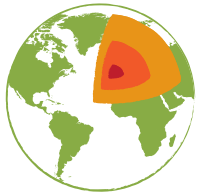


Polish Geological Institute
National Research Institute

/ looking deeper

Some history

1918
in a meeting of the Polish Academy of Learning in Cracow prof. Józef Morozewicz advocates the necessity of founding a Polish geological institute to provide scientific support to the state administration

7th of May 1919
a festive opening of the Polish Geological Institute in its temporary seat at the Staszic Palace in Warsaw

1936
completion of the construction of the Institute's main building (designed by M. Lalewicz) in Wiśniowa street in Warsaw (now the Geological Museum , Polish Geological Institute)

31st of March 1938
by the decree signed Ignacy Mościcki, the President of the Polish Republic, the Polish Geological Survey is formally instituted

August – September 1944
the seat and collections destroyed during the Warsaw Uprising

3rd of March 1945
the Institute reactivated by the Minister of Industry and Commerce in its temporary seat in Cracow

1946
the Polish Geological Institute transferred from Cracow to Warsaw

1947
restoration of the main building in Wiśniowa street

1952
completion of the construction of the new building (designed by M. Leykam) in Rakowiecka street 4 in Warsaw

4th of February 1994
in virtue of the Geological and Mining Law Act the Polish Geological Institute was entrusted the tasks of the Polish geological survey

18th of July 2001
the Institute is charged with the function of the Polish hydrogeological survey

24th of February 2009
following a proposal from the Minister of the Environment, the Institute is granted the status of the national research institute by the Council of Ministers

The first building of the Polish Geological Institute, erected in 1926.
It contained chemical laboratory and flats for the Institute employees.
At present, it houses modern Central Chemical Laboratory as well as IT laboratories.

Photo PIG

Our major mineral discoveries

1924
hematite and pyrite in the Holy Cross Mountains

1925
phosphates in the Lublin area

1937
hard coal on the Bug river

1947
rock salt and potassium salt in the Wielkopolska area (Kłodawa)

since 1951
numerous brown coal fields in Central Poland, Wielkopolska and Lower Silesia

1953
native sulphur in Tarnobrzeg,
iron ore in Łęczyca (province of Łódź)

1957
copper ore in the Lubin-Sieroszowice area (Lower Silesia)

1962
iron, titanium and vanadium ore in the Suwałki area

1964
hard coal in the Lublin area,
polyhalites (multi-mineral salts) in the Puck Bay area

Photo PIG

ABOUT GEOLOGY

Geology is a practical and clear-cut science dealing with rocks, ores and minerals – a hard world of abiotic nature. Geologists, however, have a deep emotional attitude towards the object of their interest. They regard the lithosphere – the inanimate part of the Earth – as a heritage entrusted to humanity to be preserved for future generations by reasonable use of their resources.

The Institute's priorities have been changing in the course of its over 90-year long history. Ever since its foundation mineral resources had been the main target of Institute's activities but in the last decade the main focus has been on environmental geology, hydrogeology and recognition of natural hazards. New fields of activity are emerging – CO_2 sequestration , nuclear energy, non-conventional hydrocarbon resources, HDR geothermy. To face the new challenges the geologists are bound continuously to improve their skills, show a flexible approach to the arising problems and introduce new research methods. This is no easy task, but we are pleased to say that the Institute tries hard to fulfill its obligations by providing information essential for a rational and safe functioning of the state.

Nevertheless, the classical disciplines still hold their due position among other fields of interest. A good example is palaeontology with its spectacular discoveries – often of crucial significance for the current evolution concept – such as the well-known finding of the world's oldest tetrapod footprints in the Holy Cross Mountains dated at 400 m.y. and described in the January 2010 issue of "Nature" one of the most prestigious scientific periodicals.

First tetrapods, ancestors of modern-day mammals, reptiles and birds, emerged from the water at least 18 million years earlier than previously believed. Contrary to the commonly accepted views, they did not came ashore from lakes or rivers but rather from warm and shallow sea. The photo shows fossilized footprints of Devonian tetrapods from the Zamienie quarry near Kielce.

