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report 2009-2010

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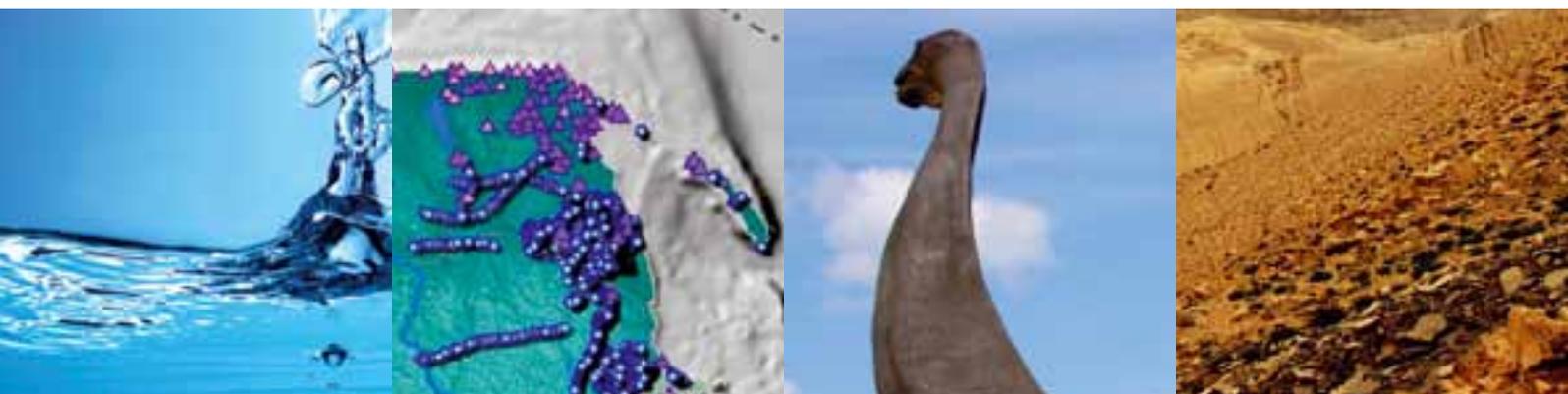
Front cover photo: Upper Paleozoic, Upper Permian, Rotliegend aeolian sandstone, Września IG 1 borehole, a fragment of a well core from the depth of 4,069.2-4,070.2 metres; Lower Paleozoic shale (Silurian), Tłuszcz IG 1 borehole, a fragment of a well core from the depth of 1,960.4-1,961.4 metres

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Warsaw 2011

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Foreword from the Director



In 2009, the Polish Geological Institute celebrated its 90th anniversary. That May jubilee was preceded by the fact of the Institute being granted, by the Council of Ministers, the status of a National Research Institute. The central theme of the celebrations was to continue to foster cooperation of the Polish Geological Survey with other leading national geological surveys. The patron of the commemoration was our eminent compatriot, Pawel Edmund Strzelecki, a geologist of the British Geological Survey, whose bust had been unveiled in the main hall, named after him, of the Geological Museum. A conference of representatives of European geological surveys was naturally an important element of such conceived celebrations.

In another year, 2010, the Institute adopted and started to implement a new operational strategy for 2010 – 2015. To its essential components, organizational changes can be included, as the Institute has been transformed from its methodological structure, known since it was established, into a task-based structure which better conforms to the changing needs of the society. Hence, among the Institute's priority programmes, there are such ones as *Energy Security* or *Safe Infrastructure*. Direct safety, understood as counteracting the effects of natural disasters, was the objective of a long-term project of landslide exploration and monitoring. Emergency actions taken at the time of repeated floodings and intensified soil mass movements that afflicted our country in 2010 were thought to serve the purpose. Regional information and training conferences designed for local governments held in Cracow and Gdańsk were focused on geosafety aspects.

Projects on hydrocarbon basins exploration for the occurrence of unconventional natural gas reserves, on updating the lignite resource base and the prospects of launching HDR geothermal energy in Poland were dedicated to the raw material safety, and first of all, to energy safety. Another big project, *the Exploration of Formations and Structures for Safe CO₂ Storage together with a Programme of their Monitoring*, was closely connected with energy safety.

While performing the Institute's new tasks related to the exploration of unconventional hydrocarbon deposits and the up-to-date systems of mass movement monitoring, we have been closely working together with the United States Geological Survey (USGS) since 2010. An event that started a public discussion on the significance of unconventional hydrocarbon deposits for our energy safety was a conference organized by the Institute in January 2010,

the Unconventional Natural Gas Deposits in Poland – Shale Gas and Tight Gas, which was accompanied by a press conference of the Chief National Geologist under a meaningful title, *Poland Like Texas?*

Geotourism, which supplements the traditional educational activities conducted by the Geological Museum, is a new thriving field of the Institute's operation. As an example of an effective action in this area can be given by the study of *the St. Ann's Hill Geopark*, which formed a basis for that object to be awarded the rank of a national geopark.

Also, 2010 saw tremendous scientific discoveries by the Institute's staff. The discovery of trackways of the oldest tetrapods in the Holy Cross Mountains and the publishing of the study results in a prestigious journal, *Nature*, by a team in which there were three scientists from the Institute, was certainly a world ranking event. The discovery of relict permafrost in the Udryń PIG-1 borehole, near the town of Suwałki, was another quite unexpected success of our scientists. Owing to a subsidy awarded by the Ministry of Science and Higher Education, the Institute purchased the most modern electron microprobe which is going to be one of the basic tools of an advanced microarea analysis laboratory which is being created in accordance with our strategy.

At the end of 2010, the Institute out of concern for a higher integration of the activities of the *geo* sector scientific and business entities, took an initiative of establishing Geocentrum Polska – Scientific and Industrial Centre. Its composition, apart from the Institute, included: the AGH University of Science and Technology, the Maria Skłodowska–Curie University of Lublin, the Maritime Institute, the Institute of Oil and Gas, the Mining and Metallurgical Copper Conglomerate (KGHM) Polish Copper, the Polish Geological Institute – National Research Institute, the PGE Polish Mining and Conventional Power Generation Joint Stock Company, the Polish Oil and Gas Company

Prof. Jerzy Nawroński



Director of
Polish Geological Institute
National Research Institute

MAJOR EVENTS 2009-2010



2009

24 Feb The Polish Geological Institute was granted official status as National Research Institute by the Council of Ministers

12 Mar Dr. Regina Kramarska, the PGI-NRI Marine Geology Director was the winner of the competition *Bursztynnik Roku 2008* (Amber Jeweller of 2008), as announced by the International Amber Association

13 Mar The academic degree of an Earth Science Professor was awarded to Dr. Izabela Bojakowska by President Lech Kaczyński

15 Apr On the occasion of the 90th Anniversary of the PGI-NRI, a press conference entitled *Ninety Years of the Polish Geological Institute – Tradition and New Horizons of the Polish Geology* was held at the Press Centre of the Polish Press Agency in Warsaw. Dr. Henryk Jacek Jezierski – Chief National Geologist and Prof. Jerzy Nawrocki – Director of the PGI-NRI participated in this meeting with the press

18-19 May The 4th All-Poland Conference – *Petrological and Mineralogical Studies in Geology* held at the PGI-NRI in Warsaw; with a session devoted to the 50th anniversary of Prof. Anna Maliszewska's research

8 Jul The 1st Geological Picnic at Olsztyn near Częstochowa, with a press conference involving Dr. Henryk Jacek Jezierski, the Chief National Geologist, Undersecretary of State in the Ministry of the Environment and Katarzyna Sobierajska, Undersecretary of State in the Ministry of Sport and Tourism

3 Sep Opening of an outdoor photographic exhibition *Unusual Galapagos – at the Roots of the Theory of Evolution* in the PGI-NRI, Warsaw, arranged by the Embassy of the Republic of Ecuador and the PGI-NRI

28 Sep A ceremony of the opening of the Educational and Conference Centre of the Polish Geological Survey, held at Leszcze, near Kłodawa



15 Apr



14 May



15 May



3 Sep

14-15 May Celebrations of the 90-th Anniversary of the PGI-NRI in Warsaw; the Chief National Geologist and Undersecretary of State in the Ministry of the Environment, Dr. Henryk Jacek Jezierski, and the Director of the PGI-NRI, Prof. Jerzy Nawrocki, met journalists; there was a ceremony and the opening of exhibitions on *Paweł Edmund Strzelecki* and on *Jan Rzymelka's Agates*

14-15 May GEOLOGIA 2009, the 7th International Geological Fair GEO-EKO-TECH, held at the PGI-NRI, Warsaw

15 May A conference of the representatives of European geological surveys, *GEOBRIDGE – Eastern Partnership*, held at the PGI-NRI in Warsaw

22-24 Oct A meeting of the Management of the PGI-NRI and the Lithuanian Geological Survey, at Sidorówka in the Suwałki Region

24-27 Nov International Trade Fair for Environmental Protection POLEKO in Poznań; at the stand of the PGI-NRI's, services provided by the Institute with respect to environmental protection and geotourism were presented

2010

7 Jan The article *Tetrapod Trackways from the Early Middle Devonian of Poland* was published in the prestigious journal, *Nature*; it was written by Grzegorz Niedźwiedzki (M.Sc.) (University of Warsaw) and Dr. Piotr Szrek, Dr. Katarzyna Narkiewicz, Prof. Marek Narkiewicz of the PGI-NRI and Per E. Ahlberg (Uppsala University)

7 Jan A press conference entitled *On the Track of the First Tetrapods*, held at the PGI-NRI in Warsaw, was devoted to the sensational discovery of the footprints of the first tetrapods at the *Zachemie* quarry in the Holy Cross Mountains

27 Jan *Unconventional Deposits of Natural Gas in Poland – Shale Gas and Tight Gas*, a scientific conference held at the PGI-NRI in Warsaw, accompanied by a press conference entitled *Is Poland like Texas?*



7 Jan



27 Jan



6 Aug



12–17 Sep

30 Mar A conference *Polish Shale Gas Day* at the PGI-NRI, Warsaw, was attended by scientists and managers of the world largest oil concerns

7-8 May GEOLOGIA 2010 8th International Geological Fair GEO-EKO-TECH, on the premises of the PGI-NRI in Warsaw, with a conference *New Challenges to Polish Geology* organized by the Institute

11-12 May 2nd All-Poland Scientific Conference, *Mineral Deposits – Current Problems of Prospecting, Exploration and Documentation*, held at the PGI-NRI, Warsaw

19 May Dr. Ingrid M. Verstraeten, a representative of the United States Geological Survey (USGS), visited the PGI-NRI, Warsaw; cooperation between the Polish and American geological surveys was the subject of the talks

25 May Commemoration of the 91st Anniversary of the PGI-NRI in Warsaw; opening of the Electronic Microscopy Laboratory equipped with a digital Cameca SX 100 electron microprobe

14 Jun *CCS Day in the Polish Geological Institute* – a scientific conference and panel discussion at the PGI-NRI, Warsaw

21-22 Jun *United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009 (UNFC-2009) – Theory and Practice* workshop held at the PGI-NRI, Warsaw; the workshop was organized by the PGI-NRI and the United Nations Economic Commission for Europe (UNECE) in consultation with the Ministry of the Environment Department of Geology and Geological Concessions

7 Jul The Board of local government in the Holy Cross Mountains decided to subsidize, under the Regional Operational Programme, the PGI-NRI Project entitled *The Holy Cross Mts. Preparatorium of Fossils 'Under the Tetrapod'* (with a total value of PLN 3.48 million, subsidized from the Regional Operational Programme (PLN 2.24 million)

11 Jul 2nd Jurassic Geological Picnic at Olsztyn near Częstochowa

22 Jul *Geology for Journalists*, a workshop held in the PGI-NRI in Warsaw

6 Aug Press conference organized by the PGI-NRI at the Polish Press Agency Press Centre Press entitled *Frozen Time*, dedicated to the discovery of permafrost in the Udryń PIG-1 borehole, near the town of Suwałki

23 Aug Geologists representing the China Geological Survey (CGS) paid visit to the PGI-NRI Branch in Szczecin

6 Sep Information and training conference organized by the PGI-NRI in Kraków, *Activities of the Polish Geological Survey with Respect to Geohazards – the Carpathian Landslides*, attended by over 200 representatives of the local authorities from the provinces most afflicted by the landslides: Silesia, Małopolska and Podkarpackie

12-17 Sep 38th World Congress of the International Association of Hydrogeologists in Kraków organized with the participation of the PGI-NRI

19 Oct Ceremony of fixing a foundation plaque for the Library of Original Geological Documents of the PGI-NRI Central Geological Archives at Halinów, near Warsaw

26 Oct Information and training conference, *GEO: Hazards – Information – Tourism. Activities of the Polish Geological Survey and the Polish Hydrological Survey on the Baltic Coast* in the Marine Geology Branch of the PGI-NRI in Gdańsk

23-26 Nov International Trade Fair for Environmental Protection POLEKO in Poznań; the PGI-NRI presented its services with respect to natural environment monitoring

10 Dec Opening of two renovated halls in the rotundas of the PGI-NRI's pre-war seat, the conference room of the Scientific Council and the reading room of the Geological Library

10 Dec Signing an agreement on establishing a scientific and industrial centre, Geocentrum Polska by: the AGH University of Science and Technology, the Maritime Institute, the Institute of Oil and Gas, Mining and Metallurgical Copper Conglomerate (KGHM) Polish Copper, the Polish Geological Institute – National Research Institute, the PGE Polish Mining and the Conventional Power Generation Joint Stock Company, the Polish Oil and Gas Company and the Maria Skłodowska-Curie University of Lublin



ENERGY SECURITY

The Institute's activities in this field aim at increasing the reserves of energy raw materials essential for the country to function and develop effectively. They include both determining the prospects of occurrence, documentation, and storage of fuels to serve the needs of the conventional power generation sector, including studies of alternative methods of their exploitation, and renewable energy development.

Operational Strategy of the PGI-NRI 2010-2015,
Warsaw 2010

Geological Atlas of the Upper Silesian Coal Basin (USCB)

An atlas, to be completed in 2011, will be the first detailed cartographic study of the USCB. The entire area of the USCB has been mapped (both Polish and Czech parts of the USCB). To compile this atlas required verifying data from 9,700 boreholes. It comprises geological and structural maps of the Carboniferous overburden deposits in the USCB together with the adjacent areas of the Upper Silesian Block at a scale of 1:200,000. It includes: solid geological maps (without Quaternary deposits), a sub-Triassic map showing the geology and structure of the Paleozoic surface, thickness of pre-Permian deposits, thickness of Miocene deposits (including the thickness of the Dębowieckie Beds, located in the southern part of the USCB). Furthermore, the atlas comprises maps of the thickness of the Triassic and Permian deposits at a lower scale.

The Project has been financed by the Ministry of Science and Higher Education.

Project Leader: Janusz Jureczka, M.Sc.

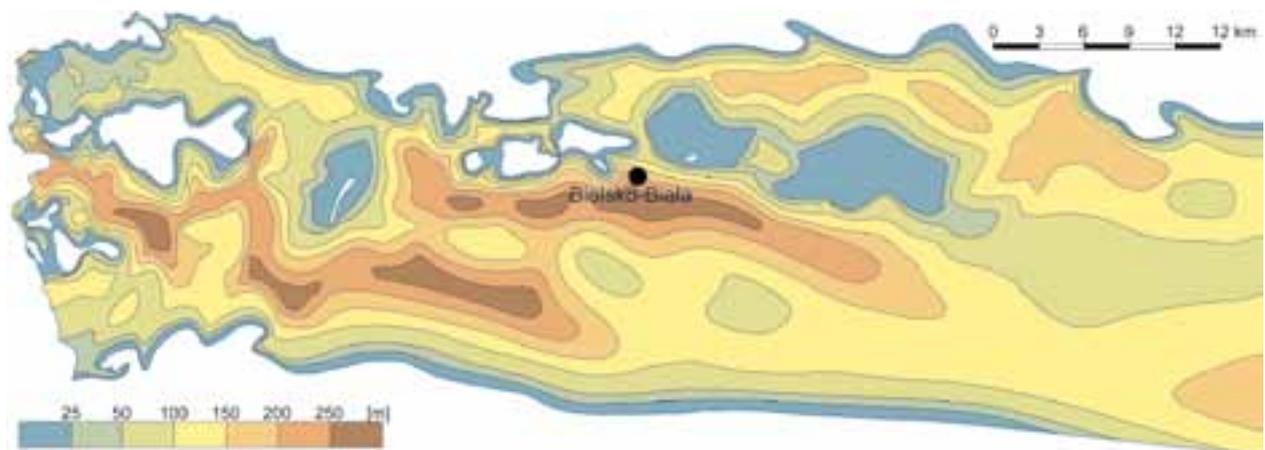
Petrological Atlas of Hard Coal of the Lower Silesian Coal Basin (LSCB)

While preparing the atlas, a unique collection of microscopic preparations of the LSCB hard coals which represent the Upper Carboniferous deposits of two lithostratigraphic units – the Wałbrzych Formation and the Żaclerz Formation was used.

In the descriptive section of the atlas, some selected aspects of the LSCB's geological structure, the most important information on the petrology of the hard coals in the LSCB as well as the methodology of petrological studies of coals are presented. Lithotypes of coal are described and classification of macerals of the vitrinite, liptinite and inertinite groups as well as of the microlithotypes of the hard coal is given. In the illustrative part, which contains 24 photographic charts, macerals of the vitrinite, liptinite and inertinite typical of the LSCB's coals and microlithotypes (138 microphotos in total) as well as microspores of the Carboniferous carbogenic plants characteristic of the LSCB's coals are presented.

The Project has been financed by the Ministry of Science and Higher Education.

Project Leader: Dr. Grzegorz Nowak, PGI-NRI Associate Professor



Map showing the thickness of the Dębowieckie Beds (Miocene) in the southern part of the Upper Silesian Coal Basin

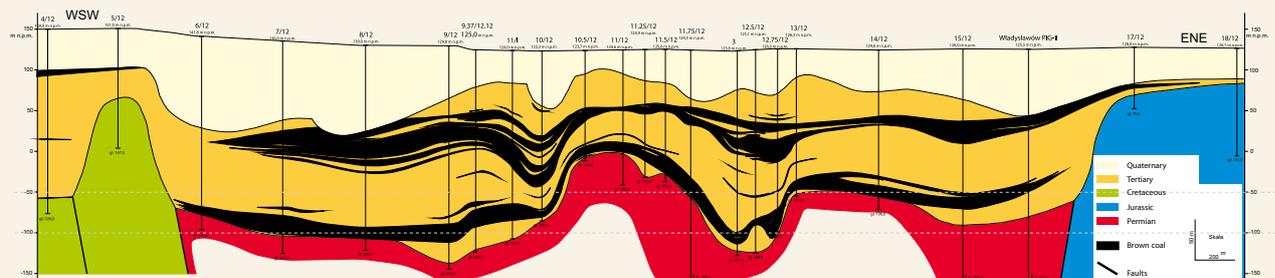
Updating the Resource Base of Selected Lignite Deposits in Poland

Lignite reserves essential for the country's energy security previously documented using out-of-date criteria of economic viability or only initially explored have been verified. Deposits of resources of more than 50 million ton, which can guarantee the operation of a power unit of about 120 MW for thirty-five years, and a few large satellite deposits have been considered. On a basis of archive materials, seventeen geological documentations of lignite deposits have been made. The deposits of *North Legnica*, *Rogóżno* and *Ścinawa* have again been assigned to the C₂ Category. Among the deposits initially explored, those of *Gubin-Zasięki-Brody*, *Łęki Szlacheckie*, *Mosina*, *Nakło*, *Naramowice*, *Oczkowice*, *Radziejów*, *Szamotoły*, *Węglewice* and *Radomierzycze* have been assigned to the D

Category. In the satellite deposit group, the deposits of *Lubska* (a satellite of the *Gubin* deposit), *Ruja* (a satellite of the *East Legnica* and *West Legnica* deposits) and *Więcbork* (a satellite of the *Nakło* deposit) have been documented. These deposits are to be included in the *Report on Mineral Reserves and Groundwater Resources in Poland*, which will result in the base of economic resources of lignite being increased by 8.0869 bln. tons.

The Project was implemented by a consortium (PGI-NRI – the leader, Przedsiębiorstwo Geologiczne we Wrocławiu *Proxima S.A.* (a geological company in Wrocław), and Przedsiębiorstwo Geologiczne S.A. w Krakowie (a geological company in Kraków), as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Dr. Jacek Kasiński



Geological cross section through the Rogóżno lignite deposit in the cover of a salt dome

< The first drilling to prospect for natural gas in the Lower Paleozoic shale – Łebień LE-1 borehole in the Pomerania region
© Lane Energy Poland

Reconstruction of the Outer Carpathians Oil Plays

The latest Early Miocene has been considered to be a critical moment for the development of the Carpathian oil play. Then, a number of genetically connected processes took place that shaped the individual elements of the system. At that time, due to tectonic burial, hydrocarbons were generated, interpreted here as the main phase of hydrocarbon generation and migration. Hydrocarbons which had been generated earlier, including those formed as sedimentation proceeded in flysch basins, may then have remigrated and/or decomposed. At this stage, the deformation drove migration paths and influenced the development of structural traps. The tectonic burial and migration of fluids in the orogen resulted in reduced reservoir properties. The upthrusting of the orogen, due to a collision and pile-up of nappes and duplexes, caused deep erosional dissection of the orogen that resulted in a partial escape of hydrocarbons. As key elements of the Western Carpathians oil play, the quality of the generation kitchen connected with menilite shale was indicated as well as the poor seal, the consequence of which was the risk of hydrocarbon accumulations being decomposed during the ongoing collisional deformation and remigration of hydrocarbons. The highest potential for the occurrence of hydrocarbon deposits is to be found in the zones where the menilite shale underlies the Magura Nappe. Such zones are characterized by high thermal maturity which corresponds to the range of a natural gas generating window or an oil generating window, and the sealing conditions are relatively good in these zones.

Also, hydrocarbon systems connected with the basement of the Western Carpathians are significant for the oil potential in the Carpathians area. In the western part of the Carpathians, there occurs a kitchen of generation from Carboniferous hard coal beds, whereas in the north-east of the study area, there is a kitchen of generation from Silurian shale. Hydrocarbons generated from these source rocks may also occur in accumulations both within the Carpathian basement and following migration to the Carpathian flysch area.

In case of the Podhale Trough, the analyses show its low potential for the occurrence of hydrocarbon deposits. An analysis of the possible occurrence of unconventional hydrocarbon deposits in the Carpathian Mts. such as shale gas and tight gas indicates that the potential of occurrence of shale gas whose exploitation would be economical is low,

despite the large thickness of the clay packets and their very favourable geochemical characteristics. This is partly due to the low thermal maturity of the Lower Cretaceous menilite shale over most of the area. A more significant limit for possible exploitation of shale gas or shale oil is the high degree of tectonic deformation which makes it more difficult or impossible to maintain an adequately long horizontal section of drilling within this formation and restricting to it the range of fracking.

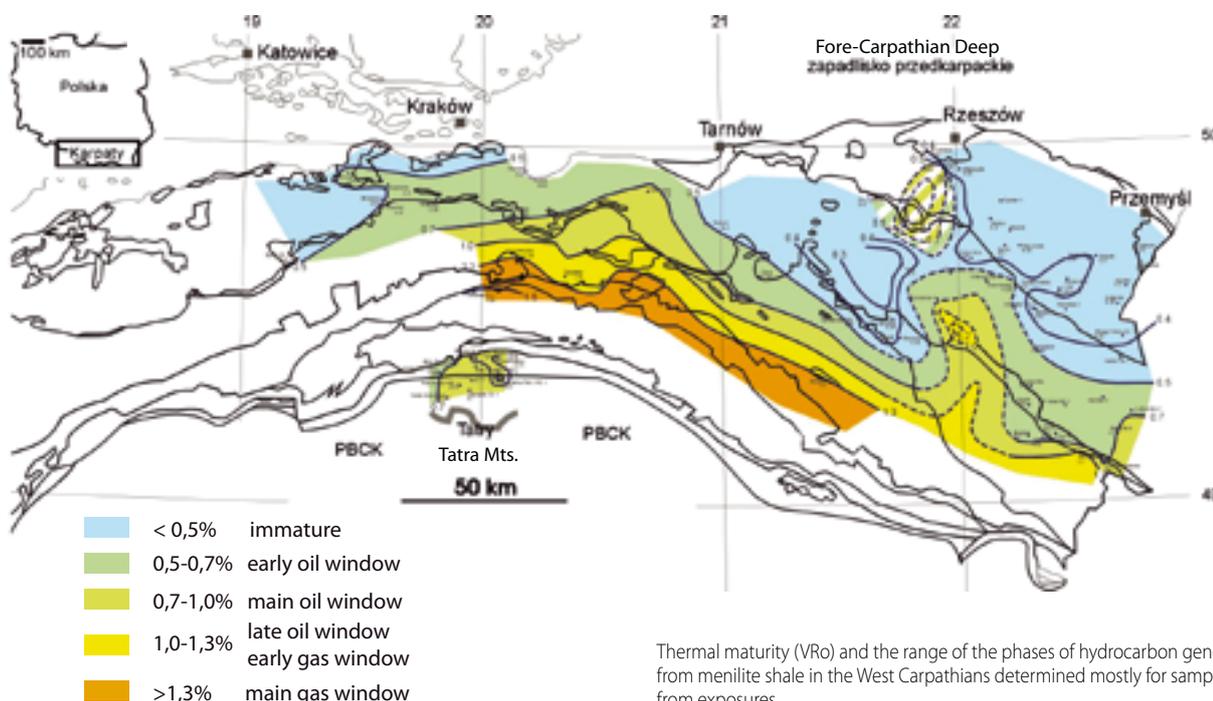
Moreover, in the Outer Carpathians there are conditions for the occurrence of unconventional deposits of tight oil. In the case of accumulation of tight oil and tight gas, the essential element of an exploration risk, and in particular the limitation in terms of possible production of tight gas, as in the case of shale gas and oil, is that of the degree of tectonic deformation.

The project was implemented as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Paweł Poprawa, M.Sc.

Hydrocarbon Potential of the Fore-Carpathian Deep in the Borderland Between Poland and Ukraine

Under a special project of the Ministry of Science and Higher Education, implemented together with the AGH University of Science and Technology research team, the hydrocarbon potential of the Fore-Carpathian Deep Miocene deposits and their Paleozoic – Mesozoic basement in the borderland between Poland and Ukraine was evaluated. A synthesis of the existing results of geological, geochemical, sedimentological, petrological, petrophysical studies and the results of new analytical studies and modelling was made. Conditions for generation, migration and accumulation of hydrocarbons within the sedimentary basins as well as the geological conditioning of those processes were determined. Analytical studies of the source and reservoir levels, and numerical one- and two-dimensional modelling of the processes of generating, expulsion, migration and filling oil traps in connection with a geological lithofacial analysis and reconstruction of the development of the sedimentary basins made it possible to give characteristics of the oil systems and outline the areas of increased prospectivity. The results of the studies are of key importance



Thermal maturity (VRo) and the range of the phases of hydrocarbon generation from menilite shale in the West Carpathians determined mostly for samples from exposures

for the orientation of prospecting for oil and natural gas in the borderland areas of the Fore-Carpathian Deep in Poland and Ukraine.

Project Leaders: Prof. Maciej Kotarba (the AGH University of Science and Technology), Prof. Tadeusz Peryt (PGI-NRI)

Llandovery in the North Part of the Holy Cross Mountains – Stratigraphic and Sedimentary Record

The Llandovery claystones and shale in the northern part of the Holy Cross Mountains are around 50 metres thick and belong to the Silurian shale succession. It has been found that the greatest possibilities for the occurrence of natural gas in Poland are in the Silurian shale on the East European Platform. The base of the Llandovery deposits in the northern part of the Holy Cross Mts. comprises the black shale of the Zbrza Member, dated by graptolites to the lowest Silurian stage (Rhuddanian), having a thickness of some 6 metres, and belonging to the Bardo Formation. This shale represents the record of a marine transgression initiated at the end of Ordovician. Its deposition took place with a limited (or even halted) supply of detrital material and redistribution of nutrients from newly flooded areas. In such conditions, an increase in primary organic production and organic supply took place which resulted in an oxygen deficit on the sea floor. The Aeronian and Telychian stages of Llandovery are represented in the Łysogóry Region by grey and green-grey claystones and mudstones with black shale interbeds which suggests frequent changes in oxygen supply during sedimentation, perhaps connected with the behaviour of the Gondwana ice sheet. The deposition of the Llandovery grey and green-grey claystones in the Łysogóry Region happened in conditions of normal oxygenation



Claystones and shale of the Łysogóry Region Llandovery in the Holy Cross Mts.; a contact of green-grey claystones with dark, horizontally laminated shale

of a water column and bottom deposit, thus allowing bioturbation of the bottom by benthic organisms. The black shale documents relatively short periods of oxygen deficit at the water-sediment contact. The changeability of the paleoenvironmental conditions can be explained by episodic stratification of the water column which followed an increase in primary productivity and supply of organic carbon. Thicker intervals of black shale in the Aeronian and Telychian claystones might reflect eustatic transgressive pulses, whereas the grey and green-grey claystones may correspond to intervals of enhanced thermohaline circulation with a low sea level during glacial phases.

The Project was financed by the Ministry of Science and Higher Education.

Project Leader: Dr. Wiesław Trela, PGI-NRI Associate Professor

Analysis of the Possibilities of Obtaining Uranium for Nuclear Power from Domestic Resources

The project is focused on geochemical, petrological, mineralogical and technological studies of geological formations possessing uranium concentrations which might potentially be a source of fuel for nuclear power plants in Poland. For the analyses, the Lower Ordovician Dictyonema Shale

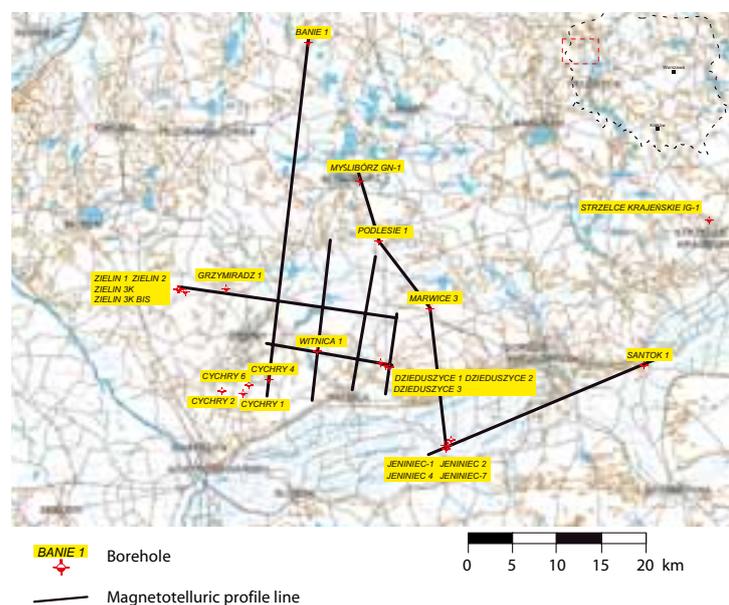
and the Lower and Middle Triassic sandstone of the Peribaltic Syncline were chosen. Initial mineralogical studies made with scanning electron microscope showed that in the Dictyonema Shale uranium occurs in a dispersed form in organic matter and clay minerals. As regards the uranium, vanadium and molybdenum content determination in the Peribaltic Syncline sandstone, there are significant variations in concentration. Here, numerous compounds of uranium has been found, including uranite.

The Project is financed by the European Fund for Regional Development.

Project Leader: Dr Stanisław Wołkiewicz, PGI-NRI Associate Professor

Hot Dry Rocks in Poland – Perspectives for Enhanced Geothermal Systems

Geothermal systems of HDR (Hot Dry Rocks) type are a novelty in Poland and they require a proper geological exploration of perspective rock successions. In order to determine potential study areas, an analysis of the map of ground heat flux density was carried out in 2010. As a result of analysis of archive materials available in the PGI-NRI and PGNIG S.A (Polish Oil and Gas Company), three areas were shortlisted for further studies: an area near the city of Gorzów Wielkopolski (the Fore-Sudetic Monocline), the Lublin Province (a sedimentary rock cover of the East European Platform) and the Suwałki Region (the East European Platform). In the area of Gorzów Wielkopolski, a magnetotelluric image was taken (320 MT/AMT soundings, including 240 one-day and 80 two-day ones, and using a reference measurement technique). A number of analyses was made, including of archive magnetic, gravimetric and seismic data as well as logging and sampling of the cores of the Main



Location of magnetotelluric (MT) profiles

Dolomite, Lower Carboniferous, Upper and Middle Devonian from some selected borehole logs. The location of an exploratory borehole was chosen: Czerwony Potok (the Karkonosze Massif) which is to be drilled in 2011.

The Project is being implemented as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Marta Wróblewska, M.Sc. (Eng)

Occurrence and Reserves of Unconventional Deposits of Natural Gas

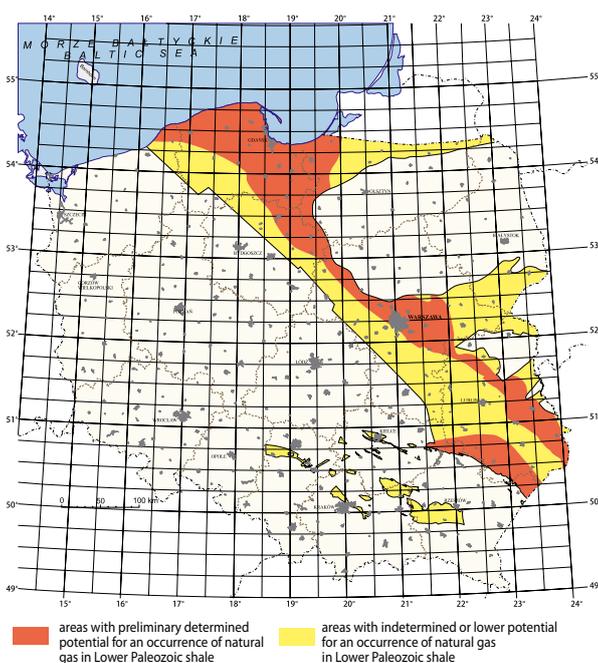
Commissioned by the Ministry of the Environment and financed by the National Fund for Environmental Protection and Water Management Authority, a project, *the Exploration of Hydrocarbon Basins in Poland for Possible Occurrence of Deposits and Licensing the Prospecting for Unconventional Deposits of Natural Gas – Stage One*, was implemented between 2009-2010.

On the basis of the existing geological data, rock areas and successions showing the highest potential for the occurrence of unconventional deposits of natural gas, including shale gas and tight gas, were selected. Quantitative criteria to be used for selection of potential targets of unconventional natural gas deposits in Poland were determined.



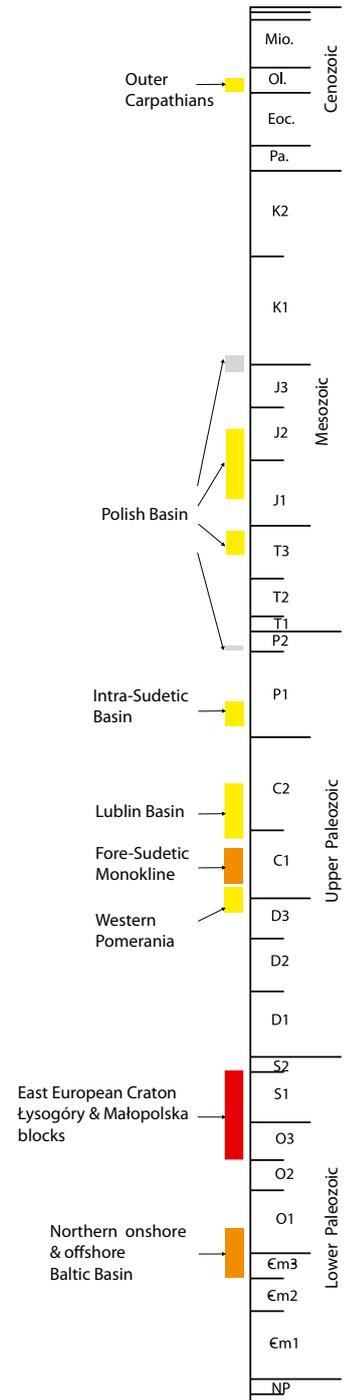
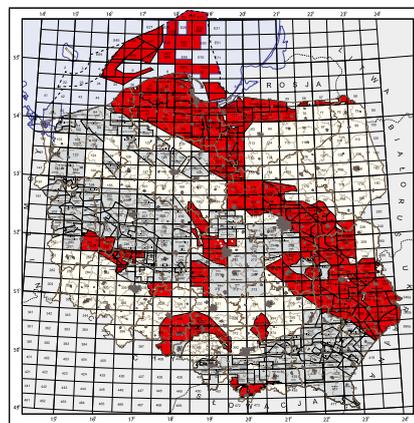
Shale gas

There exist, in Poland's sedimentary basins, numerous claystone-mudstone formations of various age, from Neoproterozoic to up to Neogene, of dark coloration and potentially elevated content of organic carbon, which have been analysed so far as source rocks. It was found that many of those formations have unsuitable properties as regards the potential for natural gas, though some of them remain as potential sources requiring further exploration.



