in Europe. This makes it necessary to minimize conflicts between the needs for extraction of natural raw materials and other uses of the sea floor and the necessity to protect ecosystems. Studies on these issues should facilitate the process of making decisions which would help to prevent or minimize such conflicts and balance exploitation in relation to the nature preservation requirements. The studies provided new details of the geological structure and relief of sea-floor as well as surface sediments and their

geochemistry. The collected information is shown in maps in the scale 1:50,000 for western part of the Gulf and 1:100,000 for the eastern part. The data made it possible to update information on concentrations of individual elements in sea-floor sediments and showed distribution and concentrations of polycyclic aromatic hydrocarbons (PAH), especially noxious to the ecosystem. It was found that concentrations of benzo[a]anthracene and benzo[ghi]perilene locally exceed admissible levels. Information on presence of potentially exploitable deposits of sands is also valuable as the sands may be used for artificial beaches nourishment. The results of the Project show the necessity to provide legal protection for inanimate nature sites such as areas of especially high differentiation of sea-floor relief, differentiation of sediments and biocenoses or sites of special importance for palaeogeographic studies, such as those with remnants of submerged ancient forest at the floor of the Gulf of Gdańsk. Here it should be stated that although the necessity to provide legal protection for animated nature and cultural heritage (antique ship wrecks, archaeological sites) in marine environment is quite obvious, the issue of legal protection of sea-floor geodiversity was not taken into account up to now.



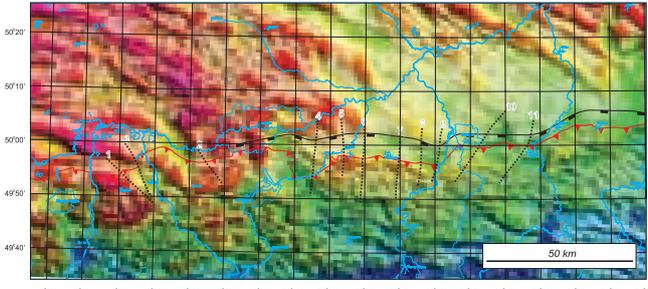


Map of surface sediments in western part of the Gulf of Gdańsk



## Structure, Evolution and Hydrocarbon Potential of the Carpathian Orogenic Front and its Basement

The studies were carried out in cooperation with AGH University of Science and Technology, Jagiellonian University and University of Wrocław, within the frame of a goal-oriented project financed by the Ministry of Science and Higher Education. The studies comprises integrated geophysical-geological analysis of structure and evolution of orogenic front of the Carpathian Mts. and its basement in the Pilzno-Andrychów zone. Geophysical surveys along



Location of regional seismic transects at the background of processed gravity map (harmonic shadowed relief of the half-width vertical derivative of Bouguer anomalies, illuminated from NE) from the area Pilzno-Andrychów

geo-seismic transects and results of biostratigraphic and mesostructural studies made it possible to recognize geometry and deposit conditions in the studied region. The Wojnicz area was found to be the most perspective from the point of view of hydrocarbon potential. In this area, hydrocarbon accumulations may be present in Miocene and/or Palaeogene sedimentary infill of the Wojnicz palaeovalley, its Jurassic surrounding or structural elements of a triangular Miocene zone. The studies are to be followed by a new seismic surveys of the Polish Oil and Gas Company.

## Zechstein Salt Structures as Underground Hydrocarbon and Fuel Storage Sites

Within the frame of international NATO-CCMS project coordinated by PGI, selected structures and salt deposits in the Polish Lowlands, Gulf of Gdańsk and Puck Bay were analysed from the point of view of their usability as sites for underground facilities for storage of oil, natural gas and fuels. All the pre-selected structures

and salt deposits fulfill the basic requirements for such sites, that is those of complete tightness and lack of any adverse reactions between hydrocabons and fuels and the surrounding rocks.

An additional advantage of rock salt deposits of the Puck Bay and Gulf of Gdańsk as potential storage sites is the location in proximity of major oil and gas pipelines. Moreover, brines originating in the process of cavern leaching may also appear very useful. The project assumes that these brines after dilution and saturation with oxygen will be discharged to the Puck Bay and Gulf of Gdańsk to improve oxygen conditions in the near-bottom water layer in these basins. Large thickness of Zechstein rock salt seams in this area makes possible formation of caverns with capacity up to 200,000 m<sup>3</sup>, that is sufficient for storage of several dozens or even up to 100 million tonnes of oil or fuels.

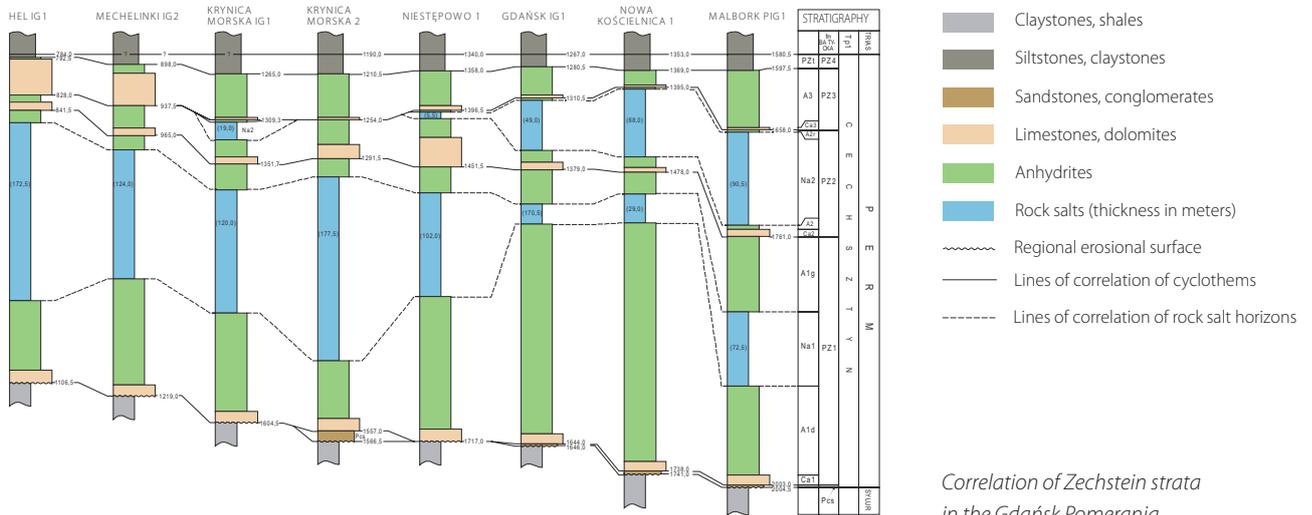
In the area of the Polish Lowlands, the analysis covered diapir-type salt structures situated close to NATO military bases. The *Goleniów*, *Damasławek*, *Rogóżno* i *Dębina* salt diapirs were shown as potential sites for fuel storage facilities, especially for the Air Force.

This project provided information of special importance for working out a strategy that would guarantee the energy safety of the country and, in this way, economic safety. The requirements of energy safety of the country and those imposed by the European Union on its members make it obligatory to hold emergency reserves equivalent to 90 days of domestic consumption. The possibilities to store several dozens million tonnes of oil also mean that the real diversification of fuel supply is achieved and, at the same time, make any eventual "energy blackmail" much less threatening.

## Possibilities of Use of Horizontal Drillings in Extraction of Coal-Bed Methane (CBM)

EurEnergy Resources commissioned PGI to conduct a geological-deposit study aimed at finding optimum locations for drillings and carrying out well tests for assessing CBM productivity of the coal-bearing formation in the *Frydek* area of the unexploited *Międzyrzecze* coal deposit in southern part of the Upper Silesian Coal Basin.

The studies on structures of the Carboniferous and its coal-bearing strata and resources made it possible to identify a potential deposit series of coal beds with methane content over 4.5 m<sup>3</sup>CH<sub>4</sub>/t of crude



Correlation of Zechstein strata in the Gdańsk Pomerania

coal matter. Detailed analyses of the setting of this series and sedimentary and tectonic conditions gave the basis for identification of target coal beds with the highest CBM recovery potential.

## Coal

### Coal Resources of Abandoned Mines

In cooperation with the Polish Academy of Sciences Mineral and Energy Economy Research Institute, PGI carried out an analysis of possibilities to reopen exploitation in 41 mines of the Upper and Lower Silesian Basins which were closed in the process of restructuring of Polish coal industry. The evaluations involved ranking of the coal deposits in accordance to size and quality of coal reserves, geological-mining conditions, potential hazards, environmental impact of exploitation, results of economic analyses, formal and legal aspects and other factors. Deposits of *Dębieńsko*, *Żory*, *Morcinek* and *Jan Kanty* mines got the highest marks, eight deposits were classified as less promising and the remaining ones were recognized as negative. There were also worked out proposals of premises for indispensable changes in the current legal regulations concerning procedures of closing the mines and protection of the remaining resources.

## METAL ORES

### Zinc and lead ores

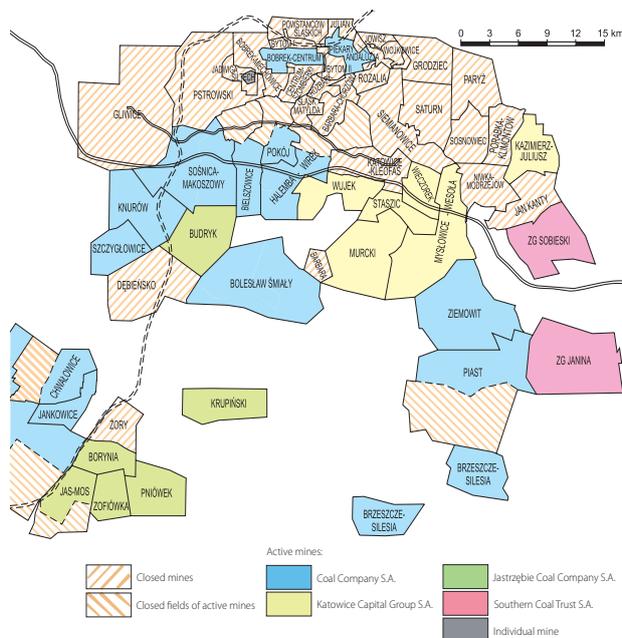
#### Deposit Prognosis for Contact Zone of the Upper Silesian and Małopolska Blocks

Core material from 284 wells in the contact zone of the Upper Silesian and Małopolska Blocks was studied in cooperation with AGH University of Science and Technology. The obtained results made it possible to trace spatial distribution of ore mineralization in Palaeozoic and Precambrian rocks in the regional scale. Compilation of maps of the mean concentrations of Mo, Cu, W, Pb and Zn in the studied rocks gave the basis for finding areas with the richest ore mineralization. In the Małopolska Block, there were differentiated five regions of perspective Mo-Cu-W porphyry mineralization (Nowa Wieś Żarecka-Myszków-Mrzygłód, Żarki-Kotowice, Zawiercie, Pilica and Dolina Będkowska), and in the Upper Silesian Block – the Mysłów region with porphyry mineralization and the Poręba-Łazy-Klucze region with polymetallic mineralization related to karstification events. Quantitative evaluations of Zn-Pb mineralization in Triassic rocks were also made and four prognostic areas (Woźniki, Żarki and an area NW of Myszków) were differentiated to facilitate delineation of concession blocks.

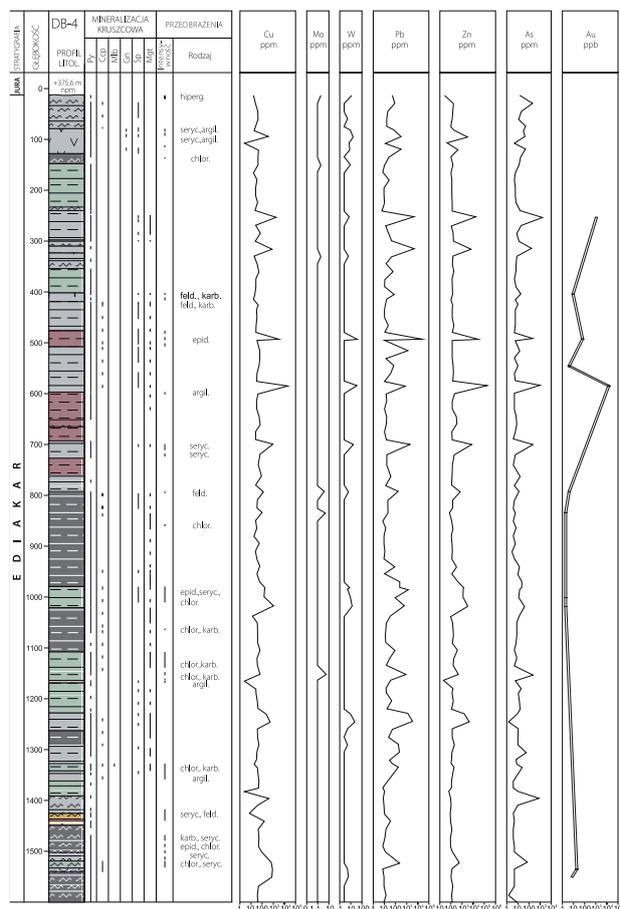
## NATURAL AGGREGATES

### Resources of Glass Sands

Valorisation of resources of hitherto unexploited glass sand and sandstone deposits in Poland showed that those of the Cretaceous of the Tomaszów and North Sudetic basins are the most perspective in this group. This is due to size and quality of the resources as well as possibilities of exploitation. Moreover, the obtained product should match requirements of high quality raw material for several sectors of the glass industry.



Coal mines in the Upper Silesian Coal Basin



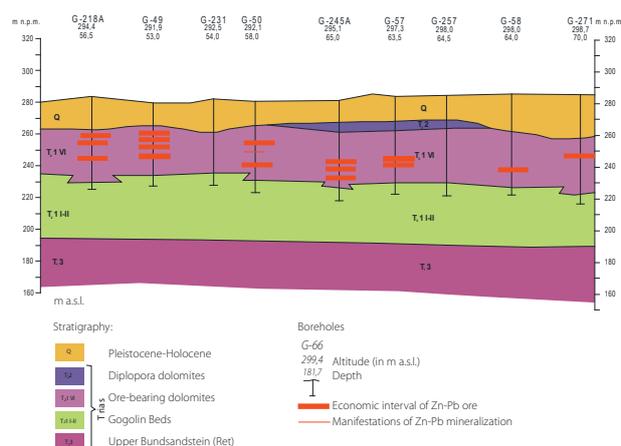
Deposit prognosis for NE margin of the Upper Silesian Coal Basin

The studies made it possible to identify perspective areas and define basic premises for further geological surveys and documentation works. The obtained results significantly changed estimates of size and quality structure of resources of glass sands and sandstones in Poland. The data made it possible to upgrade the resources for over 270 million tonnes, including about 190 million tonnes of „dry” deposits, that is deposits occurring above the water-bearing horizon.

### Reappraisal of Unexploited Zn-Pb Ore Deposits

Annexes reappraising resources of the *Goluchowice*, *Marciszów*, *Zawiercie I* and *Zawiercie II* Zn-Pb deposits to the categories of indicated and inferred resources (C1 and C2 categories in the Polish subdivision) were made. Boundaries of these deposits were redefined and maps of occurrences of ore mineralization and results of estimations of resources were compiled along with cross-sections through the deposit areas. Moreover, data on mineralization and Zn-Pb reserves were tabularized.

Resources were estimated on the basis of archival results of prospecting and documentation and with reference to new economic criteria introduced by the Regulation of the Minister of the Environment of 9 January 2007 (Journal of Laws from 17 January 2007). In these estimations there was also used a new method of spatial autocorrelation circles around every borehole in which economic mineralization has been found. The results of studies made possible reappraisal of resources of these deposits. In the *Goluchowice* deposit, indicated mineral resources of Zn-Pb ores in the ore-bearing dolomite of the Triassic, traced in area of 627.7 hectares, were estimated using the newly introduced criteria at about 29 million tonnes, with the mean concentrations of Zn equal 3.4% and Pb – 1.1%.



Fragment of geological section through economic intervals of the *Goluchowice* Zn-Pb deposit

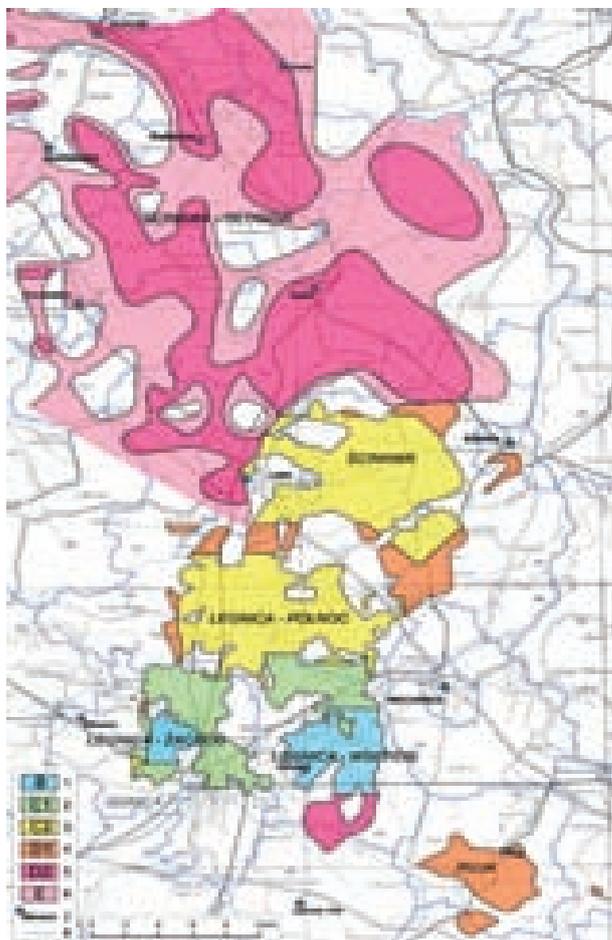
A conflict between land use plans of the city of Zawiercie and the *Zawiercie I* and *Zawiercie II* deposits made it necessary to downgrade resources of Zn-Pb ores to area of 900.1 and 345.2 hectares, respectively. This resulted in downgrading resources of these ores in the ore-bearing dolomites of the *Zawiercie I* to about 17 million tonnes with the mean concentrations of Zn equal 5.1 % and Pb – 2.1 %. In turn, reserves of the *Zawiercie II* were downgraded to about 2.9 million tonnes with the mean concentrations of Zn equal 7 % and Pb – 2.4 %. Eventual further exploration of deposits of the Zawiercie region would require making additional prospective drillings. This is especially the case of the area of the *Zawiercie II* deposit with reserves estimated on the basis of insufficiently dense network of ore-prospecting boreholes. Similar is the case of the *Marciszów* deposit. The use of new method of assessments along with insufficiently dense network of prospecting boreholes resulted in marked downgrading of ore reserves to about 0.7 million tonnes and, therefore, in removal of this deposit from

*The Annual Report of Mineral Reserves/Resources and Groundwater Resources in Poland.*

### Geological and Economic Resources of Lignites

PGL participated as a partner of consortium in *Foresight* Project of the EU Sectoral Operational Programme – *Improvement of the Competitiveness of Enterprises, years 2004–2006*, subsidized by the European Commission. In this Project PIG was the coordinator and major executor of *Analysis of balance of resources and identification of geological conditions of occurrence of lignite in perspective deposits* and co-executor in three other tasks.

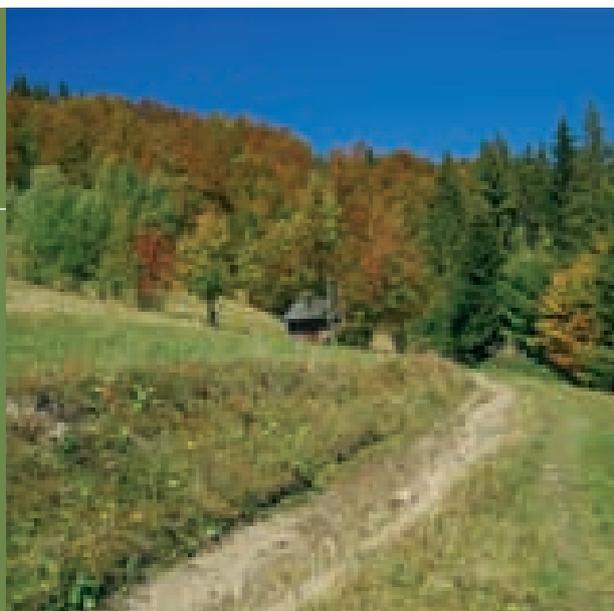
The analyses comprised lignite resources, geological conditions in areas selected as perspective for exploitation of lignite deposits and the current state of exploration of resources in coal-bearing regions and programmes of further exploration and geological studies were elaborated. The analyses made it also possible to present distribution and detailed geological characteristics of proven reserves and perspective resources of satellite deposits occurring in areas of interest of the active lignite mines (*Adamów*, *Belchatów*, *Konin*) and in selected regions of occurrence of the most perspective but still not exploited lignite deposits (Legnica and Gubin lignite deposit groups). The direct effects of these works included initiation of geological-reconnaissance studies by the *Adamów* Lignite Mine in the Grochowy-Siąszyce region. Preparation of project of these studies was commissioned to PGL by the *Adamów* Mine.



Resources of the Legnica lignite deposit group

## PROTECTION OF THE EARTH SURFACE AND NATURAL RESOURCES

With future generations in mind



### SYSTEM OF SPATIAL INFORMATION ON THE ENVIRONMENT

#### Geological-Economic Map of Poland in the scale 1:50,000

In 2007, compilation of *The Geological-Economic Map of Poland in the scale 1:50,000* has been completed and the number of its sheets prepared in the years 1997–2007 rose to 1069. PGI was the major coordinator and executor of this map. The map presents perspectives and prognoses of occurrence of mineral deposits and their use and classification as well as real and potential risks for the natural environment in result of presence and exploitation and processing of these deposits. These issues are shown at the background of selected hydrogeological elements, natural monuments and areas under protection (including soils, forests, nature reserves, national and landscape parks, protected landscape areas and ecological farms), cultural heritage objects and building site factors affecting foundation conditions, including the risk of damage due to mining subsidence. The map was designed mainly to help regional and local self-governments and state administration agencies in land-use planning processes.