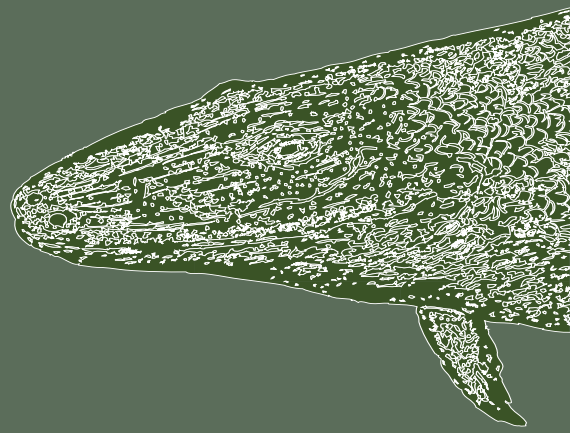


Photo Marta Hodbot

Quarry of igneous rocks (granites, granodiorites and tonalites) at Gęsiniec near Strzelin (Eastern Sudety Mts)

Photo Bogusław Bagiński

REGIONAL GEOLOGICAL STRUCTURE OF POLAND

For a geologist our country is a mosaic of regions – structural units of various order and size differing in structural styles, stratigraphy and tectonics. This geological division does not always follow the geographic division as many structural units are buried deep under the surface.

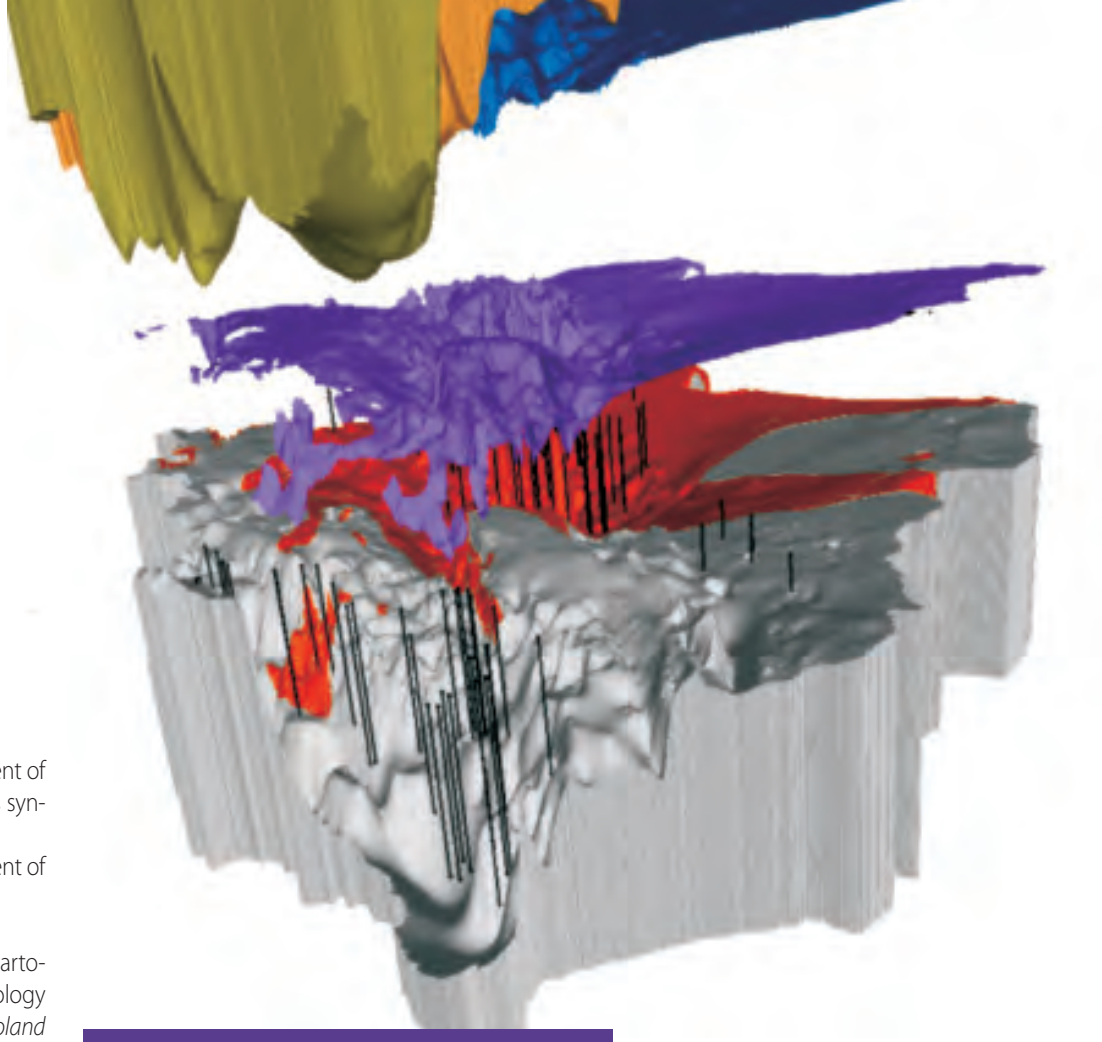
The knowledge of their structure, reconstruction of their dynamics and history and the definition of their mutual relationship and position relative to the Earth's history are of crucial importance both for science and the economy. A prime synthesis of regional studies is the "Stratigraphic Table of Poland" – a joint effort of authors from the Polish Geological Institute and other scientific centers.