< Area of occurrence of the Lower Paleozoic shale that potentially contains unconventional natural gas

Map of concessions and applications for natural gas prospecting: shale gas (red colour) and conventional (grey colour)
© Ministry of the Environment



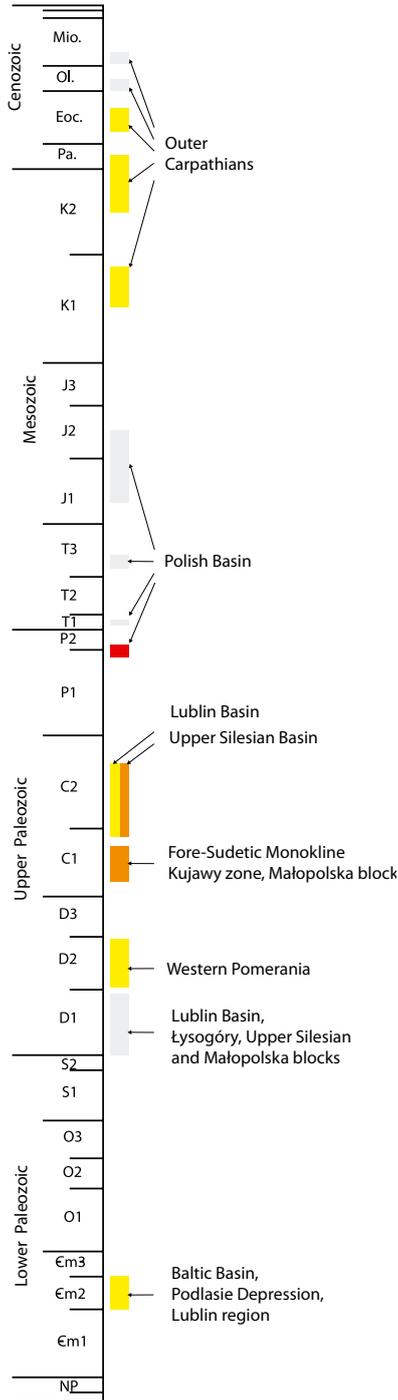
The primary deposits that meet the criteria for possible occurrence of natural gas in mudstones are the Upper Ordovician and Silurian shales in the Baltic Basin and the Lublin-Podlasie Basin. The Silurian shale in the western part of the East European Platform shows a considerable lateral extent as well as a relatively simple tectonic structure, particularly in the case of the Baltic Basin. However, with an increase in thermal maturity to the west and increasingly high ranges of gas windows reached by the Lower Paleozoic shale, its depth becomes too large for gas to be economically exploited, considering the current cost of drilling.

The criteria for natural gas occurrence in mudstones are also partly met in the Lower Carboniferous deposits in the Wielkopolska region (Fore-Sudetic Monocline). Here, the following can be numbered among adverse factors: lithological diversity, the complex tectonic structure of the Wielkopolska zone, and the large depth of the deposits in its northern and eastern parts.

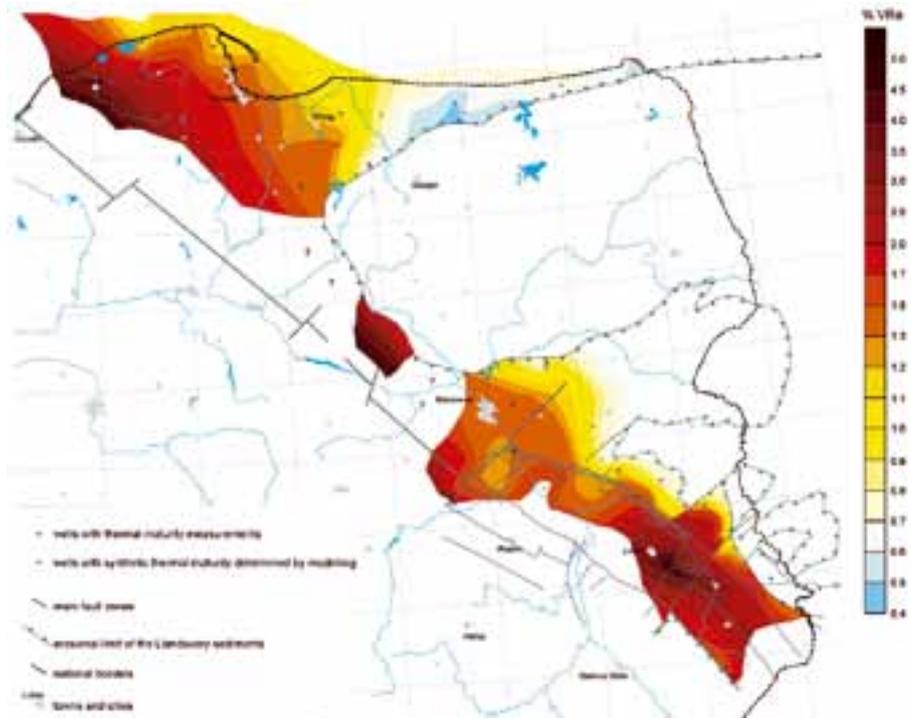
Unconventional gas fields can also be found in the Miocene Fore-Carpathian Deep. The main limitations are that there are no thick homogenous clay successions and the content of organic matter is relatively low.

Stratigraphic position of the most important claystone-mudstone formations of increased organic substance content in Poland

- high potential
- moderate potential
- low potential
- lack of potential



Stratigraphic position of the most important reservoir formation for hydrocarbons in Poland, analyzed for possible occurrence of the accumulations of tight natural gas



Thermal maturity map (Vitrinite reflectance scale; % VRo) for the Llandovery (Lower Silurian) shale at the western slope of the East European Craton

Tight gas

There exist some oil-bearing basins in Poland within which reservoir formations can be found, represented chiefly by sandstones with properties to potentially represent targets in prospecting for tight gas. On the basis of similarities to the well-proven hydrocarbon basins in North America, these qualities include mainly a moderate porosity reduction (porosity >5%) with a strong reduction in permeability (0.1-0.001 mD), the presence in a given formation of conventional deposits of natural gas and/or its shows, the co-occurrence with the source rock which is now or has been in its geological history within a gas window as well as a depth of no more than 4,000-4,500 metres.

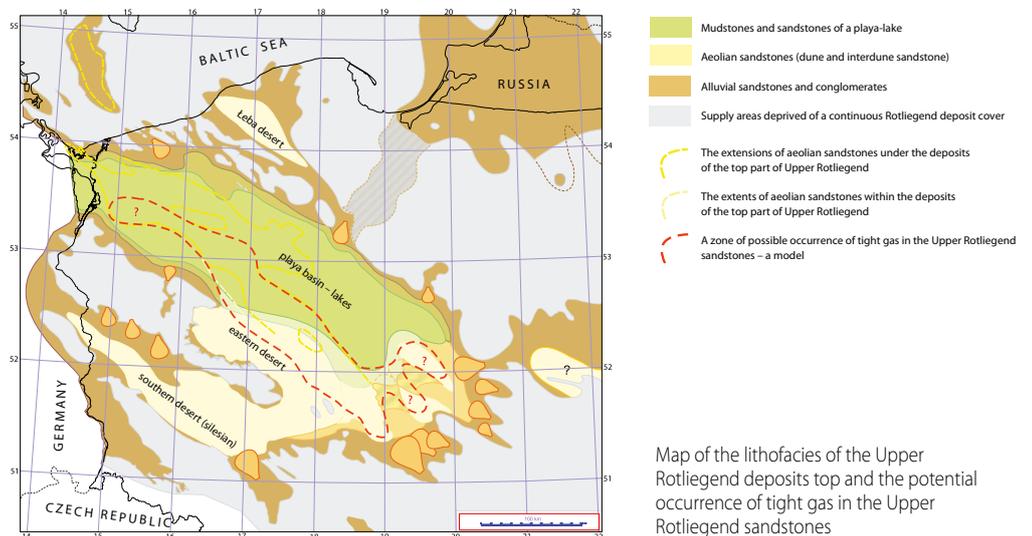
The best prospects of finding tight gas deposits are connected with the Rotliegend aeolian and fluvial sandstones, mostly in the Fore-Sudetic Monocline zone and in the adjoining areas to the north-east and east. Of key importance to determine is the extent of the deeply buried sandstones, especially in their relation to the clayey sandstone deposits of playa type in the central part of the Rotliegend Basin.

The sandy successions within the Carboniferous deposits, in the Permian-Mesozoic basement of the Polish Basin, primarily in the Fore-Sudetic Monocline zone (the Wielkopolska zone), also locally meet the conditions of tight gas occurrence. Accumulations of this kind may also occur in the Middle Cambrian deposits on the East European Platform in the western part of the Baltic Basin, in the Podlasie Depression, and in the Lublin area where the Lower Paleozoic source rocks are located in the gas window. A necessary condition is that porosity was partly retained during quartz cementation.

The Cretaceous and Paleogene sandy successions, in the deeper buried parts of the Outer Carpathians may also include tight gas accumulations. Significant limitations to the prospecting and possible exploitation of such deposits in the Outer Carpathians is the highly complicated tectonics of the orogen.

Project Leader: Hubert Kiersnowski, M.Sc.

tight gas



Map of the lithofacies of the Upper Rotliegend deposits top and the potential occurrence of tight gas in the Upper Rotliegend sandstones



RAW MATERIALS SECURITY

Activities in this area include keeping records on a permanent basis of the known incomings of the deposits of mineral raw materials other than energy raw materials together with ongoing prospecting for and documenting new finds in order to provide the best foundation for development of the Polish economy and creating infrastructure.

Operational Strategy of the PGI-NRI 2010-2015,
Warsaw 2010

Report on Mineral Reserves and Groundwater Resources in Poland

The *Report on Mineral Reserves and Groundwater Reserves in Poland* is a serial publication which has been published since 1953. The Report contains basic information about mineral reserves, the conditions of their management, production volume and imports and exports of mineral raw materials. The data are provided by the MIDAS database, where information acquired from the geological administration centres and mineral deposit users are collected. In the Report, as at 31 December 2009, information about 11,079 mineral deposits was contained, including: **633 energy raw material deposits, 33 metal ore deposits, 49 chemical raw material deposits and 10,364 rock raw material deposits**, having total economic resources of above 56 bln tons. In comparison with 2007, an increase in reserves was observed in the group of energy and rock raw materials, whereas the resources of metal ores and chemical raw materials decreased. In 2009, 5.84 bln

cubic meters of natural gas, 70.5 million tons of hard coal, 0.66 million tons of oil and 57.1 million tons of lignite were extracted as well as 25.51 million tons of metal ores, 3.36 million tons of chemical raw materials and 257.9 million tons of rock raw materials. The Report is also available online at: <http://surowce-mineralne.pgi.gov.pl/>

The Study is conducted under a contract with the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Marcin Szuflicki, M.Sc.

information about **11 079** mineral deposits

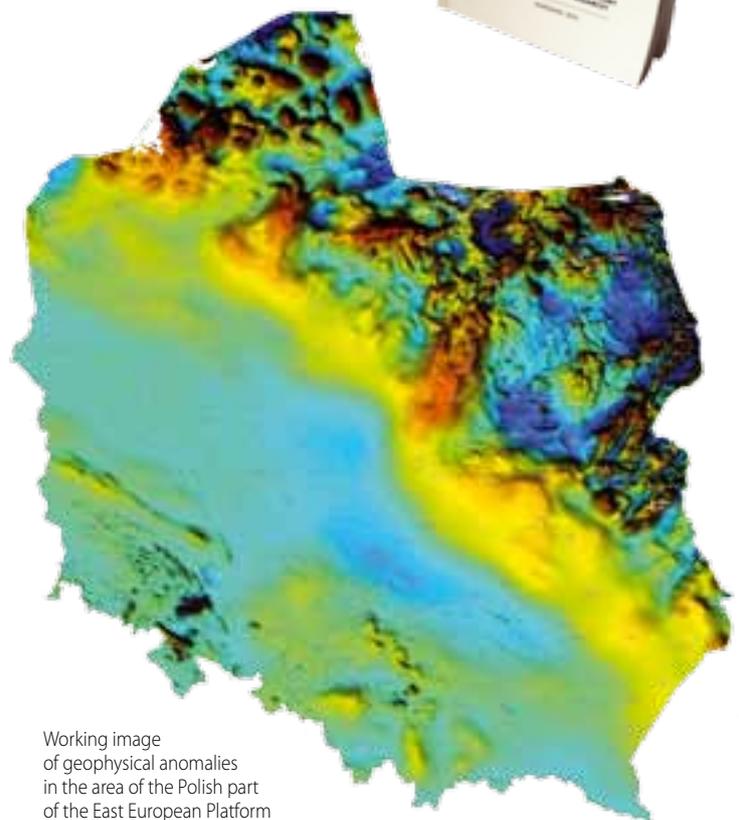


Model of the Geological Structure of the Sedimentary Rock Cover Basement of the Polish Part of the East European Platform

The Project has been implemented since 2010 and is aimed at constructing a geological map of the Polish part of the East European Platform at the scale of 1:1,000 000, together with a set of detailed maps (1:200,000). As compared with the previous study of this kind (*Geological Atlas of the Crystalline Basement of the Polish Part of the East European Platform* – Kubicki, Ryka, 1982), the map is to include the area of the Baltic crystalline basement with 11 boreholes which were made available by LOTOS Petrobaltic S.A. In the borderland between Poland and Lithuania, Belarus and Ukraine, a correlation between lithostratigraphic units is being determined. The map is compiled as based on new geophysical images – magnetic, gravimetric, transformed map (so called terrace maps) as well as existing seismic profiles. Also, reinterpretation of some 240 deep borehole sections which reached the crystalline basement is to be carried out under the Project. More than 70,000 metres of drill cores have been lithologically verified and sampled. Only the most diagnostics analytical methods are being employed such as microscope scanning, electron microprobe, isotope geochemistry. Lithostratigraphic units will be among the results of modern petrographic studies based on objective geotechnical and isotope technologies. In the studies, emphasis is placed on raw materials properties: from precise determination of chemical constitution, occurrence of ore minerals to consideration of reports related to mineral deposits (e.g. on Pre-Cambrian sedimentary iron monoxides of BIF - *Banded Iron Formation* type in the Podlasie region). An updated detailed map of the Suwałki Anorthosite Massif is in the course of preparation. Chronostratigraphy as part of the Project is an essential element of the analytical study. The wide range of geochronological methods being used, especially isotope U-Pb SHRIMP and K-Ar methods as well as the CHIME chemical method, will enable reliable determination of the age of the main rock formations, including tectonic deformation, magmatism and metamorphism of the crystalline basement rocks in north and north-east Poland.

The Project is being carried out under a contract with the Ministry of the Environment and financed by the National Fund for Environmental Protection and Water Management.

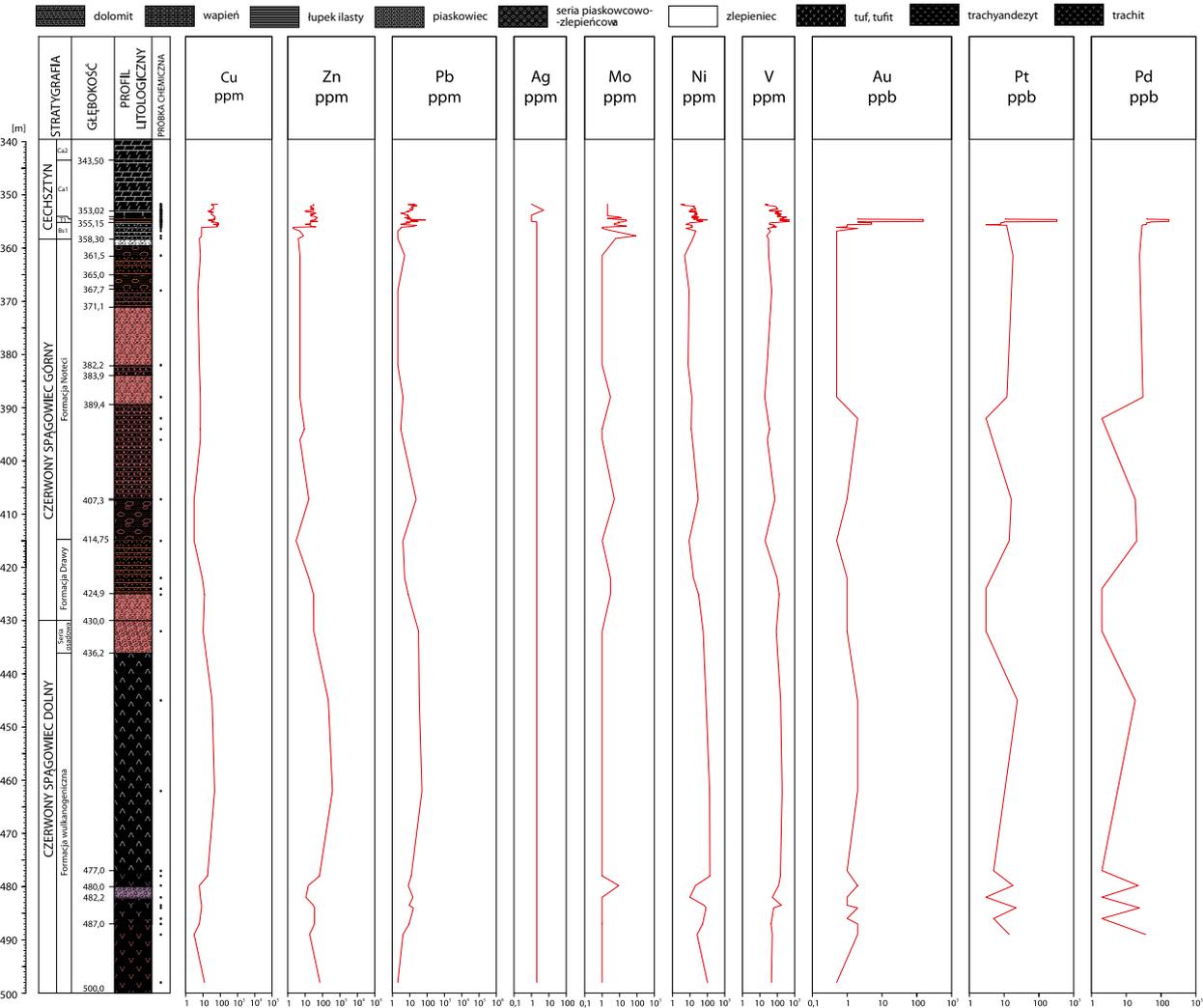
Project Leader: Dr. Leszek Krzemiński



Working image of geophysical anomalies in the area of the Polish part of the East European Platform



1. Well core from the crystalline basement of the Baltic Sea bed (B3-1/81 borehole)
2. Image (BSE) from an electron microscope of a sample of metavolcanic rock with a grain of zircon (B3-1/81 borehole)



Distribution of metals in the Zechstein copper-bearing series and those of Rotliegend in the Stypułów K-17 borehole

Occurrence of the Au-Pt-Pd Mineralization in the Rotliegend Deposits in the Western Part of the Fore-Sudetic Monocline

Rotliegend deposits from the cores of four boreholes from the southwest part of the Fore-Sudetic Monocline were subject to detailed sedimentological, petrological and chemical studies. An analysis of metal content, including Au, Pt and Pd in the deposits of the entire Rotliegend sequence, was made. Neither in the volcanic rocks nor the Rotliegend sedimentary rocks was a high concentration of noble metals found: their maximum content does not exceed 49 ppb Au, 124 ppb Pt and 57 ppb Pd. Despite the slight amount of gold, platinum metals, and other metals, the Rotliegend volcanic rocks (apart from the sub-Permian basement) are considered to have been the principal, primary source of not only the Cu-Ag mineralization, but also of the Au-Pt-Pd found in the lowermost Zechstein rocks. The Rotliegend clastic deposits which were formed due to the denudation of the magmatic and metamorphic rocks of the sub-Permian basement and the Lower Rotliegend volcanic rocks should be considered the secondary and final source of metals. The depletion of the volcanic rocks in copper and noble metals (with respect to their standard equivalents) can be considered the result of leaching by circulating deep water. There may be increased concentrations of noble metals where Rotliegend deposits contain relicts of unoxidized organic matter or pyrite.

The Project was financed by the Ministry of Science and Higher Education.

Project Leader: Dr. Sławomir Oszczepalski, PGI-NRI Associate Professor

Mława Anomaly – Geological Interpretation of the Material from Deep Boreholes

From the study of four boreholes (*Ciechanów 1, Gradzanowo 2, Konopki Wielkie 1* and *Płońsk IG2/2A*), a structure, captured in a geophysical image made near the town of Mława, was explored. The Magmatic Body of Mława is located in the central part of the Svekofen domain in the NE Poland at a depth of 2-3 kilometres. All the plutonic rocks of the Mława Anomaly occur within unmetamorphosed Phanerozoic deposits, intruding Silurian strata (by the town of Płońsk) or underlying Permian deposits (by the village of Gradzanowo). These are red, partly transformed, fine-grained rocks mostly represented by syenites and quartz syenites as well as subvolcanic rhyolites. The potassium syenites of Mława usually contain less alkalis (total alkalis of about 10% by weight) than the syenites of Elk, where foid syenites are predominant. This moderately alkaline association around Mława shows a moderately coherent and monotonous geochemical signature. In general, these rocks are strongly differentiated, depleted in strontium, barium and rubidium as a result of the fractionation of feldspar and poor in phosphorus and titanium. Attention should be focused particularly on the intense enrichment of the Mława syenites in rare earth elements, REE (total REE: 500-1,400 ppm), and with zirconium at the level of 600-1,100 ppm (i.e. 0.1 weight per cent zirconium). Extremely rapid advances in technology have made REEs highly significant as regards raw materials supplies. As a general rule, the elements are dispersed and they are mined only in a few places in the world (China, Australia), where their concentrations are considered sufficiently economic. Dispersed in the Mława syenites, the increased concentrations of REE and Zr might signal an exploration interest. With the available borehole

material, it was only possible for the features of the intrusion periphery to be documented. One may assume that the whole area of the Mława Anomaly is connected with the presence of genetically similar alkaline rocks having potentially high concentrations of REE and Zr. The Project was financed by the Ministry of Science and Higher Education. Project Leader: Dr. Ewa Krzemińska

Exploration and Visualization of the Pomorska Bay Geological Structure

In order to optimize the management of the marine natural resources, a detailed exploration of the Cenozoic geological structure and the relief of the Pomorska Bay floor is being carried out. The project includes studies of the geochemical conditions of the deposits and the development of dynamic processes as well as the exploration and valorisation of the areas of clastic raw material occurrence.

Acoustic and seismoacoustic logging of high and medium frequency was carried out. Documentation, bathymetric maps and sonar mosaics of the explored areas of the Pomorska Bay were made. For 200 deposit samples, grain analyses and chemical analyses of the content of metal, phosphorus and sulphur were carried out.

The initial results show that a syncline-anticline system of the Quaternary basement rocks is located at small depth, locally at only 20-30 metres below the bottom surface. In the Quaternary cover, numerous fossil lakes were found. The sands lying on the sea bed are characterized by a very low concentration of harmful chemical components, often below the determinability threshold. The content of some metals clearly corresponds to the concentrations of heavy minerals.

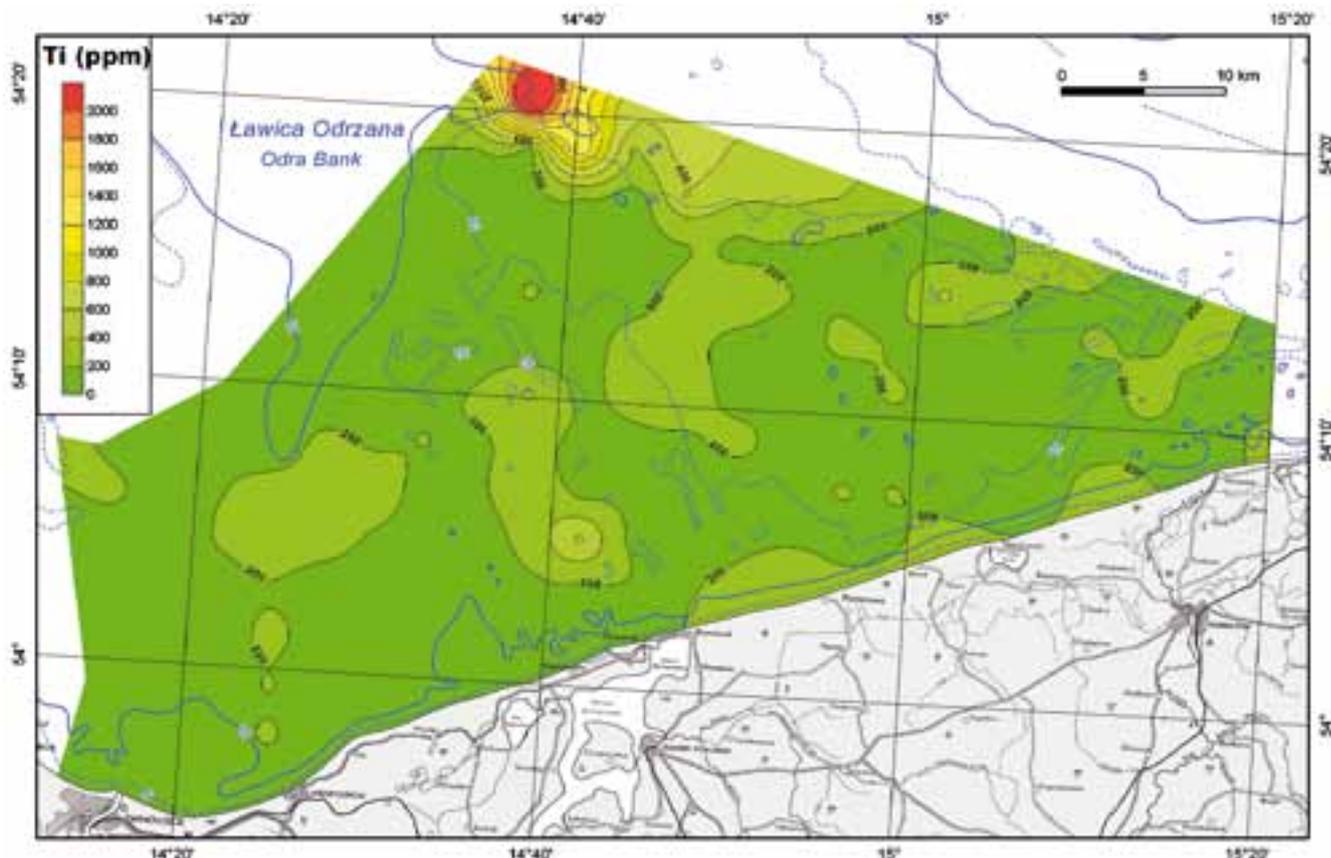
The Project is being implemented in cooperation with the Marine Institute in Gdańsk, the shipowner of the research vessel *r/v Imor*, under a contract with the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Dr. Regina Kramarska



Getting a core out from a box-corer for lithological and chemical studies

Map of the titanium content distribution in the bottom sediments in the area of the Pomeranian Bay (high contents of the element are due to the concentrations of ilmenite and rutile in the Oder River Sandbank)

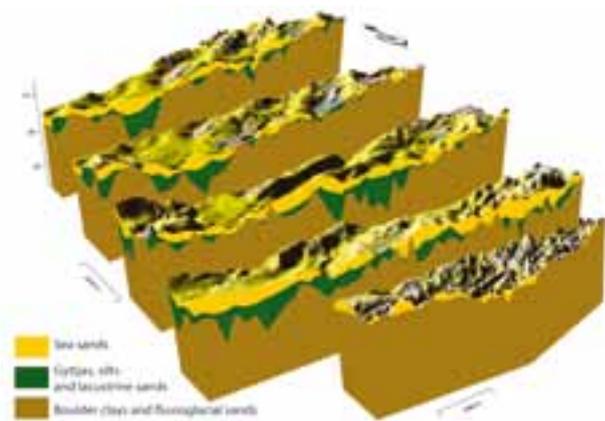


Fixing Locations for Exploitation of Sand for Artificial Sea Coast Nourishment

The Project was completed in cooperation with the Maritime Institute in Gdansk, as commissioned by the Maritime Office in Szczecin. Over an area of about 114 square kilometers, located at an economically viable distance from the sections of the seacoast to be artificially nourished, 1,725 kms of acoustic logging, 792 kms of sonar logging and 480 kms of seismoacoustic logging were carried out and 242 borehole cores of a total length of 447.45 metres were collected.

The bottom of the focus area has a discontinuous sandy cover mostly formed of fine grained and silty marine sands showing poor sorting. Medium grained and thicker sands, suitable for beach nourishment, occur only sporadically. The thickness of the sands rarely exceeds 1 metre, though in areas of medium grained sands, it reaches 2-3 metres. Nearly half of the explored area has no sandy cover, the bottom being underlain by boulder clay and lake gyttja with a sand cover less than 30 cm thick.

In the areas of thickest sands, ten fields of sand accumulation were outlined, having an average grain diameter >0.2 mm. The area of the fields ranges from 0.4 to 2.2 square kilometres (total area of around 8 sq. kms), and the reserves of sand were estimated at 11.7 million cubic metres (in individual fields from 0.5 to 2.3 million cubic metres). A trailer suction dragging system was recommended and the admissible depth of extraction determined with allowance made for sand thickness and quality.



Model of the geological structure of the survey area

The geological documentation will be used by the Marine Office in Szczecin for its statutory implementation of the Coastal Protection Programme. Sandy material from the explored fields in the area of the village of *Rewal* may be used to nourish the beaches near Niechorze, Rewal and Trzęsacz.

Project Leader: Dr. Regina Kramarska

Establishing Principles of Amber Deposit Prospecting and Documentation

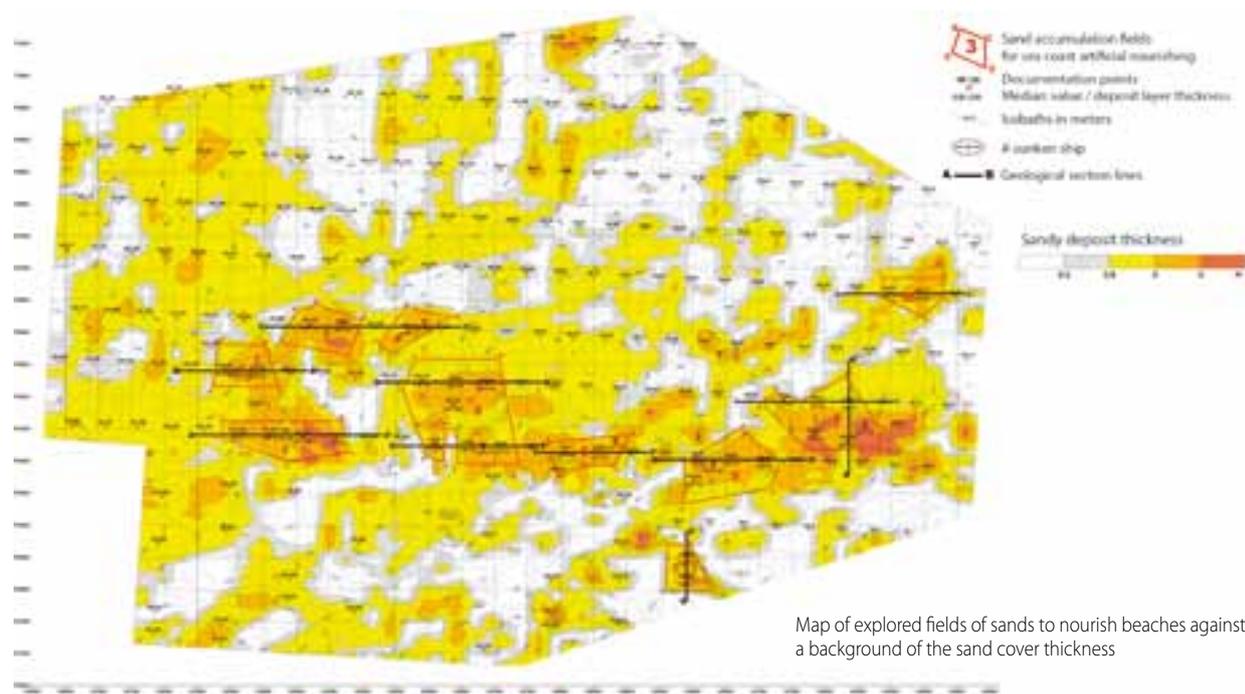
The Project was completed within the framework of a consortium comprising Polgeol (the leader) and the PGI-NRI (a member), and in cooperation with the AGH University of Science and Technology, the Mineral and Energy Economy Research Institute of the Polish Academy of Sciences and the University of Warsaw.

The studies carried out by the PGI-NRI resulted in the geological conditions being determined (lithology, lithostratigraphy, paleogeography), the explored occurrence of amber in the Paleogene deposits *in situ* and in glacial surficial deposits together with a mineral raw material forecast. The greatest prospects of increasing the reserves of amber are in the northern part of the Lublin Province, where the Upper Eocene amber-bearing deposits lie near the surface, up to 50 metres below ground level in the area of above 700 square kilometres. Amber-bearing deposits also occur in the Gdańsk Coastal Area (Pobrzeże) and the Kaszuby Lake District, but at depth of more than 100 metres, which makes their exploitation uneconomical, although near the village of Chłapowo, the concentration of amber is very high – comparable with that of the Sambia Peninsula. Modest prospects for increasing the reserves are also found in the Słowiński Coast in the area of the *Możdżanowo* deposit as well as near the city of Puławy.

The preparation and publishing of a methodical guide *Principles of Amber Deposit Prospecting and Documentation. Methodological Recommendations* has resulted from this Project.

The Project was implemented under a contract with the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Dr. Regina Kramarska

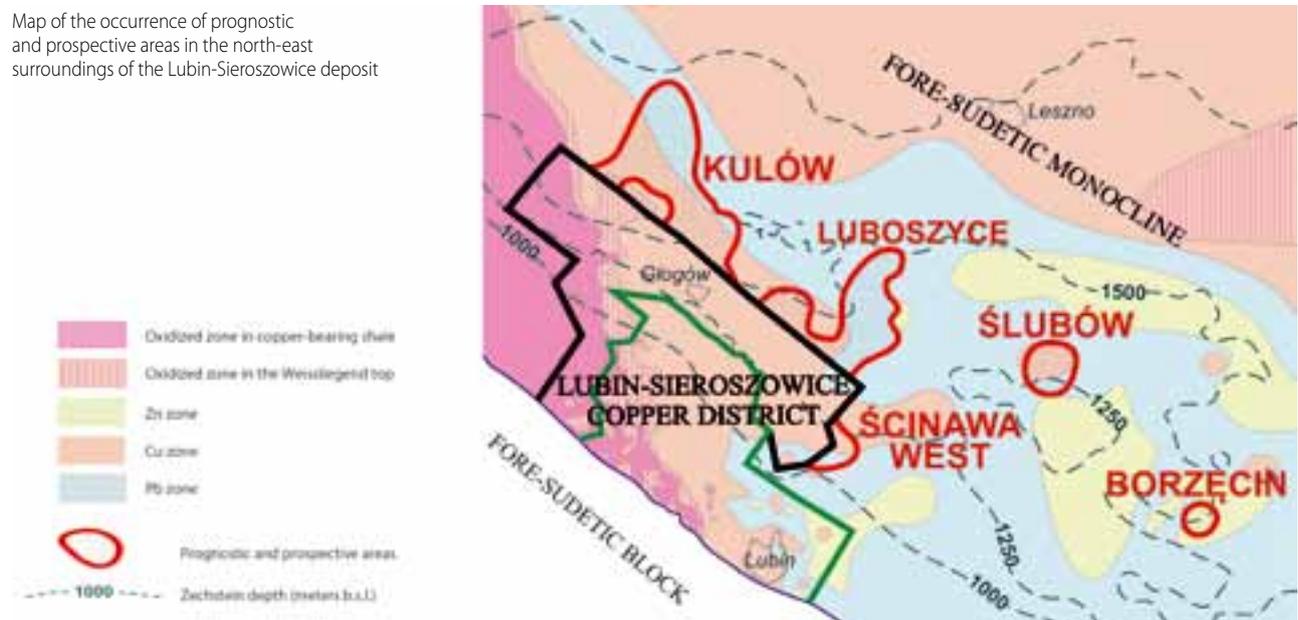


Map of explored fields of sands to nourish beaches against a background of the sand cover thickness

➔ key project

New Prognoses for Copper and Silver Resources in the Area of the Lubin-Sieroszowice Deposit

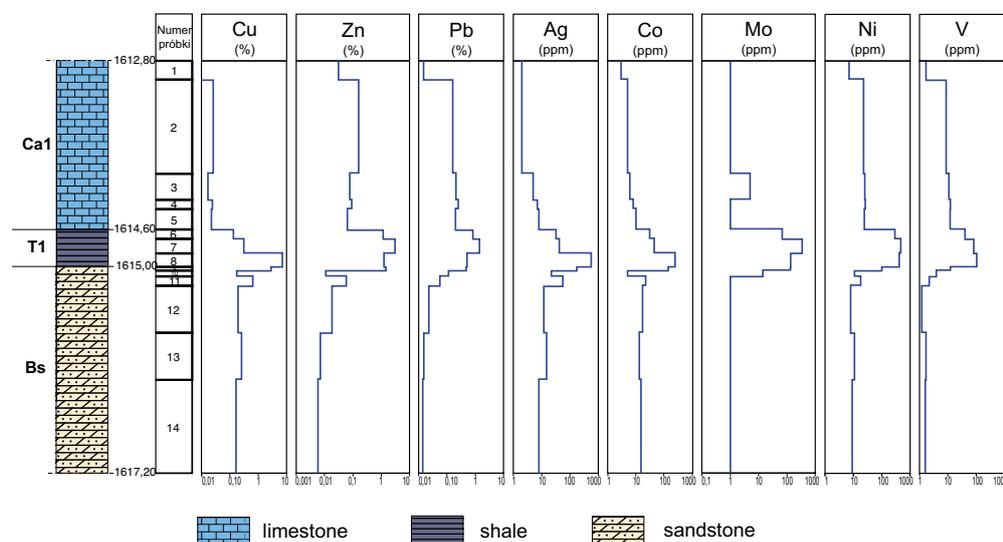
Map of the occurrence of prognostic and prospective areas in the north-east surroundings of the Lubin-Sieroszowice deposit



With the analyses of archive borehole cores, it was possible to determine a revised extent of the oxidized deposits and the extents of metallic zones and prognostic areas, considerably different from those of previous assessments, in the *Lubin-Sieroszowice* deposit surroundings. Three prognostic areas of the occurrence of copper-silver mineralization were determined: *Kulów*, *Luboszyce* and *Ścinawa Zachód* as well as two perspective areas: *Ślubów* and *Borzęcin*, having an equivalent copper content of above 35 kg per square metre. In the area of *Kulów* (an area of 130 sq. km with the Zechstein base at depths of 1,500-2,000 metres) there occur around 13 million tons of Cu and 44 thousand tons of Ag in a deposit of average thickness of 1.41 metre and an average content of 2.98% Cu_e. In the area of *Luboszyce* (of some 90 sq. km) the deposit has an estimated average thickness of 1.66 metres and an average content of 1.76% Cu_e with reserves of about 6.6 million tons of Cu and 21 thousand tons of Ag, at depth of 1,460-1,550 metres. The area of *Ścinawa Zachód* represents the eastern extension of the proven deposit of *Retków*. In the surroundings of the prognostic and perspective areas, there occur rich lead-zinc mineralization. Precise contouring of the prognostic areas of *Kulów* and *Luboszyce* requires further studies of archived borehole cores. In the western part of the study area, where the Zechstein copper-bearing series has not been drilled through so far, drilling exploration will be necessary.