#### Map of Degraded Areas and Areas of Increased Natural Hazard Risks in the scale 1:10,000

A set of cartographic guidelines was prepared along with four pilot sheets of *The Map of Degraded Areas and Areas of Increased Natural Hazard Risks*. The set is a database in GIS (SIP) system. Depending on specific character of a given thematic group, the database comprises data concerning geology, hydrogeology, environmental geochemistry, natural and anthropogenic hazards including risk of mining-induced damage, types of soils, surface and underground technical infrastructure, land use plans and protection of mineral deposits (for more information see the Chapter *Geohazards*).

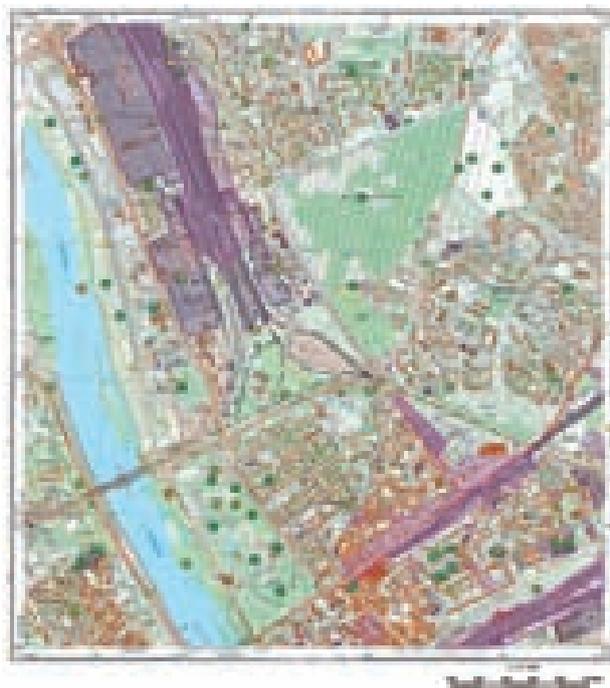
*Map of zinc concentrations in soils and sediments at the background of potential centers of pollution in area of Warsaw*

### ENVIRONMENTAL POLLUTION

#### Hydrocarbons

##### Contamination of Groundwater and Soil at Petrol Stations

Pollution of water and soil environment was studied at closed and/or still operational fuel stations on military bases in areas under supervision of the Regional Infrastructure Office in Szczecin. Soil samples were analysed for content of gasoline and mineral oils, and water samples – for content of mineral oils and compounds of BTEX group. The studies showed that several studied objects require remediation because of an excessive content of oil derivatives in soils. The recorded soil contamination was found to be related to inappropriate exploitation of the objects and not to leaky fuel reservoirs. The results of these studies will be the basis for drafting detailed projects of in-situ treatment and remediation of areas of selected closed fuel stations.





Taking water sample from piezometer located close to underground fuel reservoirs

## RADIOACTIVE ISOTOPES

### Caesium in Soils and Plants in the Opole Anomaly Area (20 Years After Accident in Chernobyl Nuclear Power Plant)

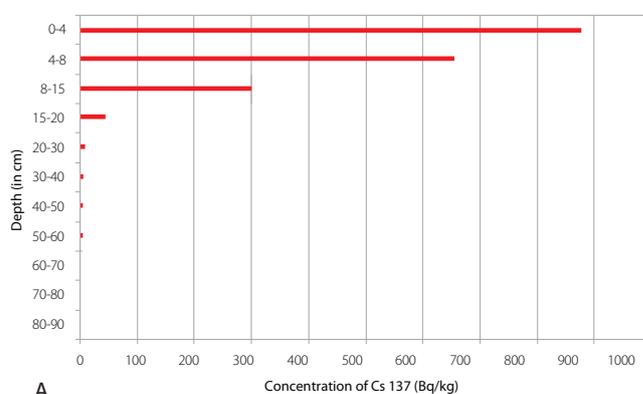
The studies performed in the year 2007 comprised analysis of 92 samples of soils, forest soils and vegetation from 10 sites situated close to trenches made in the sampling programme from the years 1996–1997. The obtained results showed significant decrease in activity of post-Chernobyl caesium, combined with some downward migration of this isotope in the soil profile. The highest recorded concentrations were as follows (values obtained 10 years earlier are given in brackets): in fresh forest litter – 1,357 Bq/kg (3,663 Bq/kg), fermented forest litter – 1,613 Bq/kg (3,561 Bq/kg), blueberry bushes – 484 Bq/kg (3,559 Bq/kg) and mosses – 776 Bq/kg (4,655 Bq/kg). The obtained values are similar only in the case of forest grass, for which they are equal 1,520 Bq/kg and 1,491 Bq/kg, respectively. In forest areas, the highest concentrations of caesium in 20 years after the Chernobyl accident are recorded at the depth of about 10 cm. However, caesium was found to be already present at depths of about 20 cm whereas 10 years ago the contamination was still limited to the forest litter and its fermentation layer, that is to 5 cm of the top part of soil profile at the most. Similar situation is found on meadows. Ten years ago the contamination was concentrated in turf and top part of the soil profile down to the depth of 5 cm whereas at present the highest contamination is recorded at the depth of 15 cm but effects of downward migration of caesium are clearly traceable even at 30–40 cm depth. This migration downward the soil profile proceeds quicker in meadow soils than in the forests which may be explained as due to less intense percolation of rainwater and more effective entrapment of caesium by litter layer in the latter areas. The presence of relatively high concentrations of caesium in fresh litter, that is litter usually 5 to 7 years old, shows that this isotope passes to solutions. This makes possible absorption of caesium by root systems of plants and when the plants die, enrichment of new layers of litter in products of their decomposition.

Concentration of post-Chernobyl caesium in soil profiles of:  
 A – forest at Szumirad;  
 B – meadow at Bierdzany;  
 C – agricultural land at Łambinowice

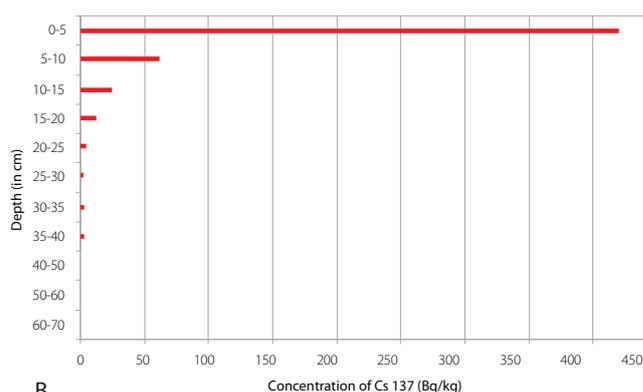
## METHODS OF STUDIES

### Groundwater Protection at Industrially Contaminated Areas

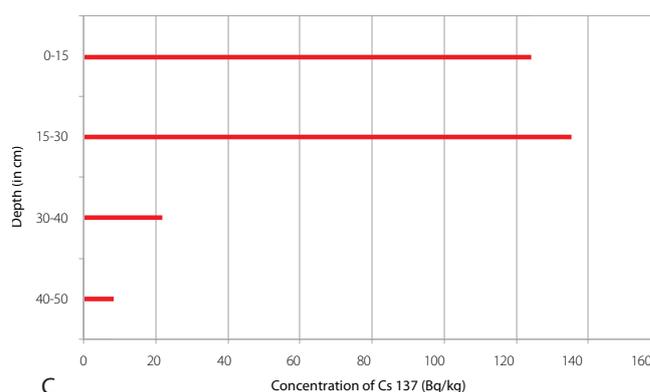
Within the frame of 3-years MAGIC Project – *Management of Groundwater at Industrially Contaminated Areas*, the concept of use of immission pumping tests (IPT) in studies on organic contaminations in groundwater was checked under realistic field conditions in the town of Olsztyn. An area with soils and groundwater contaminated by waste and leakages from coal gas plants that operated in the past in the center of Olsztyn was selected as a test site. Experience gathered in the course of IPT tests in very difficult, fluvio-glacial region of northern Poland, should be very useful in successive projects. The use of innovative IPT techniques and passive sampling devices in studies on groundwater is a significant contribution to the developments in surveys of areas of the brown-field type in Poland. The Project was implemented and completed as a part of INTERREG international cooperation programme.



A



B



C

**Efficiency of Control of Certification of Improved Soil-Groundwater Remediation and Monitoring Systems (PROMOTE)**

The Project has brought together a strong consortium of 12 partners representing small and medium enterprises, universities and research institutes as well as independent, respected laboratories and normalization centers interested in creating an European Environmental Technology Verification System (EU ETV). The certification has to guarantee that a given product (device or technology) is capable to give results of quality and reliability matching requirements of the modern environmental studies. The role of PGI was to find a strongly polluted area in Poland, which could be used as a site for checking usability of some devices and technologies and carrying out specialistic performance tests. The site was used for testing the newest model of portable Field Slandi LF300 Photometer, minipump for groundwater sampling and ceramic dosimeters. The obtained results of field works and laboratory studies made possible integrated analysis of the state of soil-groundwater environment in an area which in opinion of local administration, should be subjected to remediation as soon as possible. The Project was co-sponsored from funds of the 6<sup>th</sup> Framework Programme of EU.

**Magnetometry for Assessing Degree and Extent of Soil contamination**

Usability of field measurements of magnetic susceptibility ( $k$ ) for defining magnitude and lateral extent of pollution of soils in the neighbourhood of roads with heavy traffic was evaluated. Maps of  $k$  values were made for 18 locations and 21 soil profiles were sampled for petromagnetic and geochemical and SEM analyses. The studies showed that a zone of anomalous  $k$  values is traceable along all the roads. Such road-effect zone extends for least 15 m (and sometimes even 40 m) from edge of surface of road with heavy car traffic and should be excluded from agricultural use. Increased  $k$  values are traceable down to the depth of 30 cm from the surface. The major  $k$  carriers in such zones include iron and titanium oxides and metallic iron occurring in the form of irregu-



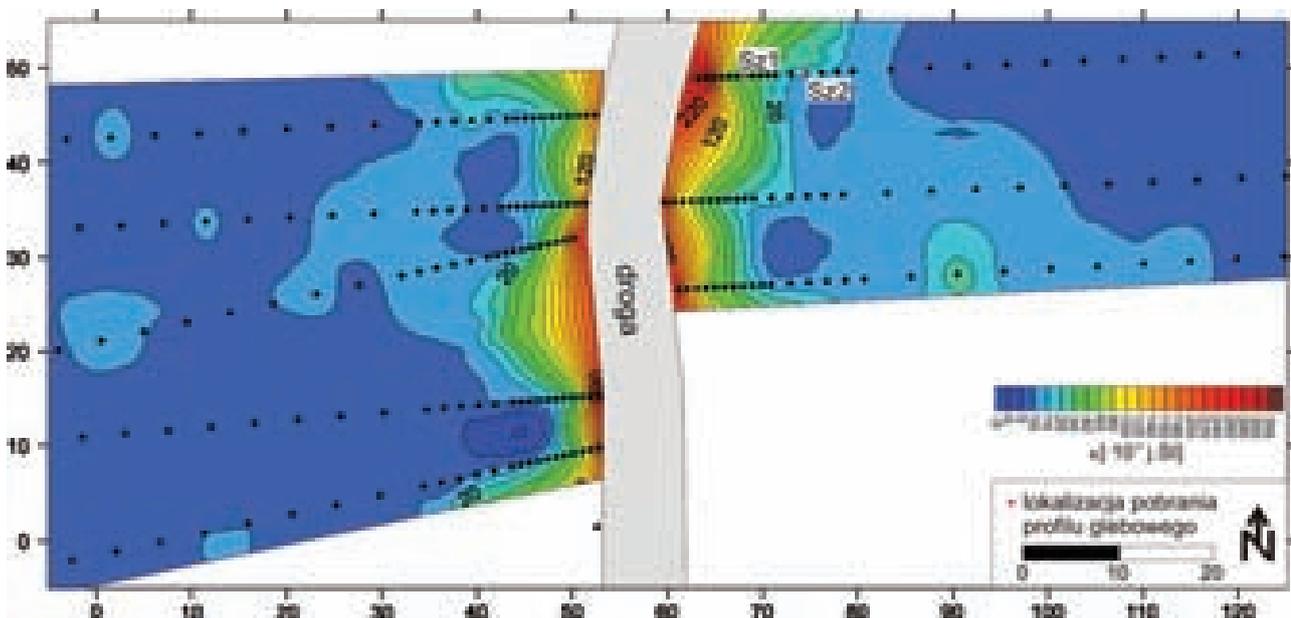
*Taking samples from piezometer of the CMT type for photometer testing*

lar grains and spherules. It should be also added that magnetic susceptibility of such anomalous areas is positively correlated with the recorded concentrations of Zn, Pb, S and Ni. Increased concentrations of these elements may be dangerous for health of people and animals. This makes quick and economic detection of zones of their increased concentrations so important.

**STATE OF THE ENVIRONMENT**

**Atlas of Abiotic Environment in the Border Zone of Ukraine and Poland**

The atlas was compiled in cooperation with the Institute of Geology and Geochemistry of Combustible Materials of the National Academy of Sciences of Ukraine in Lviv. Maps in the scale from 1:200,000 to 1:500,000 show geological structure, geoenvironmental conditions (raw material deposits and mining, surface waters and groundwaters, protection of nature and cultural heritage and land use), results of geochemical analysis, teledetection



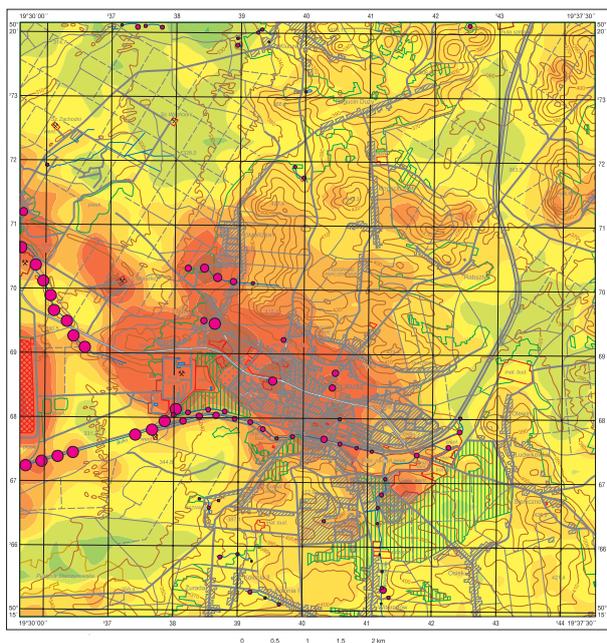
*Map of magnetic susceptibility of soils along National Road no. 47 (Zakopianka Road), about 3 km north of Szaflary*

and geophysical surveys, karst phenomena and geohazards and environmental conflicts. The collected and systematized information is indispensable for land use planning, rational use of natural resources and protection of natural environment in the boundary areas in accordance with general principles agreed by Ukraine and Poland.

### Detailed Geochemical Map of the Upper Silesia in the scale 1:25,000

The studies were aimed at geochemical recognition of the Silesian-Cracow region. They comprised systematic geochemical mapping of the Earth surface environments (soils, bottom sediments of flowing and stationary water bodies, surface waters) in areas of intense exploitation of Zn-Pb ores, coal, dolomites and clay raw materials and industrial minerals. The *Nowa Góra, Olkusz, Myslachowice i Chrzanów* sheets of the map have been published in the form of atlases with multimedia presentations on CD-Rs. The recorded concentrations of the studied elements indicate significant contamination of soils in the 0.0 to 0.3 m and 0.8 to 1.0 m depth intervals, as well as sediments accumulating in water reservoirs and surface waters. There is good correlation between results of analyses of surface soils (0.0–0.3 m) and those from the depth of 0.8 to 1.0 m. Contamination of the studied surface environments is mainly of the anthropogenic type. It is due to discharge of saline mine waters and influence of coal mining, mining and metallurgy of non-ferruginous metals and spoil heaps and waste piles of metallurgical works. In turn, outcrops of ore-bearing Triassic rocks should be treated as a natural source of contaminations with metals.

The results of these studies, presented in the cartographic form and collected in databases, will give the basis for assessments of usability of land for agriculture and forestation and may become the useful tool in land use planning (especially planning new residential and commercial areas, recreation centres and indus-



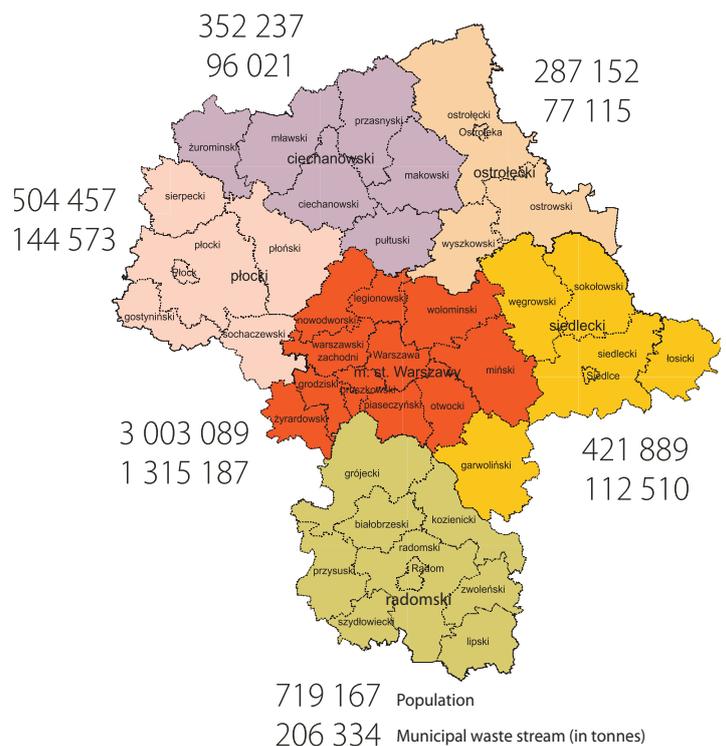
Lead in soils (0.0–0.3 m) and bottom sediments of water bodies; Olkusz sheet of The Detailed Geochemical Map of the Upper Silesia in the scale 1:25,000

trial areas), identification of areas requiring recultivation and/or remediation due to chemical pollution. They will also give a reliable basis for assessing and surveying health and environmental risks for people and animals.

### WASTE MANAGEMENT

#### Updating Waste Management Plan for the Mazowieckie Voivodeship

The Mazowieckie Voivodeship waste management plan for the years 2007-2011 and its projections for 2012-2015 was updated and revised. Priorities and major targets of this plan were indicated ensuring that they are aligned to the obligatory regulations of the domestic and European Union legislation. Moreover, there were made recommendations for management of municipal waste in accordance with EU Directive 99/31/EU. The recommendations include a proposal to divide the voivodeship area into six large subregions, each with population of over 300,000 people. Relevant goals and actions aimed at increase of selective collection of waste and a program of investments necessary for retrieval of raw materials and energy were proposed for each of these subregions. The Warsaw subregion is the major producer of municipal waste as the city of Warsaw by itself produces about 700–800 thousand tonnes of waste per year. The investment program for the Warsaw subregion must comprise installations for thermal processing of waste and retrieval of refuse-derived raw materials and compost plants for processing green and clear organic waste. The management plan is the basis for preparation of similar plans for powiats (counties) and communes as well as feasibility studies for investments in waste management for individual subregions of the Mazowieckie Voivodeship.



Municipal waste management subregions proposed for the Mazowieckie Voivodeship

### Geoenvironmental Map of Poland in the scale 1:50,000

*Geoenvironmental Map of Poland* (Plates A and B) shows the state and resources of the natural environment and at the same time it is a digital database for analysis of the environment. It is planned that this map will cover the whole area of the country in the year 2012. Its Plate A is *The Geological-Economic Map of Poland in the scale 1:50,000*, updated after five years, and Plate B – a new informative layer – *Hazards for the Earth's Surface*.

Plate A presents four groups of data: *Mineral Deposits* (measured mineral resources, indicated and inferred mineral resources, mining and processing of extracted material), *Waters* (surface waters, groundwater and offshore zone), *Subsurface Conditions* (foundation conditions, soils under protection, forest areas) and

*Environmental Protection* (protection of nature and landscape and cultural heritage).

Plate B – *Hazards for the Earth's Surface* comprises two thematic layers: *Environmental Geochemistry* and *Waste Disposal*. The first layer shows location of sampled points, contamination of soils with heavy metals, radioactive elements and organic compounds, pollution of sediments of water bodies with heavy elements, concentrations of radon emanations, classification of soils and sediments of water bodies. The second layer shows areas most suitable for location of waste disposal sites fully matching requirements of environmental protection and legislative limitations. Potential disposal sites have to match the requirements, especially ecological ones which somewhat differ depending on



*Geoenvironmental Map of Poland – the Chrzanów sheet (Plate A)*

the type of waste which is to be accepted. The three major types of waste include: hazardous, neutral, and waste other than hazardous and neutral. Such screening of areas for potential disposal sites facilitates further land use planning as well as documentation and designing works aimed at final selection of the sites. The information shown in the map should be also usable in verifying correctness of location of the active and closed waste disposal facilities from the point of view of legal and environmental criteria. The potential disposal sites shown in the map are situated in areas with packets of poorly permeable sediments in the subsoil, that is sediments which provide good natural isolation for underlying water-bearing horizons. Therefore the map should be also useful for the administration at the stage of agreeing conditions

and terms for location of investments and developments especially arduous to the environment and human health, and those which may deteriorate the environmental quality.

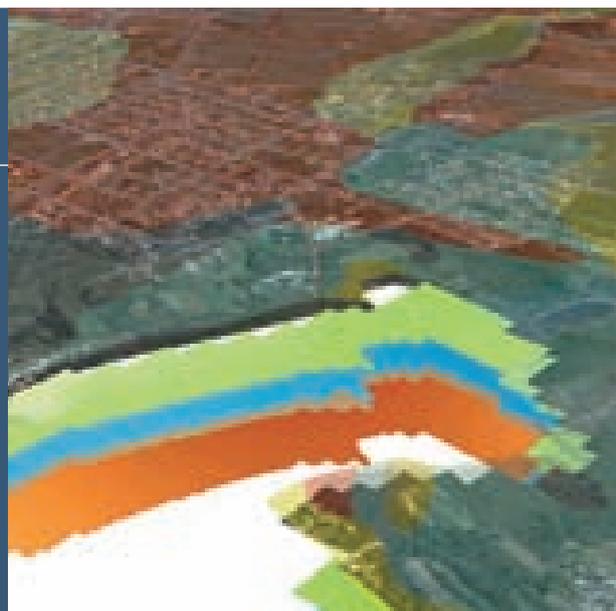
In 2007, compilation of 298 sheets of this map for the Wielkopolskie, Lubuskie, Świętokrzyskie, Kujawsko-Pomorskie and Podkarpackie Voivodeships has been completed. In 2008, there were initiated works on preparation of sheets for the Zachodniopomorskie and Pomorskie Voivodeships as well on new thematic layers of the map. The works included further development of thematic layer *Perspectives and Prognoses of Mineral Raw Materials* (within the *Mineral Raw Material Resources* information layer) and supplementing informative layer *Hazards for the Earth's Surface*.