Without the information contained in comprehensive monographs, palaeogeographic models and stratigraphic tables acquired in the course of basic research, a correct compilation of thematic maps, effective exploration for mineral resources and environment protection would be hardly possible.

GEOLOGICAL MAPS

Our entire knowledge of the structure, origin and history of the basement of our country – the achievements of many generations of geologists – is synthetised on the geological maps.
Maps created at the Institute are indispensable for a rational management of the environment and provide a basis for key economic decisions.

The Polish Geological Institute is the producer of the most significant cartographic publications – the fundamental reference source of Polish geology – the *Detailed Geological Map of Poland*, the *Hydrogeological Map of Poland* and the *Geoenvironmental Map of Poland*, all on 1:50 000 scale. With these three cartographic sources of prime importance covering the entire Polish territory and thousands of thematic maps and atlases which illustrate heat flow variations, pollution of the Earth's surface, natural hazards and many other aspects, Poland counts among the leading countries having such a vast compendium of knowledge of their natural environment at their disposal.



Deep geological structure may be also presented in 3D or even 4D mode. Numerical spatial models facilitate compilation of plans of mineral resource management and exploitation as well as risk evaluation and supervision of ongoing mining activities. The models are also highly useful in selecting sites for underground hydrocarbon storage and waste depository facilities.

Photo PGE KWB Bełchatów S.A.

POLISH NATURAL RESOURCES

Since its foundation many years ago, the Institute's fundamental task has been the development of domestic mineral deposits and securing mineral resources for the reborn national economy. Over its entire history the Institute was reliably fulfilling these obligations. The Institute is to be credited with the discoveries of the major Polish mineral deposits – native sulphur in Tarnobrzeg, copper and silver ore in Lower Silesia, potassium salts in Kłodawa, hard coal in the Lublin area, polyhalite in the Puck Bay area, oil and natural gas in the Polish Lowlands, titanium and iron ore in the Suwałki area, brown coal in central and West Poland and many others such as natural aggregate and building stone commonly underrated though extremely important for the building industry. Up to this day results of geological mapping geophysical survey and pertrological and sedimentological studies contained in numerous reports contribute to the economic safety and provide guidelines for exploration and development of the Polish mineral resources.

The lignite mine of PGE Bełchatów S.A. at Rogowiec near Bełchatów is the largest open-cast mine in Poland and one of the largest in Europe. Its excavation area is approx. 3,200 hectares. Annual output of this mine, about 33 million tonnes, covers over 50% of domestic consumption of that fossil fuel.