The Project was financed by the Ministry of Science and Higher Education.

Project Leader: Sławomir Oszczepalski, Ph.D., PGI-NRI Associate Professor



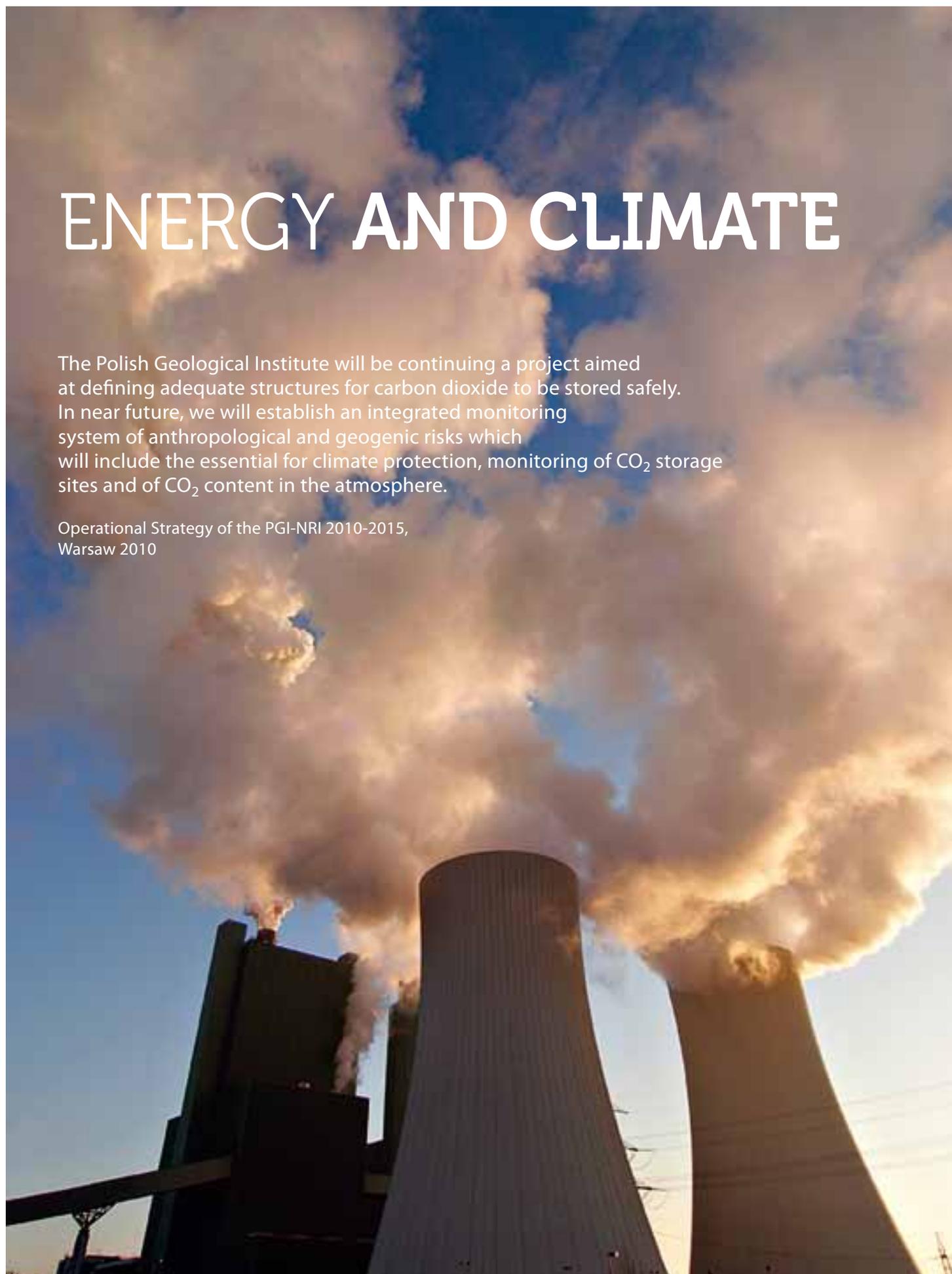
Distribution of Cu, Zn, Pb, Ag, Co, Mo, Ni and V in the Zechstein copper-bearing series in *Grochowice 35* borehole (the prognostic area of *Kulów*)



ENERGY AND CLIMATE

The Polish Geological Institute will be continuing a project aimed at defining adequate structures for carbon dioxide to be stored safely. In near future, we will establish an integrated monitoring system of anthropological and geogenic risks which will include the essential for climate protection, monitoring of CO₂ storage sites and of CO₂ content in the atmosphere.

Operational Strategy of the PGI-NRI 2010-2015,
Warsaw 2010



Transport and Storage of CO₂ for the Demonstration Polygeneration Power Plant in Kędzierzyn

Under a contract with Południowy Koncern Energetyczny (Southern Energy Concern), two projects related to the selection of the optimal geological structures for storage of CO₂ in the planned polygeneration power plant in Kędzierzyn have been drafted. The energy-chemical complex planned is designed to generate electric power, thermal power and synthesis gas which can be used to produce engine fuels and many chemical products. The first Project was carried out by a consortium: PGI-NRI (the leader), the AGH University of Science and Technology and Gazoprojekt. The work done by the PGI-NRI and the AGH included a feasibility study of the geological sequestration of carbon dioxide captured from combustion gases of a planned polygeneration power station. It has been assumed that at the stage of a demonstration installation, the capture and storage will be of 0.7-2.9 million tons of CO₂ per year. The assumption is that the polygeneration power plant will be operated for twenty-five years from the moment it is commissioned, its necessary storage capacity is estimated maximally at 73million tons.

Making allowance for geological and feasibility criteria, a ranking of geological structures and formations proper for geological storage of carbon dioxide in the immediate vicinity and remote distance from the polygeneration power plant in Kędzierzyn was determined:

- **Załęcze-Wiewierz and Żuchłów gas fields** which have been exploited since the 1970's and are considerably depleted, in these the carbon dioxide sequestration can be a method of enhancing production;
- **Mesozoic troughs near the village of Kliczków in the area of Belchatów** represent a reserve location and need more detailed exploration using geophysical methods;

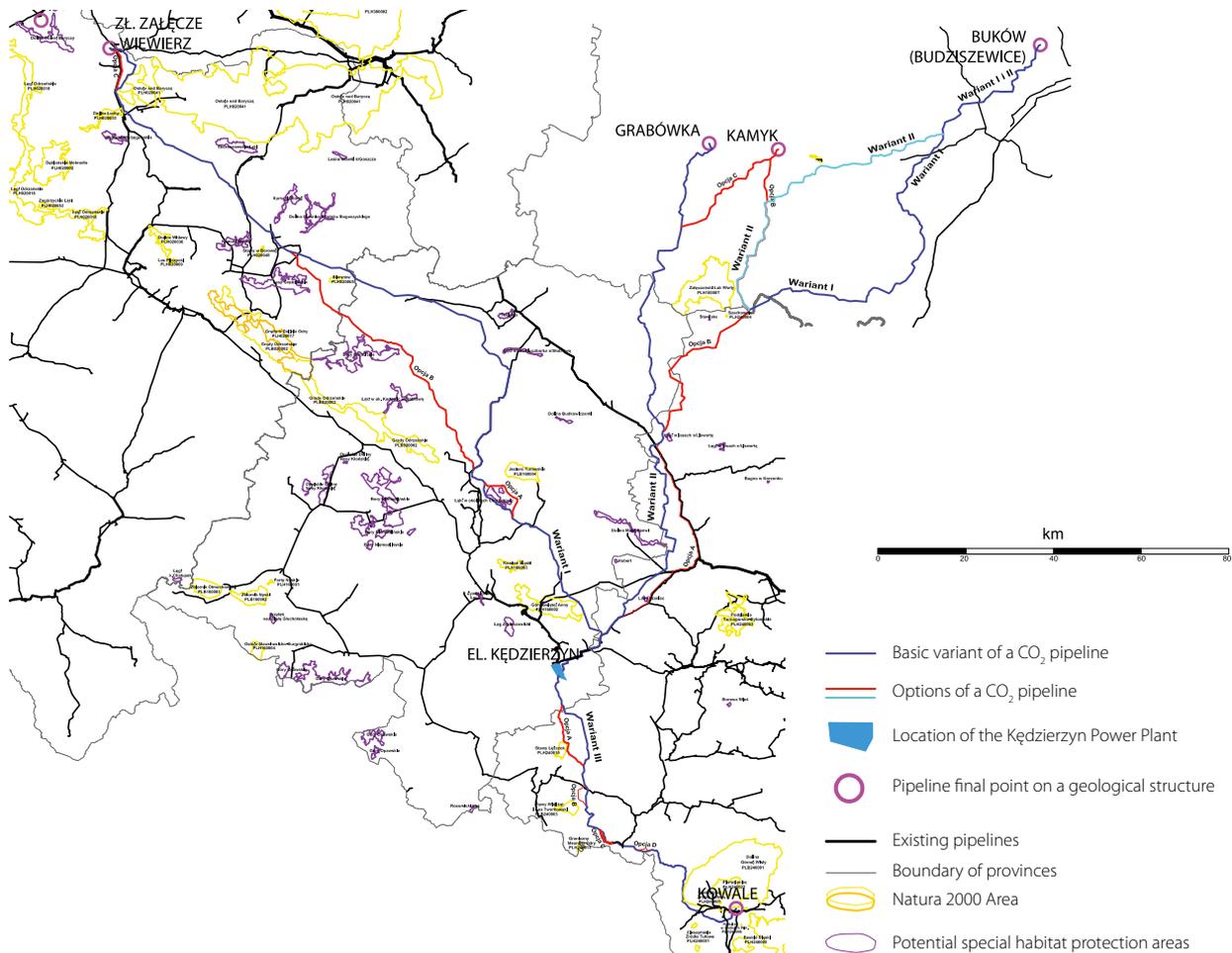
- **Dębowieckie Beds near the towns Skoczów and Czechowice** (a sequestration station near the village of Kowale) constitute a reserve location which is adequate to store minimal amount of CO₂ only.

Gazoprojekt carried out a study of the initial evaluation of possible carbon dioxide transport from the polygeneration power plant designed in the amount of around 330,000 cubic metres per hour to three potential storage sites. Three variations of the carbon dioxide transfer route were planned. Detailed feasibility studies including cost analyses for the route going to the *Załęcze-Wiewierz* gas field were conducted (the location is feasible).

Under the second project, the feasibility of storage in the brine bearing structure of *Budziszewice-Zaosie* was characterized. Features that were decisive for its suitability as a storage site for the polygeneration power plant, a schedule of its adaptation for storage to satisfy the requirements of both the financial instrument NER300 and the EU ETP ZEP programme were presented as well as estimation of investment expenditures connected with the adaptation of the potential storage site and operational costs. The structure of *Budziszewice-Zaosie* is of relevance for potential storage for the demonstration project by PGE EB SA, but it is not a priority for the project of CCS Belchatów, the concept is to use the structure to serve the needs of PKE (the Southern Energy Concern). The structure was proposed as a location feasible for the option of brine aquifers, as an alternative solution to that of *Załęcze-Wiewierz* prepared in an analogous study.

Project Leader: Adam Wójcicki, D.Sc.

Sketch map with routes of pipelines to transport CO₂ according to GAZOPROJEKT



Atmospheric CO₂ Concentration Measurement Point

In November 2010, an atmospheric CO₂ concentration measurement point was set up on the premises of the Archive of Cores and Geological Samples at Leszcze, near Kłodawa. The measurements are to determine the geochemical background of CO₂ atmospheric concentration. The point is adapted to take measurements on a continuous basis and is connected to Airhopper datalogger. Data are transmitted through an Internet link to the Institute's office in Warsaw where they are registered and analyzed.

The measurement point is equipped with a Thermo Scientific 410 infrared CO₂ analyser and a Vaisala Weather Transmitter WXT 520, which makes it possible to take continuous measurements of air temperature, atmospheric pressure and wind speed and direction.

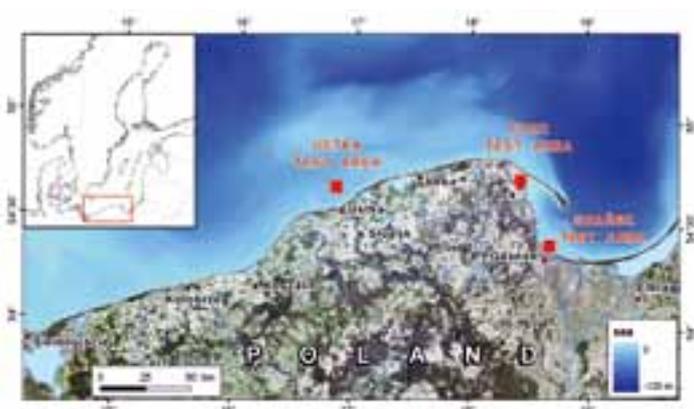
Project Leader: Dr. Monika Koniecznyńska

MACHU Project – Managing Cultural Heritage Underwater

Within the framework of the MACHU Project (financed by the European Union under the 'CULTURE 2000' Programme), a reconstruction of paleolandscapes of some selected regions of the south Baltic Sea drowned in the Holocene transgression was made, commissioned by the Central Maritime Museum. The studies were carried out in three test areas: *Ustka*, *Puck* and *Gdańsk*.

In the *Ustka* test area, at depth of 20-27 metres b.s.l., there are exposed lacustrine deposits and rooted tree trunks which grew 9.5 thousand years ago at a distance of 30 km from the contemporaneous shoreline. Within the next 300 years, the water level became higher and the lakes and forests found themselves on the coasts of the then Baltic Sea. The sea encroached in the area at about 8.2 thousand years BP. Studies conducted in the German and Danish economic zones show that there are frequent archeological excavation sites close to the analogous peat remnants of terrestrial environments and accompanying forests relicts.

The *Puck* test area is also a prospective area with respect to underwater excavation sites, with submerged remnants of a medieval port. The destruction of the port in the 13th-14th centuries may be associated with a climate cooling than: with a protracted interval of icy conditions in the bay and more floating ice.



Location of three test areas: Ustka, Puck and Gdańsk

The *Gdańsk* test area covers a terrestrial and underwater part of the Martwa Wisła River (the Dead Vistula River) estuary and the Gdańsk harbour roadstead. The results of dating the dune sand using OSL and organogenic deposits and marine bivalves using the ¹⁴C method show that the mouth of Vistula River near Gdańsk was formed 3-2.5 thousand years ago, with the estuary developing episodically. Since 1840, when a new mouth of the Wisła Śmiała River (the Bold Vistula River) was formed, the Martwa Wisła River delta has been subject to erosion.

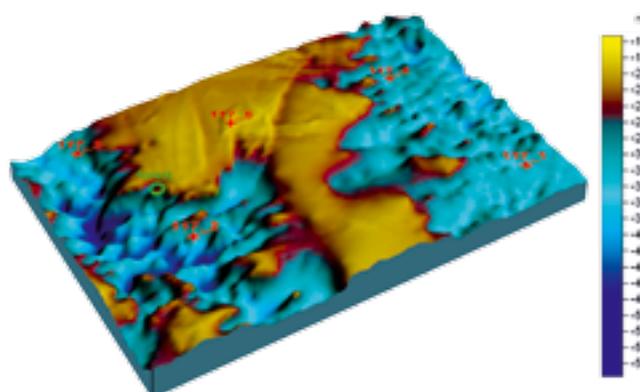
Project Leader: Dr. Grażyna Miotk-Szpiganowicz

Mechanism of Uplifting and Erosion in the Carpathians and the Fore-Carpathians Deep

Integrated geological and geophysical studies are a part of a large research project, THERMO-EUROPE *Climatic Changes vs. Tectonic Processes and Their Role in Shaping Europe's Topography Determined on the Basis of Thermochronological Studies*, which in turn belongs to an even larger project, TOPO-EUROPE, launched under the auspices of the European Science Foundation.

The basic part of the exploratory work carried out in the Carpathians region is that of thermochronological studies conducted by the PGI-NRI in cooperation with the University of Warsaw, the University of Glasgow and the Scottish Universities Environmental Research Centre, Isotope Geosciences Unit. The studies are based on samples collected in the Polish and Slovak Tatras, in the Podhale Basin and in the Fore-Carpathian Deep. Also, interpretations of seismic and borehole data from the Podhale Basin and in the Fore-Carpathian Deep are being conducted. In addition, analyses of the last stages of the tectonic deformations within the front of the Carpathians orogen for the Pilzno area have been started. The analyses will include balancing geological cross-sections to be carried out together with the University of Teras (Austin, USA). The Project is financed by the Ministry of Science and Higher Education.

Project Leader: Piotr Krzywiec, Ph.D.(Eng.), PGI-NRI Associate Professor



Model of the relief of a boulder clay top (a depositional paleosurface of late glacial and early Holocene stagnant and lake deposits)

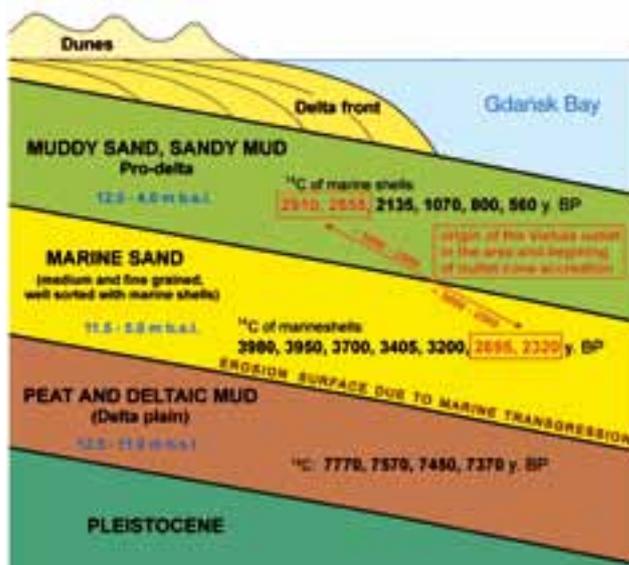
Model of the Martwa Wisła Estuary Development

As part of the reconstruction of the Gulf of Gdańsk, the geological structure around the mouth of the Martwa Wisła River was explored. Lithostratigraphic units within the estuary succession and its underlying basement were identified, depositional environments were interpreted, and the age of the deposits was determined using the ¹⁴C method. The results of a spatial analysis of the arrangement of dune ridges dated using the OSL method and bathymetric plans from the end of the 16th to the 19th century were used to deduce the late Holocene development of the coast. In addition, the effects of marine abrasion were documented which started in 1840 due to the Martwa Wisła River being cut from the main channel depriving the estuary of clastic materials supply.

On the basis of the information obtained, paleogeographic reconstructions of the development the Gulf of Gdańsk coast surveyed, within the recent 8,000 years (with one-thousand-year time interval) were made and a synthetic model of the geological structure and development of the Martwa Wisła River estuary constructed.

The Project was financed by the Ministry of Science and Higher Education.

Project Leader: Wojciech Jegliński, M. Sc.



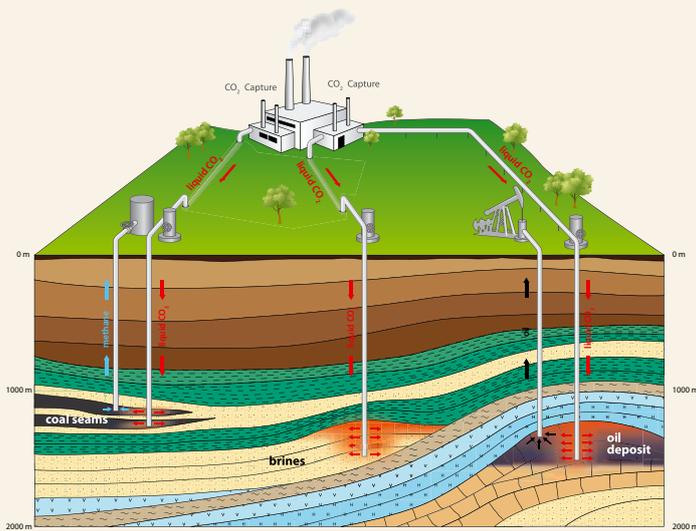
Synthetic model of the geological structure and development of the Martwa Wisła River's estuary cone



The Vistula River's mouth depicted on a historic map of 1674

→ key project

Exploration of Formations and Structures for Safe Storage of CO₂ together with a Programme of their Monitoring



→ CCS / capture / transport / storage CO₂

Impermeable layers



transport and injection of CO₂

outflow of oil

outflow of methane

Permeable layers



Being the leader of this consortium, the PGI-NRI performs several tasks under the national Programme: *Exploration of Formations and Structures for Safe Storage of CO₂ together with a Programme of their Monitoring*. The Programme is commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management. It is to be completed in 2012. Apart from the PGI-NRI, the other companies that are members of the consortium are: the AGH University of Science and Technology, the Central Mining Institute, the Institute of Oil and Gas, the Mineral and Energy Economy Research Institute of the Polish Academy of Sciences and the PBG Geophysical Exploration Company.

The Programme is run to carry out a detailed exploration of potential CO₂ storage sites in brine aquifers for eight regions of the country as well as in hydrocarbons deposits and coal beds. The information will be used by the Ministry of Environment to decide on the granting of concessions for exploration of potential storage sites and their management under the EU Directive.

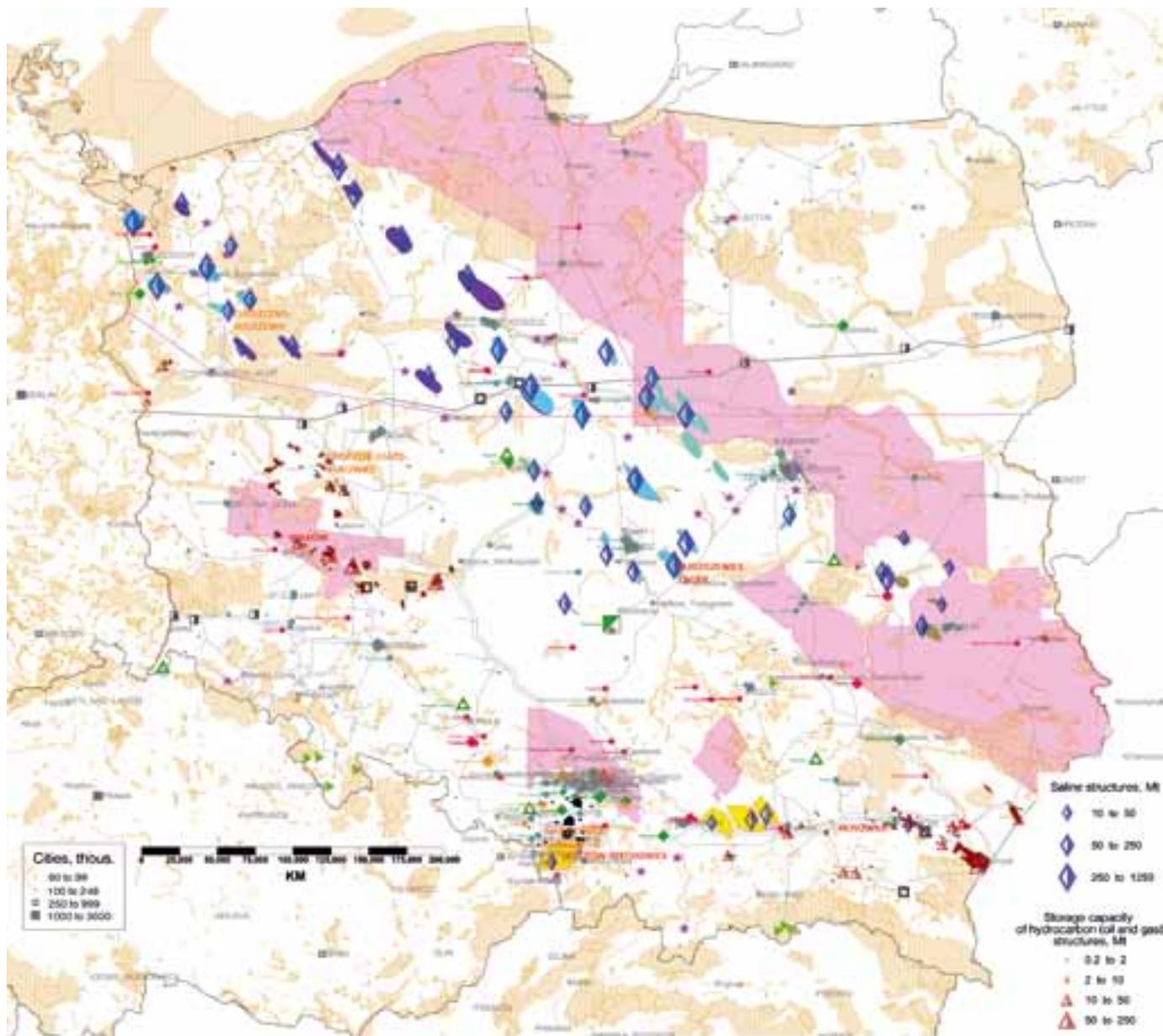
The work is to be done across Poland and in the Baltic Economic Zone and it will include studies of regional character (ten subprojects). Also, detailed studies are being carried out for seven potential storage sites (for four structures in brine aquifers and one each in oil and gas fields and one in coal beds containing methane).

Between 2009-2010, regional analyses of brine aquifers were made for the area of Bełchatów, the Upper Silesian Coal Basin (USCB), the Mazovian Region, the Fore-Carpathian Deep and a marginal zone of the Carpathians and the Lublin Region.

For the areas of Bełchatów and the USCB, a detailed studies were made of one selected structure: *Budziszewice-Zaosie* and *Skoczów-Czechowice*. Also, regional studies were carried out as well as detailed studies of a gas deposit at *Wilków* and an oil field in *Nosówka*. In addition, possibilities of CO₂ storage in coal beds were analysed and an objective at *Warszowie-Pawłowice* in the area of the USCB was selected as a potential storage site. Moreover, subsequent structures in brine aquifers were shortlisted for detailed analyses: *Choszczno-Suliszewo*, in north-west Poland, and *Grodzisk-Ujazd-Bukowiec* in the area of the Wielkopolska region. Detailed characterisation of a few potential storage sites were based on available archive materials, in accordance with the recommendations of the EU Directive on the geological storage of carbon dioxide. Two of the objects were chosen to serve the needs of demonstration projects of a power plant with reduced emissions (PGE Bełchatów and PKE/ZAK Kędzierzyn) which were proposed by Poland for the EU Programme ETP ZEP.

The final effect of the Project will be, in the case of regional tasks, the preparation of a map of the concession areas proposed for exploration of potential storage sites, and in the case of detailed tasks – plans of initial monitoring of the potential storage sites chosen, and guidelines for monitoring during exploitation and after the storage sites are closed.

Project Leader: Adam Wójcicki, D.Sc.



LEGEND

- Protected areas (NATURA 2000, national parks)
- Power plants, emission in kt:
 - 142 to 1000
 - 1000 to 5000
 - 5000 to 15000
 - 15000 to 20000
- CHP and Heating plants, emission in kt:
 - 100 to 1000
 - 1000 to 5000
- Manufacturing industries, emission in kt:
 - 100 to 1000
 - 1000 to 5000
 - 5000 to 15000
- Communist plants, emission in kt:
 - 100 to 1000
 - 1000 to 5000
- Structures in Marone saline aquifers potential storage sites (Atlas, 2009)
- Structures potential storage sites in saline aquifers of Balkhovie region
- Stoiche-Čučukova region
- area of Cepelinov font (E)
- Lutsk region (Carbonflow)
- Gas pipelines:
 - Gas pipeline (compression station)
 - Major underground gas and fuel storages
- Selected gas and oil fields (potential storage sites, Atlas, 2009)
- CBM fields (potential storage sites, Atlas, 2009)
- Geothermal installations and open cooling structures
- Nature CO₂ sources (volcanic, natural)
- Carbonates for exploitation of shale gas and shale gas & conventional hydrocarbons

Results to date of the regional studies project (together with the results of work so far, verified and supplemented on a current basis) and described structures/objects being analyzed as part of detailed studies (descriptions in capital letters; red colour – completed studies; orange colour – in progress)

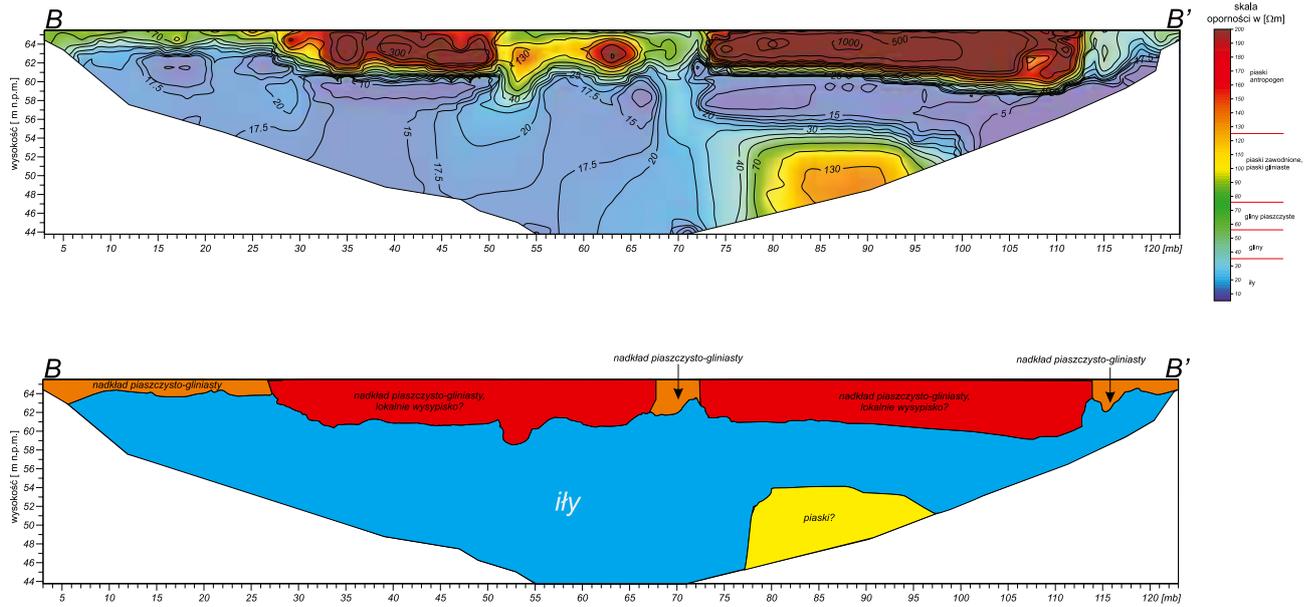


SAFE INFRASTRUCTURE

The Institute's activities in this area will include, primarily, determining the geological and environmental conditions for safe locating of infrastructure as well as the evaluation of its exploitation in the context of possible threats of anthropogenic and geogenic factors..

Operational Strategy of the PGI-NRI 2010-2015,
Warsaw 2010





Electrical resistance image with geological interpretation elements of a section of the Grabówka Street in Plock afflicted by landslide movements. In the image, a characteristic depression in the Pliocene clays top (blue colour) filled with high resistance anthropogenic material (brown colour) can be seen

Geological and Engineering Studies to Evaluate Possible Protection from Landslides

In order to evaluate the possibilities of stabilizing landslides activated between 2009-2010, the PGI-NRI carried out a detailed exploration of geological-engineering conditions in those areas. The landslide processes occurred in the Małopolska Region, the Lublin Province and the Masovian Region. In the areas afflicted by the landslides, exploratory boreholes, dynamic sounding, static sounding, shear strength tests, geoelectric survey and hydrogeological measurements were carried out and numerous soil samples were collected to determine the physical and mechanical parameters. With calculations made of the stability of the slopes where the landslides were formed, it was possible to determine the factors that maintained slope stability. On the basis of the studies, an evaluation of the possibilities of protection of the landslide areas in terms of geological and engineering conditions was made. Methods of protecting from landslides were suggested after analysis of the costs of each proposed solutions.

Guidelines were provided to define the scope of a methodological guidebook: *Rules of Documenting Geological-Engineering and Hydrogeological Conditions in Areas of Landslide Occurrence*.

Project Leader: Dr. Edyta Majer

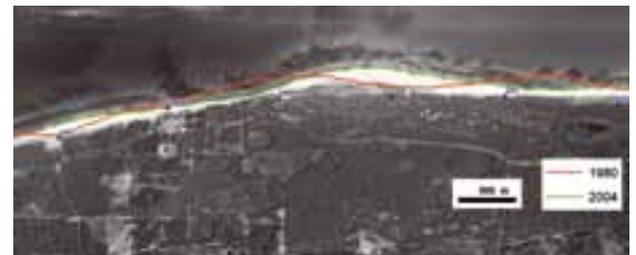
EMODNET – European Marine Observation and Data Network

The main objective of the EMODNET Project is to construct geological maps of European seas at the scale of 1:1,000,000. The Project is being implemented by fourteen partners and supervised by the British Geological Survey.

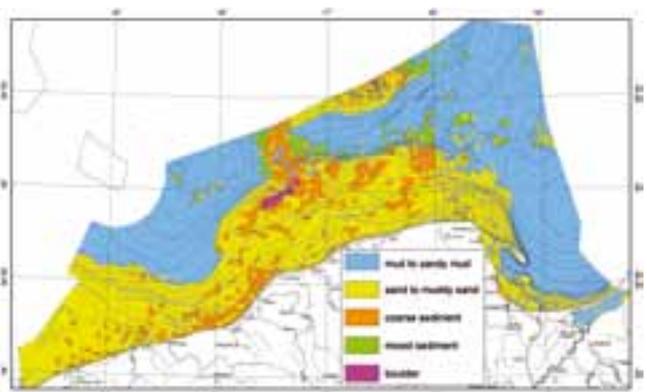
The PGI-NRI's activities are focused on the Polish area of the Baltic Sea. So far, a map of bottom sediments of the Polish zone of the Baltic Sea has been compiled, together with data on the sedimentation rate in bathypelagic sedimentary basins. The map is based on a modified lithological classification of sediments according to Folk, approved by the members of the Project. With the use of a normalized algorithm, the sea areas were classified in terms of the quantity and quality of geological exploration, thus showing the degree of documentation of the map content.

Also, as part of the Project, an initial version of the information layer was developed that shows the geodynamic processes taking place in the Polish coast of the Baltic Sea. In particular, coasts were classified according to their morpho-sedimentological and geological type as well as observed and predicted development trends. At the same time, information on artificial beach nourishing and other forms of the sea coast protection was taken into consideration.

Project Leader: Wojciech Jegliński, M.Sc.