Geoenvironmental Map of Poland – the Chrzanów sheet (Plate B)

## GEOLOGICAL CARTOGRAPHY

Power of knowledge and imagination  
– to measure and show hidden dimensions  
of underground structures



### DIGITAL SPATIAL MODELS

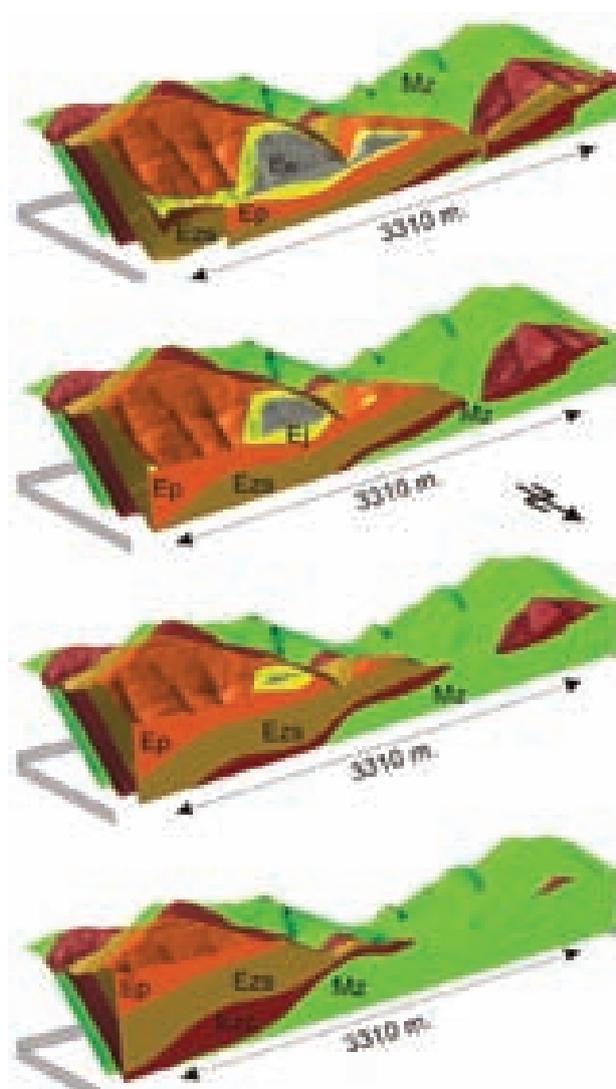
#### Modelling of Deep Structures on the Basis of Surface Data

The methodology of constructing digital models of deep geological structure of local mountain units on the basis of archival data on surface geology was elaborated at the example of the Beskid Maly Range. These methods appear useful in case of areas with relatively simple geological structure and with rich record of field geological data and archival material including geological maps and cross-sections, topographic maps, digital model of terrain surface and air photos. 3D structural models of western part of the Beskid Maly Range and Dukla Overthrust Zone in the Wetlina region and 3D lithostratigraphic model of the Eocene of the Tatra Mts. were constructed with the use of software of the Open Source type (Grass, Paraview) and the commercial one (Gocad).

### GEOLOGICAL MAPS

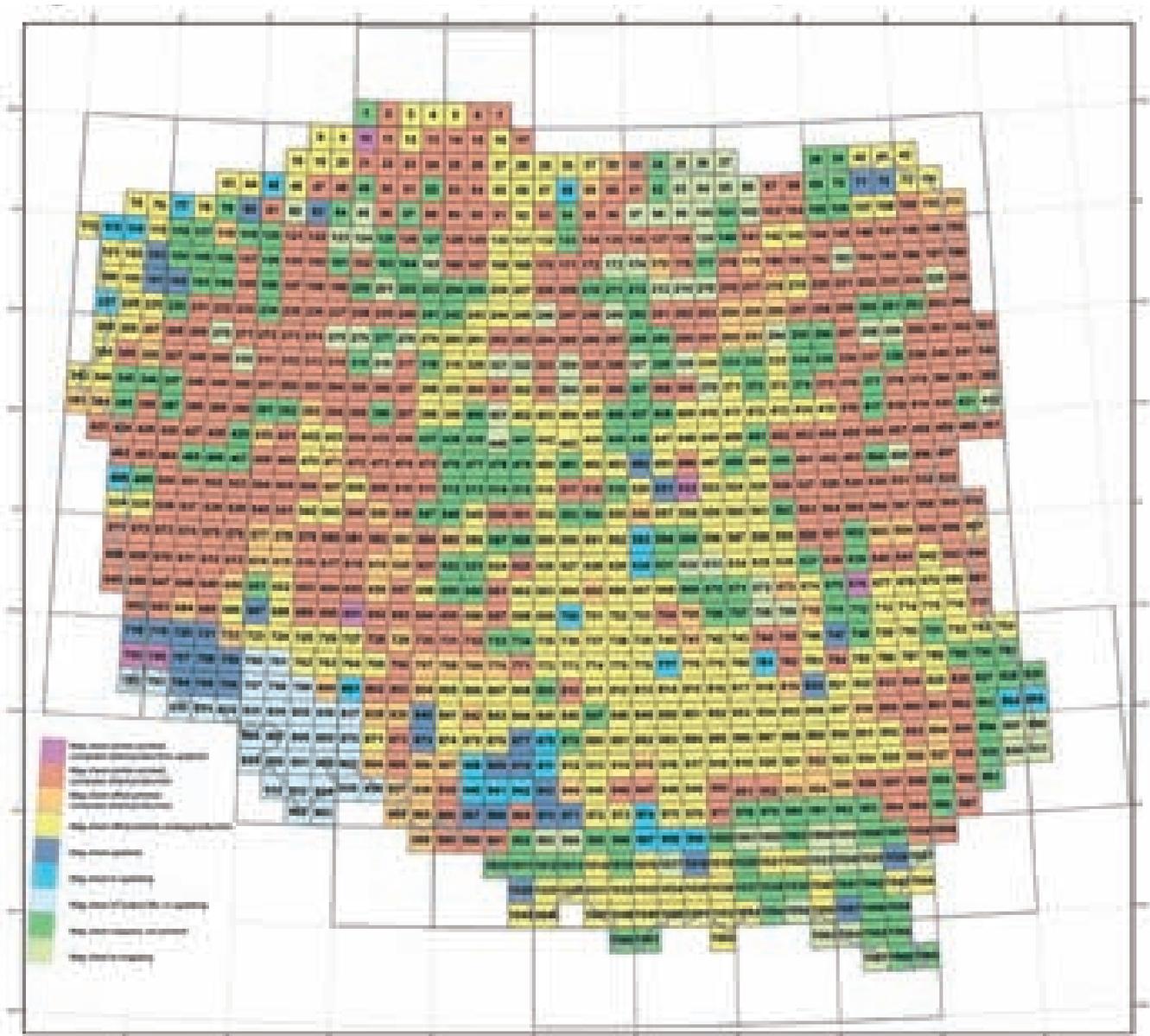
#### Lithogenetic Map of Poland in the scale 1:50,000

This is a series map compiled for the whole area of the country. It presents lithology and origin of surface sediments and selected geodynamic, anthropogenic and hydrogeological phenomena. The map should be useful in geological overviews, zoological and planistic studies and geotouristic analyses, identification of perspective areas of industrial rock deposits and in evaluation and selection of areas to be covered by more detailed studies. The map is constructed by digital processing of information gathered in database of The Detailed *Geological Map of Poland* with the use of tools such as ArcGIS and verification of lithological and genetic boundaries in the field. In the years 2007–2008, 278 sheets of this map were compiled and an instruction for compiling and editorial work on the next sheets was prepared.



Longitudinal vertical sections along W-E line (Nummulite Eocene – the Tatra Mts.)

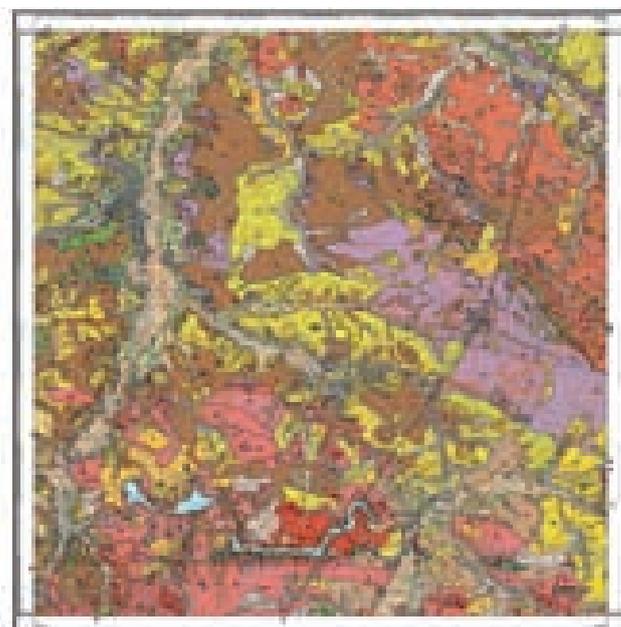
Ew – Nummulite limestones, Ej – detrital limestones, Ep – dolomitic sandstones, Ezs – gray conglomerates, Ezc – red conglomerates, Mz – Mesozoic rocks



*Implementation schedule of The Detailed Geological Map of Poland in the scale 1:50,000*

### Detailed Geological Map of Poland in the scale 1:50,000

This is fundamental geological map of the country and its compilation is one of the major statutory tasks of the Polish Geological Institute and the Polish Geological Survey. The map consists of 1,069 sheets which cover the whole area of the country. Each sheet covers an area of about 300 km<sup>2</sup> and includes colour geological surface map prepared in the field in the scale 1:25,000, and geological cross-sections, thematic sketches and an explanatory note. All the available archival geological data are used in compilation of individual sheets. The map is the basic source of geological information necessary for several sectors of the domestic economy, especially in land use planning, environmental protection and building, agriculture, forestry and tourism sectors. Successive sheets of the map are being compiled and reambulation of sheets prepared in the years 1960–1980s is being continued.



*The Detailed Geological Map of Poland in the scale 1:50,000 – the Lubań sheet*

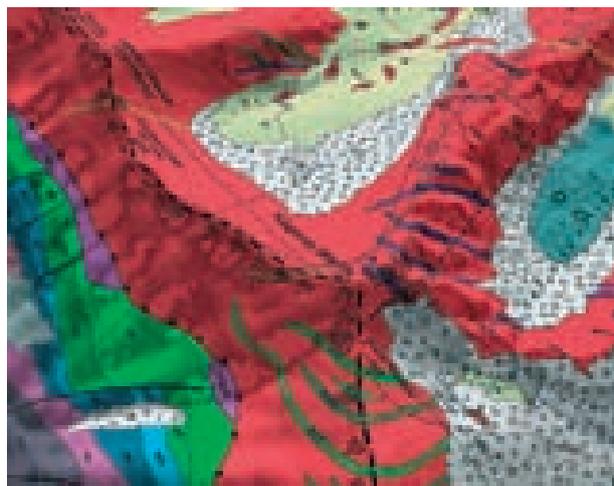
### Detailed Geological Map of the Tatra Mts. in the scale 1:10,000

Each sheet of this map consists of three maps: a geological map with Quaternary sediments on topographic base, geological map of Quaternary subcrops, and map of structural units and also explanatory note and geological cross-sections. According to original idea, *Detailed Geological Map of the Tatra Mts.* was planned as the second edition of *The Geological Map of the Tatra Mts. in the scale 1:10,000*, compiled under the editorship of K. Guzik and S. Sokołowski in the years 1958-1980.

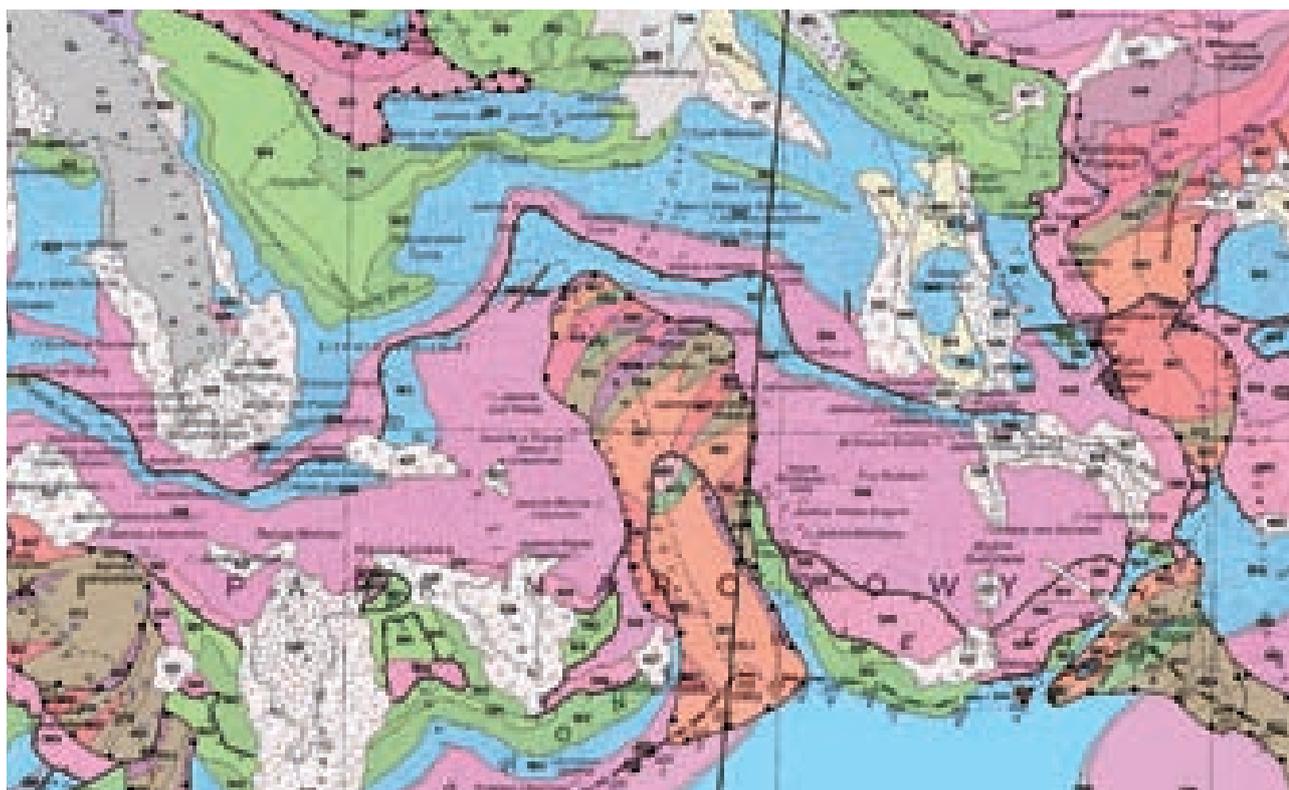
The map was prepared digitally on the „1992” geodetic reference base in division into sheets. In comparison with the edition from the years 1958-1980, the sheets of *The Detailed Geological Map* were supplemented with maps of Quaternary subcrops and maps of structural units as well as explanatory notes and additional annexes in the form of profiles and tables. The maps also show tectonic boundaries, that is faults and overthrusts differentiated according to their rank. The stratigraphy of Quaternary sediments was also elaborated. *The Detailed Geological Map* extends beyond the state boundary to cover also the adjacent areas of Slovakia in the case of all the border zone sheets. It should be noted that the differentiated lithostratigraphic units were partly correlated with the Slovak ones which, in turn, were recognized with reference to the Alpine ones.

The map was compiled by the digital method using the ArcGis 9.2. package, in which there was created a geobase of spatial data for its first 9 sheets. The geobase makes possible quick editing and processing of spatial data and, at the same time, takes care of their integrity and safety (topological rules, domains and rela-

tion dependences). The spatial data included raster data (geodetic base in „1992” geodetic reference system and digital model of terrain surface) and vector data (geological map with Quaternary sediments, map of Quaternary subcrops, map of structural elements, geological symbols). Vectorization was made using ArcInfo (*coverage*) and ArcMap (*shapefile*) packages. *The Detailed Geological Map* will be available on CD electronic carriers and on PGI websites. Preparation of a printed version is planned for the end of the third stage in compilation of this map, when works on 25 sheets of the Polish part of the Tatra Mts. and adjacent areas from the Slovak side will be coming to the end.



Fragment of the *Kasprowy Wierch* sheet of *The Detailed Geological Map of the Tatra Mts.* (transformed into 2,5 D) with view on *Kasprowy Wierch* and *Pośredni Wierch Goryczkowy*



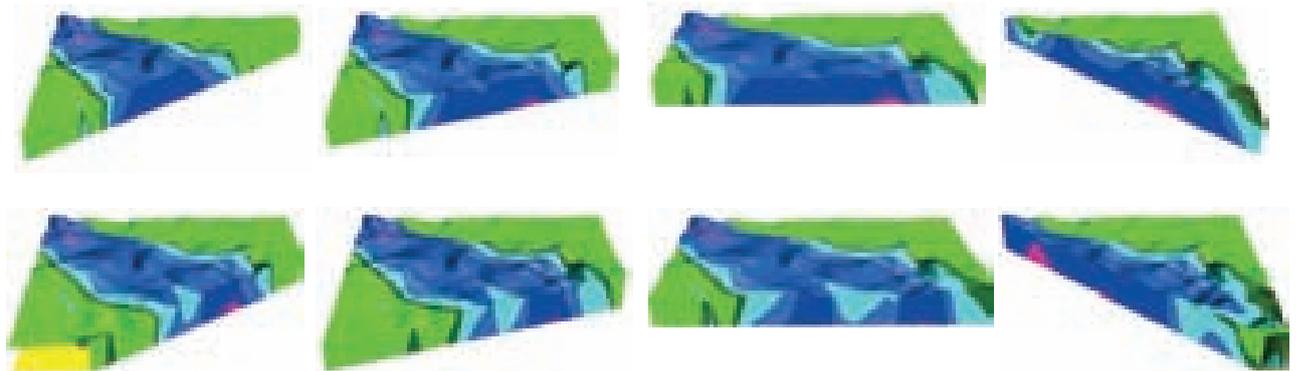
Fragment of *The Detailed Geological Map of the Tatra Mts. in the scale 1:10,000* – the *Czerwone Wierchy* sheet

### Spatial Model of Geological Structure of Poland from the Depth of –500 m a.s.l. to the Terrain Surface

The model presents geological structure of the country from the depth of –500 m a.s.l. up to the terrain surface with accuracy corresponding to the scale 1:500,000 and in the "1992" geo-reference system. It was created on the basis of surface, sub-Quaternary and sub-Cenozoic geological maps in scales ranging from 1:50,000 to 1:1,000,000, geological horizontal section maps, drilling data as well as the published and archival data and information from all the existing PGI databases. Works on this model were a continuation of the project *The Numerical Spatial Model (3D) of Geological Structure of Poland from the Depth of 6,000 m to -500 m a.s.l.*, aimed at imaging the deep structure in 1:500,000 scale, which was completed in 2005. Both projects were commissioned by the Ministry of the Environment and financed by the National Fund for Environmental Protection and Water Management.

For the purposes of digital spatial modelling there were created a special base of borehole data comprising over 400,000 appropriately processed borehole sections and a spatial base of cartographic data comprising entrance data – numerical topographic data and numerical geological maps in the form of GIS layers.

A special methodology worked out for this project comprised processes of digitalization, analysis, thematic geometric and geological processing, thematic separation, verification and integration of borehole and geological cartographic data. The methodology also comprised procedures of optimization and verification of the above mentioned processes. The numerical spatial model was created in two forms: as an interactive multidimensional system of spatial information (GIS 3D) using the GRAA-GIS package, and an interactive system of geological modelling system using GOCAD package.



*Spatial model of geological structure of Poland from the depth of -500 m a.s.l. to the terrain surface – visualization of geological sections through the Mid Polish Trough*



*Spatial model of geological structure of Poland from the depth of -500 m a.s.l. to the terrain surface – a series of horizontal sections through Cenozoic sediments in Poland*

## GROUNDWATERS

Study and protection of the most precious natural raw material of Poland



### GROUNDWATER PROTECTION AND RESOURCES

#### Evaluation of Possibilities and Constrains for Location of Investments in the Coastal Zone

Conditions for further development of the city of Gańsk in the coastal zone, that is around the two major municipal water intakes of that city (*Czarny Dwór* and *Zaspa* intakes), were studied. The studies carried out with the use of results of field works, laboratory analyses and model studies on migration of chlorides to water-bearing horizons, showed that it would be advisable to increase restrictions in relation to various investments which may be arduous for the soil-groundwater environment. Such steps are necessary to guarantee inviolability of the resources and quality of waters of the Major Groundwater Reservoir No. 112. The study was carried out under a contract awarded by the Office of Gdańsk City.