Photo PGE KWB Bełchatów S.A.

MARINE GEOLOGY

Living in a country consisting mostly of land, we Poles tend to forget that a considerable part of the Baltic Sea also belongs to Poland. In fact, the 30 600 km^2 of Baltic sea bed constitutes 10% of all Polish territories. Of course, if we are to manage our mineral resources properly and protect the environment, our knowledge of the geology of the marine area must be no less thorough than that of the of the land areas.

However, off-shore investigations are much more difficult than on-shore and require special techniques. Nevertheless studies conducted by the Institute's regional branches in Gdańsk and Szczecin increasingly add to the knowledge on this important part of our country.

The recognition of the geological conditions of the Baltic coast and of the mouths of Odra and Vistula protective measures permitted to compile the *Geodynamic Map of the Coastal Zone* thus providing the basis for an effective implementation of the *Programme for the Protection of the Sea Coasts* accepted by the decision of the Polish Parliament in 2003.

Photo of the Church at Trzęsacz from the year 1900,
The W. Jagiełło Multimedial Museum at 15 Degrees East Longitude

The Trzęsacz Cliff is one of sections of the Polish coast of the Baltic Sea most strongly affected by the modern abrasion. The famous medieval church, now in ruins, was built on upper terrace of an escarpment rising 13.1 m a.s.l. In 1885, cliff edge had reached the northern wall of the church to result in its fall to the sea in 1901.

Photo Anna Bagińska, 2010 r.

Photo Mirosław Rutkowski

Warsaw Waterworks, designed by William Lindley, began to operate on 3 July 1886. The waterworks are still operational as purification works for water from four bank river intakes and one intake from beneath Vistula river bed ("Gruba Kaśka" Intake).

GROUNDWATER

Groundwater reservoirs are becoming more and more important as surface waters – traditionally the main source of potable water for the population – are becoming increasingly unreliable and polluted. Therefore, one of the most important tasks of the Polish Geological Institute, charged with the function of the Polish hydrogeological survey, is to assess and control unpolluted groundwater resources and to ensure appropriate management of these strategic reserves which can prove crucial to our survival.

Information on domestic groundwater – fresh, mineral and therapeutic – is stored in powerful informatics systems operated by the Polish Geological Institute and their spatial distribution is shown on the *Hydrogeological Map of Poland* on 1:50 000 scale.

GEOPHYSICS

Most of the Polish territory is covered by a thick blanket of relatively young post-glacial sediments. Older rocks crop out only in the mountainous southern part of the country. That is not a favourable situation for the geologists as structural drillings are extremely costly and provide only limited information. But fortunately, the existing geophysical methods enable an effective recognition of the deep-seated layers at a relatively low cost. Under these circumstances the role of seismic sounding, resistivity, magnetic, magnetotelluric surveys along with a number of other techniques can not be underestimated.

The geophysical data interpreted by the Institute's specialists are used in all modern geological disciplines. They provide guidelines for exploration for mineral resources and groundwater, environmental protection and are the basis of our knowledge on the early chapters of the Earth's history.
The geophysical methods also enable exploration for non-conventional shale gas and tight gas resources and studies of salt structures suitable for underground oil and natural gas and difficult waste storage.

Measurement of vertical gradient of Earth's magnetic field with the use of Scintrex ENVI-MAG magnetometer. Such measurements are taken to solve some shallow subsurface geological or geotechnical problems, in this case for assessing concentrations of heavy minerals in beach sediments.

Photo Marta Wróblewska

ENGINEERING GEOLOGY

The main field of interest of engineering geology, a highly practical and mathematical geological discipline, is the interaction between the constructed object and the geological environment. In addition to traditional activities, engineering geology becomes increasingly interested in sustainable development, urban planning and environmental protection – problems that will inevitably arise where nature and highly industrialized society collide.