Characteristic, sinusoidal dislocations of the coastline documented for above 20-year time interval (an area 10 kilometres west of the town of Ustka)



Map of bottom sediments of the Polish zone of the Baltic Sea

Monitoring of Mass Movements in Sea Cliff Sections

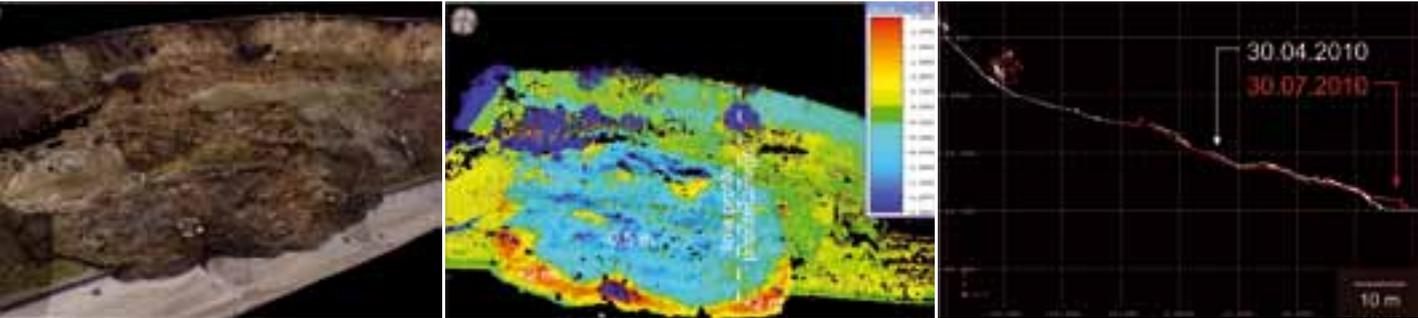
This Project has been implemented since 2010 and is aimed at outlining the parts of the Baltic coast that are most threatened by mass movements and at defining the methodology of the studies and documentation of these movements with the use of ground laser scanning. Eleven sections of the coast of a total length of 8,000 metres were covered by the studies. Morphometric data obtained through a Riegl VZ-400 scanner are used to create 3D models which accurately map the morphology of the land. In order to explore the geological structure, shallow test holes were drilled and shallow seismic logging was carried out.

A part of a cliff at the village of Jastrzębia Góra was chosen that is characterized by a complex geological structure and complicated hydrogeological conditions as well as by the presence of active landslides. Two-time

scanning of the cliff enabled illustration of the rate of erosion. Within three months, the area of the landslide was lowered by 0.5 metres, the front of the landslide reached at height of 2 metres and moved by 8 metres towards the sea, while the volume of the material eroded from the coast amounted to 770 cubic metres.

The project is financed by the Ministry of Science and Higher Education. Project Leader: Leszek Jurys, M.Sc.(Eng.)

➔ Scanning of the landslide at Jastrzębia Góra



Realistic colours of 'point clouds'

Differential model of the landslide development in the period 30 April - 30 July 2010

Transverse profile as based on a 'point cloud'

Inventory of the Shallow and Surface Exploitation of Hard Coal in the Upper Silesia Coal Basin (USCB)

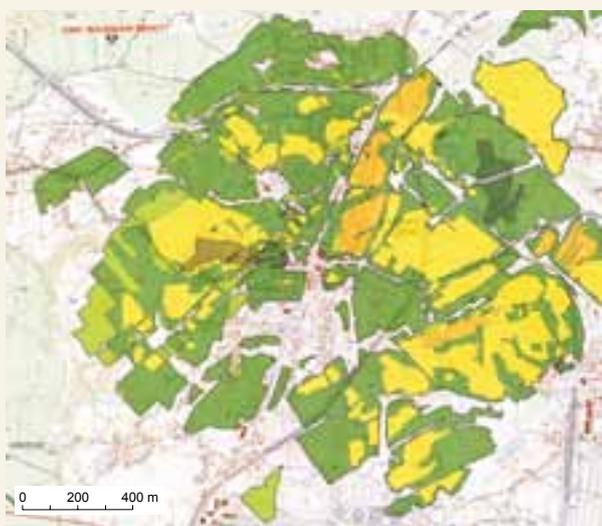
The history of industrial exploitation of hard coal in the USCB goes back 250 years. In the beginning, coal production was in small strip mines or very shallow sub-surface mines. As the shallow deposits became depleted, deeper and deeper levels were penetrated and the surface exploitation range became wider (at present, nearly 1,850 sq.km up to the depth of 1,200 metres). As late as the 1970s, shallow coal beds were exploited, and the last hard coal open pit *Brzozowica* in the city of Będzin was closed in 1968.

The effects of the previous exploitation give rise to a great concern for many districts today. Mining voids often result in the land surface being

deformed and they are dangerous for the surface and underground infrastructure. When they are accurately located, it is possible to identify threats, and the inclusion of the areas at risk in development plans will make it possible to avoid losses and maintain adequate management of the land.

The range of the shallow exploitation (up to the depth of 80 metres) is shown in topographic maps at the scale of 1:10,000, with allowance made for the total thickness of exploited coal beds. The final result is an atlas containing 60 sheets of the map, where the area of the shallow exploitation is around 143 square kilometres, which represents almost 8 per cent of the total area covered by the hard coal mining.

Project was financed by the Ministry of Science and Higher Education. Project Leader: Włodzimierz Krieger, M.Sc.



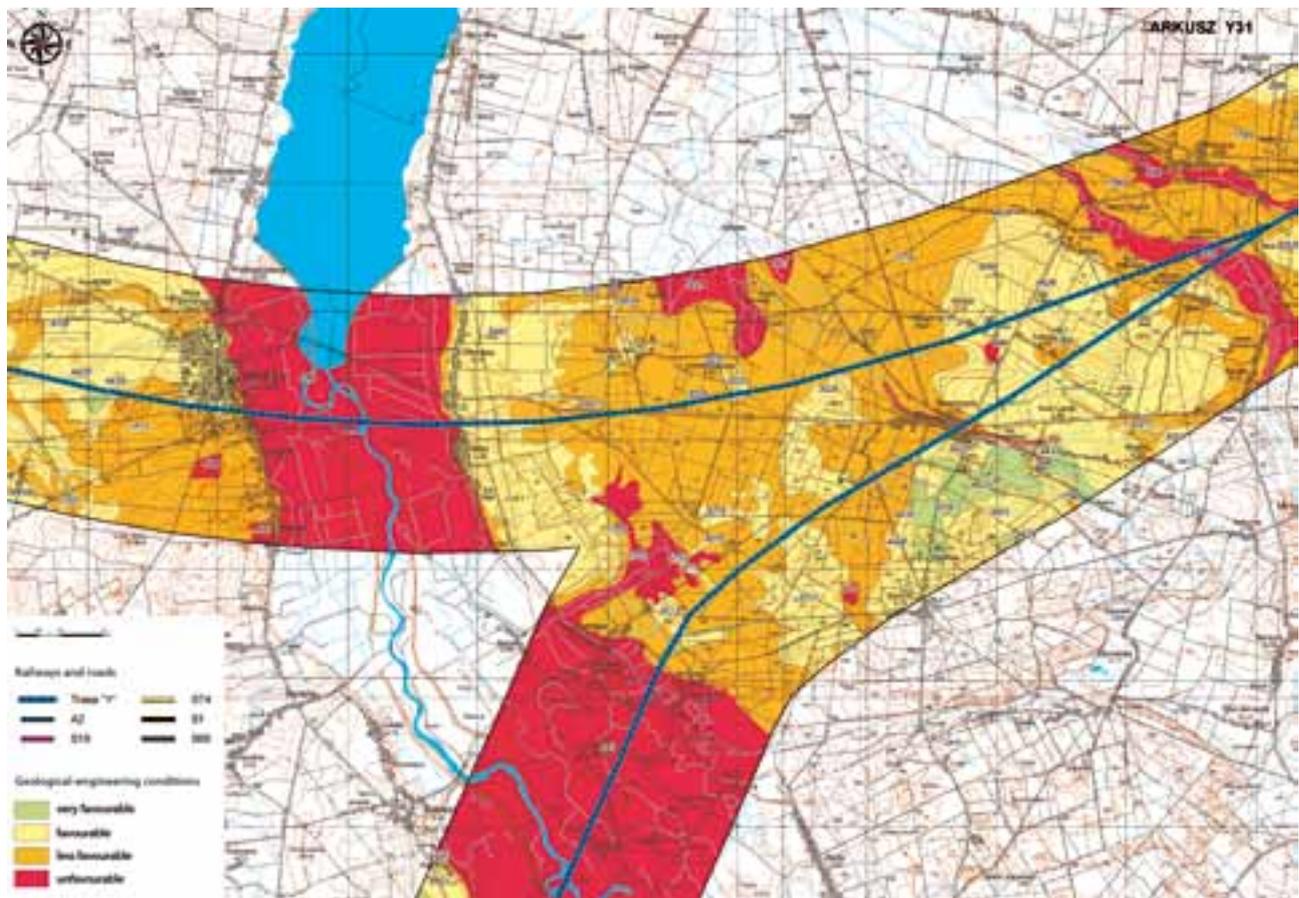
0 1 3 5 7 [m] Total thickness of coal bed being exploited ▨ Areas of opencast coal mining

Areas of shallow exploitation of hard coal near the town of Łaziska Górne



0 1 3 5 7 10 15 20 25 [m] Total thickness of coal bed being exploited

Areas of shallow exploitation of hard coal between Katowice and Siemianowice



Map of geological-engineering conditions along a planned Y railway

Geological and Engineering Conditions of the Construction of New National Roads and Railway Lines

On the basis of archive geological-engineering, geotechnical and hydrogeological documentation, a detailed analysis is being carried out of the geological-engineering conditions in the areas where new sections of road, motorway and railway routes are outlined. The type, origin, and properties of the soils to be found on the surface will be determined along the outlined routes in a zone 2 kilometres wide from the axis of the route (in total 4 kilometres), with allowance made for the occurrence of low load-bearing soils. It is assumed that under the Project, the following digital information layers in accordance with the State Geodetic Coordinate System (PUWG) will be made: the course of the express ways and motorways planned, the geological-engineering units, the depth to the groundwater table, the occurrence of geodynamic processes, the slope and geomorphological forms. On the basis, for each of the sections being analyzed of the total length of 1,527.3 kilometres, a map of the distribution of ground bearing capacities and a map of the geological-engineering conditions at a scale of 1:50,000 will be prepared. For the sections of routes of unfavourable geological-engineering conditions, proposals of a range of studies aimed at determining a proper method of reinforcing the subsoil will be submitted.

The Project, which is to be completed in 2011, has been commissioned by the Minister of the Environment and is financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Michał Jaros, M.Sc.

Hydrogeological Conditions on the Premises of the *Elektrownia Północ* (the Northern Power Plant) at the village of Rajkowy

As commissioned by Energoprojekt - Warszawa S.A., this project involves geological surveying and documenting hydrological conditions in the area of the coal power plant to be built at the village of Rajkowy (Pelplin commune, Tczew County). The survey conducted here included: an analysis of archive materials, hydrogeological and sozological mapping, drilling work, pumping tests and laboratory tests of soil and water. Calculations of potential water inflow to trenches showed a basis to prove that it would be necessary to draft a project to build drainage system. A hydrogeological model of groundwater flow enabled it to assess the impact of the work carried out in the area of the planned power station on the water intakes in the nearby villages of Pelplin, Rajkowy and Subkowy. The documentation contains recommendations which should be taken into consideration at the design stage of the power plant building project.

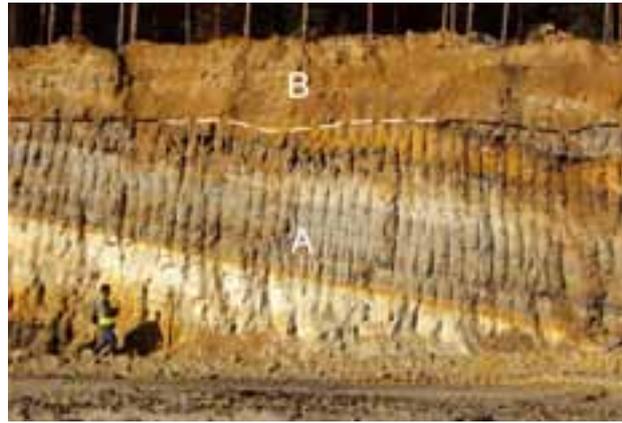
Project Leader: Marta Kielbasińska, M.Sc.

Documentation of Geological Profiles Along Linear Infrastructure Investment Projects

Documentation of geological profiles exposed during excavation along linear infrastructure investment projects all over Poland have been carried out. The work was performed along the routes of the sections of motorways and expressways being constructed: at A1 Gliwice to Dębnieńsko, A2 Nowy Tomyśl to Trzciel, A4 Zgorzelec to Krzyżowa and Kraków to Szarów, A8 Wrocław Ring Road, S3 Szczecin to Gorzów Wlkp., S7 Skarżysko Kamienna to Kielce, S8 Białystok to Katryńka, and also along many sections of national roads and ring roads. Documentation of the profiles provided much essential information about the geological structure of some regions and enriched the database of 57 sheets of the *Detailed Geological Map of Poland at the Scale of 1:50,000*.

The Project was implemented under a contract with the Minister of the Environment and is financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Dr. Stefan Cwojdzński, PGI-NRI Associate Professor



Contact of the Upper Cretaceous sandstones and mudstones (A) with the glacial sand and gravel of the Oder Glaciation (B) – A4 motorway in the area of the village of Kierzna near the village of Zebrzydów

Engineering and Geological Atlases of Large Urban Agglomerations

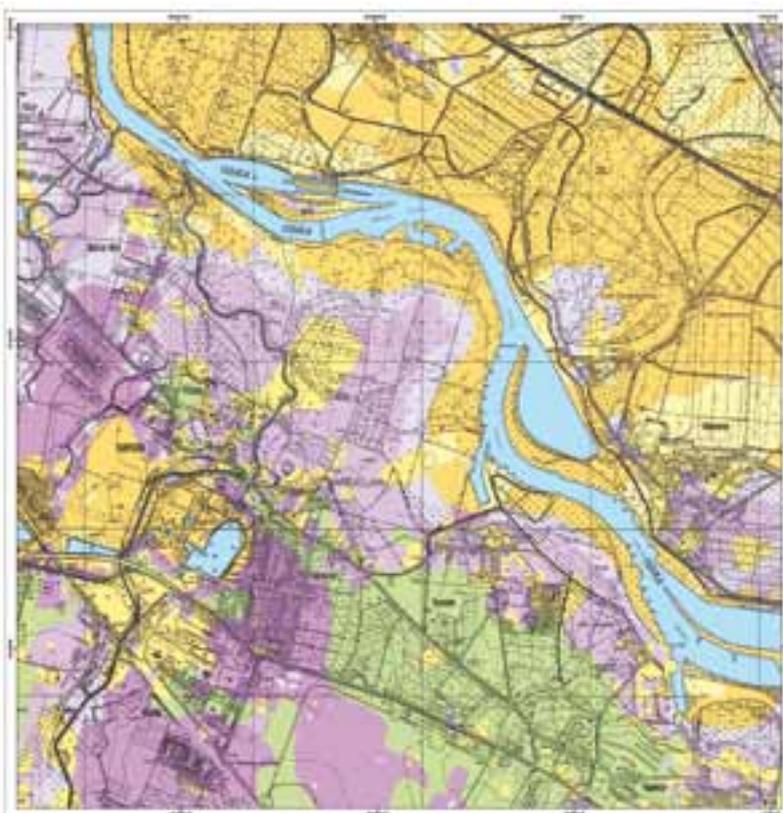
The Polish Geological Institute took part in the construction of geological and engineering atlases of large urban agglomerations of: Wrocław, Rybnik-Jastrzębie Zdrój-Żory, Koszalin, Bydgoszcz, Łódź and Wałbrzych-Świebodzice-Kamienna Góra. The first two atlases were completed in 2009 and 2010, respectively. The other atlases are to be compiled in 2011-2012.

Digital geological-engineering databases which contain information from vintage geological-engineering, geotechnical, hydrogeological documentation as well as profiles of deposit boreholes form a basis for the atlases to be prepared. The database for the Wrocław agglomeration included 50,000 wells, and that for Rybnik-Jastrzębie Zdrój-Żory conurbation: 19,000.

Spatial information shown in a proper way makes it possible to evaluate geological-engineering conditions as a whole. The numerous topic maps (including of soils at various depth, foundation conditions, depth of groundwater table, hazards, protected areas and land development), at a scale of 1:10,000, are of critical importance when decisions are to be taken about spatial planning, crisis management or designing subsoil tests for building and infrastructural investment projects.

The atlases are completed under a contract with the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leaders: Dr. Zbigniew Frankowski, Dr. Edyta Majer, Adam Roguski, M.Sc.



- Surface water
- Flood embankments

Foundation conditions:

I – useless

- Ia – non load-bearing soils with a groundwater table lower than 1 metre b.g.l.
- Ib – non load-bearing soils with a groundwater table from 0 metre b.g.l. to 1 metre b.g.l.
- Ic – weak-load-bearing and load-bearing soils with a groundwater table from 0 metre b.g.l. to 1 metre b.g.l.

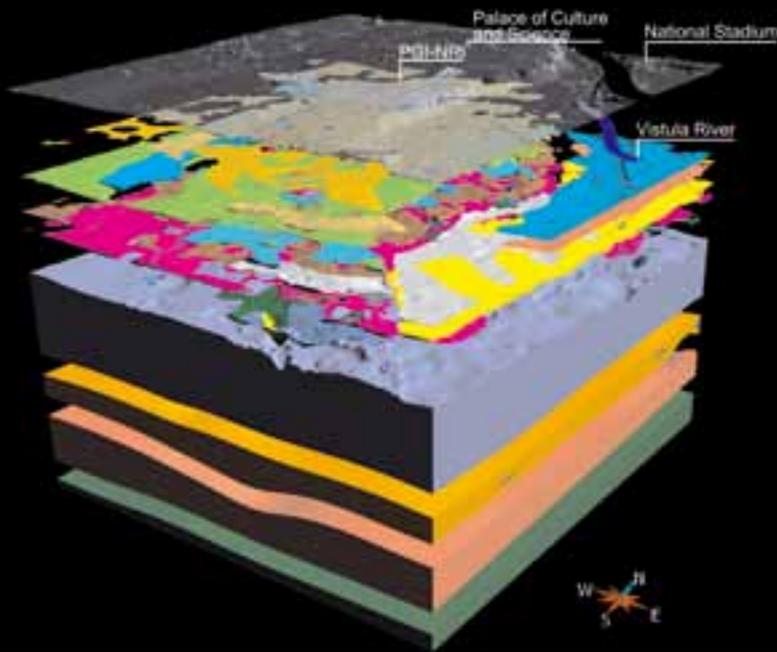
II – average useful

- IIa weak-load-bearing soils with a groundwater table lower than 2 metres b.g.l.
- IIb weak-load-bearing soils with a groundwater table from 1 metre b.g.l. to 2 metres b.g.l.
- IIc load-bearing soils with a groundwater table from 1 metre b.g.l. to 2 metres b.g.l.

III – useful

- III – load-bearing soils with a groundwater table lower than 2 metres b.g.l.

Map of foundation conditions at the depth of 2 metres b.g.l. (Geological-Engineering Atlas of the Wrocław Agglomeration; the Wrocław-Kozanów Sheet)



3D model of Warsaw ←

3D model of the deep geological structure (lithological) of a fragment of the Warsaw agglomeration

Digital Model of Deep Geological Structure of the Warsaw Agglomeration

This model is being constructed for the central part of Warsaw. It covers parts of the following quarters: Śródmieście (City Centre), Mokotów, Żoliborz, Wola, Ochota, Włochy, Praga Południe and Praga Północ. The model makes allowances for the main aspects of the deep geological structure (stratigraphy, lithology, origin) and the geomorphological structure of these parts of Warsaw. With consideration of the availability of information and the complexity of geological structure (with glaci-tectonic disturbances), a detailed analysis is going to include younger deposits (up to depths of tens of meters below ground level). The possibility of integration of geological data of different types enables it to construct a model of stratigraphic surfaces reaching the top of the Mesozoic inclusive.

A lithological model of the Cenozoic deposits of a part of the Warsaw conurbation is the result of integrating mapping studies with the data stored in the database which comprises over 7,000 boreholes. The visualization presented of the characteristic elements of the geological structure, such as: the Żoliborz-Szczęśliwice tunnel valley, the Pliocene zone of glaci-tectonically faulted deposits and the Miocene lignite beds, constitutes educational and popularizing material. The structural matrix of the model can form a basis for parametric modelling to serve the needs of geological engineering and it is also one of the elements necessary to create an integrated information system that includes geological and planning data of the Warsaw agglomeration.

The Project is being implemented as commissioned by Minister of the Environment and is financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Dr. Urszula Stępień

Ground Motions of the Earth's Surface in the Light of Satellite Interferometry Data

In the years 2009-2010 projects using satellite interferometry (*Persistent Scatterer Interferometry – PSI*) in identifying the ground motions of the Earth's surface have been continued. Analyses of interferometric data are carried out in PGI-NRI within the frame of UE research programmes: DORIS, TerraFirma 3, SUBCOAST and PanGeo. Two of the projects (DORIS and TerraFirma 3) cover the territory of the Upper Silesian Coal Basin (USCB). First of them comprises the central part of USCB, and the second – the region of Sosnowiec and Będzin and is focused on monitoring of ground deformations in areas of abandoned mines. The SUBCOAST project covers the area of the Gdańsk Pomerania from the Vistula channel near Świbno in the east to the Żarnowiec Lake in the west. The purpose of that project is to monitor ground movements along the Baltic coastline and in urban agglomerations and industrial centers (harbour facilities, shipyards, refinery etc.). The PanGeo project includes analysis of satellite interferometric data for Warszawa and Nowy Sącz areas, from the point of view of risk of flash floodings and landslides. All projects are in progress.

Project Leader: Prof. Marek Graniczny



Radar interferometry data for the Old Town in Gdańsk for the period 1992-2000 (according to FUGRO NPA Ltd.); green points mean stable places, red ones – subsidence above 1.5 mm/year, blue ones – elevation above 1.5 mm/year

→ key project

SOPO – Landslide Protection System

Mapping and Compiling Maps of Landslides and Areas at Risk of Mass Movements in the Polish Carpathians (75% of the area) and Monitoring Selected Landslides in the Carpathians



→ **More than 95%** of landslides occurring in Poland is located in the area of the **Polish Flysch Carpathians**.

In some Carpathian districts, landslides are to be found in about **30–40%** of the area.

osuwiska.pgi.gov.pl

< Schedule of the SOPO Project implementation

In 2006, the Polish Geological Institute – National Research Institute commenced the implementation, under a contract awarded by the Minister of the Environment, of the SOPO (Landslide Protection System) Project. The Project is financed by the National Fund for Environmental Protection and Water Management. The tasks to be performed in the framework of the Project are to support the self-government bodies.

The work to be carried out under the SOPO Project include the following:

- compiling maps of landslides and areas at risk of mass movements at the scale of 1:10,000 for districts in the Carpathian region, preparing registration cards of landslides and for the areas at risk of mass movements;
- setting up a system of surface and deep monitoring on sixty selected landslides in the Carpathians together with taking measurements of dislocations;
- interventions on a current basis in the areas stricken by landslide disasters;
- establishing an all-Poland database of landslide risks.

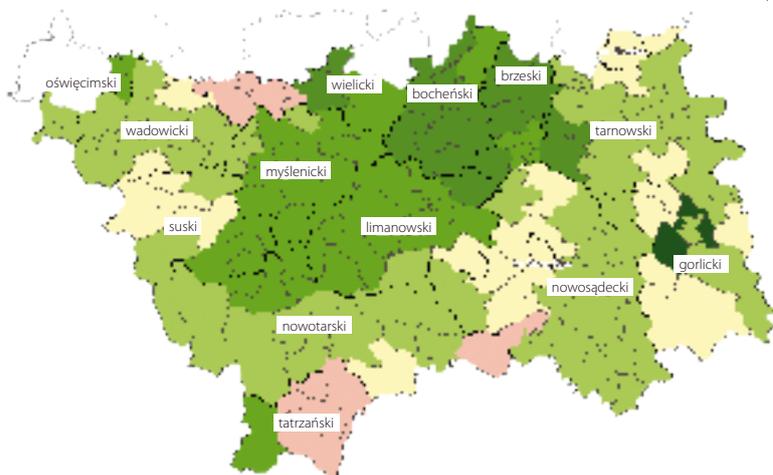
These tasks are being fulfilled in cooperation with geological, geophysical, drilling and geodetic companies as well as with scientific institutes and universities. The PGI-NRI is the chief coordinator of the SOPO Project.

The progress status of the SOPO Project implementation as at the end of 2010 is as follows:

- maps of the landslides and areas at risk of mass movements in a digital format were developed for sixty-eight districts;
- about 11,500 landslide registration cards and about 1,300 registration cards of the areas at risk were uploaded to the SOPO database;
- maps of the landslides in fifty-three communes were given to the offices of the district authorities;
- eighty-five landslide documentation cards were made, together with opinions given during intervention operations in 2010 in the Podkarpackie, Małopolskie, Śląskie and Świętokrzyskie provinces.

The intervention operations basically consisted in issuing geological forecasts related to further development of the landslides reported, and later in indicating which threatened buildings are to be relocated (demolished), monitored or renovated.

Project Leader: Dr. Dariusz Grabowski



SOPO PROJECT Małopolskie Voivodship

Districts for which maps of landslides and areas at risk of mass movements were constructed in the years:

- 2007
- 2008
- 2009
- 2010

Districts for which the construction of maps of landslides and areas at risk of mass movements is to be started:

- in 2011
- after 2012

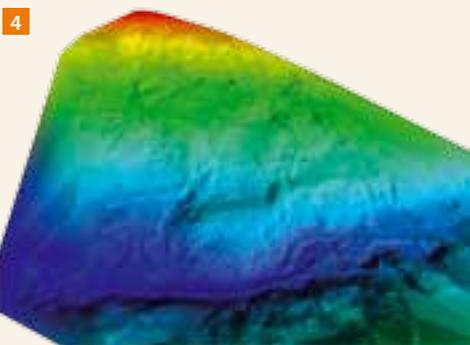
— boundaries of the districts



May 2010 – interventions in the areas afflicted by landslide disasters



Ground laser scanning



Laser scanner – Riegl VZ-1000

maximum range 1,400 metres

accuracy from 5 mm

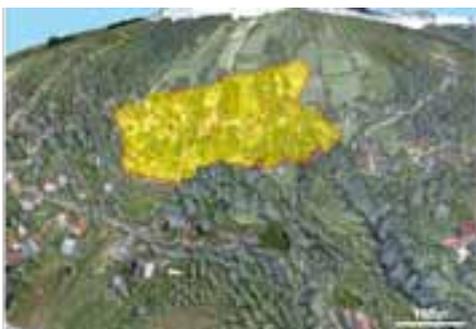
measurement frequency 122 000 Hz

1. Measurements on a landslide at the village of Kłodno

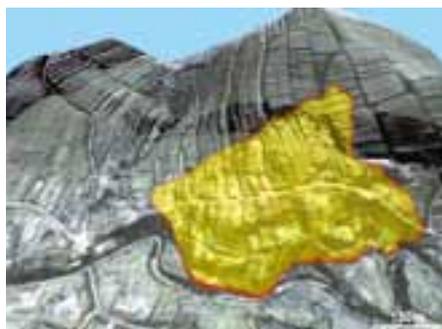
2-3. Fragment of a digital model of the landslide area at Kłodno in combination with an orthophotomap; the model was constructed in the Riegl RiScan Pro environment, as based on the measurements from a Riegl VZ-1000 ground laser scanner

4. Numerical model of the landslide area at the village of Milówka; the model was made using Riegl RiScan Pro software on the basis of measurements from a Riegl VZ-1000 ground laser scanner

Airborne laser scanning



Digital Model of Terrain with the infrastructure and crust vegetation together with an interpretation of the contour of the landslide at the village of Łańnica (the area highlighted in yellow)



Digital Model of Terrain, without vegetation cover and with an interpretation of the contour of the landslide at the village of Łańnica (the area highlighted in yellow)



Comparison of the extent of the landslide at Łańnica against the background of an orthophotomap:
A) the extent of July 1960 – acc. to T. Ziętara
B) the extent of July 2010 – a result of the interpretation of a digital terrain model (LIDAR)



GEOLOGY AND HEALTH

An access to clean water and uncontaminated soil is the precondition for the public health. Actions aimed at exploration, balancing and effective protection of groundwater – so that it can be rationally exploited by society, constitutes the basic task of the Polish Hydrogeological Survey.

It is the Institute's responsibility to limit any negative quantitative and qualitative changes of groundwater which are mainly allocated for consumption and to make sure that resources are managed properly.

Operational Strategy of the PGI-NRI 2010-2015,
Warsaw 2010

Monitoring of Groundwater Table and Outflow of Springs

Between 2009-2010, the measurements in the Groundwater Observation-Monitoring Network (GOMN) were continued which have been carrying out since 1974. Currently, the GOMN includes over 845 monitoring stations across the country, in locations representative for the evaluation of the conditions of groundwater bodies. Measurements of the groundwater level are taken once a week at 696 monitoring points in the second order hydrogeological stations and at 149 monitoring points in 41 first order hydrogeological stations on a daily basis.



Location of the observation points of the groundwater monitoring network in Poland

Some of the hydrogeological stations are equipped with automatic measuring apparatus and a system of data transmission which provides the results of measurements taken at 10-minute intervals. In 2009-2010, more than 180,000 manual measurements were taken in total, and above 60,000 automatic measurements generated. The results of the measurements and observations were verified and processed in accordance with the standard procedures as specified in the Regulation of the Minister of the Environment of 8 November 2008. Then, they were archived in the database of Groundwater Monitoring (GM) and published in the *Hydrogeological Yearbook* and in the *Quarterly Groundwater Information Bulletin*. To make sure that the PGIG-NRI monitoring conforms with the requirements of the Water Framework Directive, it is necessary to reorganize and extend the network. The target size of the network is a minimum of 1,200 monitoring stations deployed in a representative way all over Poland and evenly within individual groundwater bodies. At least 180 existing hydrogeological wells are to be adapted for the purpose of the testing and monitoring as well as a minimum of 153 new measurement points will be made. In the existing GOMN monitoring stations, the infrastructure is to be modernized and new measuring instruments purchased.

The quantitative monitoring is carried out as commissioned by the National Water Management Authority and financed by the National Fund for Environmental Protection and Water Management and the Budget.

Project Leader: Tomasz Gidziński, M.Sc.

Chemical State Monitoring and Underground Bodies Evaluation in River Basins

A continuous analysis and evaluation of the groundwater conditions with a view to protecting and improving the domestic water reserves is a key element of the implementation of the water policy. Monitoring of chemical state of groundwater is conducted in the area of 161 groundwater bodies. In 2009-2010, the results of operational monitoring carried out between 2008-2009 were worked out as well as samples of water were collected to be analyzed at 311 operational monitoring 2009 stations and at 781 diagnostic monitoring 2010 stations. Reports were drawn up on the evaluation of the groundwater pollution level in the areas especially exposed to the risk of contamination by nitrogen compounds of agricultural origin. Monitoring of the chemical conditions is conducted under a contract with the Chief Inspectorate for Environmental Protection and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Dr. Anna Kuczyńska



Diagram of automatic measurements of the groundwater tables (indicated violet) collated with the results manual measurements taken by field observers (indicated blue); a hydrogeological station I/546/2 Gdańsk Jasień

Groundwater Monitoring in Poland's Borderland

In the years 2009-2010, groundwater measurements and monitoring tests in the transboundary monitoring test networks were continued in the following parts of the borderland between Poland and EU member countries:

- the Federal Republic of Germany – within the borders of the Polish part of the Uznam island;
- the Czech Republic – in the area of the Intra-Sudetic Basin, near the Kudowa Depression, and along the state border, in the Silesian Province and Opole Province;
- in the borderland between Poland and Lithuania, with special focus on transboundary groundwater flows;
- in the borderland between Poland and Slovakia, and other countries outside the EU – in the borderland between Poland and Ukraine and the Republic of Belarus.

In 2010, the groundwater monitoring network in the borderland between Poland and the Kaliningrad District of the Russian Federation was launched.

Monitoring in the Poland's borderland is conducted as commissioned by the National Water Management Authority and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Tomasz Gidziński, M.Sc.

Groundwater Monitoring in Gdańsk and Sopot

The concept of groundwater condition and quality monitoring in Gdańsk and Sopot, developed and implemented by the PGI-NRI is an example of a complex approach to the issue of groundwater monitoring in large urban agglomerations. In this Project, separate monitoring systems are integrated into one coherent observation network, including all municipal and factory water intakes, connected with the national, regional and local networks. While selecting the location of monitoring stations, the specificity of the region that is characterized by a multi-layered aquifer system and the vicinity of the seacoast were taken into consideration as well as other important factors, such as, the geological structure, presence of large groundwater intakes, occurrence of hydro-geochemical anomalies and the existence of protected areas. For a cyclical measurement of groundwater level and quality, 288 observation wells and boreholes were selected. With a variable frequency, measurements of the water level are taken in them as well as chemical analyses made. The main purpose of the observation network being formed is to trace changes that take place in the groundwater environment and to propose actions which can guarantee that good quantity and quality of the water is maintained. The test results will be made available online for the inhabitants of the Gdańsk tri-city.

The Project was implemented as commissioned by the Gdańska Infrastruktura Wodociągowa i Kanalizacyjna Sp. z o.o. (Gdańsk Water Pipe and Sewerage Ltd.) and AQUA Sopot Sp. z o.o.

Project Leader: Zbigniew Kordalski, M.Sc. (Eng.)

Groundwater Local Monitoring in Mineral Raw Material Exploitation Areas

In order to organize and launch a groundwater monitoring system around operational open-pit mines (such as those producing energy raw materials and sulphur), large industrial enterprises and other establishments, the scale of hazard related to business activities was identified in 2009. In many areas, the impact of deposit exploitation on the groundwater chemistry and water table was demonstrated and thus it is necessary for the group of deposits and mines to be covered by an underground monitoring system. Objects that require thorough examination and analyses were indicated. They include Konin Lignite Mine S.A. at Kleczewo,

Adamów Lignite Mine S.A. at Turek, mines in the Upper Silesian Coal Basin (USCB) (with a selection made of the areas of active underground hard coal mining and those abandoned, but still drained hard coal mines,) and a hard coal mine Lubelski Węgiel *Bogdanka* S.A.

In 2010, the process of drawing up four monitoring programmes was started for the USCB coal mines, the *Bogdanka* mine and the *Konin* and *Adamów* lignite mines.

Also, an evaluation of the monitoring organization in the sulphur mining area of Tarnobrzeg was carried out.

The local monitoring is conducted under a contract with the National Water Management Authority and financed by the National Fund for Environmental Protection and Water Management.

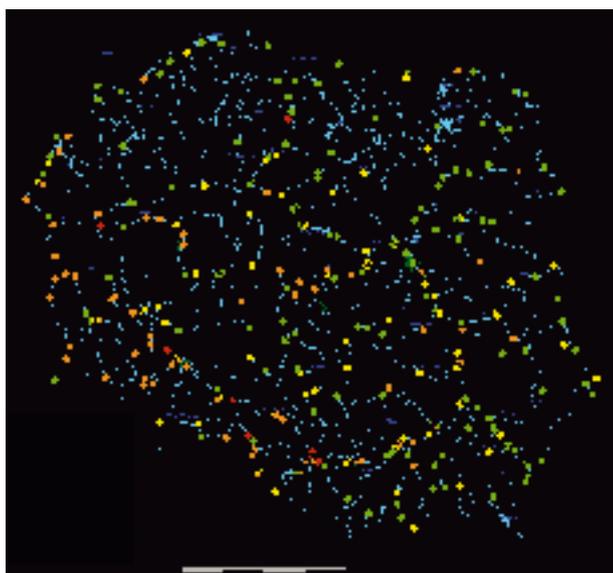
Project Leader: Dr. Bogusław Kazimierski

Monitoring of Bottom Deposits in Rivers and Lakes

In 450 samples of river and lake deposits which were taken in 2009 all over Poland, the contents of: Ag, As, Ba, Corg., Ca, Cd, Co, Cr, Cu, Fe, Hg, Mg, Mn, Ni, P, Pb, S, Sr, V, Zn and 7 PCB congeners, 17 chloroorganic pesticides, and 17 polycyclic aromatic hydrocarbons was determined.

The studies proved that high concentrations of potentially harmful elements lasted in the deposits of the rivers in which waste water is disposed of, directly or indirectly, from the non-ferrous metal ores and coal extractive and processing industries. Moreover, high concentrations of heavy metals were found in the deposits of the rivers to which insufficiently purified municipal and industrial waste waters from large urban and industrial centres are supplied, e.g. Łódź, and Wrocław. In 58% of the locations, there occur unpolluted river deposits that are characterized by low contents of trace elements, in 25% of them the deposits are poorly polluted; 8% of them are moderately polluted and in 9% of the locations tested polluted deposits were found.