#### Exploitable groundwater resources of the Letniki Central Żuławy Waterworks

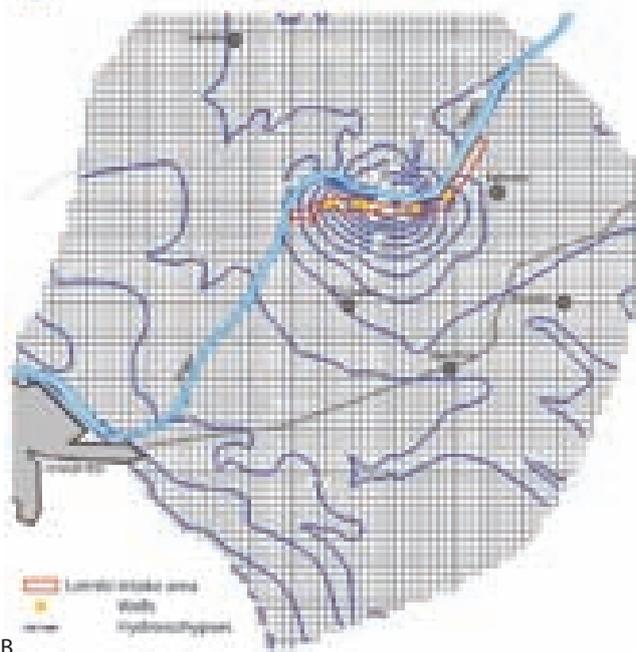
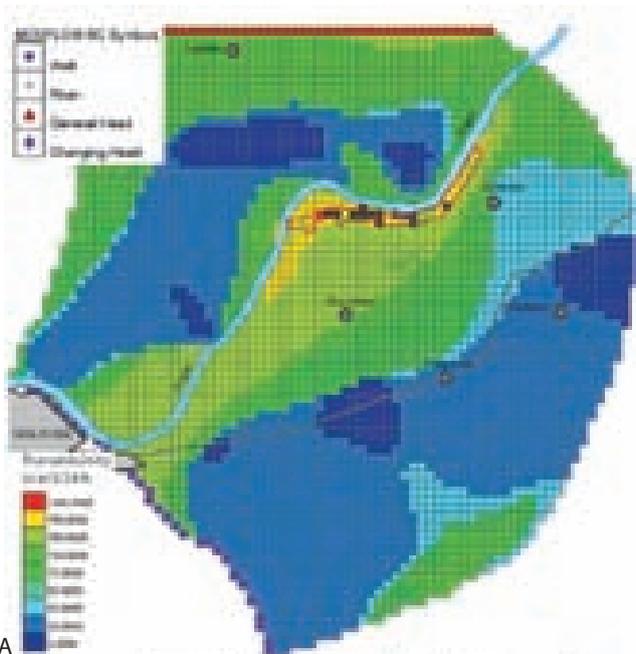
In connection with the planned expansion of the Letniki intake, the major water intake in the Żuławy region which pumps underground water from Quaternary aquifer, hydrogeological and hydrogeochemical conditions in area of this intake were reappraised. The studies made it possible to estimate save yield underground water resources and define conditions under which the groundwater may be exploited.

#### Documentation of hydrogeological conditions for establishing protection zone for the Olsztyn groundwater reservoir

The whole area of the protection zone of the Olsztyn groundwater reservoir (Main Groundwater Reservoir No. 213) was estimated at 1,696.7 km<sup>2</sup>, including 119.5 km<sup>2</sup> situated outside the boundaries

*Distribution of transmissivity and boundary conditions of the exploited water-bearing horizon (2nd model layer) in the Letniki intake area*

*Results of model calculations of hydrodynamics of the exploited water-bearing horizon (2nd model layer) in the Letniki intake area*



of this reservoir. An additional protection area under an increased rigour was delineated within the protection zone. The size of renewable and disposable resources were assessed. According to the proposals, the concept of protection of this reservoir should be implemented through a system of prohibitions and rules which would be obligatory in this zone and implementation of appropriate policy in land use planning, especially with reference to recreational character of these areas. The plans also include expansion of the existing network of groundwater monitoring by installation of additional observation points for checking quality and quantities of water in the reservoir area. The study was commissioned by the Ministry of the Environment.

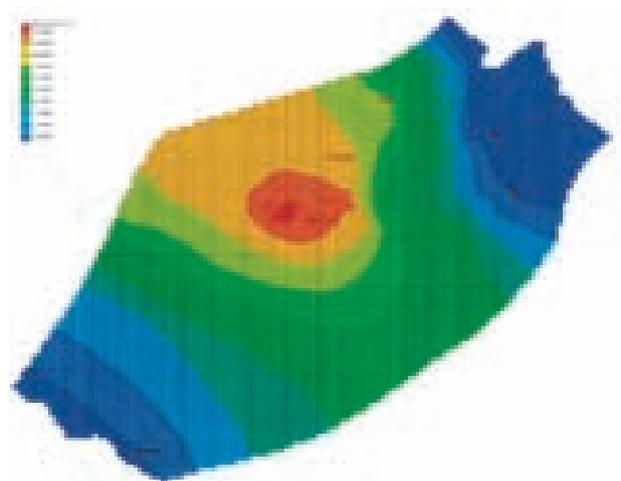
## MODELLING

### Model Prognoses of Groundwater Inflow to the Radkowiec-Podwole Open-Pit Mine, the Holy Cross Mts.

Prognosis of increase of water inflow was made with the use of a mathematical model for three variants of the planned extension of boundaries of the Radkowiec-Podwole open-pit mine workings in the horizontal and vertical direction. The workings are strongly affected by flooding. This is due to inflow of about 600 m<sup>3</sup>/h of water which has to be discharged to the Bobrza river flowing in proximity of the open-pit mine. The calculations showed that this inflow should increase to 967 or even 985 m<sup>3</sup>/h depending on the selected variant of extension of the mine. The created model takes into account planned dewatering of workings of the neighbouring mines as well as water consumption by intakes situated in this area, including the Fabet municipal intake of the city of Kielce at Dyminy. Dewatering of the extended workings will result in drainage of workings of the neighbouring *Kowala* open-pit mine and about 5 m drop of water table in area of municipal intakes which will undoubtedly lead to decrease in their efficiency.

### Mathematical Model of Groundwater Flow in Area of the ZACHEM Chemical Plant

The mathematical model was created to simulate hydrogeological conditions in area of the ZACHEM S.A. Chemical Plant in Bydgoszcz. The model presents distribution of water-bearing horizons and their



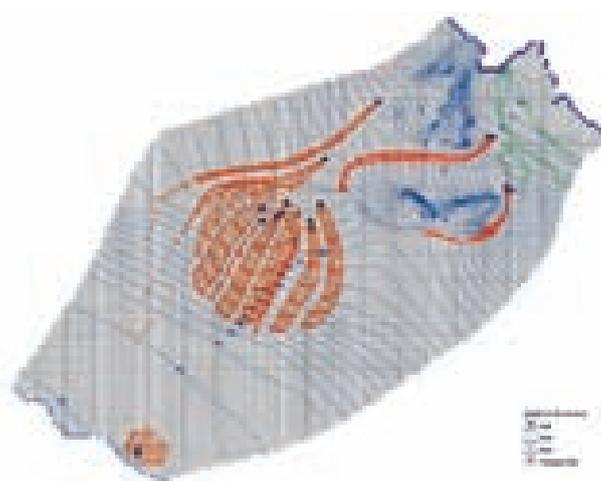
Groundwater drawdown calculated for 2nd model layer (prognosis of resources) in the area of ZACHEM S.A. Chemical Plant in Bydgoszcz

separating sedimentary packets and hydrostatic pressures in individual horizons. The modelling made possible verification of directions of groundwater flow and identification of areas of downgradient flow of waters to individual intakes in area of the plant. The studies show that the major groundwater recharge area is stretching south-eastwards from potable water intake in direction of the Noteć River. However, a clearly marked watershed developed along this bank of the river precludes flow of river water in direction of the Zachem plant. The performed simulations made it possible to assess groundwater budget. The total amount of water in circulation in all the model layers in area of inflow of waters to the analysed intakes was estimated at 12,660 m<sup>3</sup>/d. The dynamic and exploitable water reserves are equal 12,621 m<sup>3</sup>/d (525.9 m<sup>3</sup>/h) and 7,680 m<sup>3</sup>/d (320 m<sup>3</sup>/h), respectively. The exploitable resources are found to be equal about 61% of the dynamic ones which guarantee supply of unpolluted waters from western part of the resource area.

## THERMAL WATERS

### Integrated Analysis of Reservoir Rocks of Thermal Water of the Podhale Basin

The studies showed that carbonate Eocene, Jurassic and Middle Triassic rocks with permeability of the order of  $n \cdot 10^{-6}$  m/s and productivity over 200 m<sup>3</sup>/h are the most perspective collectors for thermal water. The most efficient collector is that of the Biały Dunajec tectonic unit. This unit forms axial part of a basin in which several productive wells are located, including the Bańska IG-1 well with the highest self-outflow (550 m<sup>3</sup>/h). The zone of so advantageous parameters is stretching along northern limb of the basin, forming an area where further drilling works are best justified. Mineralization of thermal waters ranges from 0.2–0.4 g/dm<sup>3</sup> in a zone adjacent to the Tatra Mts. up to about 3 g/dm<sup>3</sup> in northern limb of the basin. Their exploitation results in freshening locally exceeding even more than 25% of total mineralization recorded during drilling. Water temperature ranges from 20°C in the zone adjacent to the Tatra Mts. (the Subtratic Zone) to over 80°C in the northern limb of the basin. The studies of 14 borehole logs made it possible to carry out preliminary elaboration of the numerical flow model, indispensable for planning further works.

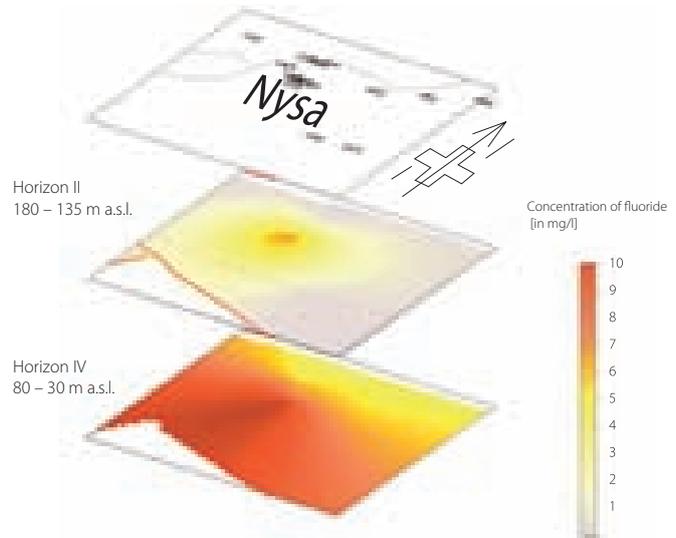


Results of simulation of the maximal prognosis – the hydrodynamics of 2nd model layer and selected groundwater flows (up to the 25 years isochrone) in the area of ZACHEM S.A. Chemical Plant in Bydgoszcz

## WATER POLLUTION

### Occurrence, Origin and Significance of Presence of Fluoride in Groundwater of the Paczków-Niemodlin Aquifer

The studies covered hydrogeological conditions, chemistry and degree of fluoride contamination of waters of the Neogene stage in the Paczków-Niemodlin region (Major Groundwater Reservoir No. 338). The studies showed that fluoride concentrations in groundwaters are very high, 6.0 to 11.5 mg/l at the most, that is 10 times higher than admissible in potable water. The highest concentrations of fluoride were found in the Nysa area. The studies confirmed that the concentrations increase along with decrease of the ordinate of top of the water-bearing horizon. They appeared to be the highest in areas where the top of the water-bearing horizon occurs at depths 30 to 80 m a.s.l. These so high concentrations are probably due to a long contact of the waters with Precambrian and Palaeozoic igneous and metamorphic rocks containing minerals rich in fluoride. Location of fluoride anomalies in proximity of major fault zones which may be privileged circulation pathways routes for fluoride-enriched waters from deep-seated parts of the Sudety Mts. could be the reason of inflow of these waters into the Neogene horizons.



Fluoride anomalies in Neogene water-bearing horizons in the Nysa River area

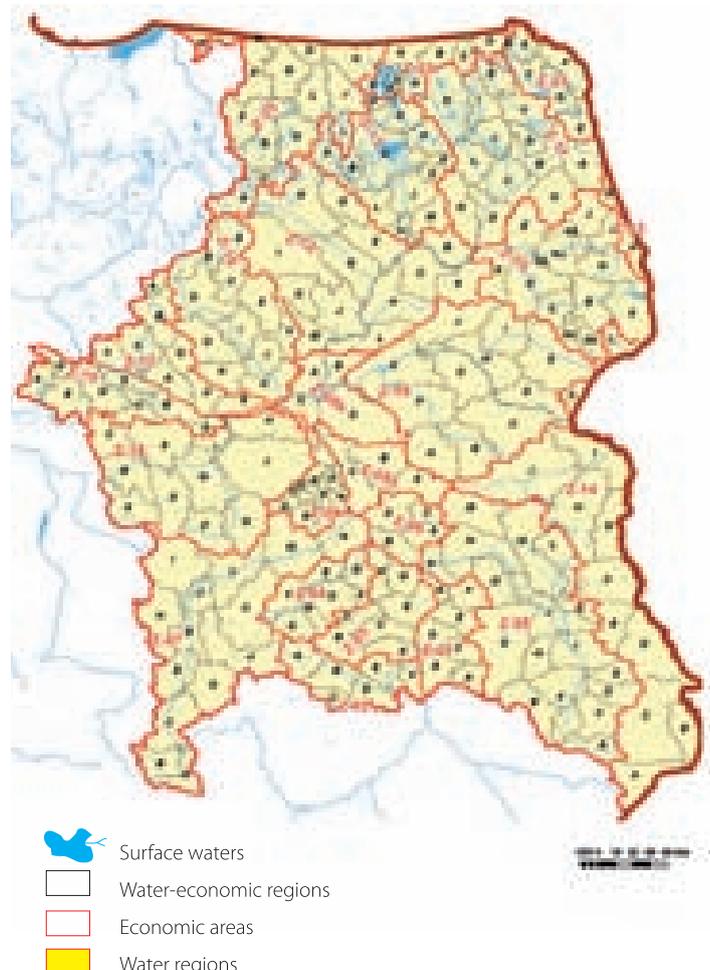
## METHODOLOGY

### Methodology of Identification of Groundwater Consumption Structure for the Needs of Evaluation of the Qualitative State of Groundwaters in Poland

The registered water consumption and degree of the use of water resources were estimated and structure of use of groundwaters was analysed in the scale of hydrogeological and administrative units for the whole area of the country. Moreover, the size of unregistered water consumption was estimated for individual powiats and voivodeships. The studies were carried out in accordance with UE Framework Water Directive and their results are indispensable as a source of information for compilation of water-economic budgets.

### Delineation of Water-Economic Regions for Integrated Management of Domestic Underground and Surface Water Resources

The subdivision of the water regions into water-economic budget areas was verified and the budget areas were subdivided into water-economic regions. The established hierarchic system of water-economic units makes possible compilation of water-economic budget of groundwaters with reference to their relation to surface waters. The water-economic regions are the basis for implementation of integrated water management and working out programs of optimal use of groundwater resources under conditions of protection of these waters and groundwater dependent ecosystems. The project was commissioned by the Ministry of the Environment.



Subdivision of the Middle Vistula River water region into budget areas and water-economic regions

### Polish Hydrogeological Survey (PHS)

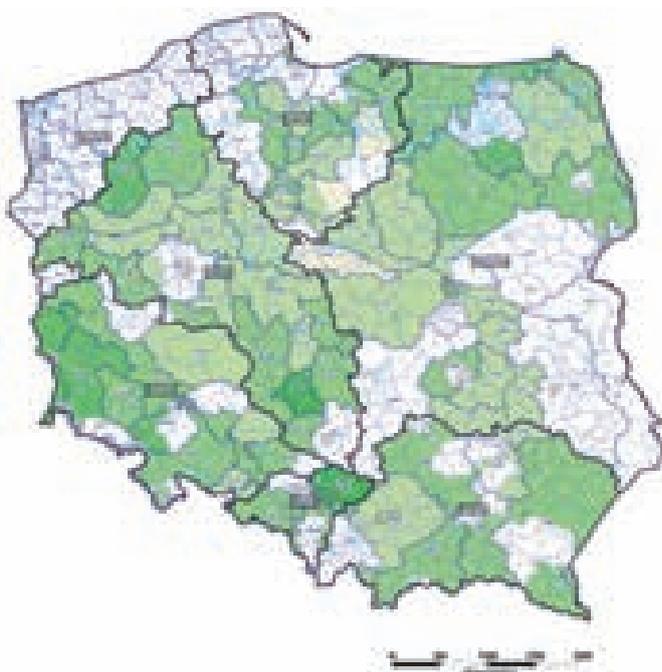
In accordance with wording of Article 102 of the Water Law, the Polish Hydrogeological Survey has continued implementation of projects aimed at limiting degradation and providing protection for groundwaters, especially those assigned for consumption, and support for activities leading to appropriate management of groundwater resources which are the source of supply of potable water for about 70% of population. The projects were carried out under contracts awarded by the National Water Management Authority (KZGW) and the Chief Inspectorate for Environmental Protection (GIOŚ) and financed by the National Fund for Environmental Protection and Water Management (NFOŚiGW). The tasks included carrying out monitoring, maintenance of hydrogeological databases, assessments of groundwater resources and analyses and assessments of hydrogeological conditions.

The results of these studies were presented in quarterly information bulletins of the Survey, hydrogeological annuals and also as communiques on the present groundwater conditions and hydrogeological prognoses of the state of groundwaters.

### PROGNOSES OF CHANGES OF RESOURCES, QUALITY AND VULNERABILITY OF GROUNDWATERS

In the years 2007–2008, there were completed projects concerning trends in changes of groundwater level and assessments of hydrogeological conditions situation in Poland and at the boundaries with other UE countries. The results of these studies were passed to central and regional administration bodies.

There was also completed a project of identifying alternative sources of potable water for towns with population over 50,000 and water supply totally based on surface water intakes only. In 2008, such analyses were completed for 11 towns: Chorzów, Mysłowice, Siemianowice Śląskie, Będzin, Świętochłowice, Wodzisław Śląski, Przemyśl, Krosno, Dębica and Nysa.



### PROSPECTING, BUDGETING AND PROTECTION OF GROUNDWATERS

The aim of the studies was to elaborate methods of creating conceptual models of groundwater bodies, identification of flow directions and evaluations of magnitude of groundwater flow at the southern boundary of Poland and completion of water-economic budget and evaluation of dynamics of renewability of water resources in budgeting individual drainage basins.

### ANALYSES AND APPRAISAL OF HYDROGEOLOGICAL CONDITIONS

The analysis of five selected municipal groundwater intakes made it possible to define the influence of the lack of established protection zones on degradation of groundwater resources used for supply of potable water for the local communities.

### DATABASES

The works on hydrogeological data management, connected with collecting, storing, processing and providing access to the data, have been continued in the years 2007-2008. The works were mainly aimed at the development of the HYDRO Data Bank, the largest hydrogeological database in Poland. The Bank provides access to geological, hydrogeological and hydrodynamic data from nearly 135,000 groundwater intakes and related hydrogeological objects – springs and observation and research wells as well as those exploiting fresh waters throughout the whole area of Poland.

Works connected with updating the remaining hydrogeological databases, that is the Groundwater Monitoring, Major Groundwater Reservoirs, Available Resources and Intake databases, have been also continued.

Each year the HYDRO BANK distributes about 170,000 records and data on hydrogeological objects to the public and private entities.

Map of groundwater resources

**MONITORING THE ACTUAL STATE OF GROUNDWATER**

Measurements were taken at over 800 observation points distributed in places representative for the studied hydrogeological units. The planned total number of the observation points is 1,200. The measurements comprised level of groundwater table or yield of springs as well as chemistry and quality of fresh groundwaters in the whole area of the country, with the special attention paid to the groundwater bodies, areas under threat of droughts or floods and border zones. Groundwater levels and yields of springs were measured weekly at 672 observation points and daily – at 149 points. In total over 170,000 measurements were made in the years 2007–2008.

The results of measurements were entered into the database and published in *The Hydrogeological Annual (Rocznik Hydrogeologiczny)* and *Quarterly Bulletin of Groundwaters (Kwartalny biuletyn informacyjny wód podziemnych)*. The collected information is used for documentation and assessment of groundwater dynamic regime and protection of the resource from over-exploitation or quality degradation.



*Lubocz observation point of the groundwater monitoring network*



*Observation of points of PGI groundwater monitoring network at the background of hydrogeological units*



*Database of PGI groundwater monitoring network*

## MONITORING OF GROUNDWATER QUALITY

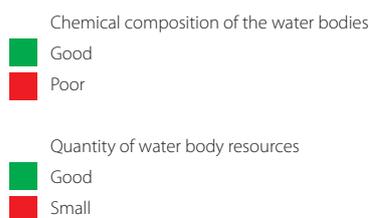
In accordance with requirements of EU Water Framework Directive, an appraisal of chemistry and quality of 161 groundwater bodies distributed throughout the whole area of the country was compiled in the form of a report. Compilation of this report required analysis of observations provided by groundwater monitoring network run within the frame of the State Environmental Monitoring System, especially the observations from the years 2000-2007, and analysis of data on groundwater exploitation and resources in the scale of the whole country.

In accordance with requirements of the Nitrates Directive of UE, the degree of groundwater pollution by nitrogen compounds was estimated in the area of the country, with a special attention paid to the pollution in 21 areas recognized as at risk of pollution from agricultural sources. The data from regional monitoring networks and diagnostic and operational monitoring from the years 2004-2007 were analysed and references were made to the relevant estimations from the pre-accession period, that is from the years 2000-2003.

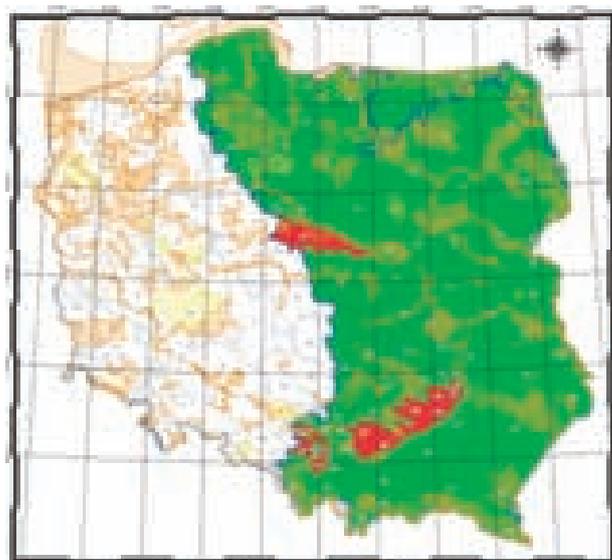
The studies covered 310 measurement points of the operational monitoring network for the selected groundwater bodies. The measurement points were sampled twice and the results of 620 analyses of groundwater chemistry made it possible to establish rankings of pollution classes from unpolluted to excessively polluted for individual groundwater bodies, voivodeships and surface drainage basins.