Besides numerous final and expert's reports, modern digital engineering-geological atlases for large conurbations (Gdańsk-Gdynia-Sopot, Cracow, Wrocław) are compiled by PGI staff along with instructions and methodological guide-books helpful for defining engineering geological conditions for various purposes – not only in terms of construction of buildings, roads, motorways, bridges but also with respect to closure of mining operations and protection of the sea coast.

Engineering-geological surveys provide data indispensible for all the major engineering and construction works, including those connected with design of linear construction projects such as highways, roads and railways.

Photo of Warsaw centre

Photo PGE KWB Bełchatów S.A.

The environmental impact of lignite mining not always has to be detrimental. There are numerous examples of recultivation which made possible the use of post-mining areas (including open-cast mines, mine waste heaps and tailings and settling ponds) for recreative purposes. The photo shows one of settling ponds recultivated by the Bełchatów open-cast lignite mine.

ENVIRONMENTAL PROTECTION

Human-induced changes of the natural environment evoke – and rightfully so – a growing concern about the future of civilization on our planet. Therefore, of utmost importance is monitoring of these detrimental processes and warnings against hazards. Research methods developed over the years for various geological domains proved to be quite suitable for these purposes. Now they are used in a specialized discipline of earth sciences – environmental geology.

Studies carried out at the Institute by environmental geologists have enabled to produce a cartographic presentation of pollution sites and assess how this affects the environment. They proved helpful for land valorization, waste management and for devising ways to repair the damage and restore the natural equilibrium.

NEW ENERGY

Geothermy

As compared with other European countries Poland's chances of acquiring thermal water energy are rather moderate. However, in many parts of the country thermal energy can be a valuable source for complementing the existing traditional domestic heating systems. Investigations conducted by the Polish Geological Institute have led to the compilation of detailed hydrogeological maps and determination of groundwater temperatures and mineralization degrees. Also a map has been constructed which shows the intensity of heat flow that arrives from the depth at the surface on the Polish territory. Studies are underway on the possible extraction of energy directly from hot dry rocks occurring at the depth of 3 km or deeper (the HDR system).

The rehabilitation and recreation center in Bukowina Tatrzańska is the largest in Poland and one of the most modern in Europe. Documentation of its thermal waters was compiled by the Polish Geological Institute.

Photo Terma Bukowina Tatrzańska

NEW ENERGY

Non-conventional gas resources

Nowadays, in search for new energy resources also *shale gas* (gas accumulated in shale) and *tight gas* (gas trapped in rocks of very poor porosity) are being taken into consideration. It is estimated that in Poland large amounts of natural gas could be obtained from these new sources. However, exploitation of the hitherto unexplored deposits will be difficult as extensive directional drilling and advanced hydraulic fissuring techniques will have to be adopted.