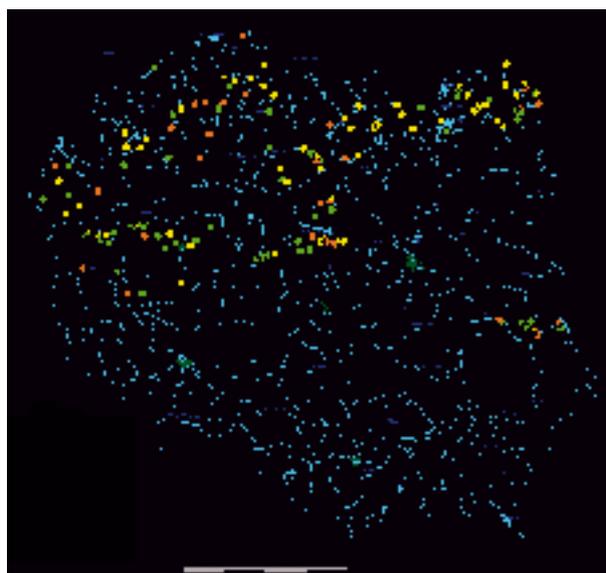
As regards lacustrine deposits, evidently increased contents of the elements Cd, Cu, Hg, Pb and Zn, were reported in lakes located in urban areas or their surroundings (e.g. Człuchowskie Lake, Trzesiecko Lake, Białe Augustowskie Lake, Wierzysko Lake), in the lakes used as recreational and tourist facilities (e.g. Jasię Lake, Kruszyńskie Lake) and in the lakes whose waters are parts of cooling systems of power stations, such as Pątnów and Konin (such as Goławskie Lake, Licheńskie Lake).



Hg – Mercury

Geochemical classification of river deposits, 2009

- Non polluted
- Poorly polluted
- Moderately polluted
- Polluted



Cd – Cadmium

Geochemical classification of lakes deposits, 2009

- Non polluted
- Poorly polluted
- Moderately polluted
- Polluted

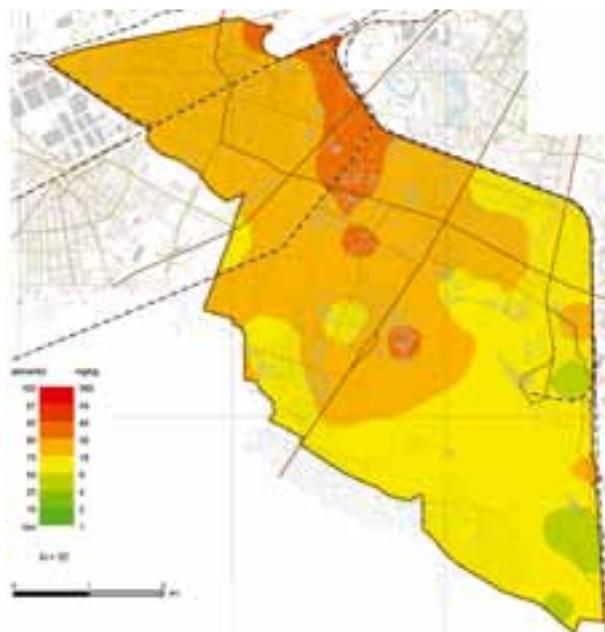
In 55% of the lakes, the deposits are not polluted, in 31% are poorly polluted, in 10% moderately polluted, and in 4% polluted deposits were found. The monitoring is conducted as commissioned by the Chief Inspectorate for Environmental Protection and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Prof. Izabela Bojakowska

Monitoring of Soils in Warsaw

Under a contract with the Włochy District of the Capital City of Warsaw, the PGI-NRI developed a program of soil monitoring in this district. Having traced the history of industrial development in the area of survey, some zones potentially contaminated with chemical compounds due to business activities were selected. Then it was planned to collect samples of soils from those areas for chemical analyses. The soil tests are designed to reach the depth of 0.30 metre, and in some cases, such as embankments, places of serious breakdowns, they will go deeper. On the basis of earlier studies, the PGI-NRI characterized the geochemical background of the soils. In the areas where anthropogenic anomalies were found, the need was indicated to carry out a thorough analysis of the concentrations of metals and organic pollutants.

Project Leader: Dr. Anna Pasieczna, PGI-NRI Associate Professor



Copper content in the surface layer (0.0-0.2 meter) of soils in the Włochy District of Warsaw

Groundwater resources and water-economic balance including groundwater-surface water interactions

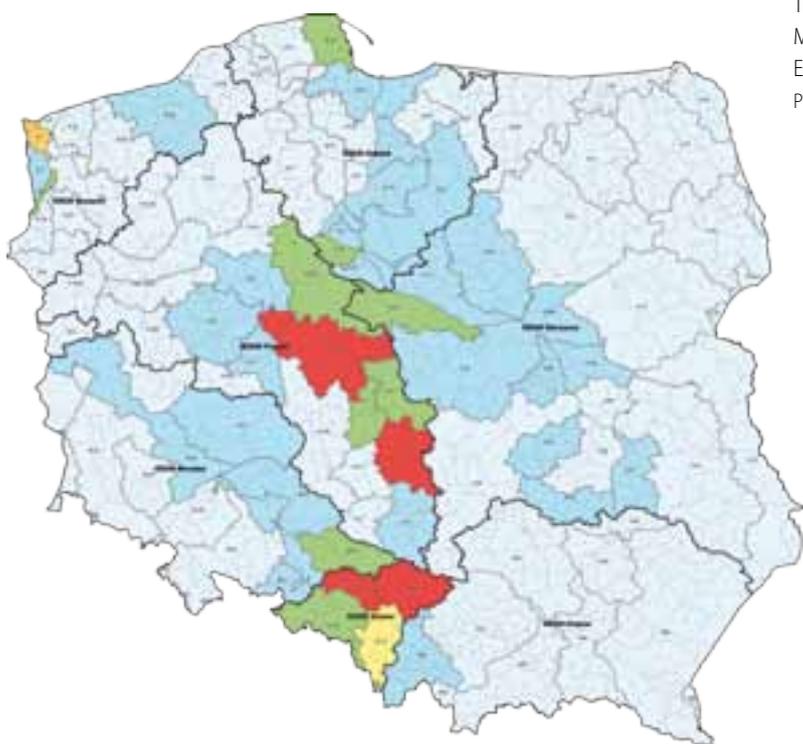
The percentage of the utilization rate of the groundwater resources of the hydrogeological system being subject to a balance was determined. At the same time, allowance was made for groundwater intake due to specialized use of water (i.e. that requires a water and legal permit) for collective water supplies to population as well as for industrial, agricultural purposes and drainage (the mining drainage systems in the Upper Silesian Coal Basin and in lignite mines were taken in consideration). The utilization rate of the resources of freshwater in the area subject to the balance was determined. It was included into one of seven classes of the state of reserves, defined by a specific interval α , whose spatial distribution is shown on the map.

In the predominant part of the areas of balance, which totally cover 90.4% of country's area, there can be found very high and high reserves of groundwater resources ($\alpha < 30\%$), medium size reserves ($30\% < \alpha < 60\%$) occur in 5.5% of the area, whereas low and very low reserves ($60\% < \alpha < 90\%$) cover 0.8% of the country's area. The risk of shortage of reserves ($\alpha > 90\%$) takes place in 3.3% of the country's area. Excessive depletion of groundwater resources was found in three regions connected with a lignite mining industry and in the area of the Upper Silesian Coal Basin – each of these needs individual treatment and a thorough analysis.

Groundwater reserves (disposable and prospective in total), according to the current status of exploration, determined for the whole country, are about 37.3 million cubic metres per day, i.e. around 13.6 cubic kilometres per year.

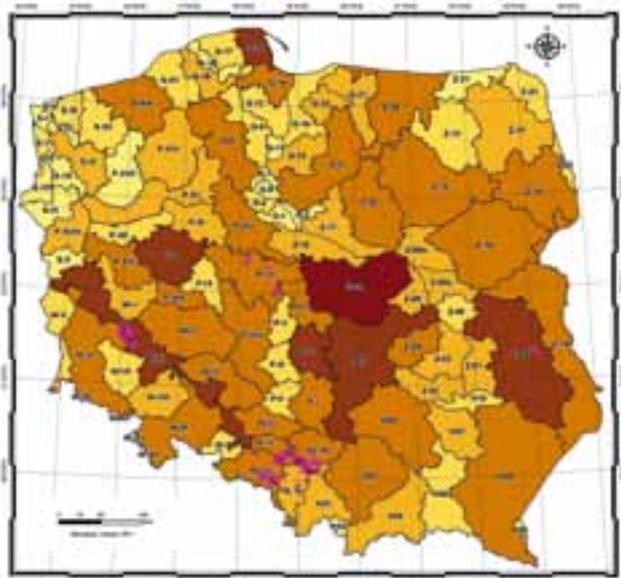
The Project is implemented as commissioned by the National Water Management Authority and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Elżbieta Przytuła, M.Sc.



Degree of the use of groundwater resources in determined economic areas

| α (%) |
|--------------|
| < 15 |
| 15 - 30 |
| 30 - 60 |
| 60 - 75 |
| 75 - 90 |
| 90 - 100 |
| > 100 |



Groundwater extraction from intakes (in thousand cubic metres per year)



Total groundwater registered extraction from intakes (as at 2009), interpreted in a division into areas of balance

Database of Groundwater Registered Intake

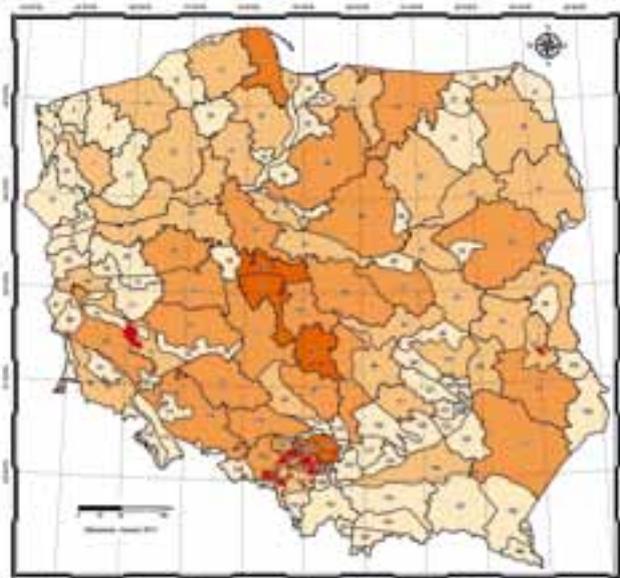
In the INTAKE base, data on the registered groundwater intake from over 18,000 intakes are collected. Information reported by users to the Marshal's Offices and related to the use of the environment, including for charges for groundwater consumption, constitutes the primary data. In 2010, current groundwater intake of 1,585 million cubic meters was documented and uploaded to the INTAKE database. Furthermore, the intake of above 910 million cubic meters, connected with mine waters collections, was documented. Information from the INTAKE database is used to prepare balance studies, in documentation assessments and computational models on a yearly basis. The number of records from the database made available was over 70,000 in 2010.

The Project is implemented as commissioned by the National Water Management Authority and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Piotr Gałkowski, M.Sc.

Groundwater Registered Intake in Groundwater Bodies

The value of registered intake is one of the main factors to be taken into consideration while making assessment of the quality of groundwater bodies. These values are to be determined and demonstrated every year so that the data from the entire six-year period can be taken into account in the subsequent groundwater evaluation in 161 groundwater bodies according to the Water Framework Directive. To develop or update the state of groundwater bodies is the task required by the standard procedures specified in the Regulation of the Minister of the Environment of 6 November 2008. An analysis of the data on water intake for all 161 groundwater bodies enables it to gather reliable information which makes it possible to conduct annual monitoring of the quantitative state of groundwater bodies through a control balance. The result of the work is a specification of groundwater registered intake in 161 groundwater bodies which is based on current data on the water consumption from the intakes supplying



Total groundwater registered extraction from intakes and in mine drainage systems (in thousand cubic metres per year)



Total groundwater registered extraction from intakes (as at 2009), interpreted in a division into groundwater bodies

water to society and industry as well as from drainage systems in mines. The final values were corrected on the basis of the experience of hydrologists and references to other vintage data, so that the values of the consumption represented a reference data for assessments and balances. The Project is implemented as commissioned by the National Water Management Authority and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Piotr Gałkowski, M.Sc.

Map of Total Annual Groundwater Registered Intake in Balance Areas at Scale of 1:50,000

The purpose of the determination of the total values of the registered groundwater intake for each area covered by the balance, together with a proper characteristic, is to present the distribution of the intake values in this country, with a division into balance units. The task is to be fulfilled, first of all, by carrying out an analysis of water consumption data stored in the INTAKES base, in combination with the information on layers representing: balance areas, deposit extensions, mine-fields and mining areas, areas of lowered water-bearing table due to the exploitation of intakes and mining drainage systems, archive data of consumption from the Polish Hydrogeological Survey, data on consumption in districts given by the Central Statistical Office of Poland or dislocation of active objects of the intakes of the Bank HYDRO. Thorough GIS analyses and all the above mentioned data form a basis for the value of water consumption in the balance areas to be determined. The final effect is the *GIS Map of Total Annual Groundwater Registered Intake in Balance Areas at Scale of 1:50,000*, the main purpose and application of which is to assist the groundwater management in river basins.

The Project is implemented as commissioned by the National Water Management Authority and financed by the National Fund for Environmental Protection and Water Management.

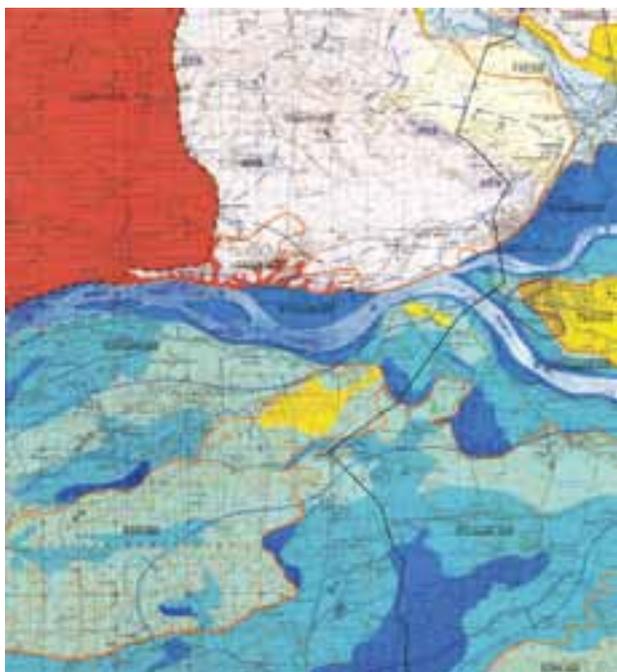
Project Leader: Krzysztof Majer, M.Sc.

Hydrogeological Map of Poland at the Scale of 1:50,000 *First Aquifer – Occurrence and Hydrodynamics (FA-OH)*

The realization of the next 150 sheets (the fourth tranche) of the information layers of the database GIS MHP 1:50,000 *First Aquifer – Occurrence and Hydrodynamics* was launched. The preparation of the FA-OH information layers includes hydrological identification and regionalization of the first, from the ground level, aquifer or a succession of aquifers which show good hydraulic communication and reach the total thickness of at least 2 meters, with an average retention of groundwater. Moreover, within the identified forms of FA occurrence the following is to be determined: hydrodynamics of the aquifer, with allowance made for hydraulic communication with surface water and ecosystems depending on surface water, depth of the FA top, form of natural groundwater discharge to the surface and anthropogenic changes of the aquifer having the scope which is essential to the conditions of land ecosystems and surface water. This information is necessary for the evaluation of the groundwater conditions in accordance with the provisions of the Water Framework Directive to forecast the risk of local flooding and pursue land development studies. After the fourth tranche is completed in August 2011, FA-OH information layers will be explored in 684 MHP sheets.

The Map is being constructed under a contract with the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Dr. Piotr Herbich



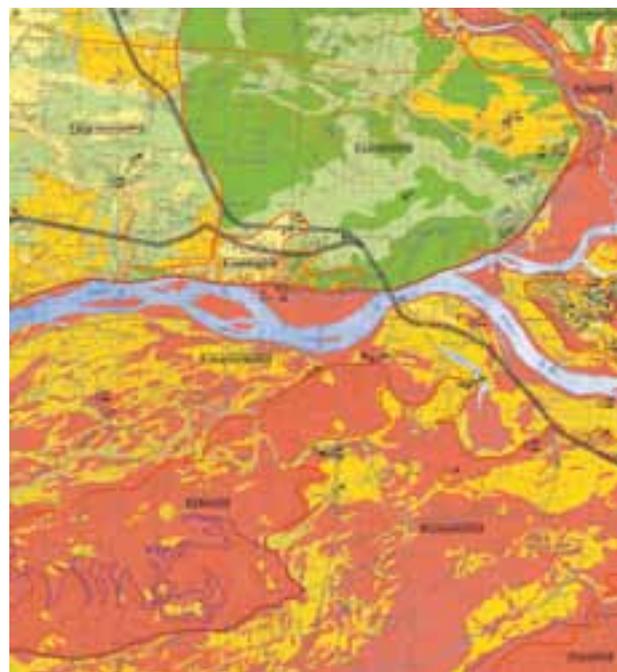
Hydrogeological Map of Poland at the Scale of 1:50,000 – First Aquifer – Occurrence and Hydrodynamics – the Modlin-Twierdza Sheet

Hydrogeological Map of Poland at the Scale of 1:50,000 *First Aquifer – Vulnerability to Pollution and Water Quality (FA-VQ)*

As part of the second tranche, 155 sheets of information layers of the database GIS MHP 1:50,000 FA-VQ were completed. The task is to be fulfilled due to the necessity of making an assessment of the quality of the shallow groundwater which is directly communicated with the surface water ecosystems and land ecosystems depending on the groundwater, including the special protection areas NATURA 2000. This is required by the provisions of the UE Directives and of the *Water Law*. An aquifer provides a basic source of provision of water to people in rural areas. Therefore, it is one of the objectives of the undertaking being embarked on to determine the degree of sensitivity of the aquifer (FA) to pollution, in particular caused by nitrogen compounds in the areas under anthropogenic pressure from agriculture and rural settlement. The task is being executed as based on the information layer of the base GIS 1:50,000 *First Aquifer – Occurrence and Hydrodynamics* and it continues to explore the characteristics of the aquifer. Vulnerability is to be determined on the basis of the MRT – Mean Residence Time of water in the vadose zone in soils and rocks. The quality of underground water is specified on the basis of a classification which is given in an adequate legal act in force at the moment a sheet is being prepared. Selected water quality physical-chemical indicators (pH, PEW, temp., SO_4 , Cl, NO_3 , NO_2 , NH_4) are presented point-wise on the map and in the form of a table. In addition, preliminary identification of the areas is established where waters were found to be polluted with nitrogen compounds $NO_3 > 50mg/l$ or where there is a risk of nitrate contamination $25 < NO_3 < 50mg/l$.

The map is being constructed as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Dr. Piotr Herbich



Hydrogeological Map of Poland at the Scale of 1:50,000 – First Aquifer – Sensitivity to Pollution – the Modlin-Twierdza Sheet

Hydrogeological Map of Poland at the Scale of 1:250,000

The purpose of the *Hydrogeological Map of Poland at the Scale of 1:250,000* is to present widely the hydrogeological, environmental and economical (anthropogenic) characteristics of the conditions of fresh groundwater occurrence within a scope and in a form which makes it possible to carry out survey analyses to serve the needs of planning and administering the groundwater management in the areas of river basins and water regions as well as making an initial analysis of local problems related to groundwater and its relations with the environment which are essential for water-economy regions. The map at a medium scale of 1:250,000, together with its GIS database, will be employed, to fulfil the tasks in compliance with the requirements of the Directive 2000/60/WE of the European Parliament and the Council of the European Union of 23 October 2000 which establishes the framework for the EU activities with respect to the water policy.

At Stage One of the project, organizational principles were laid down for the undertaking to be realized, a detailed concept of the thematic contents of the map, the scope and schedule of work as well as guidelines on the methodology of preparing the information layers and the form of their presentation.

The Project is being constructed as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Dr. Piotr Herbich

Bank of Waters Classified as Mineral Raw Materials

In the database, there is information collected on above 600 hydrogeological facilities where intake waters are classified as mineral raw materials or having similar physical-chemical characteristics.

Also, work of an exploratory nature is being carried out, including the calculation of the age and determining the origin of groundwater being exploited which is classified as mineral raw materials, on the basis of testing its isotope content, preparing documentation of unexploited springs constituting a natural therapeutic raw material as well as calculating the temperature of groundwater at deep boreholes on the basis of geophysical data. Determination of the isotopic content of water from 44 intakes was carried out. In addition, observations, field measurements and laboratory determination for 58 springs were made, 42 of which provide water of qualities similar to curative waters. For those springs, information cards and documentation materials were prepared. Temperatures of the groundwater occurring at deep aquifers for 30 deep boreholes were calculated. The compilation of the *Map of Management of Groundwater Classified as Mineral Raw Materials for the*

Pre-Cambrian and Paleozoic Platform Provinces at the scale of 1:500,000 was completed. At the same time, a website informing about the groundwater classified as mineral raw materials is being kept.

Also, a number of expert opinions and analyses of geological-economic conditioning related to the intake and exploitation of mineral and geothermal waters across the country were carried out. Such analyses are made to serve the needs of state and self-governing administration at various levels as well as being commissioned by business entities. In the years 2009-2010, assessments of this kind were made for the town of Prabuty and the commune of Koźminek.

The Project is being carried out under a contract with the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Agnieszka Felter, M.Sc.

Podhale Trough Thermal Waters – Age, Temperature, Recharge Area

With an up-to-date helium method and a method of determining the recharge temperature on the basis of atmospheric concentrations of inert gases Ne and Ar in the Podhale Trough groundwater being employed, it was possible to determine more accurately the age of the water and the character of flow in the thermal system. The Podhale Trough is the largest reservoir of renewable thermal waters in Poland, with temperatures of around 20°C near the catchment area and above 80°C deeper inside the unit.

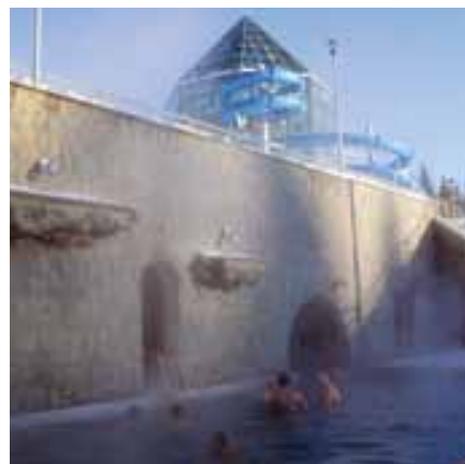
A significant age difference exists between the waters containing tritium in the southern part of the Podhale Trough and the waters in its north-east part that were probably recharged in a colder climate at the end of the last glaciation. The presence of a zone of very slow flows in the north-east part of the Trough can be caused only by the existence of faulting zones which constitute a strong barrier to horizontal flows. The reserves of water in this zone need special protection through limited exploitation and a possibly large proportion of return injection of water exploited.

The Podhale Trough thermal waters are used for heating and more and more frequently for recreation. Thorough exploration of the reserves and renewability of the thermal waters, with allowance made for their trans-boundary flow, are essential for the management of the waters in the entire system.

The Project was financed by the Ministry of Science and Higher Education.

Project Leader: Józef Chowanec, Ph.D. (Eng.), PGI-NRI Associate Professor

Leisure and Rehabilitation Centre at Bukowina Tatrzńska; a hydrogeological documentation of the thermal waters drawn up by the PGI-NRI
© Terma Bukowina Tatrzńska



Activities of the Team for Pollution Extension Investigations due to Incidental Events, Accidents or Catastrophes

It is within the responsibilities of the Polish Hydrological Survey to prepare and issue to the public administration organs warnings of dangerous phenomena taking place in groundwater recharge and intake zones. With this end in view, a team was set up to respond quickly to reports of disasters or pollution events. The team is to evaluate the nature and extent of pollution and take measures to identify its source and to take remedial measures. The operations carried through by the team are thought to identify potential hazards for the groundwater which arise due to events of a catastrophic character (which are taking place currently or happened in the past). Instruments of data analysis (GIS) and advanced tools of hydrodynamic modelling are used to perform the tasks. Tests of water samples collected during the team's operations are made by the PGI-NRI's certified laboratory.

Among the major exploratory-intervention operations undertaken between 2009-2010, the studies carried out in the area of the groundwater intake for the town of Borne Sulinowo and landfill site at the village of Choroń can be mentioned.

Project Leader: Rafał Janica, M.Sc.

Announcements, Prognoses and Warnings of the Hydrological Situation in Poland

One of the responsibilities of the Polish Hydrogeological Survey (PHS) is to prepare announcements of current hydrological situation, prognoses about hydrological situation and warnings of dangerous phenomena taking place in the groundwater recharge and intake zones. This information is passed on by the PHS to public administration organs. Prognoses are prepared as based on the evaluation of current hydrogeological situation and an analysis of long-term changes of groundwater levels, with allowance made for cyclical seasonal changes. Due to the direct relation between groundwater level and precipitation, two scenarios of the development of a situation are prepared in the prognoses depending on the meteorological phenomena predicted. Every year, four announcements and four prognoses are issued. In 2010, because of heavy rainfall and flood waves that took place in Poland in May and June, one warning was issued. The operations are being carried out as commissioned by the National Water Management Authority and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Piotr Wesołowski, M.Sc. (announcements), Agnieszka Kowalczyk, M.Sc. (prognoses and warnings)

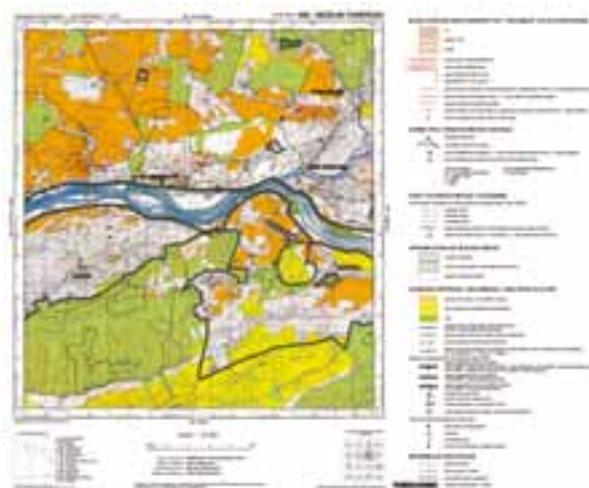
Geoenvironmental Map of Poland at the Scale of 1:50,000 (GenvMP)

The *Geoenvironmental Map of Poland at the Scale of 1:50:000* constitutes a basic, long-standing project related to geoenvironmental mapping which is carried out by the PIG-NRI. The map consists of two charts (A and B). Chart A contains four types of information: *Mineral Deposits* (measured mineral resources, prospects, perspectives and forecasts about mineral resources occurrences, mining, processing), *Waters* (surface waters, groundwater, coastal), *Subsoil Conditions* (foundation conditions, protected soils, woodland) and *Environment Protection* (nature and landscape protection, cultural heritage protection).

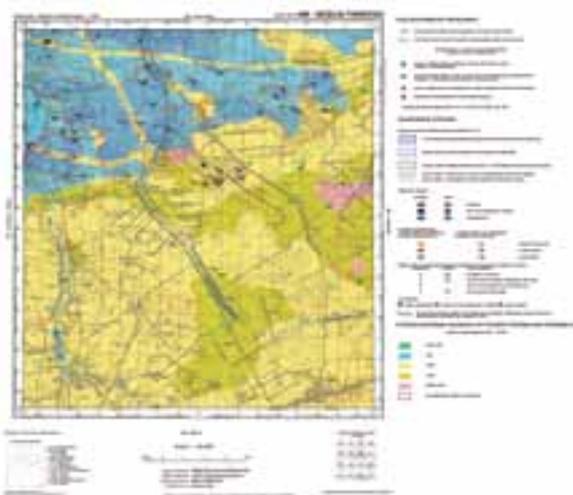
Chart B – *Hazards to Land Surface* contains two thematic layers: *Geochemical Conditions of the Environment* and *Waste Disposal*. The first layer shows the locations of sampling along with information on possible contamination of the soils with heavy metals, radioactive elements, organic compounds, and also on contamination of water sediments with heavy

metals, radon emanation rates, together with a classification of soils and water sediments. The *Waste Disposal* layer shows areas predisposed to localizing landfill sites in them, on the condition that the requirements of the natural environment protection and legal restrictions are satisfied. In order to identify environmentally burdensome or potentially burdensome objects to the ground and water environment that cause changes to the chemical state of this environment, in 2009, a concept was invented of making a layer of *Anthropopression – Objects Burdensome to the Environment*. It consists information about the type of pollution or potential pollution that results from the operations of those objects. In 2010, collection of the data started in the provinces of: Lubuskie, West Pomerania, Pomerania, Warmińsko-Mazurskie, Łódź, Lublin and Podkarpackie. It is planned to cover the whole Poland's territory with this thematic layer by the end of 2012. Work on a normative layer, *Mineral Raw Materials*, which presents the prospects and forecasts about the development of exploitation of mineral raw materials was continued in 2010. The project is expected to be completed (for ten provinces) in mid- 2012. GenvMP is useful when land development and management conditions are being established, particularly while the locations of objects extremely burdensome to the environment and human health and objects that can deteriorate the state of the environment are being looked into. The map is in the course of construction under a contract with the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Dr. Małgorzata Sikorska-Maykowska



Geoenvironmental Map of Poland (Plate A) – the Modlin-Twierdza Sheet



Geoenvironmental Map of Poland (Plate B) – the Modlin-Twierdza Sheet

Protecting a Toxic Waste Dump of Red Mud Type

Since 1980s toxic solid waste of *red mud* type, generated in the process of the production of aluminum hydroxide as well as other industrial and common waste, has been stored at a quarry *Górka*, near the town of Trzebinia. The waste dump covered an area of 4.7 hectares. The amount of waste collected in the quarry was estimated at around 600,000 cubic metres. As a result of a clogging of the side drift that drained waters out of the waste dump, the excavation was flooded and an underground water flow was activated and Jurassic and Triassic aquifers contaminated. As commissioned by the National Fund for Environmental Protection and Water Management a consortium consisted of: the Polish

Geological Institute – National Research Institute (the leader), Scotec Polska Sp. z o.o and Przedsiębiorstwo Geologiczne Sp. z o.o developed a concept of rehabilitation of the waste dump. The Project provides for relocation of some parts of waste in the excavation, creating a cut to reveal the quarry walls in the area of groundwater discharge and making a tight insulation of the waste surface. Thanks to those operations and the implementation of some hydrological solutions in the form of canals and drainage ditches, the waters flowing to the quarry will be carried away from the object to avoid further contamination of aquifers.

Project Leader: Dr. Tomasz Nałęcz



Landfill site in the *Górka* quarry near the Town of Trzebinia – state as at April 2008



Side drift which drains effluence waters out of the landfill site



Layout of the landfill after rehabilitation; green colour means the area to be covered by an insulating layer

Methodology of the Registration of Inoperative and Abandoned Tailings Neutralization Objects that Negatively Affect the Environment

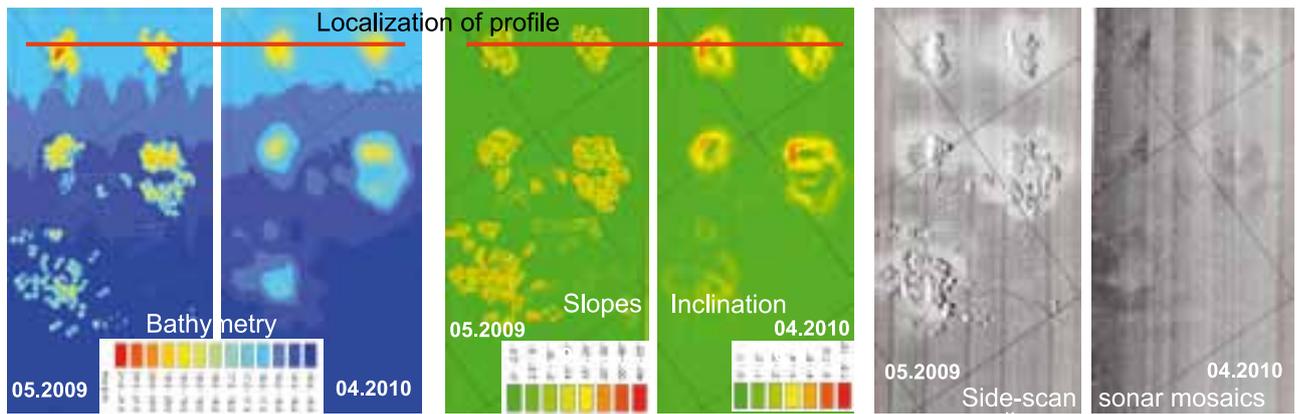
Methodology was established of carrying out a registration of closed and abandoned objects, neutralization of mine tailings – mine waste dumps, mine slag heaps and sedimentation ponds in which in the 19th century and up till 1990s waste was deposited without any protection. Technologies of mineral raw materials exploitation and processing were characterized as well as types of waste generated and its potential impact on the environment was described. Waste was analyzed from mining and energy raw materials processing industries (hard coal, lignite, oil and natural gas), metallic raw materials (ores of: zinc and lead, copper, iron, nickel, tin and cobalt, arsenic, chromium, uranium, polymetallic and gold) and chemical raw materials (sulphur, barite, phosphorites, gypsum and anhydrite). The methodology developed has uniform criteria of the evaluation of the negative impact of waste dumps on the environment and human and animal health as well as enables it to indicate objects which pose the biggest threat. The objects selected will be subject to a thorough analysis, including the physical and chemical aspect of their influence on individual components of the environment and human health. This methodology is to be applied across the country to carry out a registration of closed and abandoned objects of tailings neutralization. The Project was implemented as commissioned by the Chief Inspectorate for Environmental Protection and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Dr. Joanna Fajfer

Monitoring of the Natural Environment In and Around the National Repository of Radioactive Waste (NRRW) at Rózan

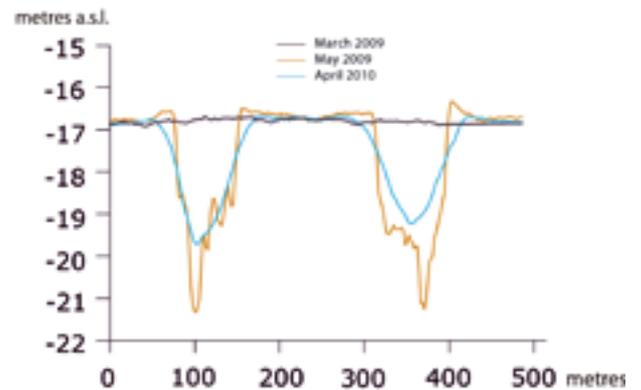
Between 2009-2010, an annual monitoring of the repository of low level and intermediate level waste at Rózan which is exploited by the Radioactive Waste Neutralization Unit – State Enterprise in Świerk was carried out. Meteorological data were analyzed, hydrological conditions determined and the quality of the groundwater evaluated. In benchmark points, measurements of volumetric soil moisture were taken and water samples collected from some selected piezometers, in which the content of tritium and total beta radioactivity were determined. On the basis of the results obtained, the state of selected elements of the environment within and around the NRRW was evaluated. The above mentioned tests are to be carried out to meet the obligatory requirements for further exploitation of the repository.

Project Leader: Dr. Zbigniew Frankowski



Bathymetry, gradients of slopes and sonar mosaics of the northern part of the testing ground carried out directly after the extraction process and eleven months after the exploitation was over

Changes in the profiles in the excavations after a stationary method extraction >



Environmental Impact of Sand Extraction from the Baltic Seabed

The PGI-NRI, the Marine Fisheries Institute and the Maritime Institute implemented together a research project, *the Impact of Sand Exploitation from the Southern Baltic Seabed on the Seabed Structure and Meio- and Macrobenthos Communities*. It was carried out as part of an international programme, COST 638 *Investigating and managing the impacts of marine sand and gravel extraction and use*.

The work was performed in a testing ground having dimensions of 2 x 0.5 kilometers, located to the NE of Rozewie, at a depth of 15-17 metres b.s.l. The testing ground was divided into two parts: a northern one, in which sand extraction was carried out and a southern, a reference one. Three research voyages were made: before the sand extraction started, just after it finished and eleven months later.

After the extraction was completed, four excavations were documented of a diameter of 80-120 meters, the depth of from 3 to 4.5 metres and with the gradient of slopes of 30-55°, that were formed as a result of the exploitation of around 58,500 cubic meters of sand using stationary method. Also, some irregular grooves were found at the depth of 0.3-0.5 meter and hollows generated due to the extraction of about 52,500 cubic meters of sand through a trailer suction dragging method and uncontrolled stationary method.

A year later, complete disappearance of the extraction marks was found and partial levelling of the excavations after the stationary extraction method. Some slides on the slopes of the excavations were the main processes responsible for levelling the excavations after the stationary extraction. In the exploited areas, soon after the sand extraction was finished, a significant reduction of number of species or complete extinction of zoobenthos was found. However, after twelve months, the abundance of fauna was much greater than before the extraction. It was found that recolonization processes take place relatively quick, mainly due to the fact that the bottom invertebrates are well adapted to a dynamic habitat.

The experience acquired during the Project's implementation will enable it to formulate recommendations on the methodology of sand extraction and monitoring its impact on the marine environment.