In accordance with requirements of the European Environment Agency and its EIONET-Water Network, the results of monitoring of chemical composition of waters in three Major Groundwater Reservoirs were analysed. The analyses covered ionic budget and chemical type of waters, concentrations of biogenic matter ( $\text{NO}_3$  and  $\text{NH}_3$ ) and their time changes, and reinterpretation of data from the monitoring of groundwater table variations.

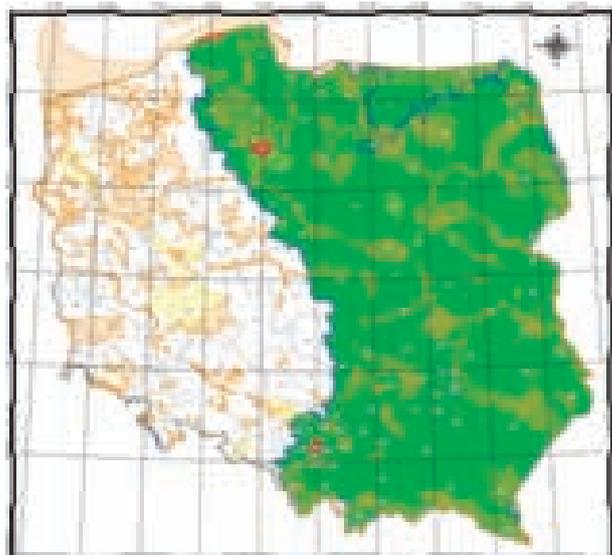
The results of this project were used by the Chief Inspectorate for Environmental Protection (that is by the agency which commissioned the studies) and the National Water Management Authority in compilation of reports for the European Commission and in current works of 16 Voivodeship Inspectorates for Environmental Protection and 7 Regional Water Managements Authorities.



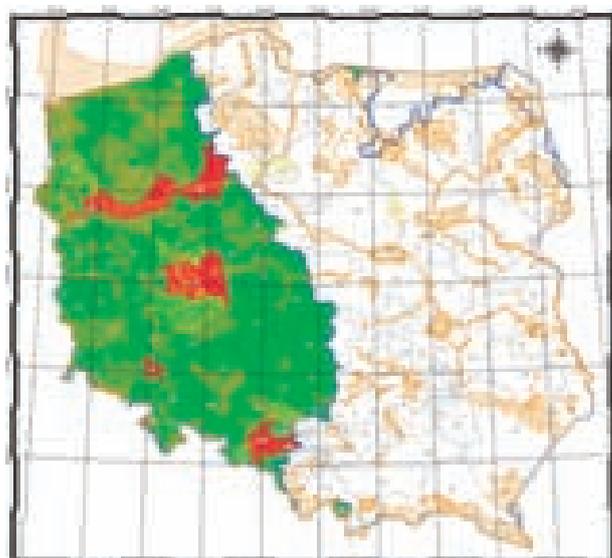
- A – Quantitative assessment of the water bodies of the Vistula drainage basin and Dnester, Niemen, Pregola and Świeża (Prochladnaja) rivers  
 B – Chemical composition of the water bodies of the Vistula drainage basin and Dnester, Niemen, Pregola and Świeża (Prochladnaja) rivers  
 C – Chemical composition of the water bodies of the Odra drainage basin and Danube, Jarf, Łaba and Ucker rivers



A



B



C

## ENGINEERING GEOLOGY

Reliable account of engineering geology as a guarantee of safe conditions of infrastructure



### MOTORWAYS

#### Geological Documentation for the Motorway A-1

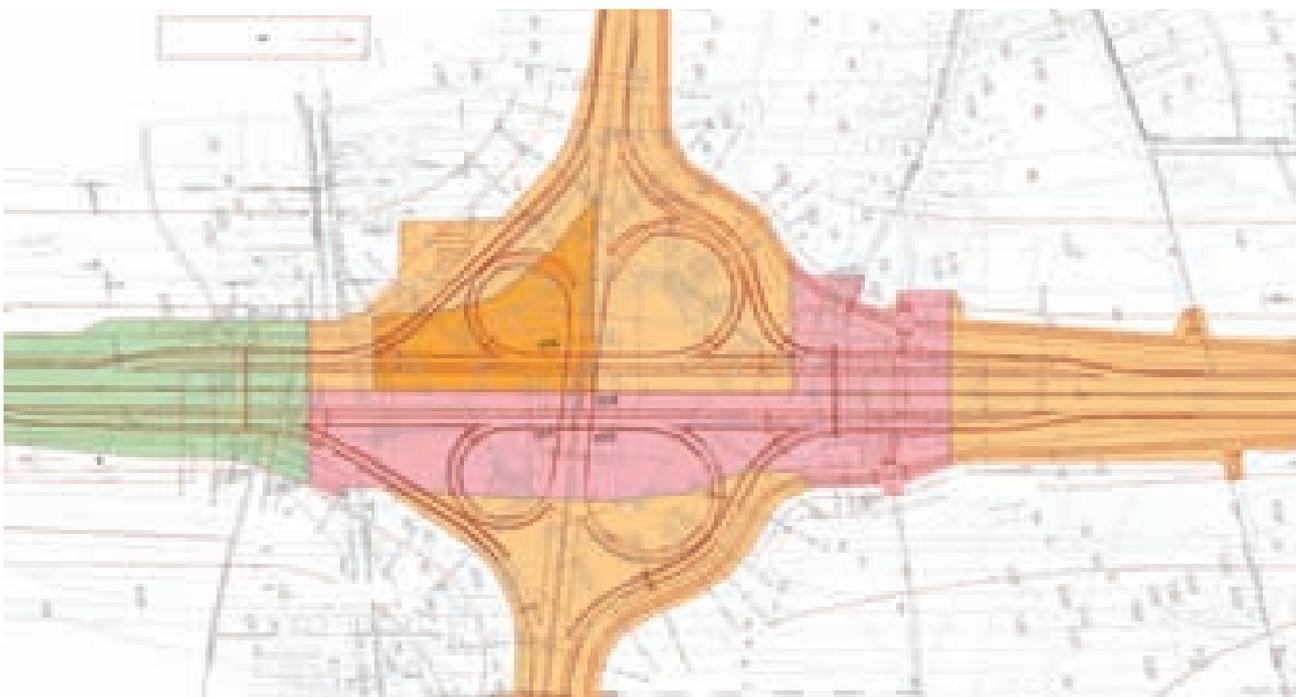
PGI as a member of consortium comprising the Institute of Building Technology, Road and Bridge Research Institute and SEGI-AT, compiled a project of geological surveys and engineering-geological and hydrogeological documentations for two sections of the Motorway A-1, about 180 km in total length: from the *Stryków* junction to the border of the Łódź Voivodeship and from that border to the *Pyrzowice* junction. The study comprised engineering-geological investigations carried out to establish adequacy of foundation conditions in the area along these two sections. The study also involved analysis of geological structure and engineering-geological and hydrogeological conditions along the two sections, documentation of mineral deposits which could be used as sources of material for

construction of the motorway and a prognosis of changes in engineering-geological conditions which may result from construction and use of the motorway. Moreover, it appeared necessary to reassess mining damage due to exploitation of Jurassic ore-bearing clays in area of the Motorway A-1 about half a century ago.

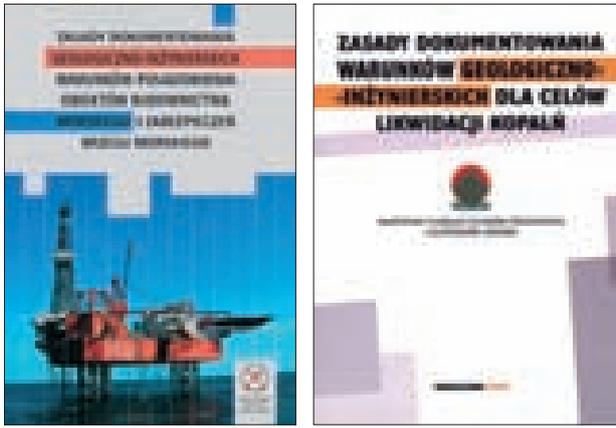
#### METHODOLOGY OF ENGINEERING-GEOLOGICAL STUDIES

##### Recommendations for Engineering-Geological Assessments of Foundation Conditions for Offshore Structures and Sea Coast Protection

Recommendations for assessments of foundation conditions were compiled on the basis of published data, archival engineering-geological, geotechnical and hydrogeological assessments



Map of engineering-geological conditions at the Belchatów junction of the Motorway A-1



and experience from works carried out in the coastal zone and offshore. This compilation is of the guide-book type and comprises recommendations for carrying out studies and engineering-geological assessments, methods of engineering-geological studies, the advised range of such studies in assessing foundation conditions for various offshore constructions and protection of sea coast and general characteristics of objects localized in coastal zone and offshore. The methods for carrying such studies were worked out by Polish Geological Institute, Institute of Hydroengineering of the Polish Academy of Sciences and GEOSTAB Ltd. Research Enterprise.

### Recommendations for Assessments of Engineering-Geological Conditions for the Needs of Mines Closing

Uniform rules and recommendations concerning the range, type and methods of carrying out studies and engineering-geological assessments of areas of underground and open-cast mines and borehole mining in the process of closing and liquidation were elaborated under a contract awarded by the Ministry of the Environment. The works were carried out in the years 2007–2008 by a consortium comprising the AGH University of Science and Technology, Polish Geological Institute, Warsaw University and Central Mining Institute. The rules are made available for all the interested institutions – the State Mining Authority and its district mining offices, commune offices, mines in the process of closing and geological enterprises compiling relevant assessments. The rules should facilitate making appropriate decisions concerning use and recultivation of post-mining areas. They should also help in preventing and mitigation of damages to buildings and technical infrastructure which could be due to the lack of knowledge and skills to assess properly the effects of engineering-geological processes evoked by closure of mines.

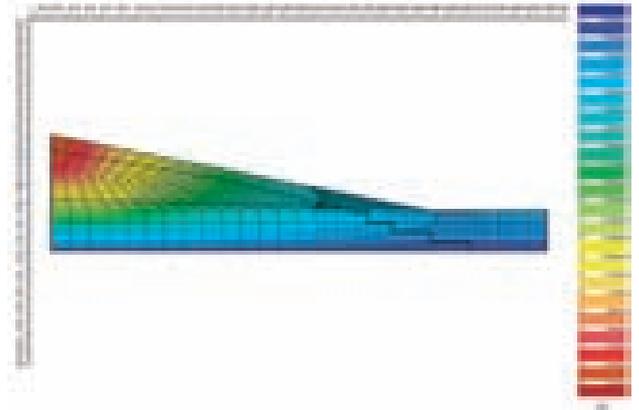
## SAFETY ASSESSMENTS

### Geological-Engineering Studies of Loess Gullies

Engineering-geological studies of loess areas of the Lublin Upland prone to intense gully erosion, have been carried out for several years. In 2007–2008 the studies were conducted in areas of the Kazimierz and Szczepieszyn Landscape Parks. Physico-mechanical properties of loesses were studied with the use of various field and laboratory methods. Moreover, fixings locally used to strengthen loess gully floor were reviewed to assess and compare and their efficiency.

### Engineering-Geological and Hydrogeological Conditions in the Adamów Lignite Open-Cast Mine

The Adamów Lignite Open-Cast Mine commissioned PGI to make engineering-geological assessment of the actual state of the safety pillar of the Przykona water reservoir situated in the area of the mining workings. The study also comprised assessments of stability of a slope built of mining reject rocks. The analyses were made with the use of the Bishop and Spencer-Wright methods and numerical calculation methods. Because of variability in soil-water conditions, the analyses were made in variants for individual soil-water systems and with reference to distance between mining front and area of disposal of reject rocks from mining operations.



*Analysis of stability of western slope of the major mining workings of the Adamów Lignite Open-cast Mine*

### Monitoring and Assessment of Protection of Waste Disposal Facilities

Since the beginning of the 1990s, the Polish Geological Institute has been carrying out monitoring studies of selected elements of the environment in the area of the National Radioactive Waste Depository and its surroundings. The monitoring comprises hydrogeological-meteorological observations, hydrogeochemical studies of piezometer samples of groundwaters, determinations of concentrations of tritium and gross beta radioactivity in groundwater samples and measurements of changes in volume soil moisture in zone of aeration by the isotope method. Moreover, analyses connected with assessments of the conditions of radioactive waste disposal, closure of the depository and long-term environmental monitoring are made each year.



*Geological-engineering studies in loess gully – electric resistance measurements with the use of electric cone; Kazimierz Dolny on the Vistula River*

### Engineering-Geological Atlases of Large Urban Agglomerations

Polish Geological Institute participated in compilation of geological-engineering atlases of large urban agglomerations such as Gdańsk–Gdynia–Sopot, Cracow and Wrocław, carried out under a contract awarded by the Ministry of the Environment and financed by the National Fund for Environmental Protection and Water Management.

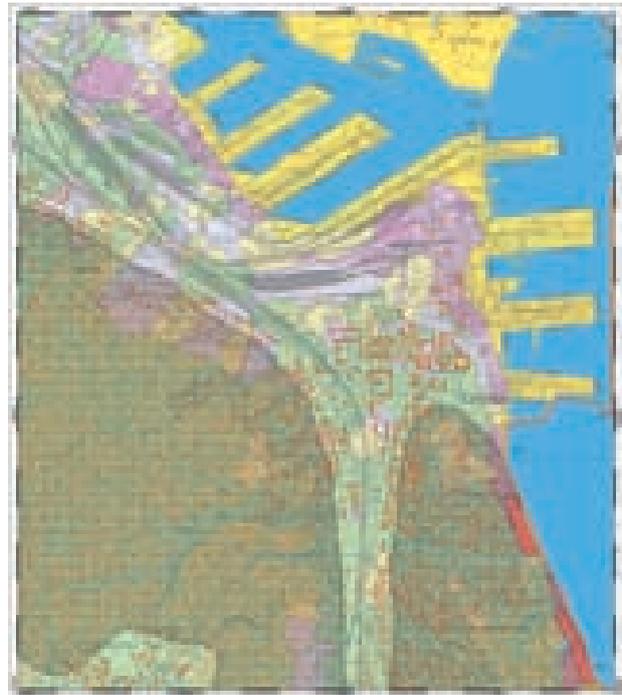
The obtained data from observation wells, field mapping, digitalized archival materials and geostatistic calculations were used for creation and superposition of various information layers. This made it possible to compile the so-called thematic maps, including maps of foundation conditions.

The map of foundation conditions presents a synthesis of factors influencing the conditions in the subsurface, including:

- geological factors (type of soil, physico-mechanical properties shown by assignation of a given soil to a definite engineering-geological series);
- hydrogeological factors (ordinate and depth of occurrence of the water table and character of the table, waterlogged ground, floodings and water seepages);
- geodynamic and geomorphological factors (topographic features, areas of landslides, risk of suffosion, areas affected by mining damage);
- geoenvironmental factors (geochemical background of an area, contaminations, water aggressiveness in relation to metals and concrete).

Such spatial information makes possible assessment of engineering-geological conditions in urban areas for the needs of land use planning, for example, in selecting location for industrial areas

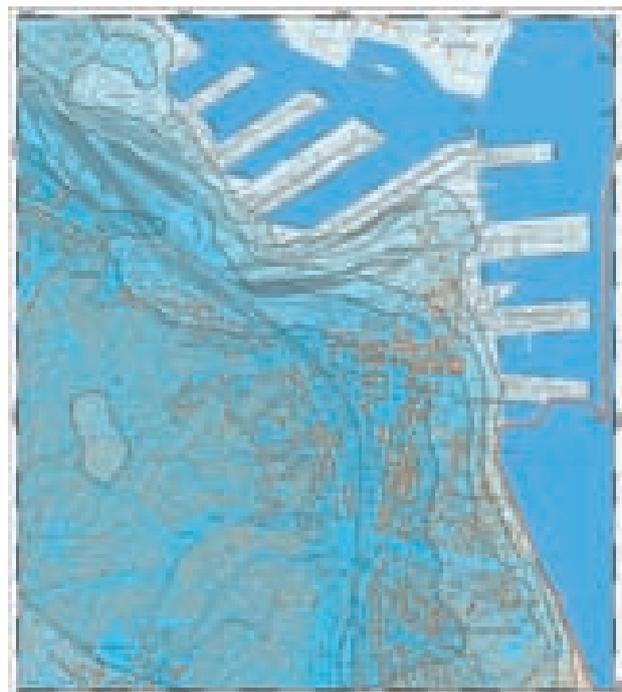
and housing estates or delineation of routes of linear objects and underground infrastructure. It also facilitates the process of making decisions in planning more detailed studies of the subsurface, mitigation of damage to the environment and preparation of prognoses and economic aspects of investments. Joint analysis of information layers on geological and economic risks makes possible compilation maps of risks.



Map of foundation conditions (Engineering-Geological Atlas of the Gdańsk-Sopot-Gdynia in the scale 1:10,000)



Map of soils occurring at the depth of 4 m below terrain surface (Engineering-Geological Atlas of the Gdańsk-Sopot-Gdynia in the scale 1:10,000)



Map of depth to the first groundwater table (Engineering-Geological Atlas of the Gdańsk-Sopot-Gdynia in the scale 1:10,000)

## GEOHAZARDS

Assessment, forecast, warning and prevention



Documentation and studies of natural hazards, especially landslides, land subsidence, karst, sea-coast erosion, floods and floodings and presence of geochemical anomalies are necessary for assessments of vulnerability of a given area to these hazards and creation of a warning system. Results of such studies may markedly help to avoid or at least mitigate catastrophic effects of geodynamic processes. Therefore, identified areas prone to natural geohazards should be taken into account in making local land use plans.

### LANDSLIDES

#### Practical Use of Dendrogeomorphological Monitoring of Carpathian Landslide Areas at the Example of Beskid Niski

The method of dendrogeomorphological monitoring, based on analysis of annual growth rings of evergreen conifers and deciduous trees, provides evidence for landslide movements. The analysis of traces of growth-ring anomalies makes it possible to establish the time and extent of landslide movements and their reactivation. The method worked out for the research allowed dating the movements of colluvia (products of mass movements) in different parts of a landslide and, in this way, gave the basis for determinations of both the landslide dynamics in the past and the present-



*Assessing age of a tree growing in the landslide area on basis of number of its annual growth rings; note asymmetry in growth of the trunk*

day dynamics of its individual parts. The studies covered landslides developed in the area of the Beskid Niski Range and with well know time of origin and reactivation. A few time cycles may be distinguished in development of these landslides in the time span from the year 1906 to 2002. The cycles appeared to be correlable with years of increased annual sum of precipitation. The obtained results confirm usability of dendrological analysis in monitoring of landslide areas.

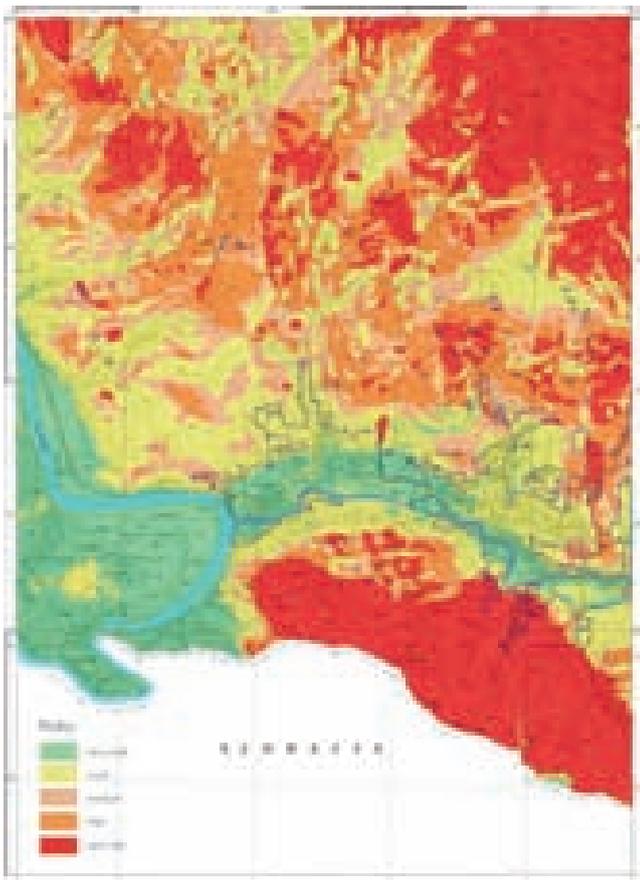
### HAZARD MAPPING

#### Geodynamic Map of Polish Coastal Zone of Southern Baltic Sea in the scale 1:10,000

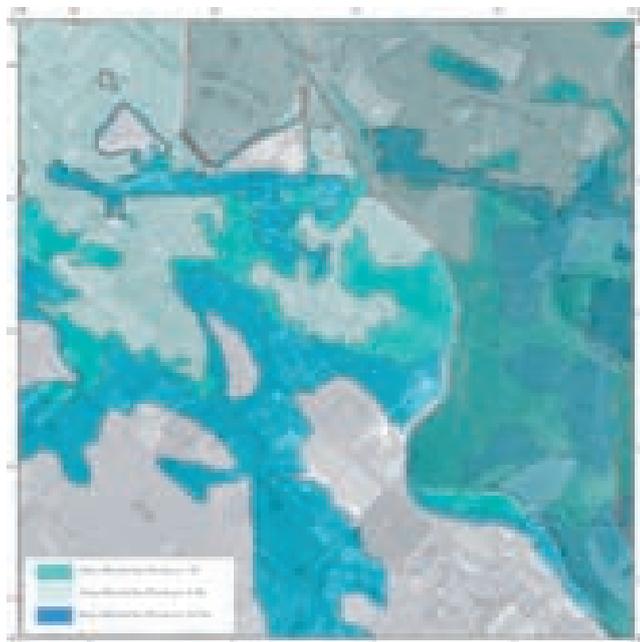
The map is an important source of data for delineating and designing protection zones for the coastline-encircling "technical belt" and indispensable for implementation of strategy of coastal protection measures in accordance with the Act of the Polish Parliament, introducing many years' *Programme of Sea Coast Protection* (for more information see the Chapter *Baltic Sea and its coast*).