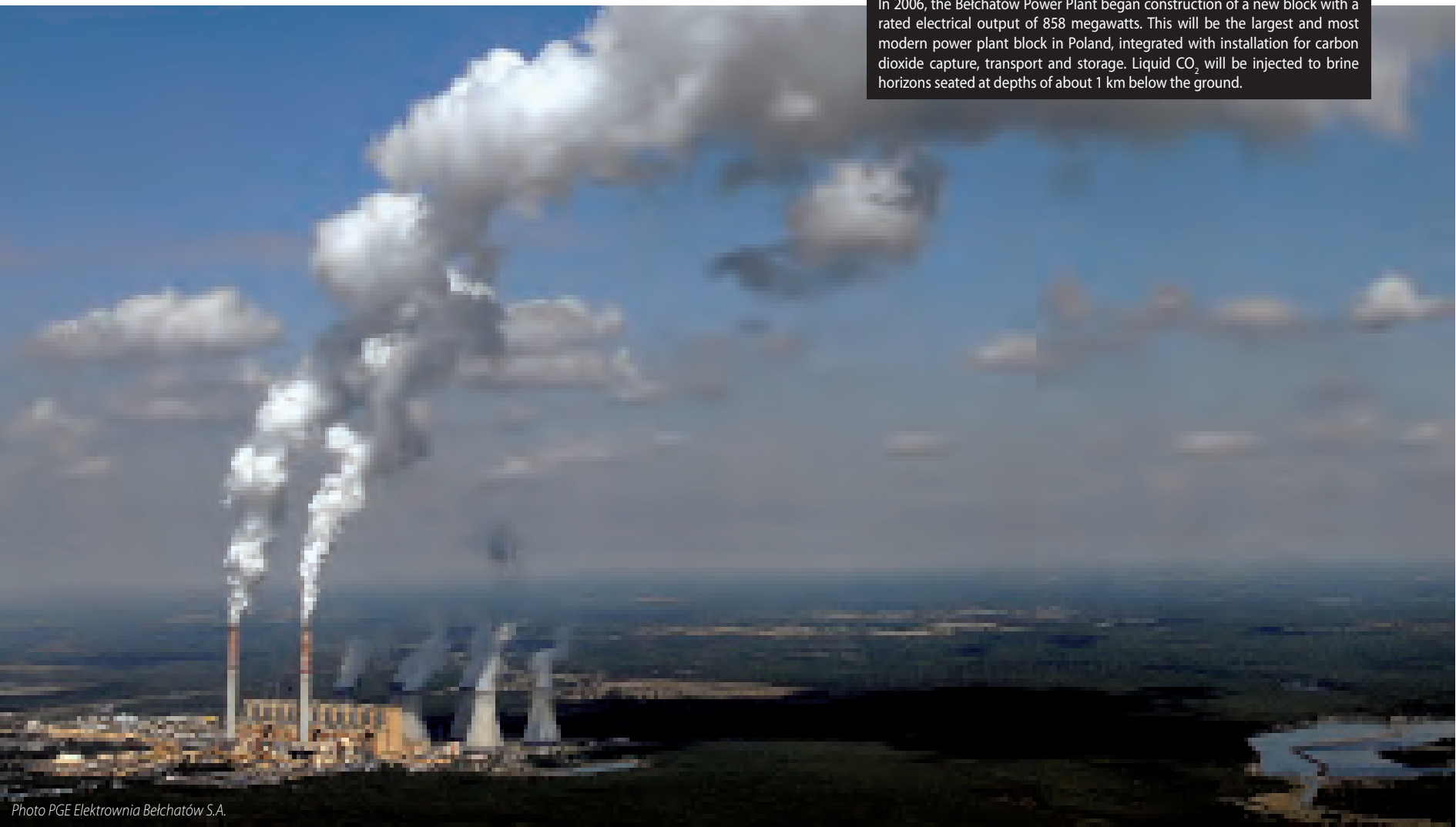
The studies carried out by the Polish Geological Institute made it possible to identify the most perspective areas of occurrence of potentially gas-bearing dark shales of the Lower Paleozoic age. The first exploratory well began to be drilled near Lębork (Gdańsk Pomerania) in spring 2010.

Photo Krzysztof A. Fugiel

CARBON DIOXIDE SEQUESTRATION

The injection of carbon dioxide derived from burning fossil fuels into deep-seated geological structures will safely exclude this gas from atmospheric circulation for many millennia. This procedure is called geological sequestration. The likely storage sites in Poland are exhausted oil and natural gas fields, deep brine aquifers and abandoned hard coal mines.

Studies under the four year (2008–2012) national programme *Assessments of Formations and Structures for Safe CO_2 Storage and Programme of Monitoring* are conducted by a consortium of renown geological and mining research centres under the leadership of the Polish Geological Institute. The objective is to find potential CO_2 storage sites which meet the requirements of injectivity feasibility, safety and environmental impact.



In 2006, the Bełchatów Power Plant began construction of a new block with a rated electrical output of 858 megawatts. This will be the largest and most modern power plant block in Poland, integrated with installation for carbon dioxide capture, transport and storage. Liquid CO_2 will be injected to brine horizons seated at depths of about 1 km below the ground.

Photo PGE Elektrownia Bełchatów S.A.