Project Leader: Dr. Szymon Uścińowicz, the PGI-NRI, Associate Professor

Rehabilitation and Revitalization of Areas After Industrial Peat Exploitation

Exploitation of peat is usually carried out in a large area of several hundred hectares and takes several dozen years. When the extraction is completed, the excavation represents a mosaic of land of different water contents, geochemical properties and landform features where there occur many ecosystems at different stages of development. After many experiments were performed, a methodology was developed of simple tests, mostly geochemical, which are useful in determining the features of a peatland essential for future rehabilitation. With this methodology employed, it will be possible to choose a suitable means of land rehabilitation, and wherever it is possible, renaturalization of the ecosystem of high peat bog.

The Project was financed by the Ministry of Science and Higher Education.

Project Leader: Leszek Jurys, M.Sc. (Eng.)



Renaturalized part of the Rucianka peat mine

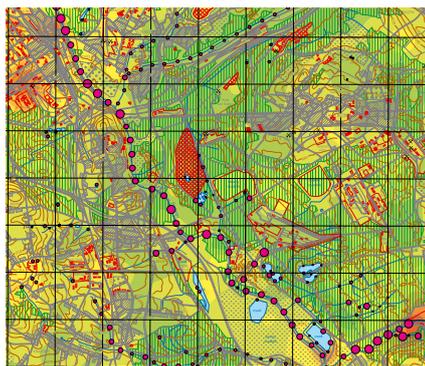
Analyses of Environmental Samples – Laboratory Tests

The Central Chemical Laboratory of the PGI-NRI is one of the largest laboratories in this country. It has a certificate PCA No AB 283, confirming that the requirements of the standard PN-EN ISO/IEC 17025: 2005 Ap1:2007 concerning competences of research and calibration laboratories are satisfied. The laboratory is accredited in chemical analysis and testing physical properties of water, waste, soils, grounds, sediments, environmental and geological samples and plant materials. The scope of the accreditation covers determination of around 400 qualities both in liquid and solid samples. Analyses are carried out in accordance with 33 test procedures.

Certificate No AB 283 ← by the Polish Centre for Accreditation

The laboratory is equipped with up-to-date apparatus, manufactured by leading world producers, which enables it to determine contents of elements (spectrometer UV-VIS, AAS, XRF, ICP-OES i ICP-MS), to analyze physical-chemical parameters of soils, deposits and waters (pH-meters, conductometers, spectrophotometers) and organic compounds (chromatographs HPLC, GC, GC-MS, spectrometres FT-IR, coulomats). In 2009-2010, 691,298 determinations were made on 56,817 samples.

Laboratory Head: prof. Izabela Bojakowska



Mercury in soils (0.0-0.3 metre) and in bottom deposits; the Detailed Geochemical Map of the Upper Silesia - the Myslowice Sheet



ICP – OES (inductively coupled plasma optical emission spectrometry (ICP-OES), and CAP 6500 DUO, Thermo-Scientific



Gas chromatograph with detector and dual mass spectrometer GC-MS/MS, 7890A-7000A Agilent Technologies (USA)

Detailed Geochemical Map of the Upper Silesia at the Scale of 1:25,000

Since 1996, the PGI-NRI has been implementing a project which is aimed at mapping the chemical conditions of soils, water sediments and surface waters in the Upper Silesia and in adjacent areas. Between 2009-2010, the following sheets were constructed: *Katowice, Myslowice, Bieruń Stary* and *Imielin* as well as original versions of the sheets of *Dąbrowa Górnicza, Strzemieszyce, Jaworzno* and *Libiąż*. The atlas of each sheet contains monoelement geochemical maps of surface soils (0.0–0.3 metre), soils from the depth of 0.8 to 1.0 metre, sediments of water bodies and surface waters, accompanied by a geological map and land use maps. The explanations contain tables of statistical parameters of elements and descriptions of their anomalies.

The maps are intended to support regional and local activities in the field of environmental protection and spatial planning, including preparations of the studies of conditioning and trends in spatial management as well as giving opinions concerning drafts of local land development plans. They are useful in geological mapping and making assessment of a deposit potential, carrying out procedures of granting decisions about environmental conditioning and water and legal permits.

The Project is being implemented under a contract with the Minister of the Environment and is financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Dr. Anna Pasieczna, PGI-NRI Associate Professor

Migration and Accumulation of Potentially Harmful Elements in the Wieprz River's Basin

In the area of the Wieprz River's drainage basin, the chemistry of the soils of flood plains, the bottom deposits and the waters of the Wieprz River and its tributaries were tested. An increased content of trace elements in the river sediments accumulated below larger towns was noticed. It was found that from the town of Łęczna to the town of Dęblin, and along the section from Serniki to Sułoszyn in particular, the sediments are contaminated with cadmium. Moreover, high concentrations of heavy metals were found in the bottom sediments of the Bystrzyca River which collects waste waters from Lublin. An increased content of strontium in the sediments is conditioned by the lithology of the river basin.

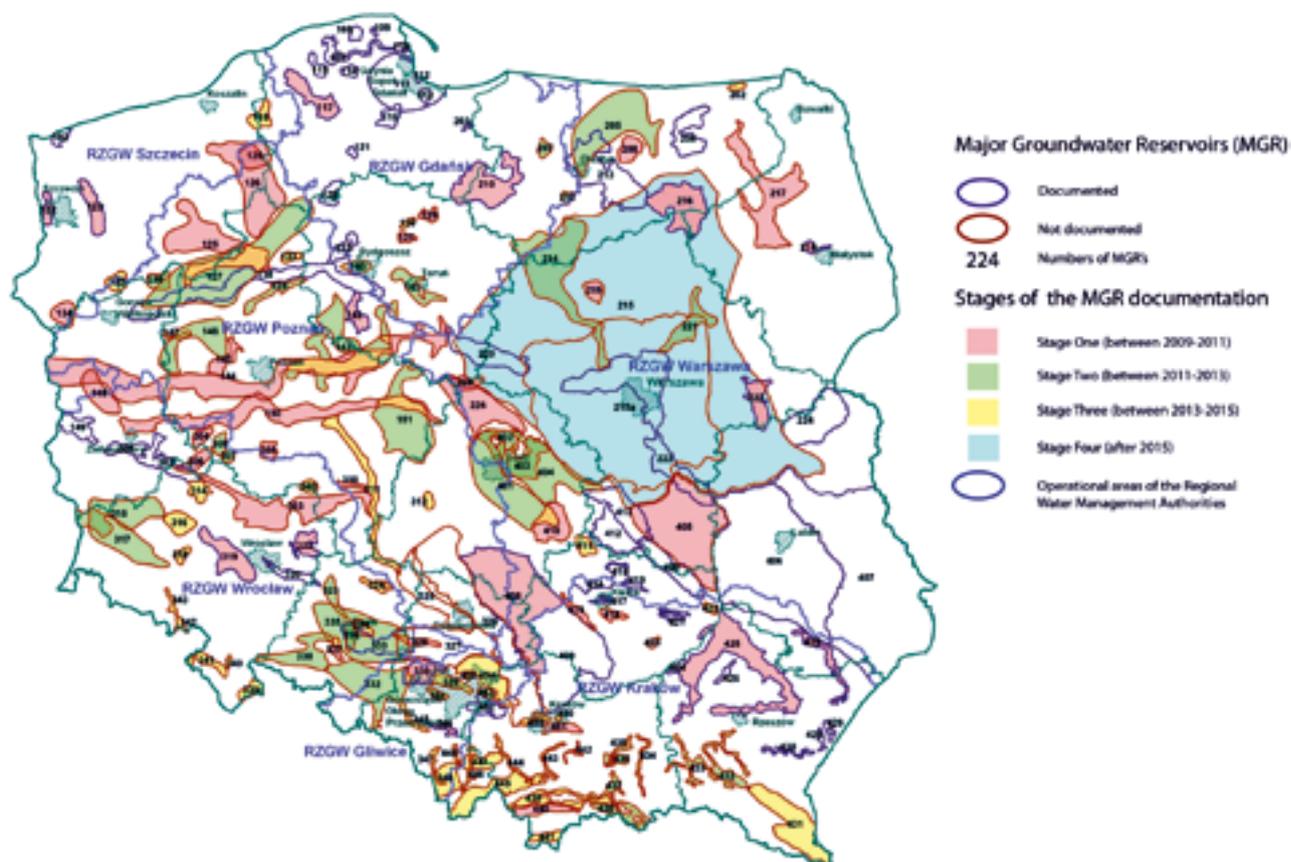
In the soils of the Wieprz River's flood plain, it was found that permissible concentrations of heavy metals in the lower course of the river below Łęczna were exceeded and increased content of Cd, Cr, Cu, Pb, Sn and Zn were registered, in the upper course of the river, from Szczepieszyn to Ujazdów there were increased contents of Cu, Pb, Zn, Sn and Hg.

In the Wieprz River waters, along the course of the river, an increase in the concentration of Na, K, Cl⁻ and SO₄²⁻ was discovered, together with increased content of Ca and Sr. Above normal contents of elements were also found in the waters of some tributaries of the Wieprz River, such as the Bystrzyca River (Co, Cu, Mo, Pb, Cd, Zn), the Świnka River (Ba) and the Siennica River (Ba, Co, Ca, Fe, Mn, K, Na, Mg, P).

The Project was financed by the Ministry of Science and Higher Education.

Project Leader: Prof. Izabela Bojakowska

Protected Areas of the Groundwater Main Reservoirs (GMR)



This Project, *the Implementation of the Geological Documentation Programmes Specifying Hydrogeological Conditions in Connection with Establishing Protected Areas of the Groundwater Main Reservoirs for Water Planning and Management in the River Basin Areas*, is being realized as commissioned by the National Water Management Authority and financed by the National Fund for Environmental Protection and Water Management. This undertaking, which is planned for the years 2009-2015, is aimed at documenting hydrogeological conditions, due to the establishment of protected areas for 101 Groundwater Main Reservoirs that have not been documented so far, and carrying out a pilot reambulation of the existing hydrological documentation for 15 reservoirs. Within the framework of the GMR documentation Project, their protected areas are determined, i.e. selected parts of the GMR recharge zone, where actions should be taken, in the form of bans, orders and restrictions on using the land, aimed at protecting the quality and reserves of the groundwater. This will result in documentation specifying hydrological conditions, in connection with the GMR protected areas being established as well as maps of protected areas together with some recommendations on the rules of management resulting from the hydrogeological conditioning and the existing local land development. The results obtained will be used by the Regional Water Management Authorities in the process of the implementation of the protected areas project and for the protection of quantity and quality of the groundwater reserves in these territories. The PGI-NRI is the general contractor of the entire Project and prepares hydrological documentation for 5 of the 101 GMRs.

The arrangements contained in the hydrogeological documentation for individual groundwater reservoirs will form a basis for formally establishing their protected areas which is a key element of the development and implementation, by the National Water Management Authority and the Regional Water Management Authorities, of the programmes of water management in areas of river basins to ensure good quality of potable water for the population. This satisfies the requirements specified for the member states of the European Union in the Directive 2000/60/WE of the European Parliament and the Council of the European Union of 23 October 2000 which establishes the framework of the activities taken by the EU with respect to water policy (the so called Water Framework Directive) as well as the Directive 2006/118/EC of the European Parliament and of the Council of the European Union 2006/118/WE of 12 December 2006 on the protection of groundwater against pollution and deterioration. A separate, and essential, task fulfilled by the PGI-NRI is to collect and unify the work performed and setting up an up-to-date GIS database of the Groundwater Main Reservoirs. With such a database, it will be easy to access the results of work for both local administration units, who should use them while performing their statutory tasks, and for society, providing information related to the availability and requirements of protection for the most valuable reserves of groundwater in the country.

Project Leader: Dr. Józef Mikołajków



GEOINFORMATION

The Institute is the main depository of the Polish geological information. It is our intention to make it available to the government and self-government administration, to businesses as well as pupils, students and every citizen who would like to know more about geology. Information is collected and made available according to the highest national and international standards and requirements.

Further facilitating the access to the geological information mainly through the Internet and its updating on a constant basis is the main challenge with respect to geoinformation.

Operational Strategy of the PGI-NRI 2010-2015,
Warsaw 2010

GDANSK

The Central Geological Archive (CGA)

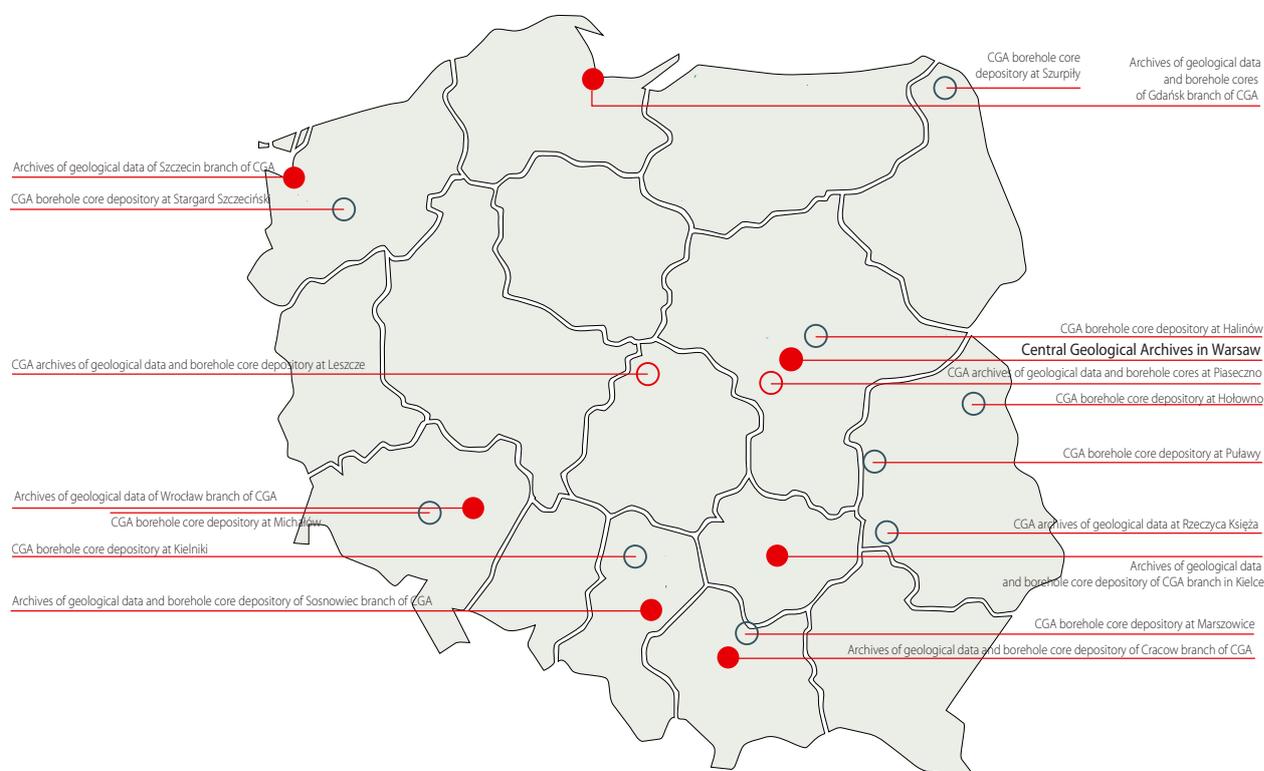
Keeping the Central Geological Archive is one of the tasks of the Polish Geological Survey. The CGA collects, secures and makes geological, hydro-geological and geophysical materials, maps and borehole cores available. The Archive, apart from its seat in Warsaw, has its branches in the Institute's all regional branches. Borehole cores are stored in the archive of cores and geological samples to be found in eight locations in the country: Halinów, Hołowno, Kielniki, Leszcze, Michałów, Piaseczno, Puławy, Szurpiły and in the regional branches.

In 2010, on the premises of the Borehole Core Archive at the village of Halinów, near Warsaw, the construction of a storehouse for the archive of geological documents was started. The construction project is being carried out as subsidized by the Ministry of Science and Higher Education. The investment is to be completed by the end of 2011. Also, some efforts have been made in order to raise funds for the construction of storages to collect borehole cores, including a new borehole cores storage at the village of Kielniki. These actions result from the intensification of the drilling work across Poland.

Head of the CGA: Prof. Stanisław Speczik

The PGI-NRI archives' assets as at 31 December 2010:

➔ **165,513** folders with borehole cards
233,886 text and cartographic studies
282,258 sheets of maps
619,682 boxes with cores from **3,654** boreholes



Integrated System of Spatial Geological Information IKAR

The system contains key elements of the infrastructure of spatial information related to geology, including the IKAR geoportal and catalogue of geological metadata. The IKAR Project is aimed at providing an easier access to the spatial geological information stored in the PGI-NRI, through its standardization and harmonization. By the implementation of this Project, service networks in accordance with the international standards (ISO, OGC) and the requirements of the Directive INSPIRE were initialized. The system includes: Catalogue Service for Web which makes geological metadata available as well as browsing services, i.e. map browsers compatible with the standard WMS (Web Map Service). The catalogue service makes information available on more than 3,000 geological data sets and about series of spatial data sets, including geological maps at the scales of 1:50,000-1:1,000 000.

The map browsers make the service of browsing of a dozen of maps available and they make it possible to browse maps which are made available, in compliance with the WMS standard, by other providers. The first stage of the Project was completed between 2006-2009 as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management. Project Leader: Waldemar Gogolek, M.Sc.

Central Geological Database CGDB

<http://baza.pgi.gov.pl>

The Central Geological Database is the largest collection of digital geological data in Poland. The data are collected in seven interconnected subsystems: *Reports, Boreholes, Drill Cores, Well-log Data, Survey Sites, Analyses, Geological Collections*.

CGDB ←

is the largest collection of digital geological data in Poland

As at the end of 2010, the information stored in the CGDB included, among others:

- **880,000** geological documentations and studies
- **140,000** boreholes
- **54,000** collections and geological specimens
- **11,000** locations of 2D and 3D seismic profiles
- **2,000,000** geophysical tests and surveys

atlas.pgi.gov.pl/). Among others, a geographic browser was made available that illustrates the effect of the work related to the compilation of the *Atlas Geological-Engineering Atlas of Rybnik - Jastrzębie Zdrój – Żory Agglomeration*.

The CGDB is kept as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

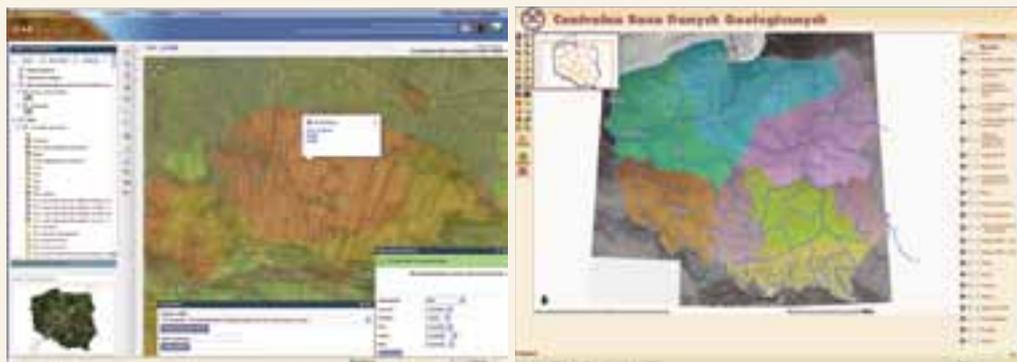
Project Leader: Magdalena Jakóbczak, M.Sc.

Central Bank of Hydrogeological Data (CBHD HYDRO)

The Central Bank of Hydrogeological Data forms a basis in which hydrogeological data are collected about intakes of fresh groundwater and hydrological objects that are included in it – springs and exploitation, exploratory and observation wells. The subject area of the base enables it to fast get information on the current state of the hydrological exploration of a given region of this country. The data are obtained, collected and stored in seven local databases by the personnel of Regional Banks of Hydrogeological Data (RBHD) and then sent to the Central Bank of Hydrogeological Data which is an all-Polish database.

Totally, between 2009-2010, in the CBHD, information about more than

→ PGI-NRI keeps above **20** databases



The application of the subsystem, *Boreholes* (<http://otwory.pgi.gov.pl>), rendered to public use makes available, among others, detailed information about stratigraphic and lithologic profiles, geophysical surveys and borehole cores. The profile browser, which is a component of this application, shows the data of a borehole selected by the user in a graphic form. Using the *Flash/Flex* technology significantly increases the speed of accessing data and adds to the attraction of the information presented.

The *CBDG Portal* has been expanded. It is a platform of a wide access to the PGI-NRI's assets (<http://geoportal.pgi.gov.pl>). This universal solution organizes and provides a safe access to many applications, both on the Internet and in the PGI-NRI's intranet. Owing to the advanced technology of authentication and the up-to-date applications, it is possible to accurately manage the rights of access to the all collected data sets that are stored in the corporate database. This platform is used by contractors of major projects run by the PGI-NRI, such as *Midas*, *SOPO*, *Boreholes* and others.

Cooperation with the PGI-NRI's various research units bears fruits in the form of subsequent applications being launched that serve other groups of data, just as in case of geological-engineering atlases ([2,800 hydrogeological objects was coded. At the same time, data on 2,900 new hydrogeological objects were uploaded to the database and 60 objects were removed from it, as they had been duplicated during the conversion of the data to the Oracle system. Field updating of the data was carried out for 1,200 objects. At present, the CBHD's information assets include above 136,291 hydrogeological objects registered in the database. Furthermore, between 2009-2010, 570 requests were fulfilled for making the information stored in the Bank HYDRO available, related to about more than 490,000 hydrological objects.](http://</p></div><div data-bbox=)

Project Leader: Szymon Forst, M.Sc.

System of Management and Protection of Polish Mineral Raw Materials MIDAS

MIDAS constitutes a database in which since 1988, information on documented mineral deposits in Poland has been collected on a continuous basis. It contains geological, cartographic and administrative data on individual deposits. Currently, there are data about 14,114 mineral deposits, among others: 288,722 changes in the state of resources, 25,303 deposit contours, mining areas and mining protective areas,

387,851 contour points. Each year, the database increases by information about around 900 new mineral deposits. Nowadays, the database is being modernized, and its text version has been made available on the website: <http://geoportal.pgi.gov.pl/portal/page/portal/MIDASGIS>. Also, the MIDAS system forms a basis for an annual publication: *The Report on Mineral Reserves/Resources and Groundwater Resources in Poland*. Furthermore, the information contained in the system is arranged in the form of reports which are designed for realization of cartographic studies carried out by the PGI-NRI, and mainly for the sheets of the *Geoenvironmental Map of Poland at the Scale of 1:50,000*. Information from the MIDAS system is used for preparation of numerous expert opinions and studies of deposit which are commissioned by governmental and self-government administration bodies and both domestic and foreign business entities. Among others, assessments of geological information value, evaluations of deposit values (as expertises for courts) are carried out as well as analytical studies for entire raw material industries.

The MIDAS database is run as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

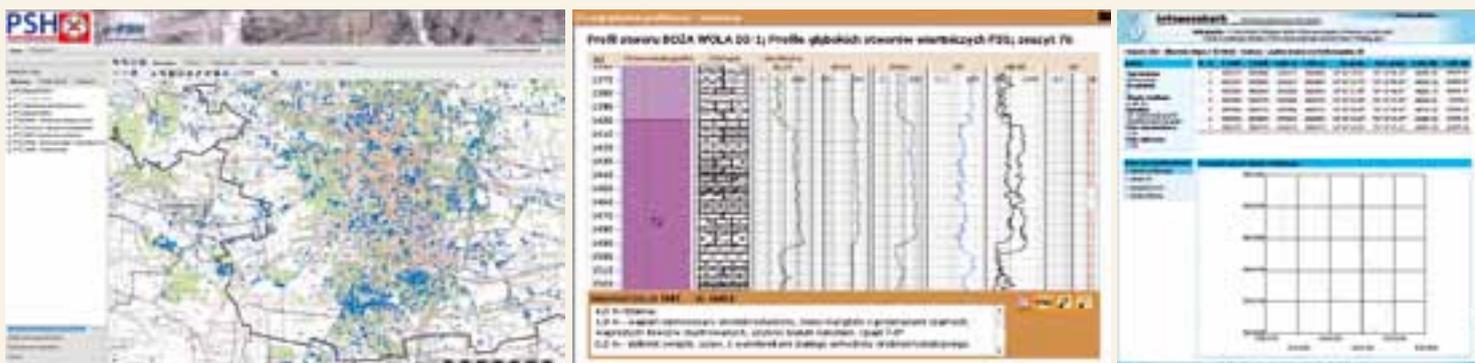
Project Leader: Marcin Szufficki, M.Sc.

Management of Mineral Raw Materials (MMRM)

The MMRM module is one of the MIDAS system modules which replaced the previous PRICESMIN system set up in 1993. The MMRM module is made up of two elements. The first of them includes the data about mineral raw materials trade turnover in Poland (volume, value and directions of exports and imports of mineral raw materials) and forms a basis for preparation of an annual chapter: *Exports and Imports of Mineral Raw Materials* in the *Report on Mineral Reserves/Resources and Groundwater Resources in Poland*. The other part contains data about the world management of selected mineral raw materials – energy, metallic, chemical, and rock mineral deposits with respect to: resources, production, consumption as well as prices in the world markets. This information, together with other data contained in the MIDAS system make it possible to carry out analytical studies related to the management of mineral raw materials, economics of deposits, analyses of demand and supply, and, first of all, the prices of mineral raw materials in international trade and the share of the Polish raw material industry in the world exports and imports.

The MMRM module is run as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Marcin Szufficki, M.Sc.



Register of Mining Areas

The Register has been kept by the PGI-NRI since mid-1995 as one of the responsibilities of the Polish Geological Survey. Mining areas are registered on a current basis in books for individual basic mineral deposits, groups of basic mineral deposits and common mineral deposits, in accordance with the territorial division of the country. The register contains 9,061 mining areas, 5,673 of whom represent currently existing areas. These figures do not reflect changes and transformations within concessions already in existence. For a few years, the data collected in the Register related to mining areas (together with graphic data) are uploaded to a digital database as an integral part of the MIDAS database. Owing to this fact, the Register is available for everyone interested, also on the PGI-NRI website. The Register's assets are used chiefly by government of self-governmental bodies, among others, to draft local development plans, by companies that undertake studies related to the natural environment and by individual customers, including users of deposits and owners of real estate. The Register of Mining Areas is kept as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Marek Napieraj, M.Sc.

INFOGEOKARB Database

The Database is designed to provide information on the geological information rights of property concerning mineral deposits and hydrogeological objects. It supports the System of Management and Protection of Polish Mineral Raw Materials MIDAS, the Central Geological Database and the Central Hydrogeological Data Bank (Bank HYDRO). Into the INFOGEOKARB system, data are uploaded on documents, the scope and costs of geological projects implemented, the history of documentation of objects as well as about proprietary rights to the information contained in individual geological documents. As at 31 Dec 2010, the Database contained data about possessive rights to geological information included in 153,823 documents (129,493 hydrogeological documents and 24,330 documents related to deposits). Between 2009-2010, the costs of preparing 6,211 deposit documentations were determined, 4,756 new deposit documentations and 15,889 new hydrogeological documents were uploaded to the system.

The INFOGEOKARB Database is kept as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Tadeusz Smakowski, M.Sc. (Eng)

The PGI-NRI used in the OneGeology Project, the *Geological Map of Poland at the Scale 1:1,000,000,000* and took part in the implementation and testing the GeoSciML standard of geological data exchange as well as in the work on technical and semantic harmonization of geological data. Major assets of the Polish geological cartography were described with the use of multilingual meta data located in the metadata catalogue of the *OneGeology-Europe Project*.

The Project was financed by European Funds and the Ministry of Science and Higher Education.

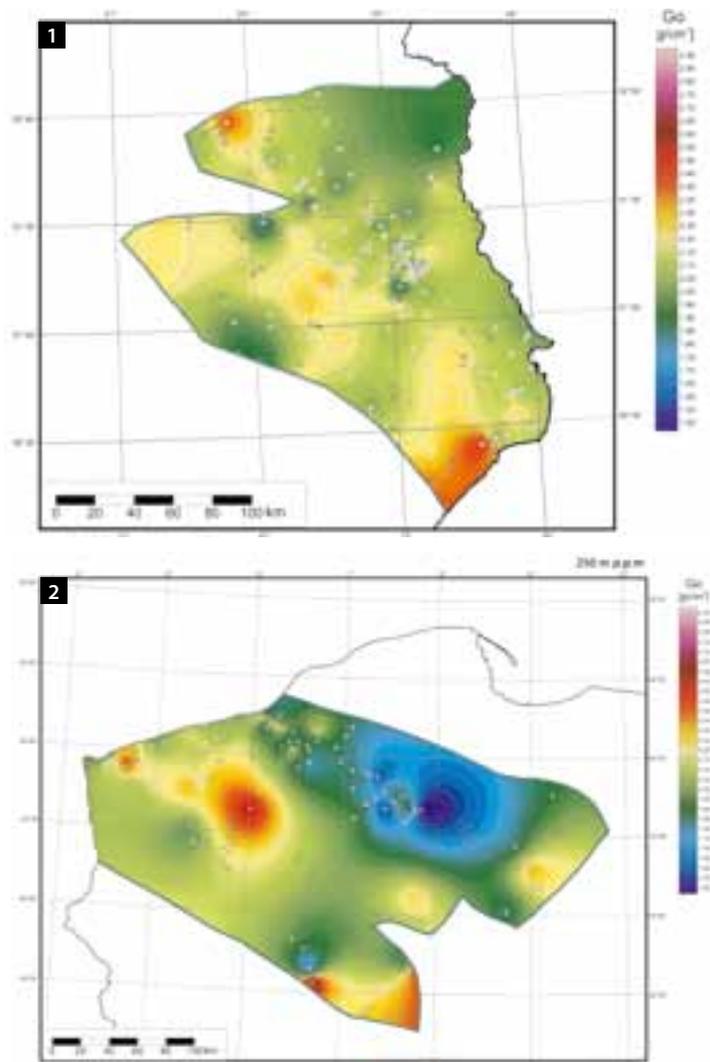
Project Leader: Dr. Urszula Stępień

Model of Density Distribution of Main Geological Units in Poland

Within the framework of the Project, archival results of density measurements in the major geological units in this country were worked out. They were presented in the form of a density database, included into the Central Geological Database (CGDB). In incomplete density profiles, the gaps were made up with estimated values (mostly on the basis of depth relations determined, but also the information from boreholes having similar lithostratigraphic profiles). All the depth data were referenced to the sea level which enables it to quickly construct maps, e.g. density maps at a selected depth level. The knowledge of the levels of potentially high density contrasts between adjacent rock centres is of special importance for gravimetric interpretation. Maps of such contrasts can be easily constructed for any area. The density database constitutes a valuable tool while exploring the geological structure of this country and prospecting for mineral raw materials as well as for environmental protection.

The Project was implemented as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Dr. Olga Rosowiecka



1. Lublin Province; a map of the average volumetric density of Cretaceous deposits
2. Pomerania; a map of volumetric density of horizontal shear, the level of 250 metres b.s.l.

Geological Library

The Geological Library collects and makes available publications on geosciences and related fields. It works out *The Geological Bibliography of Poland* on a systematic basis and works together with the American Geological Institute (AGI) with respect to compiling GeoRef bibliography and exchanges the PGI-NRI publications. It cooperates with the libraries in the regional branches of the PGI-NRI. With above 260 research centres (including 40 centres in Poland) and geological surveys in 60 countries, it exchanges publications and cartographic studies of the Institute.

The Library's book collection, between 2009-2010, increased by 2,336 volumes, and also 913 titles of periodicals were acquired. Now, its collection includes 170,613 volumes of non-serial publications (books and editorial series) 64,259 volumes of serial publications (periodicals). In the years 2009-2010, the reading rooms of the Libraries (Warsaw + Branches) were visited by above 12,000 people. To readers from outside the Institute, about 9,000 publications were lent, and more than 16,500 items were made available on the spot. The Libraries in the Institute's regional Branches continued to cooperate with the Warsaw Library with respect to creating a common catalogue to be kept in the ALEPH system. The assets of the Library's main catalogue, built on the basis of bibliographic data converted from the CDS/ISIS programme, as at the end of 2010, amounted to 21,982 records. Since June 2008, the catalogue has been available on-line.

Head of the Geological Library: Joanna Kacprzak, M.Sc.

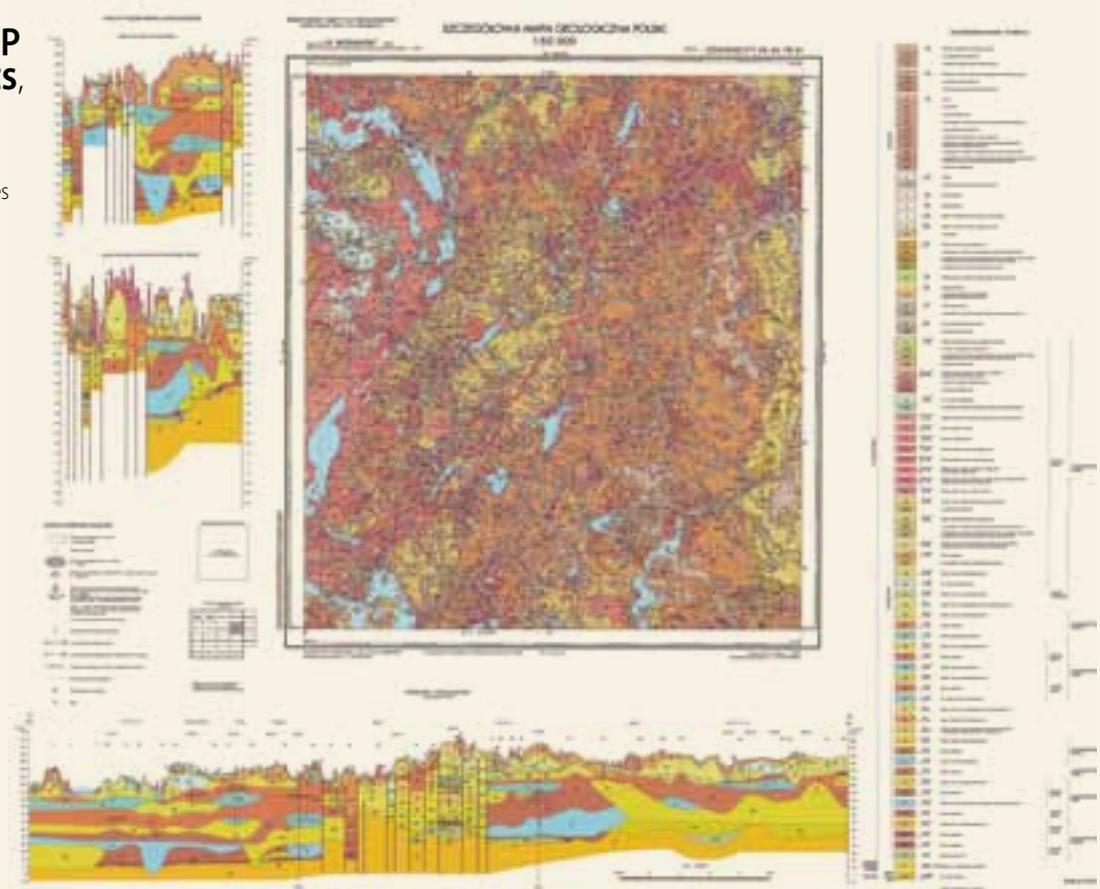


Reading Room of the Geological Library in Warsaw

→ key projects

Detailed Geological Map of Poland at the Scale of 1:50,000 (DGMP)

→ The entire edition of **DGMP** comprises **1,069 sheets**, each of whom covers the area of around **300-330** square kilometres



Detailed Geological Map of Poland at the scale of 1:50,000, the Dzwierzuty Sheet

A series map, the *Detailed Geological Map of Poland at the Scale of 1:50,000* is a basic geological map which comprehensively presents the geological structure, together with geomorphology, stratigraphy, petrography, tectonics and also the origin of deposits. It is being realized for the whole country. The DGMP constitutes a compendium of the information of the geological structure of individual areas and is a basic source of geological information. With the information presented on the map, it is possible, among others, to indicate the occurrence of mineral raw materials deposits, and also areas at risk of mass movements. The DGMP forms a basis for compilations of thematic and geological monographs and regional studies. In 2009, an original study of the last 72 sheets of the DGMP was completed. In the same year, also original studies of 32 sheets from the area of the Sudety Mts. were completed, and this way the whole area of the Lower Silesia was covered by a basic geological map at the scale 1:50,000.

The DGMP edition was started in the 1950s. Since then, the requirements to be satisfied by such a study have significantly increased, and therefore the sheets that were compiled long ago are subject to gradual reambulation. Up till now, 68 sheets of the DGMP have been reambulated.