#### Map of Degraded Areas and Areas of Increased Natural Hazard in the scale 1:10,000

Compilation of this map was commissioned by the Ministry of the Environment and financed by the National Fund for Environmental Protection and Water Management. Four pilot sheets of the map were compiled for areas exposed to hazards such as: impact of industry on residential parts of urban agglomeration (Warszawa-Praga), impact of mining (Mysłowice) and risk of mass movements (Szczażwnica) and floods (Siechnice). Instruction for preparation of the next sheets was published and digital database was created in the GIS (SIP) system. The base is storing data on geological structure, types of soils, groundwater table and vulnerability of the water-bearing horizon to pollution, geochemistry of the environment, natural and anthropogenic hazards, mining damage and underground and above-surface technical infrastructure surface, land use, protection of deposits of mineral raw materials and perspective areas of their occurrence as well areas and natural monuments under legal protection. The



Map of degraded areas and areas of increased natural hazards; mass movements risk zones; the Szczawnica and Góra Szafranówka sheets



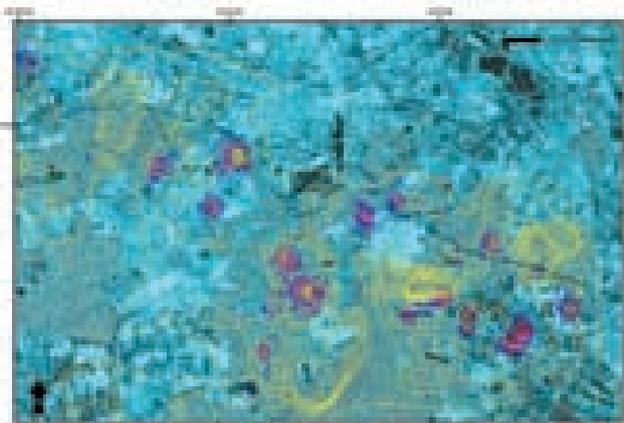
Map of Degraded Areas and Increased Natural Hazards of Floods; the Siechnice sheet

map facilitates valorisation of the environment in the studied areas. It was designed mainly for use by local self-governments and government administration and institutions responsible for sustainable management of natural environment resources and implementation of regulations of the *Environmental Protection Law* and other Polish legal norms concerning these matters. The information shown in this map may be used in land-use planning as well as in reclamation and revitalization works.

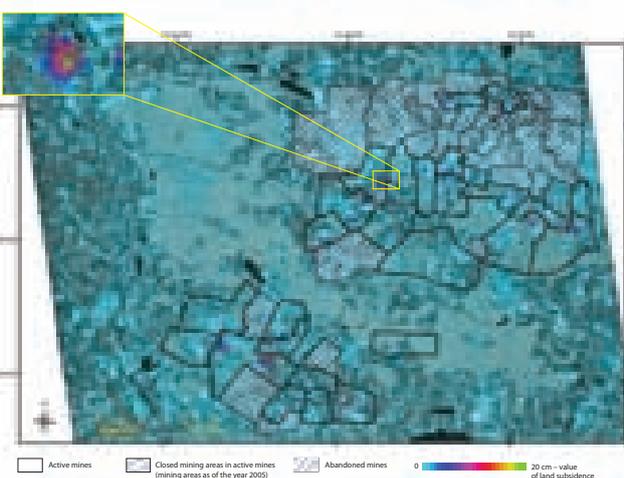
## MINING DAMAGE

### Satellite Radar Interferometry Method (PSInSAR) or Assessing Mining Damage in North-Eastern Part of the Upper Silesian Coal Basin

The latest satellite radar interferometry for ground subsidence monitoring, acquired by the Japan ALOS satellite, covered also the region of the Upper Silesia. The data have been obtained thanks to participation of the Polish Geological Institute in the TerraFirma international consortium, especially in works on the second stage of its research project. The interferometry data were processed by Swiss company GammaRemoteSensing and interpreted by PGI. The *Rybnik–Ostrawa* database comprises areas of Poland and Czech Republic from Czesochowa to the Ostrava–Karvina region. The analysis of the ALOS database showed ground surface displacements. This is especially the case of mining areas of active coal mines for which ALOS data showed ground subsidence even up to 20 cm in 46 days (from 10.07. to 25.08.2007). The differential interferograms allow to record subsidence due to coal extraction and show the present-day dynamics of ground surface in the Upper Silesia. It may be stated that at the present stage of the studies the ALOS data are an excellent supplementation of mining-geodetic information on ground surface movements.



Comparison of map of deformations from 10.07.2007 to 25.06.2007 and isolines of forecasts of land surface subsidence in the Katowice agglomeration



Map of deformations recorded from 10.07.2007 to 25.08.2007 at the background of mining areas in the Upper Silesian Coal Basin

### SOPO Landslide Counteracting System

The SOPO system may be best described as a long-term ongoing cartographic project of great significance for the whole area of the country. This project is being implemented under the contract awarded by the Ministry of the Environment and the Polish Geological Institute is in charge of its management and coordination. It consists of three phases aimed at identification and recording of manifestations of mass movements in Poland. The gathered information is designed for the use by the state administration for the purpose of effective landslide hazard risk reduction as well as making the communities aware of the risk of occurrence of mass movements and the necessity to mitigate their potential negative results.

The major task of the first stage of the SOPO Project (2006–2008) included the review of general knowledge of mass movements in Poland, elaboration of unified methods of collecting and processing of data on these movements and creation of the SOPO database as a tool for uniform system for presentation and making the results accessible for the users. This stage of the studies also comprised pilot mapping of landslides and identification and screening areas affected by mass movements in Poland. The review made it possible to summarize the knowledge of mass movements mainly in the extra-Carpathian Poland, where to now these problems did not receive sufficient attention. The review comprised analysis of archival material on regional geology and studies on geological structure and morphology of these areas with the use of database of *The Detailed Geological Map of Poland*.

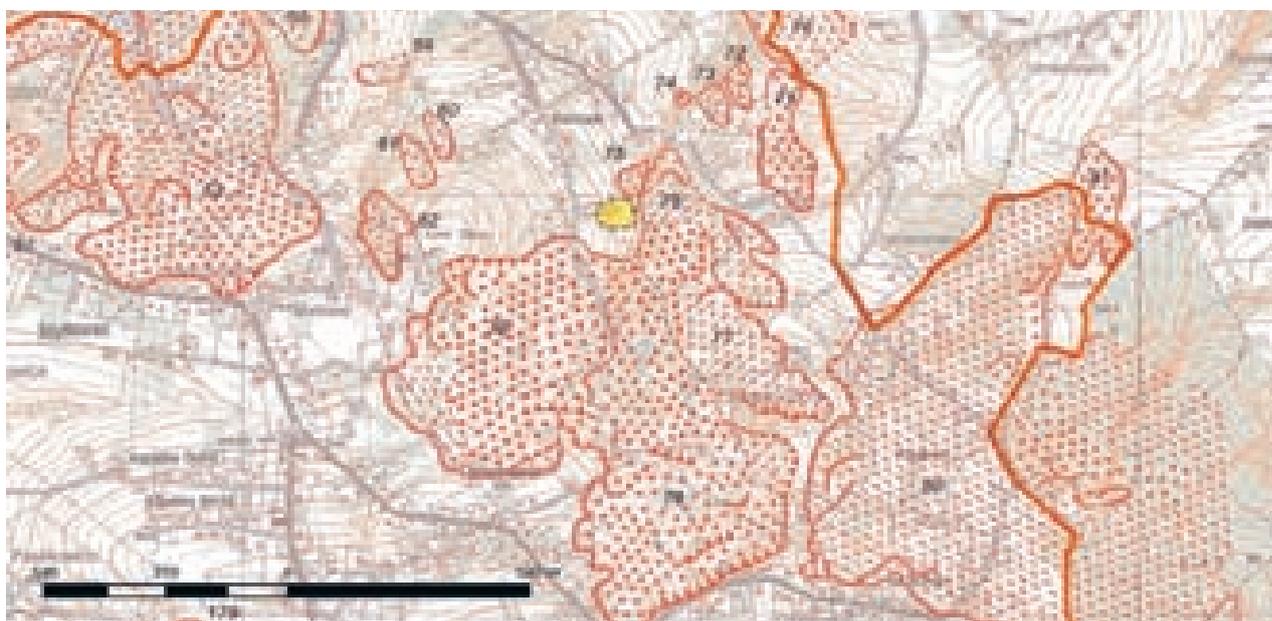
On the basis of the obtained results, distribution of almost 6,670 areas prone to mass movements were identified and shown along with location of 2,190 landslides in an administrative map of the extra-Carpathian Poland in the scale 1:50,000. The scale and extent of these phenomena in individual administrative units of the county (powiat) level were defined and the range of cartographic works which should be carried out in the third stage of the SOPO Project (that is in the years 2013–2016) was

assessed. The number of landslides in the Polish Carpathians was tentatively estimated at about 50,000 and the scale 1:10,000 was found to be the most appropriate for their documentation.

In order to facilitate further works, a registration card for landslides and areas prone to mass movements was designed, pilot maps of landslides in the scale 1:10,000 were compiled for three communes in the Carpathian Mts. (Strzyżów, Gorlice, Cieszyn communes) and three communes in the extra Carpathian Poland (Władysławowo, Włodawa, Połaniec) and pilot monitoring system was installed at the Hańczowa landslide (Gorlice commune in the Carpathian Mts.). The results of these works made it possible to elaborate *The Instruction for Compilation of Map of Landslides and Areas Prone to Mass Movements in the scale 1:10,000* which unifies methods of mapping and monitoring the areas of landslides.

Application services for the SOPO database of landslide hazards were created in cooperation with the Wrocław-based company GIS Partner. The SOPO Project website [osuwiska.pgi.gov.pl](http://osuwiska.pgi.gov.pl), provided by the Polish Geological Institute, enhances Internet-enabled access and use for the public. It makes possible identification of areas prone to landslide movements and assessment of the current risk of such movements for the users, especially those representing the administrative bodies as well as private investors. The authors of this application won the *Innovation of the Year 2008 Prize* in the competition organized under patronage of the Ministry of Regional Development.

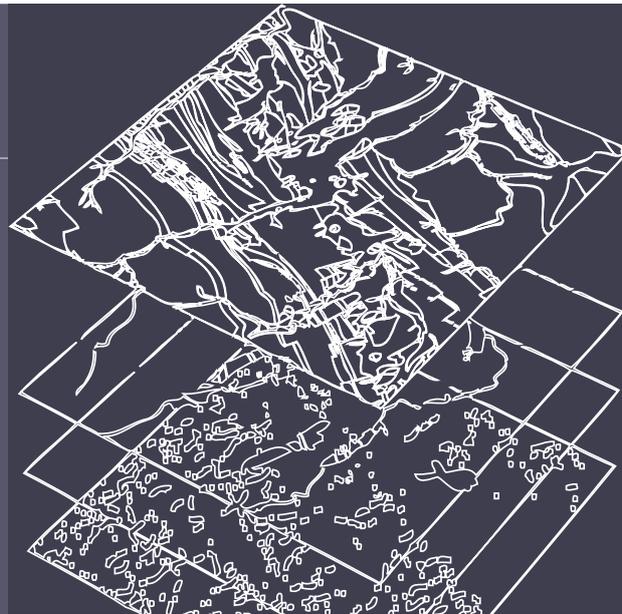
The second stage of the SOPO Project (2008–2012) began in July 2008. This stage should comprise cartographic works and mapping landslides and areas prone to mass movements in the area of the Polish Carpathians and monitoring of selected landslides in the Carpathian Mts. Works of the third stage should comprise compilation of the map of landslides in the Polish Carpathians (about 25% of area of Poland) and the extra-Carpathian Poland and monitoring of selected landslides in the Carpathians and extra-Carpathian Poland.



Fragment of map of landslides and areas of hazard of mass movements in the Wieliczka commune; scale 1:10,000

# GEOLOGICAL INFORMATION

Recording data in digital databases in support for modern science and economy



## CENTRAL GEOLOGICAL ARCHIVES

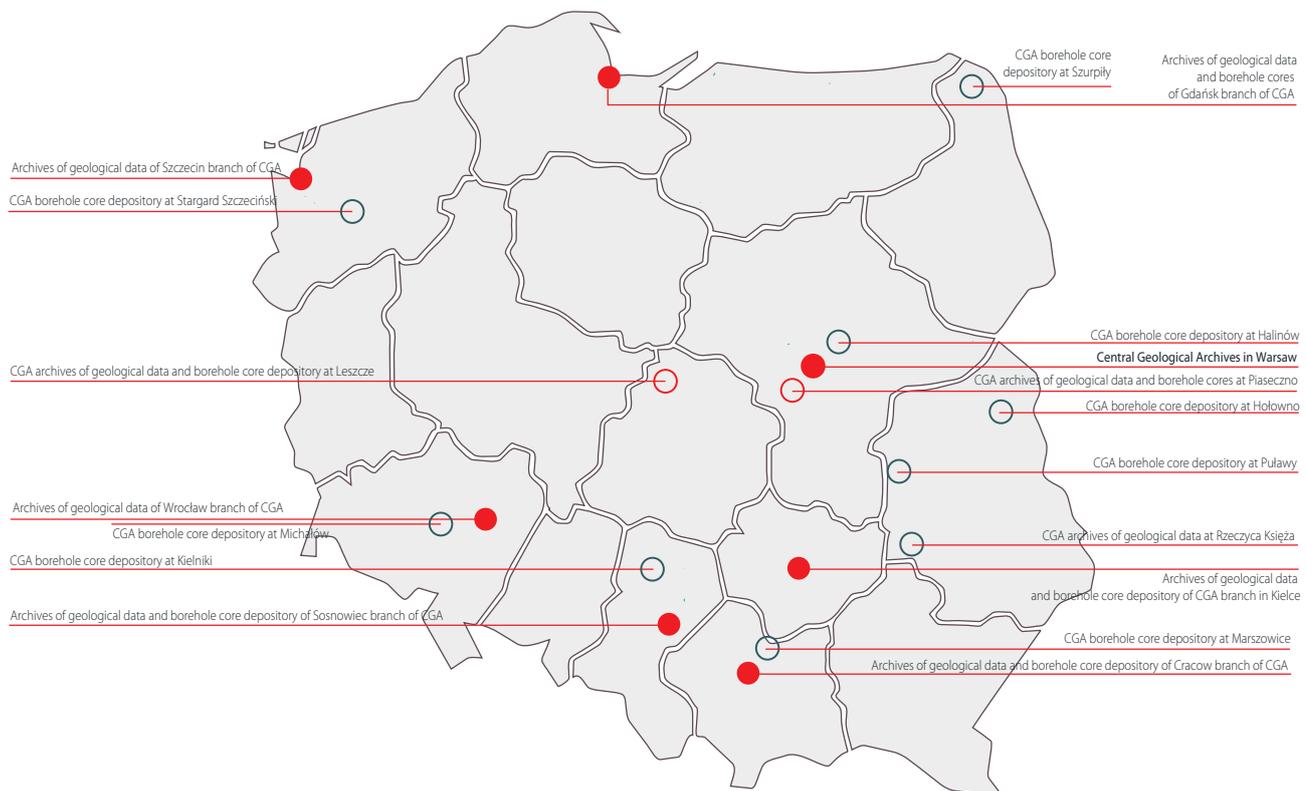
### Central Geological Archives (CGA)

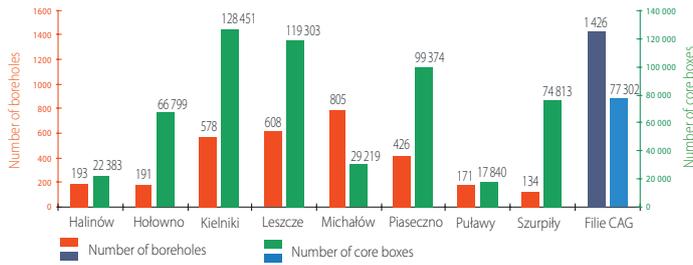
The role of CGA is to fulfil statutory tasks of the Polish Geological Survey to store, secure and provide access to geological, hydro-geological and geophysical materials, maps and core material for a wide range of government, industry and academic users. Data stored in the Central Geological Archives are disseminated in accordance with the Regulation of the Minister of the Environment of 22 July, 2005, and its subsequent amendments concerning the methods and procedures for disposing the right to the

geological information upon payment or making the information available free of charge.

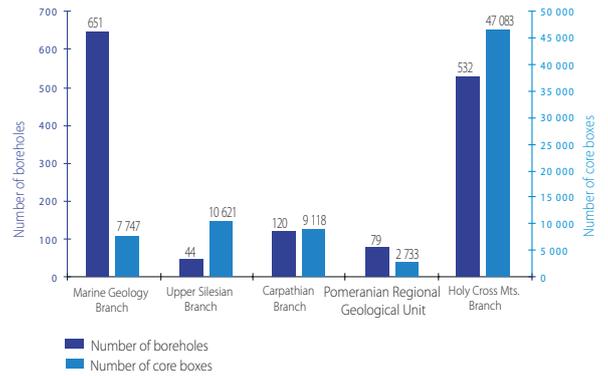
As specified by the Department of Geology and Geological Concessions of the Ministry of the Environment, the geological information which is to be used free of charge shall be made available to the entities concerned upon their application accepted by an authorized representative of the State Treasury, in the present case – the Director of the Polish Geological Institute. The geological information is made available as print-outs or in the xls, pdf, or mdb form.

The Archives have divisions in all the regional branches of the Institute.





Total number of boreholes and boxes with borehole core material in the depositories of the Central Geological Archives and its regional branches



Number of boreholes and boxes with borehole core material in regional depositories of the Central Geological Archives of the PGI branches

In order to preserve core material for future description and observations, the Archives maintain several borehole core archives – depositories located in several places around the country: at Halinów, Hołowno, Kielniki, Leszcze, Michałów, Piaseczno, Puławy and Szurpiły.

- 1,597 applications for access to geological information for non-commercial purposes were examined
- 14 applications for paid access to geological information for commercial purposes were examined
- 15,828 unpublished reports were entered to the database of the Archives

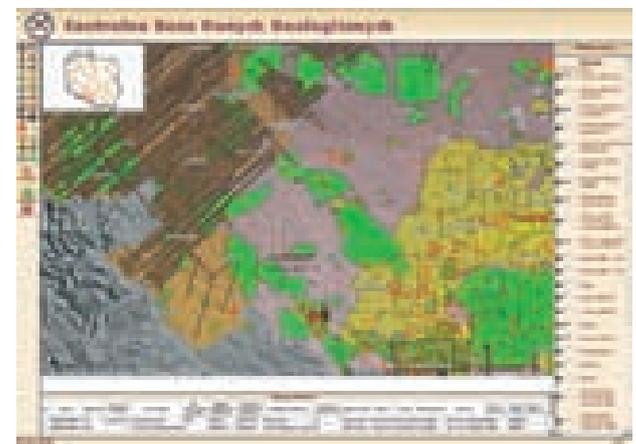
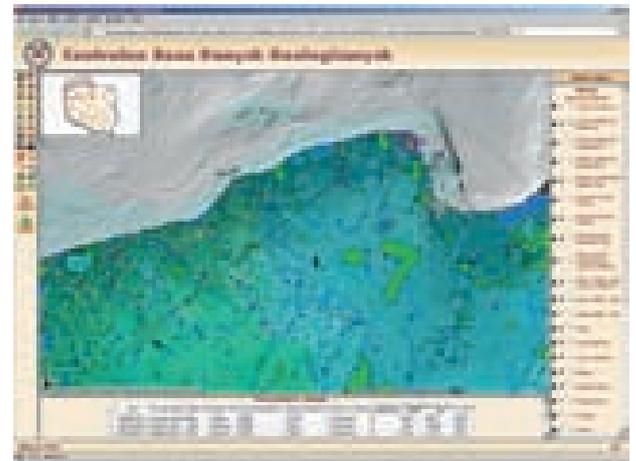


Workroom of the Central Geological Data Base

- 216 drilling protocols were entered to the database of the Archives
- 300 specialists were describing and sampling core material from 340 borehole profiles

## DATABASES

**Central Geological Database (CGDB)** is an original product of the Polish Geological Institute. Thanks to continuous modernization and development it is the largest base of digital data on Earth sciences in Poland. The database is a modern, multi-thematic information system making possible for its users to get



access to digital data collected in individual PGI databases as well as data from other archives.

The database contain information on:

- Boreholes and their lithological descriptions, stratigraphic columns and information on borehole core material stored in CGA depositories
- Geological documentations and reports
- Published maps
- Air and satellite photos
- Geological collections and specimens
- Results of studies and measurements
- Location of 2D and 3D seismic sections
- Numerous reference layers.

The Central Geological Database began to be transformed in connection with migration from the version 8.1.7 to 10g of the Oracle database. This results in modernization of applications and increase of potential of the individual subsystems, starting with *Boreholes* and *Analyses* subsystems. All the modern projects currently implemented by PGI, such as *Caves in Poland* or *Geosites*, are created using the new server for databases. The introduction of ArcGIS Server technology increased possibilities for editing and presentation of spatial data. Continuously updated data and more and more efficient applications of the internet service provides easy and wide access to information stored in the Central Geological Database, also in English version.

**Central Hydrogeological Database** called as **HYDRO Bank** is the hydrogeological database steadily expanded with new data on geology, hydrogeology, hydrogeochemistry and hydrodynamics of groundwater intakes and other hydrogeological objects such as springs and observation and research wells and wells exploiting potable waters. The HYDRO Bank stores data on about 130,000 hydrogeological objects from the whole area of Poland. Its role is also to update and verify the information gathered in the Central Hydrogeological Database and its seven Regional Hydrogeological Subdatabases. The stored data come from hydrogeological documentations and, in the case of older wells, water well registration forms. When necessary, the stored data are carefully verified, also in the field.

The HYDRO Bank System makes possible swift retrieval of information on current state of knowledge on hydrogeology in a given part of the country on the basis of number and spatial distribution of hydrogeological wells. The collected information is widely used in designing and documentation and cartographic works in the field of hydrogeology, geology, engineering geology, environmental protection and land use planning and water management.

The HYDRO Bank system and its data resources appear useful as a support for decision-making processes in natural environment management by central and local administration and government agencies. The major users of the HYDRO Bank data resources include: the Ministry of the Environment, Polish Geological Institute, government administration, geological enterprises, regional and local administration, universities and other research centers, the Polish Army, Regional Water Management Authorities and the Chief and Voivodeship Inspectorates for Environmental Protection.