The originally prepared sheets, previously made, are currently being edited (factual and technical editing of the maps and texts), digitalized and prepared to be available both in the form of printouts of maps and explanations and maps in a vector version. In 2009, the 5th stage of those studies was completed which comprised 140 sheets. The DGMP is being constructed as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

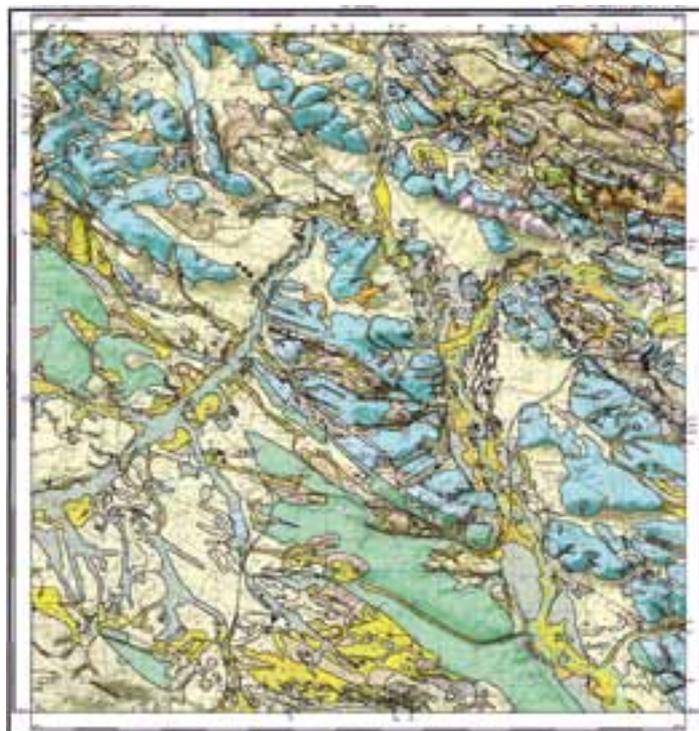
Project Leader: Dr. Wojciech Morawski, PGI-NRI Associate Professor

Lithogenetic Map of Poland at the Scale of 1:50,000 (LMP)

In 2009, the first stage of the constructing of the *Lithogenetic Map of Poland at the Scale of 1:50,000* was completed. The LMP is made through digital processing of the *Detailed Geological Map of Poland at the Scale of 1:50,000*. The LMP shows, in an accessible way, the lithology and origin of the deposits occurring on the land surface and selected geodynamical and hydrogeological phenomena. It is used in geological, raw materials, geological-engineering studies and in environmental protection and spatial planning. Within the framework of the first stage of the LMP compilation, 400 sheets in original version, a data base being a part the Central Geological Database, technical and informatic documentation of the LMP database and 400 sheets in a digital form available on the PGI-NRI server were made. At the second stage of the project (2010-2013), 300 sheets of the LMP will be completed.

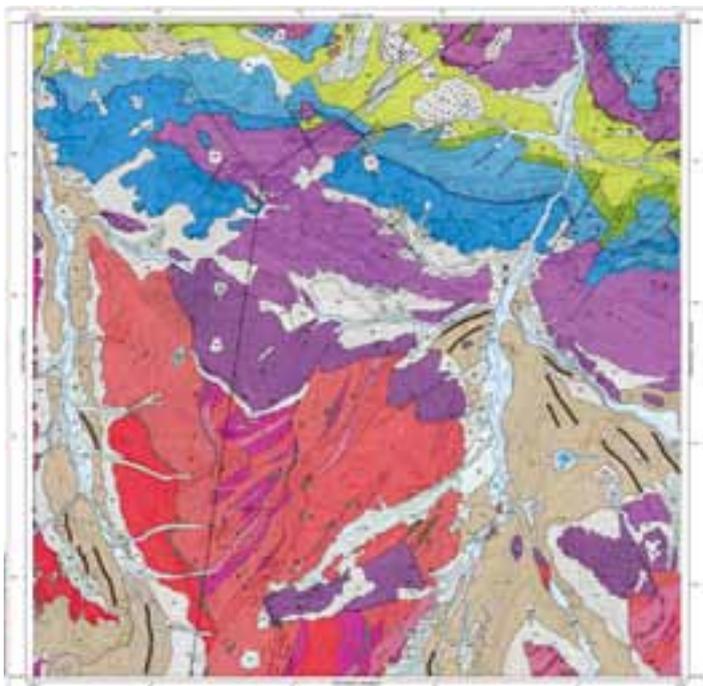
The LMP Project is being pursued as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Dr. Marcin Żarski



Lithogenetic Map of Poland at the Scale of 1:50,000; a fragment of the Chęciny Sheet

➔ The whole edition of the **DGMT** consists of **25 sheets** and covers the area of the Tatra Mountains on the Polish side together with transboundary areas on the Slovak side



Detailed Geological Map of the Tatra Mountains (DGMT) at the Scale of 1:10,000; a fragment of the Schronisko Ornak (Ornak Mountain Hostel) Sheet

Detailed Geological Map of the Tatra Mountains at the Scale of 1:10,000 (DGMT)

In the years 2009-2010, work was continued on the preparation of the subsequent sheets of the DGMT. The entire edition (25 sheets) is to cover the area of the Tatras on the Polish side, along with the borderland on the Slovak side, and is going to be completed in 2015. The border sheets are being prepared together with the Slovak Geological Survey. The map is constructed using a numerical method in ArcGIS 9.3.1 environment. In this software, the geobase scheme of spatial data and the methodology of vectorization and edition of the DGMT at the scale of 1:10,000 were developed. The spatial data geobase enables it to fast edit and modify spatial data. As part of the second stage of the Project (2008-2011), field geological mapping and geophysical exploration as well as verification of the geological units and limits with the members of the Slovak Geological Survey are carried out. Nine sheets of the DGMT are being compiled: *Magura Witowska, Gubałówka, Góra Furkaska, Schronisko Ornak, Jarząbczy Wierch, Czerwone Wierchy II, Małe Ciche, Brzegi, Schronisko Murowaniec*.

The DGMT is being prepared as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Prof. Krystyna Piotrowska

GEOTOURISM

For the development of geotourism, a cooperation of scientist and leaders of local communities is essential. Without the synergy of action, no geotourist undertaking – a geopark, geological educational trail, geotouristic site – does not have a chance to be fully successful. We can offer all our geological knowledge and experience in designing and organizing geotouristic projects of various type.

Operational Strategy of the PGI-NRI 2010-2015,
Warsaw 2010

Geopark Góra Św. Anny (St. Ann's Hill Geopark)

A study, *St. Ann's Hill Geopark – Documentation and Proposal of Its Protection*, carried out by the PGI-NRI formed a basis for the St. Ann's Hill to be granted the rank of a National Geopark by the Ministry of the Environment. In a relatively small area (29 sq. kilometers) there occur numerous exposures in which interesting fossils, various types of rocks, characteristic correlation levels, thermal metamorphism signs, thermal columnar joint, continuous and discontinuous deformations and the effects of the activities of volcanoes, atmospheric waters (surface and underground karst) and glaciers can be found. In the area of the St. Ann's Hill, there exist a lot of archeological, culture and natural sites. Here, one can find a well developed non-commercial accommodation and touristic-information infrastructure.

The Project was completed as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Paweł Woźniak, M.Sc.

**On the 1st of June 2010 ←
the St. Ann's Hill Geopark
was awarded the status
of a national geopark**



Ligocka Góra – outcrops of Middle Triassic carbonate rocks



Terebratula lumachelle – a fragment of a rock slab made mostly of brachiopods and oysters



Rock slabs with *Rhizocorallium* – feeding ground canals formed in originally soft bottom sediment by marine invertebrates



Geological reserve, *Skalki Piekło pod Nieklaniem* (the Hell Klippens near Nieklani)

Dolina Kamiennej Geopark

The *Dolina Kamiennej* Geopark to be built is going to cover the area from the sources of a river near the village of Nieklani, up to the village of Bałtów. Dolina Kamiennej is characterized by exceptional geological attractions that include exposures of Jurassic and Triassic rocks with footprints of reptiles and Jurassic dinosaurs among them. Also, from under the Mesozoic cover, outcrops of Devonian rocks emerge.

To the geosite network of the Geopark planned more than twenty geological objects were included, among them a reserve *Skalki Piekło pod Nieklaniem*, a reserve *Gagaty Sołtykowskie*, where footprints, nests and bone remains of dinosaurs were documented as well as an abandoned quarry, *Dół Opacie*. This is an area where numerous objects of material culture can be found, with a valuable post-industrial landscape, closely connected with natural reserves (rock and mineral raw materials).

The Project is financed by the Ministry of Science and Higher Education. Project Leader: Dr. Anna Mader

Małopolska Vistula River Ravine Geopark

The implementation of a project, *the Geological-Mining-Environmental Conditions of Creating the Małopolska Vistula River Ravine Geopark (from Zazwichto to Puławy)* was started. Field inventory and verification on either side of the Vistula River ravine for selection of the most attractive geosites were carried out. The field inventory followed a review of vintage materials. The area from Góra Puławska to the surroundings of the villages of Solec, Tarłów and Ożarów was covered by a survey of potential geotopes. The Project is being implemented as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Dr. Wojciech Brochwicz-Lewiński

Geological Educational and Tourist Trail in the Kraków-Częstochowa Jurassic Upland

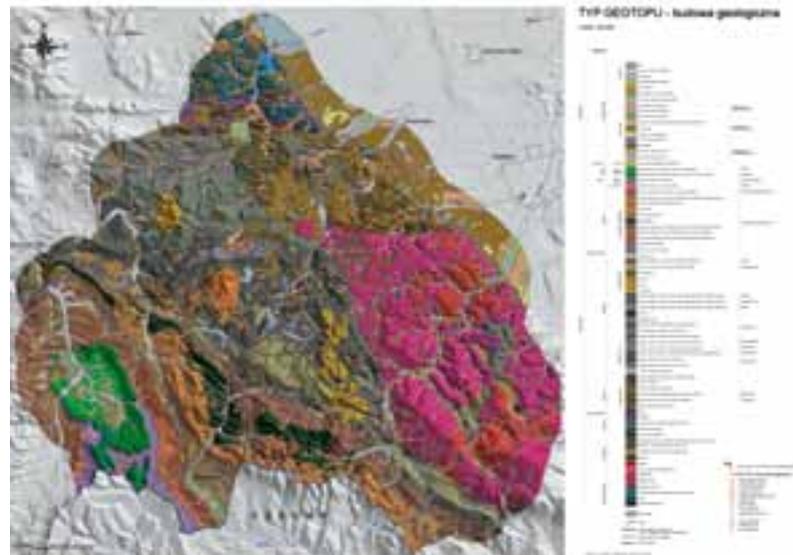
The PGI-NRI drafted a project of a geological educational and tourist trail in *the Land of White Rocks*, in the area of the Towarne Mts., in the commune of Olsztyn (the Silesian Province). The route of the trail was mapped out and eight information display-boards were prepared. The trails was opened on 11 July 2010, during the Second Jurassic Geological Picnic.



Geological educational and tourist trail, *W krainie białych skał (In the Land of White Rocks)*

Geosites for the Needs of Geotourist Area near Wałbrzych

Documentations of geological geosites that satisfy the geotope criteria for the area of Wałbrzych was made. They contain information about the methodology of the identification and valorization of geosites, basic data on the survey area, physiography, management and protection of the



Wałbrzych Geotourist Area; a geological map of the area against the background of the land relief

natural environment and geological structure presented in the context of the evaluation of geodiversity of the area. Three thematic maps at the scale of 1:50,000, illustrating the above mentioned issues were compiled as based on GIS data. The most attractive areas in terms of geotouristic management were indicated. The geotouristic area proposed was called the *Wałbrzych Geotourist Area*.

The study was carried out as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

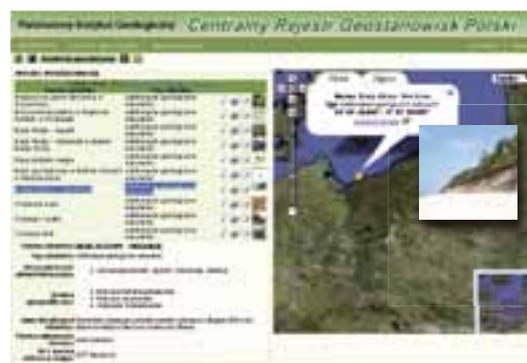
Project Leader: Jacek Koźma, M.Sc.

Central Register of Geosites www.geostanowiska.pl

The Central Register of Geosites is a service on scientific themes for the general public, provided by the PGI-NRI, as part of the Central Geological Database's activities. The following can be ranked among geosites: individual outcrops, groups of outcrops, klippens, erratic boulders, karst and weathering forms and other geological objects important from a point of view of geodiversity preserving.

In the Register, information is collected on the most valuable objects of inanimate nature in Poland. Data about 1,500 items were gathered in the Register at the end of 2010. The data set is supported by an online application that makes it possible to retrieve information according to the criteria selected, e.g. according to the administrative region (province), type or rank of a geolocality. The user has an access to the basic information on a given object, from geological characteristics, photo gallery and explanatory illustrations to the bibliography of an object.

Project Leader: Dr. Anna Piątkowska



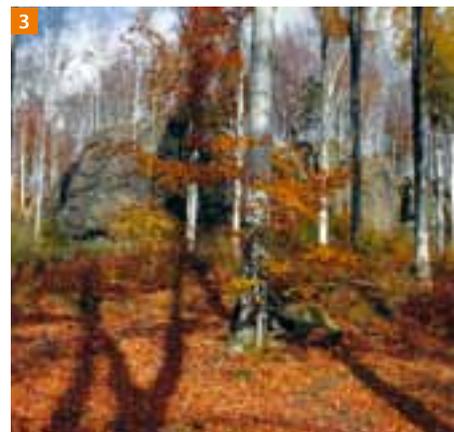
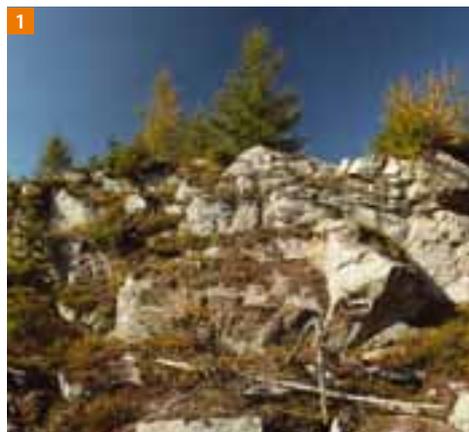
The Sudetic Geostrada – Geological and Tourist Guide

The Project, which is being implemented together with the Czech Geological Survey under the Operational Programme of Transboundary Cooperation the Czech Republic – the Republic of Poland for the years 2007-2013, is aimed at promotion of a tourist-recreational trail from the town of Bogatynia to the town of Opava. A geological-tourist guide to the whole route will be prepared in three language versions: Polish, Czech and English as well as in the form of folders, bilingual information boards and a website. It is going to be the first route of recreation to go through the Polish and Czech Sudetes at the same time. By the end of 2011, projects of the information boards will have been drafted (10 boards on the Polish side and 11 on the Czech one) on which information will be presented about the geological structure and geological-tourist objects.

The Project is partly subsidized by the European Regional Development Fund.

Project Leader: Dr. Andrzej Stachowiak

1. Białe Skąły, Grzbiet Lasocki (White Rocks. The Lasocki Ridge)
2. Solna Jama (Salty Hollow) (the Bystrzyckie Mts.) – a cave in granular limestone on the slopes of Czerniec Mount near the village of Gniewoszów
3. Spękane Skąły (Cracky Rocks) at the village of Jarkowice; an open cut of Lower Carboniferous fanglomerates



Exotic Klippens in the Flysch Carpathians – Age, Origin, and Location in Sedimentary Succession

The studies of 'klippens' covered the zone of Waschberg – a region of Ernatbrunn in Austria, the edge zone of the Outer Carpathians in the Czech Republic, Poland, Ukraine and Romania.

In the Czech Republic, the studies included the deposits of the Ždanice Unit – the north-east part of the Waschberg zone, the deposits of the edge part of the Ždanice-Subsilesian Unit, the edge part of the Silesian Unit and the edge part of the Magura Unit.

In Poland, in the area of Andrychów (Roczyny, Targanice, Pańska Góra, Inwałd), the profiles of the external part of the Skole Unit were the subject of the studies. This region, with the beautiful outcrops of the Andrychów klippens, is a potential area for a geological educational trail to be created in future. Here, the presence of Miocene fauna in the basement of the klippens was proved. In the areas of Bachowice, Spytkowice, Woźniki, Witanowice and Leśna, profiles of the edge part of the Subsilesian Unit and Silesian Unit were found. From the Kruhel area to Ukraine (Utoropy), the structure of the edge part of the Boryslav-Pokuttia Unit was explored. The Klippens in the area of Kruhel Wielki lie on the Lower Miocene chaotic deposits (similar to the Worotyckie Beds

of the Boryslav-Pokuttia Unit from the Ukrainian Carpathians). Olistolites of different age deposits originated probably from the profiles of the Skole Unit, the Subsilesian Unit or the Boryslav-Pokuttia Unit can be found in them. At present, there are also older (e.g. Devonian) exotic klippens representing the deposits of the platform basement. In Romania, the youngest parts of the profile of the edge faults unit were found. On the basis of microfossils, it was proved that the youngest formations of the unit are from the early Miocene.

The Project was financed by the Ministry of Science and Higher Education.

Project Leader: Prof. Barbara Olszewska

Geological-Tourists Maps in Selected National Parks

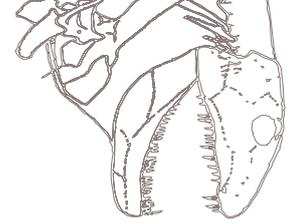
In 2010, geological-tourist maps were constructed for the following national parks – the Babiogóra Park, the Białowieża Park, the Polesie Park, the Roztocze Park and the Wigry Park.

The studies printed at the scales from 1:13,000 to 1:30,000, have the form of a traditional folding map with illustrated descriptive part and an interactive map on a CD. The descriptive part contains general information of a park, about its natural values, geological structure, land relief and descriptions of geological sites along with illustrations as well as tourist information.

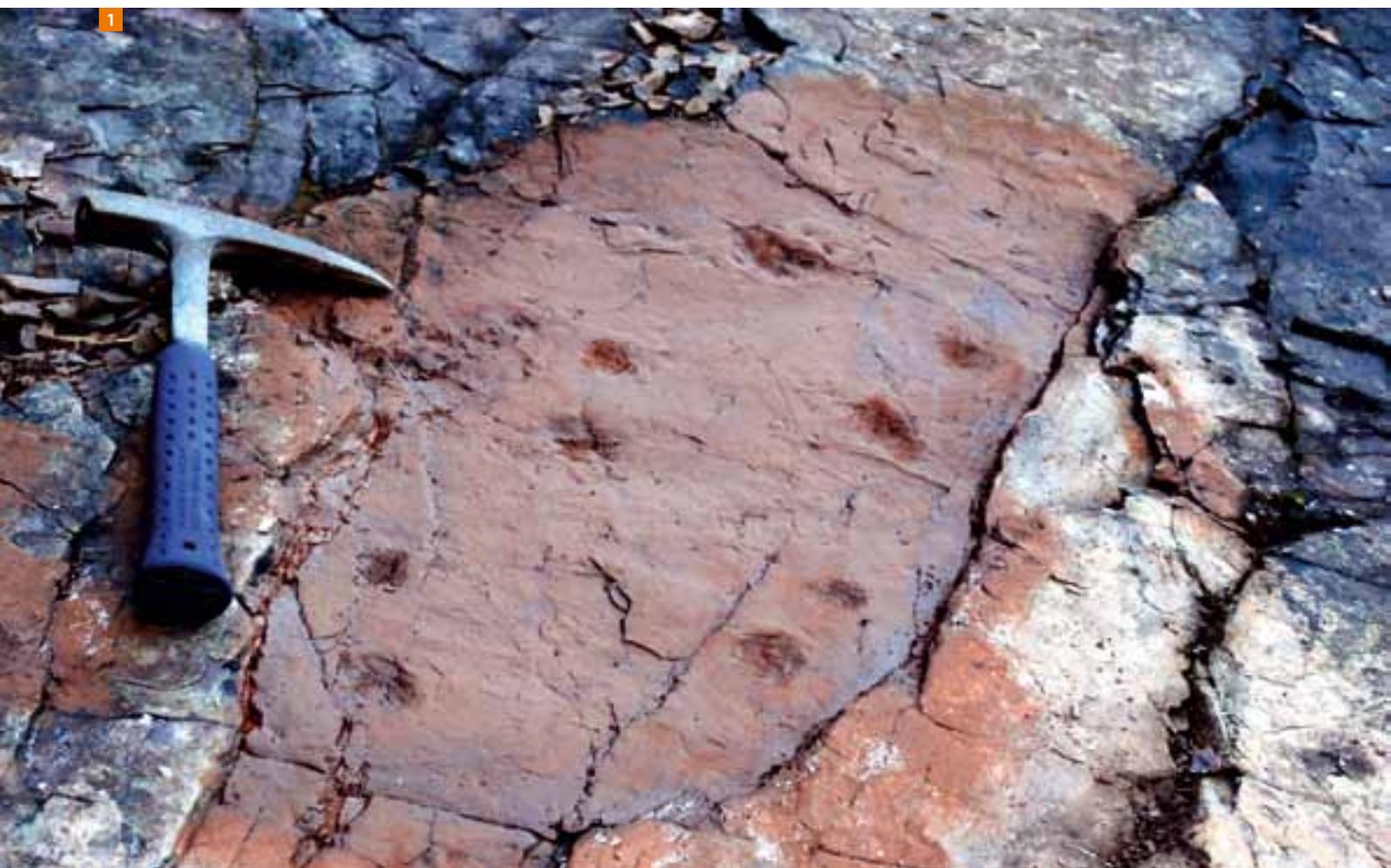
The maps were compiled as commissioned by the Minister of the Environment and financed by the National Fund for Environmental Protection and Water Management.

Project Leader: Magdalena Kucharska, M.Sc.





The Oldest in the World Footprints of Tetrapods in the Zachełmie quarry in the Holy Cross Mountains



At the beginning of 2009, a project of studies of the tetrapod footprints discovered in the *Zachełmie* quarry in the Holy Cross Mts. was launched. The footprints prove that in the area of the present Holy Cross Mts., on vast marine shallows, there used to live animals having four walking limbs with toes and able to move on a dry land. The environment of forming those deposits is unusual, in the light of the existing views and it shows that the cradle of tetrapods were not rivers and lakes, but a shallow and being periodically emerged part of a shelf (carbonate platform). The structure was formed at the end of Lower Devonian, and was developing within a very widespread southern shelf of the Old Red continent in the conditions of tropical climate. As a result of strong tides, changes in the sea level and tectonic movements, some parts of the platform could periodically emerge, revealing the seabed, extremely rich in various organisms of marine invertebrates. It was just them that might have been the reason why the first tetrapods liked that place, while searching for an easy prey. The numerous levels with dessication cracks and traces of rain drops provide the evidence to confirm the periodic land conditions. On the basis of microfossils, it was possible to accurately determine the age of the layers in the quarry. It was found that a part of the profile with the footprints was formed in the early

Middle Devonian, and therefore not later than 395 million years ago. This indicates that the footprints from the Holy Cross Mts. are by 18 million years older than the oldest bones of animals considered to be the first tetrapods so far.

A culmination of this stage of studies was the article published in a weekly *Nature* and the press conference organized on that occasion in the PGI-NRI seat in Warsaw (7 January 2010). In order to make good use of the discovery to promote geotourism and increase the attractiveness of this region of Poland as well as to protect this geological site in the *Zachełmie* quarry, a request was submitted to establish a geological reserve in that area. Also, a virtual geological educational trail in the *Zachełmie* quarry was created and a diorama prepared that illustrated the environment and the appearance of the oldest tetrapod which enriched the PGI-NRI's exhibition. Also, a project of studies of the environment in which tetrapod emerged to land financed by the Ministry of Science and Higher Education was launched.

Discoverers: Grzegorz Niedźwiedzki, M.Sc. (University of Warsaw), Dr. Piotr Szrek (PGI-NRI); Cooperation: Dr. Katarzyna Narkiewicz, Prof. Marek Narkiewicz (PGI-NRI) and Per E. Ahlberg (Uppsala University)

→ Tracks from the Zachełmie – a breakthrough in evolution



1. Footprints left by a Middle Devonian tetrapod
2. Trackway of an ancient tetrapod; Grzegorz Niedźwiedzki (in the background) and Piotr Szrek
3. Perfectly preserved desiccation cracks; characteristically arranged structures originated due to the deposit being drained

4. Scan of the footprint from Zachełmie
 5. Probable look of the limb
- © Grzegorz Niedźwiedzki et al.





INTERNATIONAL COOPERATION

The Association of the Geological Surveys of Europe, EuroGeoSurveys, will remain the basic platform of international cooperation for the Institute. We will take part in studies under auspices of this organization and also we will actively participate in the work of expert groups whose purpose is to advise adequate structures of the European Commission. Moreover, bilateral cooperation with individual national geological surveys will be developed in many fields.

Operational Strategy of the PGI-NRI 2010-2015,
Warsaw 2010

- 19 international research projects
- 11 projects under contracts with the European Commission and the European Regional Development Fund (ERDF)
- 43 bi- and multilateral agreements on scientific and technological cooperation
- 10 contracts related to providing services and conducting research studies for foreign entities (chiefly the oil sector)
- 27 international conferences, seminars and scientific workshops organized or co-organized by the PGI
- 128 conferences, seminars and symposia abroad participated by the PGI-NRI's staff
- 167 oral and poster presentations
- 237 consultation meetings and scientific workshops abroad
- 21 international training for the PGI-NRI's staff
- 306 individual and group business trips of the PGI-NRI's staff
- 68% business trips to the EU countries
- 43% business trips abroad to the neighbouring countries

The PGI-NRI
is a member of
→ **EuroGeoSurveys (EGS)**
association of European
geological surveys



Between 2009-2010, the international cooperation of the Polish Geological Institute – National Research Institute, just as in the previous years, focused on the Poland's borderland, including the Polish zone on the Baltic Sea.

The main partners of the Institute were European geological surveys. The cooperation covered all branches of the Earth sciences, and first of all, regional geological, geoenvironmental, hydrogeological, hydrogeological, geophysical studies as well as geological cartography, studies of natural hazards and environmental pollution. Also, issues related to deposits, geoinformation, geodiversity protection and promotion of geotourism were dealt with.

The Institute was engaged in the implementation of research cooperation projects under the Executory Programmes to the intragovernmental agreements concerning science and technology, managed by the Ministry of Science and Higher Education, with Austria, Belarus, France, Russia, Slovenia, Ukraine, Hungary and Italy.

Belarus

The cooperation with the Belarus partners (geological enterprises, geophysical expeditions, research institutes of the Academy of Sciences of Belarus) covered geological cartography, regional geology, paleontological and sedimentological studies of the borderland between Poland and Belarus, the region of Sokółka and Grodno in particular.

The joint research work was carried out as part of the agreement on cooperation between 2009-2012, concluded with the Institute for Natural Management of the National Academy of Sciences of Belarus, concerning geology with emphasis put on the paleogeography issues of the late Pleistocene in Poland and Belarus. The monitoring of groundwater in the borderland between Poland and Belarus in the River Bug basin was continued. Cooperation with the Institute of Prospecting and Geological Studies of Belarus related to the preparation of a geological map of the crystalline of the borderland between Poland, Lithuania and Belarus at the scale of 1:500,000 was carried out.

Czech Republic

In 2010, the *Sudetic Geotrada* Project was launched, together with the Czech Geological Survey (CGS), the purpose of which was to prepare a geological-tourist guide. The Project is co-financed by the ERDF under

the Operational Programme of Transboundary Cooperation between the Republic of Poland and the Czech Republic.

The Institute participated in the proceedings of the Polish-Czech Commission for Transboundary Waters and the International Commission for the Protection of the Oder River against Pollution. Monitoring of the border groundwater, with a special focus on the zone of intensive anthropopressure, was conducted.

Cooperation was continued with the Ostrava Institut of Mining and the Institute of Geonics with respect to the assessment of geohazards in the mining and post-mining areas in the Upper Silesia Coal Basin, with the use of satellite interferometry methods, and with the Institute of Geology of the Academy of Sciences of the Czech Republic and the Masaryk University in Brno with respect to paleoclimatic and paleomagnetic studies of the Moravian Karst and the Holy Cross Mountains. A project concerning the methodology of monitoring of some selected areas in Poland, Czech Republic and Slovakia was completed.

Lithuania

A framework agreement on scientific cooperation, and an annex specifying the basic trends in the cooperation in the years 2009-2011: hydrogeology, Eastern Partnership, geoecology, geohazards, geological and geoenvironmental cartography, geology heritage protection and re-



Director of the PGI-NRI, Jerzy Nawrocki, and Director of the Geological Survey of Lithuania, Juozas Mockevicius, after signing an agreement on cooperation

gional geology, with the Lithuanian Geological Survey (LGS) was signed. The cooperation with the LGS concerning the monitoring of groundwater in the borderland between Poland and Lithuania was continued. An agreement with the LGS on the translation into Lithuanian and dissemination in Lithuania the popular science stratigraphic table, *the History of Life on the Earth* was completed. The initial assumptions for the project of a transboundary geopark, *Pleistocene Glacial Park* at Szurpily were made. The cooperation related to the promotion and popularization of Earth sciences among children and youth, through organizing *Our Earth* arts competitions, was continued.

Germany

Geological cartography of the borderland between Poland and Germany, protection of the transboundary groundwater reserves and protection of the geodiversity were the main subjects of the cooperation with the geological surveys of Saxony (LfUG), Mecklemburg-Vorpommern (LUNG) and Brandenburg (LBGR). In 2009, a transboundary geopark, *Muskauer Faltenbogen/Luk Mużakowa*, was the first in Poland to be awarded the status of a National Geopark.

The PGI-NRI together with the LBGR continued to work on the construction of a geological map at the scale of 1: 50,000 of the borderland between Poland and Germany (the Eisenhüttenstadt/ Cybinka sheet).

The Institute participated in the work of experts for the management of the groundwater and data in the International Commission for the Protection of the Oder River against Pollution. Monitoring of the groundwater in the borderland between Poland and Germany was conducted. Cooperation developed with the geological institute, TU Bergakademie Freiberg (geological cartography of the borderland), the Institute of Baltic Sea Research (marine geology), RWTH Aachen (geology of mineral deposits), Frei Universitat Berlin (geochronology of the Pleistocene glaciations) and the Federal Institute for Geosciences and Natural Resources (BGR).

Cooperation was established with the German institutions and companies participating with the TASK Project in order to draw their experience in the field of studying and control of the processes of natural regeneration of the environment as a method of the remediation of degraded areas.

In 2010, an agreement was concluded on scientific and research cooperation between GFZ Potsdam, acting as a centre that manages the International Continental Scientific Drilling Programme (ICDP), and the PGI-NRI, and the Institute of Geological Sciences of the Polish Academy of Sciences.

Russia

The cooperation with the Institute of Oceanology of the Russian Academy of Sciences was continued with respect to stratigraphic and sedimentological studies of the Tertiary deposits in Sambia and the north-east Poland, including amber-bearing deposits. With the All-Russian Institute of Geological Research (VSEGEI) in Sankt Petersburg the geological and geoecological studies of the Vistula Spit, the Gdańsk Bay and the Vistula Lagoon were consulted.

Slovakia

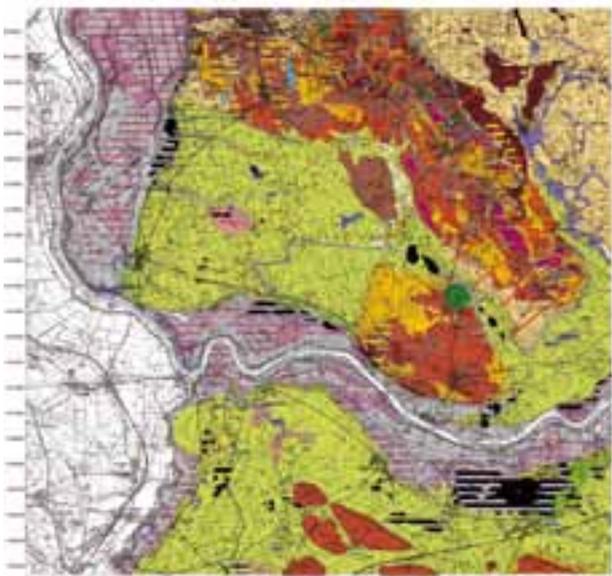
The cooperation with the Geological Survey of Slovakia (SGUDS) was focused on the *Detailed Geological Map of the Tatra Mountains at the Scale of 1:10,000* (DGMTM) and the *Educational Geological Map of the High Tatra Mountains*.

In 2009, the Polish-Slovak-Czech project of the monitoring of selected landslides in transboundary areas of the Carpathians was completed.

Representatives of the Institute took part in a meeting of the Polish-Slovak Commission for Transboundary Waters. Monitoring of the transboundary groundwater and studies of the thermal water reserves in the Podhale Trough were carried out. Together with the Geological Institute of the Slovak Academy of Sciences, a journal, *Geologica Carpathica*, was published and paleomagnetic studies conducted. In the Slovak Carpathians, field work was performed concerning the stratigraphic studies and a project related to deep geological cross sections in the Carpathians.

Ukraine

Cooperation was continued with the geological survey of Ukraine and its subordinated institutions and enterprises, including that related to the preparation of the publication of a geological map of Ukraine in the *OneGeology*. During a conference organized by the PGI-NRI, *Geobridge – Eastern Partnership* (15 May 2009), a framework programme of cooperation with respect to geology under the Eastern Partnership was defined. The geological, hydrogeological and



Geological Map of the Borderland between Poland and Germany; the Eisenhüttenstadt / Cybinka Sheet



Field work in a quarry of the Proterozoic gabbro rocks in the Korosten Massif, Ukraine

geoenvironmental cartography in the borderland between Poland and Ukraine, management and protection of transboundary groundwater, geoinformation, marine geology, studies of mineral reserves and protection of geological heritage were recognized as priorities of the cooperation.

With a state geological enterprise *Prychornomor* in Odessa, a framework programme of cooperation on marine geology was agreed upon in 2009. Together with an enterprise *Pivnichgeologia*, an atlas of geophysical areas in the borderland between Poland and Ukraine was constructed.

Hydrogeological and hydrochemical studies in the Carpathian transboundary region were conducted and Polish-Ukrainian Commission for Transboundary Waters meetings attended.

The cooperation with the research institutes of the Ukrainian Academy of Sciences in Kiev and in Lviv was fixed on regional geology, geology of mineral deposits (deposits of hydrocarbons, energy raw materials, evaporates) and geoecology. Cooperation with the University of Lviv related to magnetostratigraphic and paleomagnetic studies was carried out.

Other European Partners

The Institute worked together, in the field scientific research and through service contracts, with numerous foreign partners:

- Geological Survey of Finland (GTK) – training of the PGI-NRI employees in a software for the interpretation of recordings from marine seismoacoustic and sonar equipment as well as consultations about hydrogeological studies and localization of nuclear waste repositories;

- Geological Survey of the Netherlands (TNO) – the preparation of *the Southern Permian Basin Atlas (SPBA)*, an international undertaking coordinated by the TNO and cooperation with the studies of the impact of the mineral aggregates extraction from a seabed on the environment, under the COST programme, and with the project concerning shale gas (GASH);
- Geological Survey of Slovenia – the project: *the Vertical Movements of the Earth Crust in the Light of the Satellite Interferometry Data and Geological and Paleogeographical Analyses - Reconstruction of the Previous Events and Evaluation of Contemporary Hazards*;
- Eötvös Loránd University in Budapest and the Geophysical Research Institute of the Hungarian Academy of Sciences – paleomagnetic studies of the Upper Cretaceous red marls in the Pieniny Klippen Belt and the origin of the Carpathians orocline;
- the British Geological Survey (BGS) – trainings of the PGI-NRI staff in the application of the GSI3D software for geological structure modelling and consultations about geological CO₂ storing, the implementation of EU projects on geoinformation and marine geology as well as the projects under the COST programme;
- Universities in the United Kingdom: the Durham University (potential source units for hydrocarbon generation in Zechstein), the University of Glasgow (thermochronological studies), the University of Oxford (studies of stable carbon isotopes), the University of East Anglia in Norwich and the University of St. Andrews (erratic boulders dating and glaciectonic studies);
- Istituto di Ricerca per la Protezione Idrogeologia in Bari (CNR-IRPI) in Italy – the application of satellite radar interferometry to interpret dynamic events;
- ExxonMobil – the geology of the Lublin-Podlasie Basin;
- BG International Ltd. – making seismic data available;



Collecting samples of the Lower Cretaceous limestone for a cyclostratigraphic analysis in the Montclus profile, the Vocontis Basin, southern France

- Pierre and Marie Curie University, Paris – studies of paleoclimatic and paleoceanographic changes in the Tethyan Basins in Poland and France, under the Polish-French Integrated Actions Programme POLONIUM;
- French Petroelum Institute – prospecting for hydrocarbon deposits;
- Marathon – preparation of concession applications for exploration of mineral deposit reserves and exploitation of mineral deposits;
- Esso Exploration International Ltd. – prospecting for and exploration of oil and gas fields in selected concession areas of Poland.

Australia

The Institute cooperated with an isotope laboratory, Research School of Earth Sciences (RSES), at the Australian National University in Canberra. The methodology of geochronological analyses and isotope microanalysis, application of the SHRIMP ion microprobe and geochronology of crystalline rock basement of the East European Platform were the subjects of the consultation and training. With Australian companies and research centres, some issues of CO₂ storage were consulted.

Israel

The Institute worked together with the Geological Survey of Israel (GSI) on the protection and management of groundwater reserves, geochemical studies and the methodology of isotope analyses.

Libia

Participation with the realization of a contract with the Polish-Oil and Gas Company-Libya VB related to the consultations and interpretations of seismic data of Hydrocarbons in Murzuq Basin in Libia.

the USA

In 2010, contacts with the United States Geological Survey (USGS) developed intensively. A project of the USGS advisory assistance with the monitoring of landslides in the Carpathians was agreed upon and a letter of agreement on scientific cooperation in this respect was signed. The collaboration with the USGS also included the assessment of the shale gas reserves as well as the GMRAP project related to the studies of deposit potential of the salty rocks in the Polish Zechstein Basin.

The issues of the sedimentology of evaporative deposits were the subject of consultations at the universities in Washington and Oregon, whereas at the Colorado State University – Ford Collins – the methodology of the age determination of geological samples using Re-Os method. The cooperation with the University of Texas at Austin concentrated on the application of the *Lidar* equipment for geological work.

Geological Studies Carried Out Abroad

Afghanistan

The PGI-NRI's representatives took part in an official visit to Ghazni province, Afghanistan, in 2009, aimed at investigating possibilities of the implementation of aid projects including, among others, geological-environmental work. An initial assessment of geoecological aspects of the localization of a landfill for the city of Ghazni was made.

Angola

Under the *Polish Aid* programme, carried out by the Ministry of Foreign Affairs for developing countries, a training project for the Instituto Geológico de Angola (IGEO) was implemented in the years 2009-2010. Annual aid programmes for the IGEO, which have been realized since 2004, are focused on supporting the development of geological survey in Angola by the PGI-NRI. In 2009, the Institute undertook advisory-training missions for the personnel of the IGEO. An expert opinion on the state of resources and teleinformatic needs of the Instituto Geológico de Angola was made. In the PGI-NRI's seat in Warsaw, training of specialists from the IGEO took place in 2010 in satellite scene analyses and geological cartography, petrology and ore mineralogy, and chemical analysis.

Mongolia

The PGI-NRI coordinated geological work related to a project of the assessment of metallic raw material reserves in the area Hasagth in Mongolia, within the framework of a research work programme which was covered by the Performance Agreement to an agreement contract between the

government of the Republic of Poland and the government of Mongolia concerning the restructuring of the Mongolia debt owed to Poland.

Ukraine

The implementation of a project coordinated by the AGH University of Science and Technology, *the Oil Prospecting Perspectives and Hydrocarbon Potential of the Miocene and Mesozoic-Paleozoic Basement in the Transboundary Area of the Fore-Carpathian Deep in Poland and Ukraine* was completed. Geological studies related to the assessment of the hydrocarbon reserves in the northern border of the Fore-Carpathian, in the area of the village of Mikolajewo were conducted. In the area of the towns of Krzemieniec and Tarnopol, Badenian and Sarmatian outcrops were profiled due to the implementation of a grant awarded by the Ministry of Science and Higher Education, whereas in the area of Tarnopol and Kamieniec Podolski – the Miocene rocks in order to carry out paleomagnetic studies.

Zambia

In 2010, the project of a programme of the Ministry of Foreign Affairs, *Polish Aid*, was implemented, the purpose of which is to develop a research potential of the Environmental Research Centre in the Directorate of Research and Graduate Studies at the University of Zambia (UNZA) in Lusaka. The support given by the PGI-NRI related, among others, to the organization of an IT laboratory to carry out environmental analyses. In the PGI-NRI headquarters in Warsaw, training for specialists from the University of Zambia was done in the subject of remote sensing, geochemistry and analytical chemistry.

International Projects and Programmes

In the years 2009-2010, among others, the following projects with the participation of the PGI-NRI were completed:

- *OneGeology-Europe* under a EU programme, *eContentplus*. The Project coordinated by the British Geological Survey was aimed at creating and constructing an Internet database of the geological map of Europe and a multilingual geological portal. The PGI-NRI team constructed *the Geological Map of Poland at the Scale 1:1,000,000* to be made available in the form of WMS and WFS network services;
- *Ecosystem Approach to Marine Spatial Planning - Polish Marine Areas and the NATURA 2000 Network*, under a research programme of the Norwegian Financial Mechanism;
- *MACHU Programme - Managing Cultural Heritage Underwater* within the framework of the EU programme, *Culture2000*. The work of the Polish team, related to underwater environmental archeology, was coordinated by the Central Maritime Museum in Gdynia;
- *The Atlas of the Southern Permian Basin (SPBA)*, coordinated by the Geological Survey of the Netherlands (TNO). The PBI-NRI's staff participated in the construction of *the Petroleum Geological Atlas of SPBA*, published in 2010, and they coordinated the work of the Polish research team;
- A project related to the geochemistry of the European groundwater and bottled water, implemented by a group of the EuroGeoSurveys experts.

The following projects partially funded by European funds were being realized:

- *AEGOS – African-European Georesources Observation System*; a project implemented under the EU's FP7; the coordinator – BRGM (France); the PGI-NRI is the co-leader of a task related to preparing innovative projects based on the AEGOS;
- *GeoSeas* – on the subject of the European infrastructure for management of marine geological and geophysical data; a project under the EU's FP7 coordinated by the British Geological Survey (BGS);

- *EMODNET* – a European Commission project related to the construction of an observation network and the data on European seas, implemented by a consortium of European geological surveys and coordinated by the British Geological Survey (BGS);
- *EuroGeoSource* – the development of the systems of the geoinformation on reserves of mineral and energy raw materials (*CIP-ICT Policy Support Programme*); the coordinator – the Geological Survey of the Netherlands (TNO);
- *CGS Europe* – a coordination project under the EU's FP7, concerning carbon dioxide geological storage and coordinated by the BRGM (France);
- *SubCoast* – the development of the GMES system for monitoring and predicting hazards caused by subsidence in the coastal areas of the European seas (EU's FP7); a project coordinated by the Geological Survey of the Netherlands;
- *DORIS* – preparing scenarios of the risk of ground deformation and advanced services related to their assessment (EU's FP7); the coordinator – Consiglio Nazionale delle Ricerche (CNR), Italy;
- *MAGNET* – *Action COST No 63* concerning the study of the impact of the extraction of mineral aggregates from the southern Baltic Sea on the environment, under the EU COST programme;
- *SPLASH* – *Action COST No TD0902* related to underwater geoarchaeological objects on the continental shelf.

Within the Framework of the Operational Programme of Transboundary Cooperation between the Republic of Poland and the Czech Republic for the years 2007-2013, the PGI-NRI in cooperation with the Czech Geological Survey was carrying out the work in 2010 on the project: *the Sudetic Geostrada – Geological-Tourist Guide*, partially funded by the ERDF. Under a research programme, EUROCORES of the European Science Foundation and a programme TOPO-EUROPE and Thermo-Europe, a research project *Mechanism of Uplifting and Erosion in the Carpathians and the Fore-Carpathians Deep* was being realized. A workshop and educational activities of the pilot project, *the Sustainable Use and Protection of Groundwater Reserves – Management of Transboundary Waters in Belarus, Poland and Ukraine*, in the NATO scientific programme *Science for Peace and Security* were continued. In cooperation with a consortium of the TERRAFIRMA Project, under the auspices of the European Space Agency (ESA) and the programme of the Global Monitoring for Environment and Security (GMES), the PGI-NRI participated in the studies of using remote sensing methods to register hazards related to ground instability. The Institute's staff took part in the GEMAS project, under the auspices of the EuroGeoSurveys, focused on the preparation of a geochemical atlas of agricultural and grazing land soils in Europe. They also participated in research projects related to Antarctic: *Antarctic Climate Evolution* concerning the degree of human impact on climatic changes and *Census of Antarctic Life* with respect to building up a collection of bryozoa. The Institute continued to be engaged in the implementation of research projects of the International Geoscience Programme (IGCP) carried out under the auspices of the International Union of Geological Sciences (IUGS) and UNESCO.

International Scientific and Research Networks and Platforms

The PGI-NRI participated in the following undertakings: EnerG (geoenergy and geological CO₂ storage), CO₂GeoNet (geological CO₂ storage), Geocad (constructing three-dimensional models of deep structures), GSI3D (users of the software to model geological structures), SedNet (management of deposits and environmental quality standards), EIONET (European Environment Information and Observation Network at the European Environment Agency), SciColl (natural scientific collections), ELGIP (European Large Geotechnical Institutes Platform), ETP SMR (European Technology Platform on Sustainable Mineral Resources).

International Working Groups

The PGI-NRI became internationally involved in expert projects related, among others, to:

Raw Materials Supply Group (RMSG) at the European Commission (the Directorate-General for Enterprise and Industry) with respect to the EU raw materials policy; a working group of the European Commission for the Implementation of the Water Framework Directive; a group of experts for the International Classification of Mineral Resources System (UNFC) acting at the UN; a working group at the European Commission TWG Geology&Mineral Resources INSPIRE for Geology and Mineral Raw Materials; the *Data Management and Monitoring* working groups of the International Commission for the Protection of the Oder River against Pollution, of the International Council for the Exploration of the Sea (ICES) with respect to the exchange of information, reports and preparation of publications; consultations for the UNIDO – the United Nations Industrial Development Organization concerning the organization of projects on environmental protection and climatic changes in the Eastern Europe countries.

International Organizations

The PGI-NRI's representatives participated in the work and activities of many scientific and professional associations and organizations, among others:

the International Year of Planet Earth (IYPE) acting on behalf of the Polish Steering Committee; the International Continental Scientific Drilling Programme (ICDP) representing the Polish party together with the Institute of Geological Sciences of the Polish Academy of Sciences; the International Union for Quaternary Research (INQUA); the International Union of Geological Sciences (IUGS) and its commission and working groups: *Cogeoenvironment* for Geoenvironmental Studies in Transboundary Areas, group for preparing a multilanguage digital dictionary of Earth sciences; the Stratigraphic Commission and Scientific Committee for Jurassic Congress; the International Association of Hydrogeologists (IAH); the International Association on the Genesis of Ore Deposits (IAGOD); the International Commission on Stratigraphy (ICS); the International Committee for Coal and Organic Petrology (ICCP); the International Association of Sedimentologists (IAS); the International Commission for the Paleozoic Microflora (CIMP); the International Mine Water Association (IMWA); the International Confederation for Thermal Analysis and Calorimetry (ICTAC); the International Bryozoology Association (IBA); the International Council for the Exploration of the Sea (ICES); the European Association for the Conservation of the Geological Heritage (ProGEO) and its *Northern Europe* working group; the European Geosciences Union (EGU); the European Coal Conference (ECC); the European Association of Organic Geochemists (EAOG); the European Association of Geoscientists and Engineers (EAGE); the European Association of Geologists (EAG); the Carpathian-Balkan Geological Association (CBGA); the Meeting of the Association of European Geological Societies (MAEGS); the Society of Economic Geologists (SEG); the Baltic Sea Geologists (BSG); the Society for Organic Petrology (TSOP); the Swiss Geological Society (SGS); the American Association of Petroleum Geologists (AAPG); the Geological Society of America (GSA); the American Geophysical Union (AGU); the Society of Exploratory Geophysicists (SEG); the Environmental and Engineering Geophysical Society (EEGS); the Society for Sedimentary Geology (SEPM); the Deutsche Mineralogische Gesellschaft (DMG); the International Geographical Union's Commission on Land Degradation and Desertification (COMLAND); the Pander Society.

Head of International Cooperation Section: Ilona Śmietańska, M.Sc.

PUBLICATIONS



The Institute leads the field in publishing geological maps, atlases, books and periodicals. Our publications include Geological Quarterly, indexed in the data basis of the Institute for Scientific Information in Philadelphia. We wish our publishing activity to be continued. We will compile and publish, in particular, monographs, natural resources reference books, geological maps and guide-books.

Operational Strategy of the PGI-NRI 2010-2015,
Warsaw 2010



In the years 2009-2010 serial and non serial geological maps, atlases and periodicals as well as editorial series of a continuous character were published, such as: *Geological Quarterly*, *Bulletin of the Polish Geological Institute*, *Studies of the Polish Geological Institute*, *PGI Special Papers*, *Volumina Jurassica*, *Geological Bibliography of Poland*, *the Report on Mineral Reserves/Resources and Groundwater Resources in Poland*, *Scientific Sessions of the Polish Geological Institute* and others.



In the years 2009-2010, in total
 → **2 392,39** publisher's sheets of books
 of books, periodicals
 and explanatory notes to maps
 were published
 → **IF 0,580**

Cartography

Just as in the previous years, the editing and publishing of series maps at the scale of 1:50,000 was continued. In 2009, 35 sheets of the *Detailed Geological Map of Poland at the Scale of 1:50,000* and 30 explanatory notes to this map were published. The maps are made available by the Central Geological Archive in the form of plotter printouts or in an electronic format on CDs. The construction of a serial map, the *Lithogenetic Map of Poland at the Scale of 1:50,000* as well as making it available was continued, and 148 sheets of the map were prepared.

Five items of the series of the geological-tourist maps of national parks were published: the Babiogórski National Park (at the scale of 1:13,000), the Białowiecki National Park (at the scale of 1:25,000), the Poleski National Park (at the scale of 1:30,000), the Roztoczański National Park (at the scale of 1:30,000) as well as the Wigierski Park National Park (at the scale of 1:30,000).

The second edition of the *Tectonic Map of the Sudetes and the Fore-Sudetic Block*, at the scale of 1:200,000, in an English version with a Polish translation was released. In comparison with the first edition of 2004, the map was expanded by many valuable elements, which was mainly due to the results of new radiometric and structural studies being published.

In addition, four subsequent sheets of the *Detailed Geochemical Map of the Upper Silesia at the Scale of 1:25,000* – the sheets of: *Bieruń Stary*, *Imielin*, *Katowice* and *Mysłowice* were published as well as the *Paleogeological Atlas of the Sub-Permian Paleozoic of the East European Platform in Poland and in Neighbouring Areas*.

Serial and Non-Serial Publications

Each paper to be published by the PBI-NRI is sent for review. The decisions about appointing a reviewer and accepting a paper to be published are taken in consultation with the chairmen of the editorial committees.

Eleven issues of the *Bulletin of the Polish Geological Institute* PIG (433-443) were published, including two two-volume editions and three volumes of the *PGI Special Papers* (25-27). Four volumes of the *Studies of the Polish Geological Institute* (192-195) were printed.

A quarterly which appears on the Philadelphia list, *Geological Quarterly* (IF 0,580) – v. 53 and 54 was published on a regular basis. In 2009, two special numbers of volume 53: the first number dedicated to Prof. Władysław Pożaryski and the fourth one, containing materials from the Second International Ichological Congress, were published.

Due to the fact that the PBI-NRI has to fulfil its duties as a Polish Hydrogeological Survey, subsequent numbers of the *Quarterly Groundwater Information Bulletin* and *Hydrogeological Yearbook* were issued.

The PGI-NRI continued to publish the *Report on Mineral Reserves/Resources and Groundwater Resources in Poland*. The year 2010 was a beginning of new editorial undertakings, since PGI-NRI became a co-publisher of a yearbook, *Volumina Jurassica*. Presentation started of a popular science series: *Around Geology*. The *Volumina Jurassica* is an important periodical, supported by the International Subcommittee on Jurassic Stratigraphy (ISJS) of the International Commission on Stratigraphy (ICS), and presents articles discussing many aspects of studies of the Jurassic system throughout the world. In the 7th volume published, apart from scientific articles, there were also included the most important fragments of the ISJS Newsletter, which is intended to be continued in the next years as well. In the first volume of a new editorial series, *Around Geology*, memoirs of Stefan Cieślinski were included. *The Ice Areas of the Remote North* contains the reminiscences of his more-than-a-year stay in a Polish polar base in Spitsbergen, where apart from hard work, while constructing the polar base, the author carried out geological studies, too.

SELECTED SCIENTIFIC PUBLICATIONS

The blue print denotes publications indexed in the databases of the Institute for Scientific Information, Philadelphia (so called *Philadelphia List*) Authors from the PGI-NRI are written in upper case.

2009

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SHRIMP zircon study of a micromonzodiorite dyke in the Karkonosze Granite, Sudetes (SW Poland): age constraints for late Variscan magmatism in Central Europe *Geological Magazine*: 1-9

BADURA JANUSZ, PRZYBYLSKI BOGUSŁAW, Zuchiewicz Witold (Red.) VIII Ogólnopolska Konferencja z cyklu *Neotektonika Polski*. Neotektonika Europy Środkowej. Szklarska Poręba-Turoszów, 24-27 czerwca 2009. Materiały konferencyjne Wrocław: Komisja Neotektoniki Komitetu Badań Czwartorzędu PAN: 97 s

BER ANDRZEJ

Litologia i sytuacja geologiczna osadów interglacjału augustowskiego z profilu Sucha Wieś (Pojezierze Elckie) i Czarnucha (Równina Augustowska). W: Stratygrafia dolnego plejstocenu północno-wschodniej Polski na podstawie badań osadów jeziornych interglacjału augustowskiego *Biuletyn Państwowego Instytutu Geologicznego*, 435: 3-22

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Vertical stress of the Pleistocene continental glaciers and its hypothetical evidence in present relief of northern Europe. W: Quaternary of the Gulf of Gdańsk and Lower Vistula regions in northern Poland: sedimentary environments, stratigraphy and palaeogeography. International Field Symposium of the INQUA Peribaltic Group, September 14-19, 2008. Frombork, Poland / Ed. Leszek Marks *Polish Geological Institute Special Papers*, 25: 7-12

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BER ANDRZEJ, KRYSIAK ZOFIA (Red.)

Struktury glaciektoneczne w Polsce *Prace Państwowego Instytutu Geologicznego*, 194: 1-128

BER ANDRZEJ, LISICKI STANISŁAW, WINTER HANNA

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Influence of palaeoclimate and the greenhouse effect on Hettangian clay mineral assemblages (Holy Cross Mts. area, Polish Basin) *Geological Quarterly*, 53 (3): 363-368

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MISCELLANEOUS INFORMATION



The **Polish Geological Institute** is a research institute having the status of a National Research Institute. It was established in May 1919 and is supervised by the Minister of the Environment. Under *the Act on Geological and Mining Law*, and *the Act on Water Law*, it performs the tasks of the Polish Geological Survey and the Polish Hydrogeological Survey. The tasks fulfilled by the Polish Geological Institute meet the current needs of the country and social development.

The responsibilities of the **Polish Geological Survey (PGS)**, under *the Geological and Mining Law* (Journal of Laws of 4 February 1994 No 27, Item 96, as amended), include as follows:

- keeping the Central Geological Archive;
- running the Central Geological and Hydrogeological Data Bank;
- compiling materials for the Report on Mineral Reserves/Resources and Groundwater Resources in Poland and handling the register of these resources;
- coordinating the geological cartography projects and performing pilot programmes;
- keeping the register of mining areas;
- coordinating tasks related to geodiversity.

The Act on Geological and Mining Law, as amended in 2011, broadens the PGS's tasks, among others, by the following:

- initiating and coordinating activities aimed at the exploration of the Poland's geological structure, including projects of a key importance for the national economy, e.g. studies of the geological environment with respect to geoenergy resources or possibilities of underground storage of greenhouse gases or radioactive substances;
- keeping various thematic geological databases;
- coordinating the tasks related to environmental geology, including geohazards;
- preparing materials required when granting concessions for prospecting or exploration of hydrocarbon deposits and exploitation of hydrocarbons from deposits.

The responsibilities of the **Polish Hydrogeological Survey (PHS)**, under *the Water Law* (Journal of Laws of 11 October 2001 No 115, Item 1229, as amended), include as follows:

- carrying out measurements and hydrogeological observations;
- collecting, processing, archiving, and making the information gathered available, in particular that concerning the amount of resources and the chemical and qualitative condition of groundwater;
- keeping and updating the hydrogeological databases;
- carrying out current analyses and assessments of hydrogeological situation;
- preparing and transmitting forecasts about changes in the amount of reserves, state and hazards for groundwater;
- preparing warnings against dangerous phenomena occurring in the groundwater recharge and intake areas and sending them to the public administration organs.

Scientific Council

The PGI-NRI Scientific Council is a regulatory, initiating and advisory authority of the Institute with respect to its statutory activities and development of its scientific and research-technical staff.

Composition of the Scientific Council of the 6th Term 2008-2011

The Chairman

Prof. Krzysztof Jaworowski, PGI-NRI, Warsaw

Deputies of the Chairman

Prof. Stanisław Speczik, PGI-NRI, Warsaw

Prof. Andrzej Szczepański, Ph.D., (Eng.), the AHG University of Science and Technology; Cracow

Members

Prof. Izabela Bojakowska, PGI-NRI, Warsaw

Paweł Brański, M.Sc., PGI-NRI, Warsaw

Zbigniew Buła, D.Sc., PGI-NRI, Sosnowiec

Józef Chowaniec, Ph.D. (Eng.), PGI-NRI Associate Professor, Cracow

Ryszard Dobracki, M.Sc., PGI-NRI, Szczecin

Prof. Józef Dubiński, Ph.D. (Eng.), the Central Mining Institute, Katowice

Dr. Zbigniew Frankowski, PGI-NRI, Warsaw

Waldemar Gogołek, M.Sc., PGI-NRI, Warsaw

Prof. Marian Harasimiuk, the Maria Skłodowska-Curie University of Lublin

Gertruda Herman, M.Sc., PGI-NRI, Kielce

Katarzyna Jarmołowicz-Szulc, Ph.D., PGI-NRI Associate Professor, Warsaw

Marek Jaroński, Ph.D., PGI-NRI Associate Professor, Warsaw

Prof. Jadwiga Jarzyna, Ph.D. (Eng.), the AGH University of Science and Technology, Cracow

Dr. Jacek Kasiński, PGI-NRI, Warsaw

Hubert Kiersnowski, M.Sc., PGI-NRI, Warsaw

Prof. Ryszard Kotliński, Interoceanmetal, Szczecin

Prof. Andrzej Kowalczyk, the Silesian University, Katowice

Prof. Ewa Krogulec, the University of Warsaw, Warsaw

Dariusz Lech, M.Sc. (Eng.), PGI-NRI, Warsaw

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

Prof. Ryszard Marcinowski, the University of Warsaw, Warsaw

– until 4 April 2010

Prof. Bronisław Matyja, the University of Warsaw, Warsaw

Prof. Jacek Matyszkiewicz, Ph.D. (Eng.), the AGH University of Science and Technology, Cracow

Prof. Eugeniusz Mokrzycki, Ph.D. (Eng.), the Mineral and Energy Economy Research Institute of the Polish Academy of Sciences, Cracow

Dr. Teresa Mrozek, PGI-NRI, Cracow

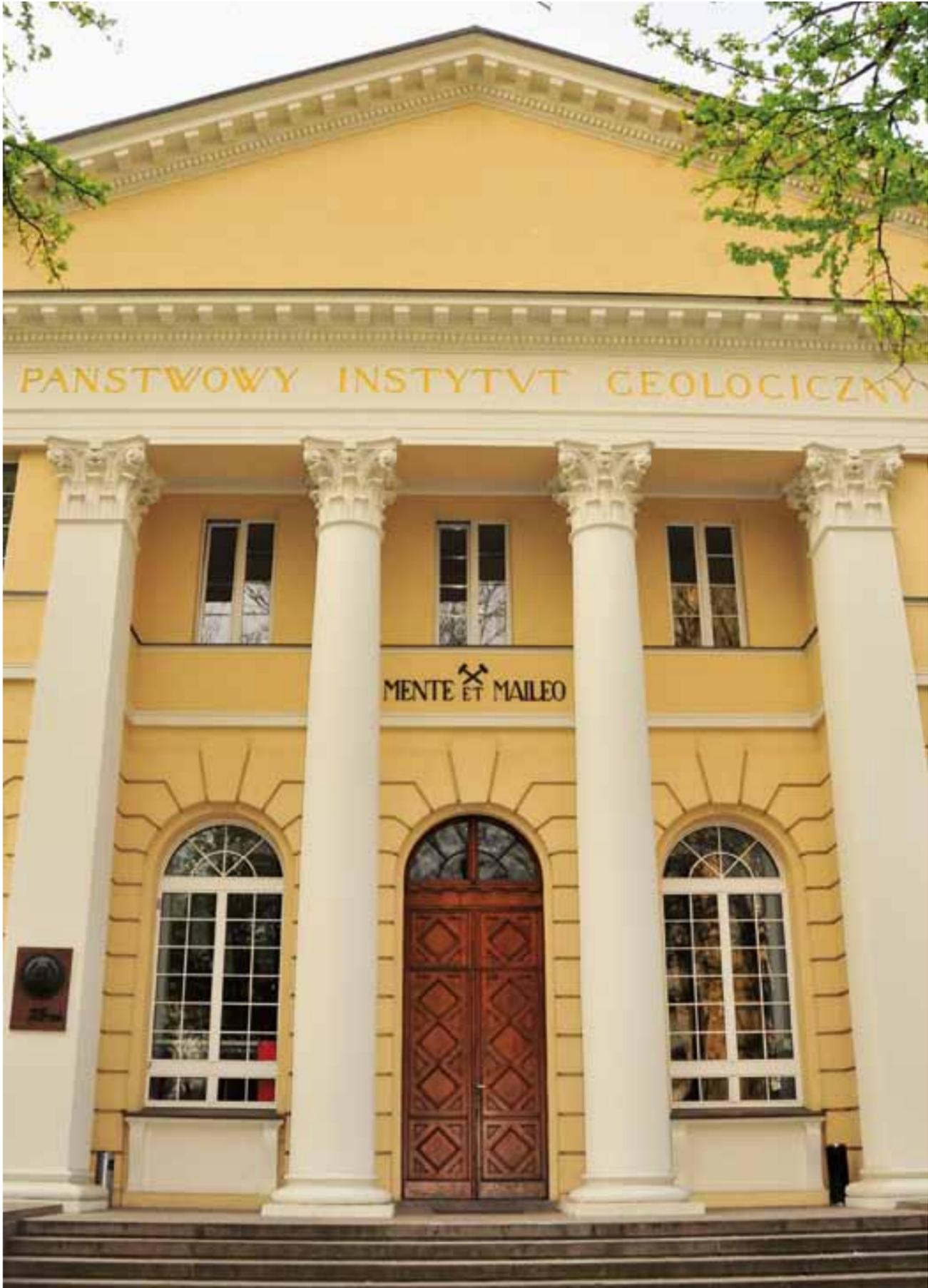
Andrzej Pacholewski, M.Sc. (Eng.), PGI-NRI, Sosnowiec

Anna Pasieczna, Ph.D., PGI-NRI Associate Professor, Warsaw

Prof. Krystyna Piotrowska, PGI-NRI, Warsaw

Prof. Jan Przybyłek, the Adam Mickiewicz University of Poznań

Prof. Paweł Rowiński, the Institute of Geophysics of the Polish Academy of Sciences, Warsaw



Edifice of the PGI-NRI Geological Museum

Magdalena Sikorska-Jaworowska, Ph.D., PGI-NRI Associate Professor, Warsaw

Prof. Tadeusz Słomka, Ph.D. (Eng), the AGH University of Science and Technology, Cracow

Prof. Stanisław Staśko, the University of Wrocław, Wrocław

Prof. Jerzy Trammer, the University of Warsaw, Warsaw – from September 2010

Prof. Alfred Uchman, the Jagiellonian University, Cracow

Prof. Andrzej Wierzbowski, the University of Warsaw, Warsaw

Prof. Andrzej Witkowski, the University of Szczecin, Szczecin

Prof. Andrzej Żelaźniewicz, Institute of Geological Sciences of the Polish Academy of Sciences, Wrocław

Budget

| | 2009 | 2010 |
|--|-----------|-----------|
| Income (in PLN thousand) | 146,615.0 | 159,450.5 |
| Costs (in PLN thousand) | 144,013.0 | 152,903.5 |
| Gross profit (in PLN thousand) | 2,602.0 | 6,547.0 |
| Corporate income tax (in PLN thousand) | 263.5 | 294.9 |
| Net profit (in PLN thousand) | 2,338.5 | 6,252.1 |
| Net profitability (%) | 1.6 | 3.9 |

The years 2009-2010 closed with positive net financial results: in 2009 – PLN 2,338.5 thousand, in 2010 – PLN 6,252.1 thousand.

The total income amounted to PLN 146,615.0 thousand in 2009 and PLN 159,450.5 thousand in 2010.

The proportions of the PGI-NRI's income from individual sources of income were similar to those in previous years. Still, among the major sources of financing the Institute's operations the National Fund for Environmental Protection and Water Management (64% in 2009 and 72% in 2010 r.) and the Ministry of Science and Higher Education (15.4% and 13% respectively), were included.

For the last few years, an increase in the Institute's income from a financial source described as *external contracts* can be observed. In 2009, it amounted to 6.7%, and in 2010, it accounted for 7.2% of the total Institute's income.

From a differentiation in the bookkeeping entries of income and costs of the Polish Hydrogeological Survey (PHS) and the Polish Geological Survey (PGS), it appears that the PHS's income in the years 2009-2010 amounted 23% and 30.7%, respectively, and the PGS's income was – 7.1% and 7.9%.

In 2009, a significant increase, as compared with the previous period, in the income from foreign sources was observed. That was mainly due to the final settlement, for the years 2004-2008, of the *Marie Curie* scholarship system under the UE's FP6 which amounted to PLN 4,120.7 thousand.

In 2010, yet another, new, source of the Institute revenues was noticeable, namely, the financial means due to the work carried out under the Operational Programme for the years 2007-2013, such as *the Innovative Economy or the Infrastructure and Environment*.

In 2009, income and costs increased in a similar way (by 22.5% and by 22.6% as compared with the previous year); whereas, in 2010, the revenue growth rate was admittedly lower and it was equal to 108.8%, but at the same time, the increase in costs was running at the 6.2% in comparison to 2009.

The category which reflects the Institute's development is that of capital expenditure and in 2009 it amounted to PLN 1,922.4 thousand. The main entry in it was the modernization of buildings. In 2010, expenditure on fixed assets was PLN 9,303.7 thousand. The expenditures on so called assets in the course of construction amounted to PLN 5,988.2 thousand,

and from the subsidies of the Ministry of Science and Higher Education in 2010, a CAMECA SX electron microprobe was purchased for the amount of PLN 4,065.2 thousand and the construction work of the Library of Original Geological Documents of the CGA at Halinów was started (PLN 565.7 thousand).

The PGI-NRI financed from its own assets the modernization of two halls in the rotundas of the historic building of the Geological Museum as well as guest rooms in the building of the Chemical Laboratory. For the purchase of equipment, research apparatus, computers and software in 2009 the amount of PLN 9,708.1 thousand was allocated while in 2010 – PLN 9,118.9 thousand.

Financial statements for 2009 and 2010 were approved by certified auditors.

Staff

Core Activity Staff – 86% of the Total Employees

| | |
|-----|------------------------------|
| 9 | professors |
| 25 | PGI-NRI associate professors |
| 62 | research associates |
| 7 | assistants |
| 98 | research-technical staff |
| 473 | engineering- technical staff |
| 7 | core activity workmen |

Between 2009-2010, there was a slight increase in the staff in comparison with the previous years. At the end of 2009 and 2010, the total PGI-NRI's staff was 758 and 788, respectively, and expressed in full-time jobs 740.65 and 773.16.

The level of employment in the three basis groups, as compared with the previous years, remains more or less the same. The core activity employees account for 86%, the office administration workers 11%, the attendants and support staff 3% of the total work force.

Employees with higher education account for above 78% of the total staff. Thirteen persons has the title of a professor, twenty-eight a Ph.D. degree and a hundred and twenty five a doctor's degree.

The Minister of the Environment appointed one person to the position of a professor and one person to the position of an associate professor. The PGI-NRI Scientific Council granted 4 persons a university degree title of a Doctor of Earth sciences, and 1 person a university degree title of a Ph. D.

Awards and Distinctions

State Decorations

The President of the Republic of Poland granted the **Chevalier Cross of the Order of Poland's Rebirth** to Prof. Anna Maliszewska and Prof. Ryszard Wagner.

Distinction of the Prime Minister

The Prime Minister, Donald Tusk, granted a special distinction to Grzegorz Niedźwiedzki of the University of Warsaw and Dr. Piotr Szrek from the PGI-NRI for the discovery of the trackways of the oldest terrestrial tetrapods at the *Zachelmie* quarry, in the Holy Cross Mountains.

Ministerial Distinctions

A Honorary Badge of the Minister of the Environment of Merit for Polish Geology was given to: Joanna Czebreszuk, M.Sc. (Eng.), Witold Dymowski, M.Sc., Katarzyna Gej, Tomasz Gidziński, M.Sc., Leszek Giro,

Dr. Anna Gryczko-Gostyńska, Dr. Ewa Krzemińska, Dariusz Lech, M.Sc. (Eng.), Krzysztof Majer, M.Sc., Grzegorz Mordzonek, M.Sc., Jadwiga Rote, Janusz Skulich, D.Sc., Piotr Wesołowski, M.Sc.

Awards of the Minister of the Environment

The Minister of the Environment endowed the following awards:

- a Team Award for developing the *Stratigraphic Table of Poland – Poland Outside the Carpathians, the Carpathians* to the team composed of: Prof. Ryszard Wagner, Prof. Leszek Marks, Dr. Jacek Kasiński, Prof. Ryszard Marcinowski, Prof. Bronisław Matyja, Grzegorz Pieńkowski, Ph.D., PGI-NRI Associate Professor, Stanisław Skompski, Ph.D., Prof. Michał Szulczewski, Bronisław Szymański, Ph.D., PGI-NRI Associate Professor and Prof. Krzysztof Jaworowski
- a Team Award for drafting up a methodological guidebook, *the Principles of Documenting Geological-Engineering Conditions for Foundation of Marine Construction Objects and Protection of Seacoast* to the team composed of: Dr. Zbigniew Frankowski, Prof. Marek Graniczny, Bożena Juszkiewicz-Bednarczyk, M.Sc. (Eng.), Dr. Regina Kramarska, Prof. Zbigniew Pruszek, Dr. Piotr Przedziecki, Marek Szymtkiewicz, Ph.D. (Eng.), Prof. Maciej Werno, Ph.D. (Eng.) and Dr. Joanna Zachowicz

Other Distinctions

The **Golden Badge of the Polish Geological Institute** was given to: Eugeniusz Cieśla, Barbara Kerber and Radosław Pikies.

Management

The Management of the Polish Geological Institute – National Research Institute in 2009

Director – Prof. **Jerzy Nawrocki**

Deputy Director for Scientific Matters, Scientific Secretary
– **Grzegorz Pieńkowski**, Ph.D., PGI-NRI Associate Professor

Deputy Director, Economic Director – **Maria Stacewicz**, M.Sc.

Deputy Director, Director of the Polish Geological Survey

– Prof. **Marek Graniczny**

Deputy Director, Director of the Polish Hydrogeological Survey

– Dr. **Lesław Skrzypczyk**

Division Director, Geological Mapping Director – **Marek Jarosiński**, Ph.D., PGI-NRI Associate Professor

Division Director, Geoenvironment and Geohazards Director

– Dr. **Małgorzata Sikorska-Maykowska**

Division Director, Geoinformation Director – **Waldemar Gogołek**, M.Sc.

Division Director, Marine Geology Director – Dr. **Regina Kramarska**

Marine Geology Branch Director – **Leszek Jurys**, M.Sc. (Eng.)

(1 Jan – 1 Mar 2009 – Acting Director)

Lower Silesian Branch Director – Dr. **Andrzej Stachowiak**

Upper Silesian Branch Director – Dr. **Lidia Razowska-Jaworek**

Carpathian Branch Director – **Józef Chowaniec**, Ph.D. (Eng.),

PGI-NRI Associate Professor

Holy Cross Mts. Branch Director – Dr. **Jan Prażak**

The Management of the Polish Geological Institute – National Research Institute in 2010

Director – Prof. **Jerzy Nawrocki**

Deputy Director for Scientific Matters, Scientific Secretary
– **Grzegorz Pieńkowski**, Ph.D., PGI-NRI Associate Professor

Deputy Director, Economic Director – **Maria Stacewicz**, M.Sc.

Deputy Director, Director of the Polish Geological Survey

– Prof. **Marek Graniczny**

Deputy Director, Director of the Polish Hydrogeological Survey

– Dr. **Lesław Skrzypczyk**

Division Director, Geological Mapping Director – **Marek Jarosiński**, Ph.D., PGI-NRI Associate Professor

Division Director, Geoenvironment and Geohazards Director

– Dr. **Małgorzata Sikorska-Maykowska**

Division Director, Geoinformation Director – **Waldemar Gogołek**, M.Sc.

Division Director, Marine Geology Director – Dr. **Regina Kramarska**

Division Director, Groundwater Management Director – Dr. **Małgorzata Woźnicka**; (Acting Director from 1 Oct 2010)

Marine Geology Branch Director – **Leszek Jurys**, M.Sc. (Eng.);

Lower Silesian Branch Director – Dr. **Andrzej Stachowiak** (until 30 Jun 2010)

Lower Silesian Branch Director – **Paweł Aleksandrowski**, Ph.D., PGI-NRI Associate Professor (Acting Director from 1 Jul 2010, Director from 1 Oct 2010)

Upper Silesian Branch Director – Dr. **Lidia Razowska-Jaworek**

Carpathian Branch Director – **Józef Chowaniec**, Ph.D. (Eng.), PGI-NRI Associate Professor

Holy Cross Mts. Branch Director – Dr. **Jan Prażak** (until 30 Apr 2010)

Holy Cross Mts. Branch Director – **Wiesław Trela**, Ph.D., PGI-NRI Associate Professor (Acting Director from 1 May 2010, Director from 1 Jun 2010)