The data stored in the HYDRO Bank, especially data on depth to the groundwater table, output of intakes, results of chemical analyses and information on observation points from the groundwater monitoring network were made available to several external entities and for internal use, in accordance with the accepted applications.

**System of Management and Protection of Polish Mineral Raw Materials MIDAS** carries out registration of data on all the mineral raw material deposits and their resources and reserves as well as the output and possibilities for upgrading. In addition to geological, cartographic and administrative information, it also comprises data on individual deposits. The register is steadily

supplemented with data concerning new deposits. Changes in size of resources and reserves and other parameters of exploited deposits are entered on the basis of statistical forms as of 31<sup>st</sup> December each year, provided by the operators. At present the system comprises data concerning:

- 12,008 mineral deposits
- 31,050 administrative decisions
- 244,316 changes in size of reserves
- 25,693 outlines of deposits, mining fields and mining areas
- 378,468 contour points

By the end of 2008, the data base contained over 1.05 million records in total. Each year it is extended with information on about 600 new mineral deposits.

The MIDAS system is the base for preparation of *Annual Report of Mineral Resources/Reserves and Groundwater Resources in Poland*, presenting the state of knowledge as of 31<sup>st</sup> December of the previous year. The basic information is also available on the Institute's website. The MIDAS system is also the base for compilation of a report *Mineral Resources of Poland*, published in English in five years intervals. The data stored in this system are set in packets for use in cartographic works conducted by the Polish Geological Institute, especially in preparation of individual sheets of *The Geological-Economic Map of Poland* and *The Geoenvironmental Map of Poland*.

The MIDAS system also serves as the base for various opinions and studies prepared under contracts with both government and self-government agencies and commercial entities from Poland and abroad. This is especially the case of various assessments of value of geological information and individual mineral deposits (also as opinions for courts) and analytical evaluations for the whole sectors of mining industry.

**Register of Mining Areas** has been functioning at the Polish Geological Institute since 1995. Mining areas are registered in books kept for individual basic mineral deposits or groups of deposits. In accordance with regulations of the Geological and Mining Law of 4 February 1994, mining areas are also established for common mineral deposits. At present the register contains 7,701 mining areas, of which 5,089 are current mining areas. However, these numbers do not reflect the latest changes and transformations.

The register is accessible through the Institute's website. The stored information is mainly used by central administration and self-government agencies, especially in compiling land use plans, enterprises preparing various environmental reports, and by individual clients, including operators of mines and real estate owners.

**INFOGEOSKARB Database** is a system created for distribution of information on the ownership of geological information concerning mineral deposits and hydrogeological items. This database is interactive with The System of Management and Protection of Polish Mineral Raw Materials MIDAS, Central Geological Database and Central Hydrogeological Database – HYDRO Bank. The INFOGEOSKARB system stores data on documents, the range and costs of geological studies completed in the past, history of documentation works and ownership of rights to the in-

formation contained in individual geological documents. On 31<sup>st</sup> December 2008, the INFOGEO SKARB system was storing data on ownership of geological information contained in 146,508 documents (122,184 hydrogeological documents and 24,324 documents concerning mineral deposits). In the years 2007–2008, costs of preparation of 3,241 documentations of mineral deposits were recalculated and 3,124 new documentations of mineral deposits and 12,599 new hydrogeological documents were entered to the system.

**PRICESMIN.** This database stores information on trade turnover of mineral commodities at the domestic and foreign markets. The gathered information presents domestic production as well as values and quantities of various groups of commodities in export and import (including references to countries of origin and destination) and production and trade turnover in exports and imports worldwide. The database contains information on raw materials of strategic importance, such as oil, natural gas, coal and lignite, zinc and lead, copper, aluminium, gold, silver. The base also stores information on prices of energy, metallic and chemical and industrial raw materials on world markets. Open market and producer prices are also taken into account in the relevant analyses.

The gathered data make possible tracing trends in economy of mineral raw materials and preparation of expertises and studies and are used in compilation of *Annual Report of Mineral Resources/Reserves and Groundwater Resources in Poland*.

## **INFORMATION TECHNOLOGY INFRASTRUCTURE**

The Polish Geological Institute has a modern, systematically expanded and updated information infrastructure. The local computer network includes over 800 computers in Warsaw and over 250 in the regional branches. The hardware housed in the server room includes 25 Window servers and 20 servers working under operational systems such as HP-UX Solaris, IRIX, Red-hat, NetBSD or Secure Platform. The data resources are stored mainly in Oracle, MS SQL and MySQL databases.

New solutions were introduced in the year 2008 in order to increase safety and comfort of work in the PGI network. The solutions included installation of anti-spam F-secure system, in-

crease of Firewall safety and installation of a safe post system on Exchange server. The servers were connected to mass memory network of Storage Area Network-SAN and configured as discs matrix, which extended the matrix resources by 32 discs as Fibre Channel with 147 GB capacity each. Moreover, encoded transmission to VPN corporate network (Check Point VPN-1 Edge XU) was provided for all the Institute branches and laboratories. Moreover, Checkpoint modules were purchased to make possible connection of the CGA core depositories to the corporate network.

## **GEOLOGICAL LIBRARY**

The Geological Library collects and distributes scientific publications from the Earth sciences, environmental protection and other related fields by traditional methods and by modern computer techniques. It is involved in systematic compilation of *The Geological Bibliography of Poland* and exchange of publications of the Polish Geological Institute. The library and its regional branches have a collection of about 170,000 books and editorial series and 649 titles of currently subscribed Polish and foreign periodicals. It is one of the biggest collections of geological publications in the country. The library has about 2,800 titles of periodicals including 20 titles collected from their first issues from the beginning of XIX century.

In the years 2007–2008, the library resources were increased with 2,510 new volumes and 1,021 periodical titles. Due to access to the electronic version of the periodicals through the bases of the EBSCO-IPS company, online versions of numerous periodicals became available.

Within the frame of cooperation with the American Geological Institute over 2,000 positions were described and indexed in the GeoRef system and the Polish Geological Institute got free online access to that base. The exchange of books, periodicals and cartographic publications of the Institute has been continued with over 280 research centers (including 40 Polish centers) and geological surveys from 60 countries. The library reading rooms were visited by over 18,000 readers in the years 2007–2008. About 20,000 publications were made available for the readers in the library rooms and 14,000 publications were loaned.



Under the quality control scheme, the Laboratory participates in annual inter-laboratory comparative tests connected with studies of environmental and geological samples.

In the years 2007–2008, the Laboratory made over 850,000 chemical analyses and over 83,000 samples were prepared for further studies.

### PETROGRAPHIC-MINERALOGICAL AND BIOSTRATIGRAPHIC STUDIES

There were continued integrated petrological studies on structure and origin of rocks. The studies were carried out with the use of scanning electron microscopy, analysis of cathodoluminescence images, computer image analysis for pore space measurements as well as methods of analysis of fluid inclusions. Detailed mineralogical-geochemical studies covered agates of the Sudety Mts., vein quartz and Jurassic siderites of the Kujawy and Wielkopolska regions and northern margin of the Holy Cross Mts. The studies on diagenesis of Early Cretaceous rocks of the central Poland were completed and those on diagenesis of Mesozoic rocks of the Łódź-Miechów and Ordovician rocks of the Gdańsk-Prabuty region are in progress.

Besides typical mineralogical and micropalaeontological studies, scanning electron microscopy was also used in studies for the needs of:

- Environmental protection – in analyses of presence of asbestos in soils, studies on chemical composition of dust caught by filters and chemistry of sediments settling in sewage systems;
- Industry – mineralogical analysis of solid phases originating in the process of enrichment, bioleaching and leaching of ore samples, semiproducts and concentrates of the shale fraction of copper ores; tests of natural building stones
- Renovation of pieces of art – identification of so-called earth pigments used in icon painting.

There were also conducted studies on petrology of organic matter, mainly from the point of view of relations between dominating types of macerals, their content and degree of maturity and origin of oil-bearing horizons in selected areas. A comparison of a highly productive Triassic of the western Spitsbergen vs. Triassic of the Kujawy Swell may serve here as an example.

In order to establish the age of sediments and reconstruct palaeoenvironmental changes there were made over 3,000 micropalaeontological and palaeobotanic analyses, including palynological ones. A large part of these analyses were made within the frame of cartographic works connected with preparation of *The Detailed Geological Map of Poland in the scale 1:50,000*.

### DETERMINATION OF PHYSICO-MECHANICAL PARAMETERS OF SOILS

Numerous field studies (engineering-geological drillings, dynamic soundings, taking drill core samples) and laboratory tests were performed to determine engineering-geological parameters in assessing foundation conditions for infrastructure and land use and technical conditions of building objects. The studies were conducted in accordance with Polish and European norms (such as ISO/TS 17892, EN ISO 22476 and PN-EN 1997-2:2007) and the

American ones and with the use of appropriate modern measurement equipment.

The following physico-mechanical parameters of soils are being determined: granulation (sieve and aerometric and laser analyses – laser particle sizer *Analysette 22*), moisture content, coefficient of consolidation (CRS tests), volume density, effective porosity and permeability coefficient (*Trautwein* system).



*Generation of phases in the course of cooling of single-phase fluid inclusions*



*Liquid limit determination of soil using drop-cone penetrometer*



*Measurement of grain size distributions using optical laser diffraction*

## INTERNATIONAL COOPERATION

### Geology without borders



18	international research projects
10	projects under contracts awarded by the European Commission and European Regional Development Fund
40	bi- and multilateral agreements on scientific cooperation (as of 31.12.2008)
6	bilateral agreements on scientific cooperation with foreign partners from Angola, Australia, Slovakia and Ukraine
9	contracts for providing services and expertise for foreign entities
25	international conferences, seminars and workshops organized or co-organized by PGI
120	scientific conferences abroad, in which PGI staff participated
194	papers and posters presented by PGI staff abroad
264	consultative meetings and scientific workshops, in which PGI staff participated abroad
15	foreign trainings with participation of PGI staff
73%	delegations to UE member states
50%	delegations to neighbouring countries

International cooperation of the Polish Geological Institute was concentrated on border areas including those of the Polish Exclusive Economic Zone of the Baltic Sea. Among foreign partners of the Institute the most important were the European geological surveys. The cooperation comprised all the fields of the Earth sciences. The predominating issues included regional geological, geo-environmental, hydrogeological and geophysical studies, geological cartography, studies on geohazards and environmental pollution, economic geology, geoinformation, protection of geodiversity and promotion of geotourism. The Institute participated in joint research projects implemented within the frame of executive programmes of inter-governmental agreements on cooperation in several fields including science and technology, signed with Belgium, Belarus, Czech Republic, France, India, Russia, Slovenia, Ukraine, Hungary and Italy.

#### Belarus

Cooperation with Belarusian research institutes and geological enterprises in lithostratigraphic studies, interpretation and visualisation of geological data for the land use planning and studies on Palaeozoic evaporitic basins was continued. Moreover, there were carried out works on establishing groundwater monitoring system in border zone of Belarus and Poland.

#### Czech Republic

Cooperation with geological surveys of the Czech Republic (CGS) and Saxony (LfUG) made it possible to compile a geo-environmental atlas for the purposes of environmental protection and land use planning in Polish-Czech-German border zone in the scale 1:250,000. The project entitled *The Method of Landslides Monitoring and Study at the Example of Selected Slope Deformations in Poland, Czech Republic and Slovakia* was continued. Geo-environmental studies connected with designing the Sudectic Geostrade, that is a touristic-recreational route in the Sudety Mts. were initiated. Representatives of PGI participated in works of the Polish-Czech Commission for Transboundary Waters and data management working group of the International Commission for Protection of the Odra River Against Pollution.

#### Lithuania

Monitoring of groundwater in the border areas and hydrogeological studies connected with implementation of UE Framework Water Directive were carried out in cooperation with the Geological Survey of Lithuania. The cooperation with Lithuania also included the issues of protection of the geological heritage and related geological-environmental studies of areas of exceptional natural and touristic value, promotion of geotourism, planning of geoparks and detailed geological cartography.

#### Germany

In cooperation with German partners, especially the geological surveys of neighbouring German provinces, the Institute was conducting transboundary monitoring of groundwater in the Odra River drainage basin, with a special attention paid to zones

of intense anthropopression. The Institute also cooperated with the geological surveys of Brandenburg and Mecklenburg-Vorpommern in planning and designing the Mużakow Arch and the Land of the Glacier Epoch on the Odra River Banks Geoparks.

### Russia

Stratigraphic and sedimentological studies on amber-bearing sediments in north-eastern Poland and the Kaliningrad region were carried out in cooperation with the Atlantic Department of the P.P. Shirshov Institute of Oceanography of the Russian Academy of Sciences.

### Slovakia

The cooperation with the Geological Survey of Slovakia (Geological Institute of Dionyz Stur) was concentrated on preparation of *The Detailed Geological Map of the Tatra Mts. in the scale 1:10,000*, especially on correlation of stratigraphic units. Monitoring of selected Carpathian landslides was continued. The cooperation also included hydrogeological studies in border zones of Poland and Slovakia and transboundary monitoring of groundwater.

Cooperation with the Geological Institute of the Slovak Academy of Sciences included palaeomagnetic studies of the Carpathian orogen and travertine rocks and co-editing of *Geologica Carpathica* journal.

Representatives of PGI participated in works of the Polish-Slovak Commission for Transboundary Waters and carried out hydrogeological studies in border zone of the two countries. Monitoring of trans-boundary groundwater reservoirs was also conducted.

### Ukraine

Framework programme of cooperation with the State Geological Survey of Ukraine has been agreed. The programme comprises cooperation in regional geology, geological cartography, geophysical surveys, oil geology, hydrogeological and geoenvironmental studies of borderland of Poland and Ukraine, and marine geology. Representatives of the Institute participated in works of the Polish-Ukrainian Commission for Transboundary Waters and working group for hydrometeorology and hydrogeology.

Cooperation with Ukrainian scientific-research institutes was concentrated on geoecology, regional geology, economic geology, including studies on deep geological structures of marginal zone of the Carpathians from the point of view of prospecting and exploration of new deposits of oil and gas. Moreover, there were conducted joint studies on Carboniferous coal-bearing formations, the results of which were presented in *Monograph of the Lviv-Volhyn Coal Basin* recently published in Kiev.

### Other Partners

The Institute participated in scientific-research works and cooperation based on service contracts with numerous foreign partners, including:

- Geological Survey of Finland (GSF) – airborne geophysical surveys for the needs of hydrogeological studies and marine and geology
- Institut Français du Pétrole – processing seismic data from the Carpathian orogen (within the frame of *Polonium* programme)

- RWTH Aachen – modelling of subsidence and evolution of the Holy Cross Mts. region
- Vrije Universiteit of Amsterdam – digital thermomechanical modelling of the lithosphere
- E. Lorand University of Budapest and Institute of Geophysics of Hungarian Academy of Sciences – palaeomagnetic studies
- US Geological Survey – stratified copper deposits
- Esso Exploration International Ltd – hydrocarbon deposits of selected concessional blocks

The Institute was involved in a long-term international project aimed at compilation of *Petroleum Geological Atlas of Southern Permian Basin* (SPBA), coordinated by the Geological Survey of the Netherlands (TNO).

In 2008, an agreement was made with the Corporation of the International Year of the Planet Earth (IYPE) which defines contribution of the Institute to the activities of this programme. The Institute was entrusted with the role of representative of Poland in the Steering Committee of the International Year of the Planet Earth.

### International Projects

The development of international cooperation of the Institute was intensified by activities aimed at securing financing for research from UE sources and other international programmes. In the years 2007-2008 the following international programmes coordinated by PGI have been completed:

- MELA (Morphotectonic Map of the European Lowlands Area) – elaboration of interdisciplinary and innovative methods of mapping, carried out within the frame of the Maria Curie Host Scholarship Programme of 6<sup>th</sup> Framework Programme of EU
- GEOMIND (Geophysical Multilingual Internet-Driven Information Service) – project of EU programme eContent<sup>plus</sup>, implemented by a consortium of 13 geological surveys, scientific institutes and commercial enterprises from 9 European countries
- GAJA (Elaboration of geoenvironmental assumptions for the Yotvings geopark in cross-border Polish-Lithuanian area) – project completed within the frame of INTERREG IIIA TACIS Programme in cooperation with the Geological Survey of Lithuania.

Moreover, there were completed the following projects carried out by the Institute as a partner of international consortia:

- In 6<sup>th</sup> Framework Programme of the European Commission:
  - » ENCORA (European platform for sharing knowledge and experience in coastal science, policy and practice)
  - » PROMOTE (Verifying the performance of Environmental Technologies – ETV)
  - » ENGINE (Enhanced geothermal innovative network for Europe)
- In INTERREG Programme:
  - » ASTRA (Developing Policies & Adaptation Strategies to Climate Change in the Baltic Sea Region) in the INTERREG III B Neighbourhood Programme for the Baltic Sea Region
  - » MAGIC (Management of Groundwater in Industrially Contaminated Areas) in INTERREG IIIB CADSES.

In 2008, the Institute became the member of a consortium *One-Geology-Europe* with the British Geological Survey as coordinator. The project, financed by EU programme *eContentplus*, is aimed at creation and implementation of dynamic geological map data of the Europe in 1:1,000,000 scale available via the web and map service matching standards of geoinformation. Thirty partners participate in this project which already became recognized as a priority initiative of the geological surveys and the International Year of the Planet Earth.

Works of AEGOS Project, dealing with geoinformation resources of Africa, were launched within the frame of 7<sup>th</sup> Framework Programme of EU. AEGOS is coordinated by the Geological Survey of France (BRGM).

The Institute participated in works of the Joint Research Centre of the European Commission in Ispra (Italy), including the project *Regional Risk Assessment for Mining and Contaminated Areas in the Upper Silesian Region*. There were also implemented projects financed by NATO Scientific Programme: *Strategic Understanding of the Security Threats Imposed by Global Climate Changes*, *Storage of Petroleum in Salt Caverns and Use of Salt Brine as a Medium for Improvement of Environment and Sustainable Use and Protection of Groundwater Resources in Border Areas of Poland, Belarus and Ukraine*.

There were also initiated works in the project of the Norwegian Financial Mechanism – *Ecosystem Approach to Marine Spatial Planning – Polish Marine and NATURA 2000 Network*, and MACHU (Managing Cultural Heritage Underwater) project dealing with submarine environmental archaeology, financed by EU Programme *Culture2000*.

The Institute was also continuing cooperation with the consortium of TERRAFIRMA Project (Pan-European Ground Motion Hazard Information Service) of the GMES programme of global monitoring of the environment, and the consortium implementing the project of investigating and managing the impacts of marine sand and gravel extraction and use, carried out within the frame of COST Action EU Programme.

In cooperation with scientific centres from Slovakia, Czech Republic and Hungary, the Institute was conducting complex interpretation of anomalies of potential fields along profiles of deep refraction surveys (*CELEBRATION 2000 Project*). The Institute also participated in studies connected with EUROCORES and TOPO-EUROPE programmes supported by the European Science Foundation (ESF) and was involved in works of GEMAS Project, aimed at geochemical mapping of agricultural and grazing land soils of Europe.

### International Organizations

PGI staff participated in works and activities of numerous scientific and professional associations, organizations and networks such as the International Union for Quaternary Research (INQUA), International Geoscience Programme IGCP, International Continental Scientific Drilling Programme (ICDP), International Programme of Deep Seismic Surveys, International Ocean Drilling Project (IODP), International Union of Geological Sciences (IUGS) and its *Cogeoenvironment* Working Group, IUGS-CGI Working Group for Multilanguage Geological Dictionary, Geoscience Information Consortium (GIC), Raw Materials Supply Group of

European Commission (RMSG), European Large Geotechnical Institutes Platform (ELGIP), Carpatho-Balkan Geological Association, Association of European Geological Societies (MAEGS), groups of geological surveys of the Central European Initiative (CEGS), International Council for the Exploration of the Sea (ICES), Co<sub>2</sub>GeoNet network (geological storage of CO<sub>2</sub>) and TOPO-WECEP European Platform Natural Laboratory network. The Institute is a member of EuroGeoSurveys (EGS), association of European geological surveys.

## GEOLOGICAL STUDIES CARRIED OUT ABROAD

### Angola

Within the frame of foreign assistance programme of the Ministry of Foreign Affairs of the Republic of Poland, the Polish Geological Institute in cooperation with the Geological Institute of Angola (Instituto Geológico de Angola - IGEO) was implementing a project supporting organization of the Geological Survey of Angola. The Institute arranged trainings for IGEO staff in Angola and Poland. The trainings were aimed at providing skills necessary for the use of modern methods of geological cartography, systems of registering and assessing mineral resources, hydrogeology, geological information, environmental geology and petrology. The skills should be useful in prospecting and exploration of mineral resources of Angola and their extraction in accordance with principles of sustainable development.



*Reconnaissance in area of occurrence of copper deposits in Upper Cretaceous rocks, the Sumbe region (300 km south of Luanda)*

### Antarctica

The Polish Geological Institute participated in the international project *Geochemical and Palaeomagnetic Record of Evolution of Climate of West Antarctica in Cenozoic Rock Succession of the King George Island, South Shetland Islands Archipelago* conducted within the frame of programme of IV<sup>th</sup> International Polar Year 2007-2008 – Antarctic Climate Evolution. PGI scientists took part in 31. and 33. Expeditions of the Polish Academy of Sciences to the Arctowski Station. The PGI team cooperated with that of the Department of Antarctic Biology of the Polish Academy of Sciences. Field works on the King George Island were a part of the Project *Isotope Geochronology and Palaeomagnetism of Cretaceous and Palaeogene Volcanic Formations of the King George*

*Island.* The aim of the project supported by the grant of the Ministry of Science and Higher Education was to establish chronostratigraphy of rocks forming southern part of the King George Island which should make it possible to date geological events of global significance as well as to define the scale and chronology of the inferred large-scale strike-slip movements of blocks which nowadays build the South Shetland Islands.



*View from the penguin colony (Adela Penguins) on the Polish Antarctic Station Henryk Arctowski; note Point Thomas and the Ezcurra Fjord Inlet in the background (Admiralty Bay, King George Island, western Antarctica)*



*Taking oriented basalt samples for palaeomagnetic studies in the Lions Rump region (King George Bay, King George Island, western Antarctica)*

### **Mongolia**

The Polish Geological Institute participated in preparations of a programme of scientific studies in accordance with the Agreement between the Government of the Republic of Poland and the Government of Mongolia on settlement of Mongolia's debt to the Republic of Poland, signed in 2006, and the subsequent Executive Agreement between the Minister of the Environment of the Republic of Poland and the Minister of Industry and Trade of Mongolia, signed in 2008. The programme of studies comprises the issue of financing geological works in Mongolia. The studies will be coordinated by the Institute from the Polish side and by the geological survey of the Office of Oil and Mineral Resources of Mongolia from the Mongolian side. The PGI staff participated in consultations and reconnaissance trips to the areas of the planned geological-research works in the Hasagth region. The programme comprises geological-cartographic works, prospecting and exploration of mineral deposits and mineralogical, geochemical and geophysical studies and eventually drillings.



*Geological surveys in the Hasagth region (Mongolia)*

### **Ukraine**

The long-term cooperation with Ukrainian scientific centers, especially the Institute of Geology and Geochemistry of Combustible Materials NANU in Lviv (IGGGK) was continued. The joint studies mainly concerned regional geology, mineral raw materials and geoecology and their results were presented in *Atlas of Abiotic Environment in the Border Zone of Ukraine and Poland* in the scales 1:200,000 – 1: 500,000. The atlas published in 2007 presents information on geological structure, geoenvironmental conditions, raw material deposits, surface and underground waters, protection of nature and cultural heritage, land use, geophysics and results of photogeological and geochemical analyses. Field geological works carried out in the Ukrainian Carpathians were connected with implementation of the Project *Transboundary Studies of Deep Geological Structures of Marginal Part of the Carpathians from the Point of View of Prospecting and Exploration of New Deposits of Oil and Gas*. Moreover, the Institute participated in studies carried out by a consortium led by AGH University of Science and Technology. The latter studies were connected with implementation of the project *Perspectives of Oil Prospecting and Hydrocarbon Potential of the Miocene and Mesozoic-Palaeozoic Basement in Border Zone Parts of the Carpathian Foredeep in Poland and Ukraine*, which will end in the year 2010. There were also continued field works connected with sedimentological studies of Miocene sediments in Ukrainian part of the Carpathian Foredeep.

## DISSEMINATION OF KNOWLEDGE ON THE GEOLOGICAL ENVIRONMENT

Education and protection of geological heritage



Education activities and popularisation of Earth sciences belong to statutory duties of the Polish Geological Institute. To meet these requirements, the Institute was organizing exhibitions, shows, lectures and museum lessons including guided tours around the Geological Museum. In 2007 Museum guides led 350 organized groups, mainly school excursions, and in 2008 – 328 groups. It should be added that a special attention was paid to preparation of various educational programmes.

### EDUCATION

The Geological Museum organized successive *Our Earth – the Natural Environment Yesterday, Today and Tomorrow* competitions for the school children. In 2007 the topic was *The Time of Mammoth*, and in 2008 – *Treasures of the Earth*. Ten thousand school pupils from Poland and Lithuania took part in these competitions.

The Museum also prepared several educational publications. *A Stratigraphic Table – The History of Life on Earth* has appeared in print. The fully illustrated table presents the development of plants and animals in time, palaeogeographic maps of the world and transgressions and regressions in area of Poland. It is primarily addressed to high school students.

An educational programme *Geological history of Poland* has just been completed. It comprised preparation of five thematic folders: *How Was the Baltic Sea Formed?*, *How Were the Holy Cross Mountains Formed?*, *How Were the Tatra Mountains Formed?*, *The Last One Million Years in the Polish Lands* and *Volcanoes of the Lower Silesia* as well as internet and multimedia presentations dealing with these topics.

A cooperation was established with the Office of Jaworzno City with the idea of creating a GEOsphere educational center of the Earth sciences in the area of the Sadowa Góra quarry in Jaworzno. In the course of preparation of the project *The PGI Geological Museum Books for Children*, works were conducted on an exposition addressed to children. The aim of this exposition was to present information on geological structure and processes taking place in Poland in a simplified and easily digestible way. Five educa-

tional folders were prepared: *Meteorites*, *How Was Coal Formed?*, *Mammoths*, *Time Spiral* and *History of Amber*.

In the course of implementation of the long-term project “Geological Rescue Service”, the following activities were carried out: geological consultations, analyses of geological specimens gathered by collectors in the area of Poland and organizing field trips to check reports and save new discoveries on place.

Didactic collections of the Geological Museum were steadily supplemented. Moreover, there were gathered specimens for preparation of didactic collections of rocks, minerals and fossils for distribution among schools across the whole country. Consultations and explanations concerning geological issues which were raised by the government and local administration were provided. The Institute staff also gave numerous lectures and presentations and arranged workshops on various aspects of geology. For promotion and popularisation of geological sciences, the Institute took part in international fairs on environmental protection and geology, such as *Geology* and *Eurolab* in Warsaw, *Poleko* and *EkoMedia Forum* in Poznań and *Interkamień* in Kielce.



Making cast of a dinosaur footprint in the field



*The museum lesson on the mammoth *Mammuthus primigenius* Blum*



*Remains of Pleistocene mammals displayed at the *Time of Mammoth* Exhibition*



*PGI exposition at the Celebrations of Day of the Earth in Warsaw*



*Reconstruction of a mammoth bone hut of prehistoric hunters at the *Time of Mammoth* Exhibition*



*PIG stand at International Trade Fair for Environmental Protection POLEKO'2007 in Poznań*

## EXHIBITIONS

The exhibitions *Mineral Raw Materials of Poland*, *History of Poland Written in Stone* and *Fossilized World* were modernized and expanded.

Seasonal exhibitions were organized: *On the Footprints of Spiny Dinosaurs* (the exhibition later presented in the Museum of the Wigry National Park) and *The Time of Mammoth* as well as ex-

hibitions in memory of the outstanding geologists Zbigniew Kotański and Stanisław Doktorowicz-Hrebniński.

In the years 2007 and 2008 also open-air exhibitions were organized. In 2007 this was *Our Earth* exhibition of large-size reproduction of children paintings sent to the *Our Earth – Natural Environment Yesterday, Today and Tomorrow*, and in 2008 – *Geology in profile and en face* exhibition of photographs awarded in second edition of photographic competition for employees of the Institute.

The open-air exhibitions from the last years were also shown in other towns. *Geology in profile and en face* exhibition was shown in the Regional Museum in Sieradz, *Gea Means the Earth* – in the Forest Culture Center in Gołuchów and subsequently in the Polish Institute in Vilnius and the T. Reytan High School in Warsaw, *Our Earth* – in the Youth Culture Center in Skierniewice and *Geological Landscapes of the Vistula River* – in Olsztyn near Częstochowa. Moreover, the PGI Marine Geology Branch in Gdańsk organized an exhibition *Rocks and Fossils of the Polish Beaches*. The aim of this exhibition was to increase interest of the local communities in natural environment and propagate knowledge on geological history of the Southern Baltic coast, with a special attention to the region of Gdańsk-Sopot-Gdynia agglomeration. It is planned to expand this exhibition to comprise other issues of the marine geology. Within the frame of celebrations of the International Year of the Planet Earth in June 2008 the Marine Geology Branch also organized an

open-air exhibition of photographs emphasizing importance of the Earth sciences for quality of life on our planet.

## GEOTOURISM

Organization of geoparks and geological educational trails and publishing geological-touristic maps and guide-books are the best ways to protect areas particularly valuable from the geological standpoint, of great natural and educational significance and attractive for geotourism.

## GEOPARKS – OPEN AIR GEOLOGICAL MUSEUMS

**Kamienna River Valley Geopark** (vicinities of Skarżysko, Starachowice and Ostrowiec Świętokrzyski) – a very special site, unique in Europe due to a combination of inanimate nature monuments, archeological monuments and unique historical-cultural landscapes. The Krzemionki Opatowskie Natural Reserve is situated in area of the planned Geopark. Moreover, Mesozoic rocks exposed in this area are well known for their valuable fossils and mineralogical specimens.



*Kamienna River Valley Geopark*

**Drawsko Lake District Geopark** – the project of geopark and geological educational trails is being prepared in cooperation with the Drawsko and Ińsko Landscape Parks.

**Land of the Glacier Epoch on the Odra River Banks Geopark** (areas of Cedynia, Moryń and Trzcińsko Zdrój communes and Gryfino powiat) – the cooperation aimed at foundation of a transboundary Polish-German Geopark was continued. The attractions of this Geopark are surface landforms related to the youngest glaciation, such as terminal moraines, eskers and kames.

## GEOLOGICAL EDUCATIONAL TRAILS

**Kielniki Quarry** – a trail leading through northern part of the Cracow-Częstochowa Jura Chain presents geological structure of that region, origin of the exposed Upper Jurassic limestone rocks and mechanism and effects of karst processes to which these rocks were subjected. The trail makes it possible to become familiar with



*Kielniki Quarry geological educational trail*

typical forms of surface karst at the example of crags of the Góra Zamkowa Hill at Olsztyn and neighbouring Cegielnia, Ostra Góra and Statkowa hills and subterranean karst in the cave at Kielniki and Magazyn cave and also with some aspects of geological structure of that area in abandoned Oxfordian limestone quarry at Kielniki. The trail has been designed and arranged by the Polish Geological Institute and Olsztyn Commune Office and co-financed by the Śląskie Voivodeship Self-government.

**Marine Cliff Coast of the Rewal Morainic Plateau** – projects of educational trail and geological exhibition in the Marine Museum at Niechorze and regional museums at Moryń and Trzyńsko Zdrój are ready. Documentation for 15 sites of inanimate nature monuments was prepared.

## GEOSITES

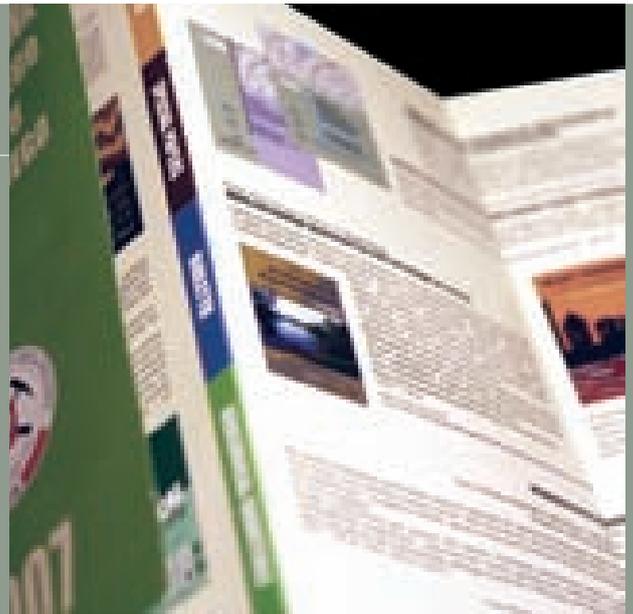
PGI is conducting studies of dinosaur footprint tracks and prepares geolocalities for educational purposes. A programme of ecological education was elaborated on the basis of ecological-geological educational trails. PGI specialists were consulted and participated in working out the idea of construction of an education centre at the *Gliniany Las* locality with unique occurrences of footprint tracks of dinosaurs and other trace fossils of the Early Jurassic age.

## GEOLOGICAL-TOURISTIC MAPS

Preparation of geological-touristic maps of areas of the Wigry, Białowieża, Roztocze, Polesie and Babia Góra National Parks is in progress.

*Sudety Mts. Geotouristic Guidebook* – this book is the first Polish publication corresponding to guidebooks of *the road geology type* – *view the geology through car window*, very popular and often republished in several countries. The advised route runs along the National Road Nysa-Złoty Stok-Kłodzko-Wałbrzych-Jelenia Góra and makes it possible to visit highly attractive towns and become familiar with geological structure and history of geological units of the Sudety Mts.

## PUBLICATIONS



The publishing activity belongs to statutory duties of the Polish Geological Institute. This activity is also a tool for promotion of the Institute and at the same time an effective education in the field of geology and related sciences, especially environmental protection. The Institute is the publisher of serial and non-serial geological maps and atlases, periodicals and continuous editorial series such as *Geological Quarterly*, *Bulletin of the Polish Geological Institute (Biuletyn PIG)*, *Studies of the Polish Geological Institute (Prace PIG)*, *PGI Special Papers*, *Geological Bibliography of Poland (Bibliografia Geologiczna Polski)*, *The Annual Report of Mineral Reserves/Resources and Groundwater Resources in Poland (Bilans Zasobów Kopalin i Wód Podziemnych w Polsce)*, *Scientific Sessions of the Polish Geological Institute (Posiedzenia Naukowe PIG)*, *Deep Well Logs (Profile Głębokich Otworów Wiertniczych PIG)*, *News of PGI (Wiadomości)* and others. In the years 2007–2008 a total of 2,670.30 publisher's sheets were published including books, periodicals and text explanatory texts to maps. This number does not include publications available through electronic media.

### CARTOGRAPHY

Similarly as in the last years, editing and publishing of series maps in the scale 1:50,000 was continued. There were published successive 91 sheets of *The Detailed Geological Map of Poland* and explanatory notes to 90 sheets of this map. Moreover, 44 sheets of *The Geological-Economic Map of Poland* and 117 sheets of *The Geoenvironmental Map of Poland* were prepared in 2007, and 10 sheets of *The Geological Map of Poland in the scale 1:200,000* were updated and edited for printing in 2008. The latter maps are made available by the Central Geological Archives in the form of plotter prints or in electronic format on CDs. Moreover, the first 288 sheets of a new serial map – *The Lithogenetic Map of Poland in the scale 1:50,000*, were elaborated and made available. There was also published *Geological Map of the Western and Central Part of the Baltic Depression without Permian and Younger Formations in the scale 1:750,000*. This is subcrop map of pre-Permian rocks in the area stretching from the Pomeranian Bay in the south-west to the Gulf of Riga in the north-east and presents



geological structure in the Polish economic zone of the Baltic Sea and neighbouring countries and major geological features of the Palaeozoic oil system which makes it important for further assessments and prospecting of hydrocarbons in this region. In 2007 there was also released *Geological Map of the Outer Carpathians: Borderland of Ukraine and Romania, 1:200,000*. This map represents a follow-up of the map of the Outer Carpathians in the borderland of Ukraine and Slovakia which appeared in the year 2004 and presents correlated and standardized local lithostratigraphic subdivisions used in areas of these three countries. The results of detailed cartographic works carried out in the Upper Silesia were presented in 4 sheets of *The Detailed Geochemical Map of the Upper Silesia in the scale 1:25,000*. The sheets (Myślachowice, Olkusz, Nowa Góra and Chrzanów) were published along with explanatory texts in Polish and English and 53 thematic tables.

The major aim of another publication, *Geological-Structural Atlas of the Palaeozoic Basement of the Outer Carpathians and Carpathian Foredeep in the scale 1:300,000*, was to present a coherent model of geological structure and trace relations and regularities in geological structure of the Palaeozoic and distribution of hydrocarbon deposits hitherto discovered in this area. Maps were compiled using data from 3,247 boreholes as well as seismic reflection, magnetotelluric and gravity surveys and published and archival cartographic material. *The Atlas* comprises geological map of Carboniferous subcrops, geological-structural map of top surface of the Palaeozoic and Precambrian and structural maps of the best known lithological-stratigraphic complexes of the Upper Silesian and Małopolska Blocks. The cartographic works showed that basement structures built of Palaeozoic and Precambrian rocks, coeval and fairly similar in lithology, continue from the foreland deep into the Carpathian Foredeep and the Outer Carpathians.

### TEXT PUBLICATIONS

*The Stratigraphic Table of Poland*, published under the editorship of Ryszard Wagner, is the result of work of stratigraphers from different geological centers in Poland. It consists of two sheets: *Extra-Carpathian Poland* and *Carpathian Mts.*, and presents all the lithostratigraphic units currently in use in Poland (down to a formation level). The units are placed according to their geographic extent and correlated with the International (Standard) Stratigraphic Scale.

Two methodological manuals (guide-books) were published: *Guide-book for Elaboration and Publishing the Lithogenetic Map of Poland in the scale 1:50,000* and *Guide-book for Elaboration of the Map of Landslides and Mass Movement-prone Areas in the scale 1:10,000*. The latter presents the recommended methods of field works, comprising identification, location and characterization of landslides and areas prone to mass movements as well as monitoring of landslides.

In connection with the entrusted tasks of the Polish Hydrogeological Survey, the Polish Geological Institute continued publishing successive issues of *Quarterly Bulletin of Groundwaters* (*Kwar-*

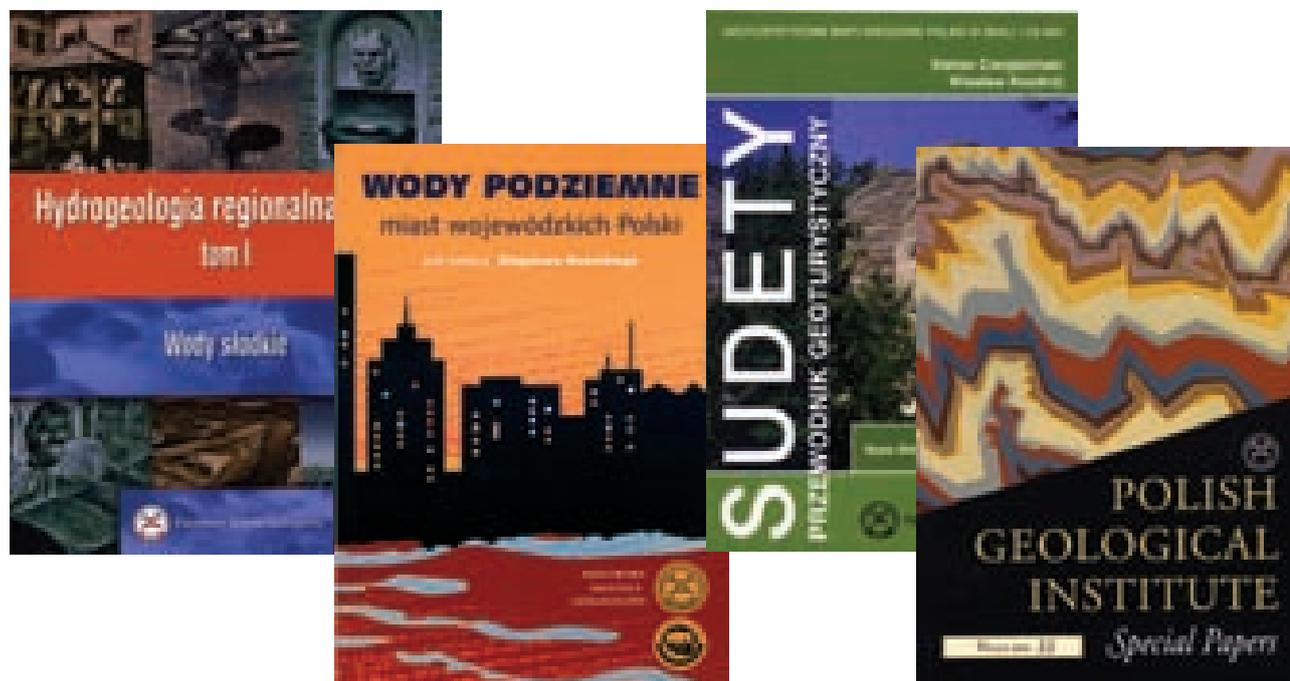
*talny Biuletyn Informacyjny Wód Podziemnych*) and *The Hydrogeological Annual* (*Rocznik Hydrogeologiczny*).

In 2007, the Institute also published a two-volume monograph entitled *Regional Hydrogeology of Poland*. Volume I, *Fresh Waters*, consists of three parts and presents general hydrogeological issues, hydrogeological characteristics of water regions and groundwater resources. Volume II is devoted to mineral, therapeutic and mine waters. The aim of this monograph is to give a coherent picture of hydrogeological conditions in Poland, with reference to origin of groundwaters, their circulation systems, the mode of origin of their resources, relations with surface waters and use and vulnerability to pollution at the background on the new hydrogeological subdivision of the country.

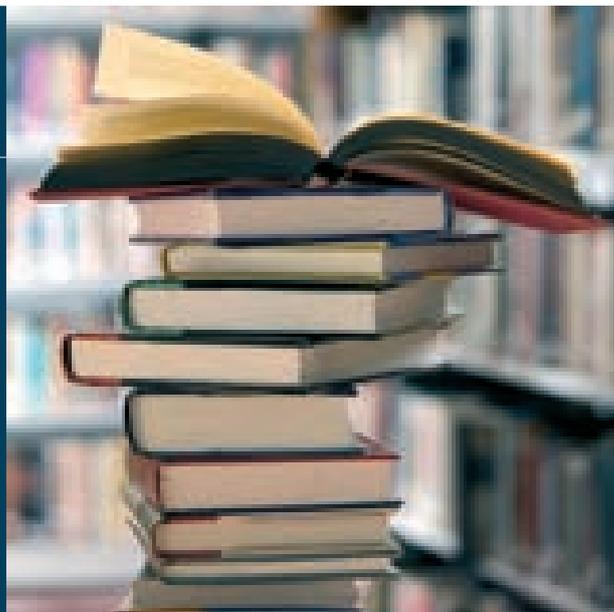
There were also published two guide-books compiled by the Polish Hydrogeological Survey: *Groundwaters of Voivodship Capitals in Poland* and *Map of Flood-prone Areas in Poland*. The former is addressed mainly to the administration and hydrogeologists and staff and institutions responsible for water management policy. It presents the resources and use of groundwaters in the voivodship capital cities and provides maps and hydrogeological cross-sections as well as information on vulnerability of water resources systems to pollution, pollution risk and water resources perspectives. The second guide-book is a brochure with short explanatory note and a map in the scale 1:50,000, showing areas of high flood risk in river valleys and their neighbourhood. The guide-book, also available on CDs, should be helpful in works carried out by anti-crisis departments of voivodship offices, Regional Water Management Authorities and the Institute of Meteorology and Water Management.

Successive issues of *Deep Well Logs* (*Profilę Głębokich Otworów Wiertniczych PIG*) and *Scientific Sessions of the Polish Geological Institute* (*Posiedzenia Naukowe PIG*) have been made available on the PGI website.

The periodical *Geological Quarterly* and *Geological Review* (*Przegląd Geologiczny*) monthly magazine published under a contract awarded by the Ministry of the Environment, have continued to appear regularly through the years 2007-2008.



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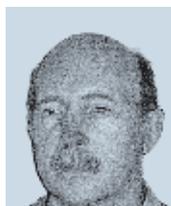
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