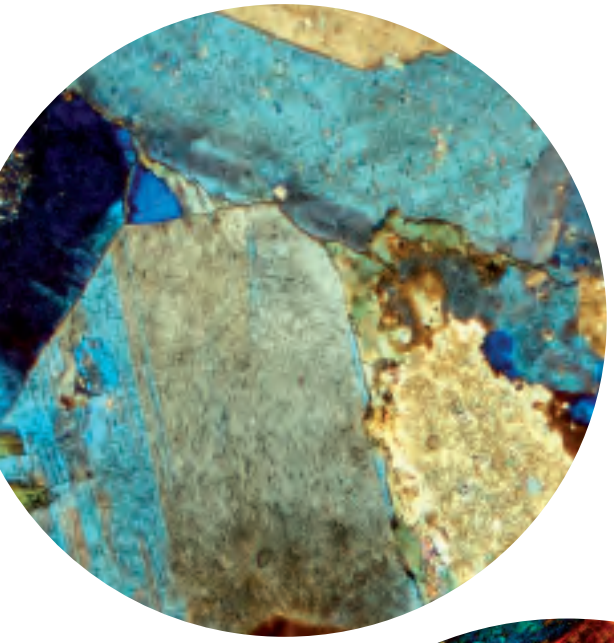
Landslide in the Carpathian Mountains (2010); Kłodne

NATURAL HAZARDS

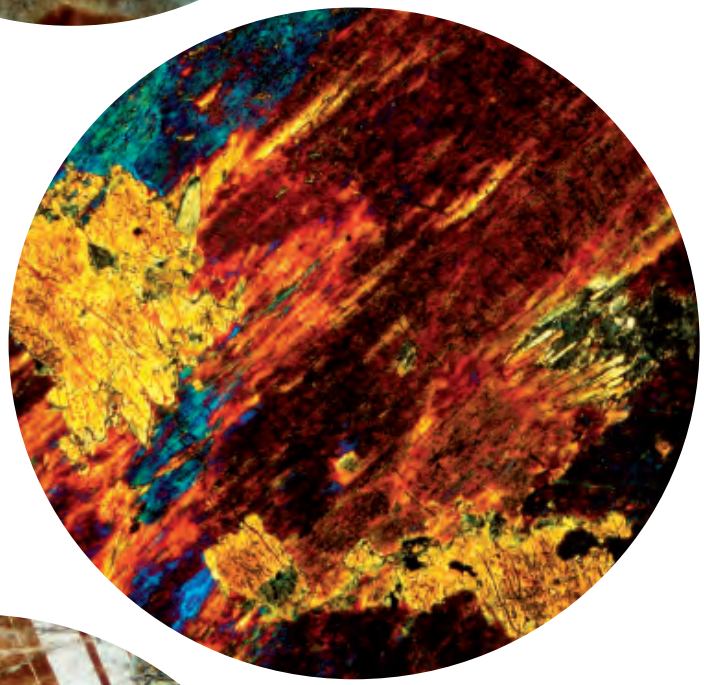
Fortunately, our country has not been affected by great geological disasters – volcanic eruptions, earthquakes – in the recent geological past. Nevertheless even in Poland the natural environment is subjected to natural forces of an enormous destructive potential. We are threatened by floods and landslides, rivers change their beds and toxic substances migrate in the natural environment and in groundwater.

Landslides

Mass movements are particularly dangerous in the southern mountainous part of Poland, in river valleys in the lowlands and on the Baltic coast. To reduce material damage the SOPO informatic informatics system was established at the Polish Geological Institute on-line providing the population and local authorities with detailed information on the hazard degree. The most active landslides are included in a permanent monitoring network and studies are underway in the potentially most threatened parts of the country.



Polarizing microscope changes gray inconspicious rocks into unusual mosaic of shapes and colours. An analysis of especially prepared samples under polarized light is the basic approach in petrography. Such analysis provides valuable information on rock composition and succession of crystallization of individual minerals and facilitates further, more specialized studies, including those with the use of electron microscopy.



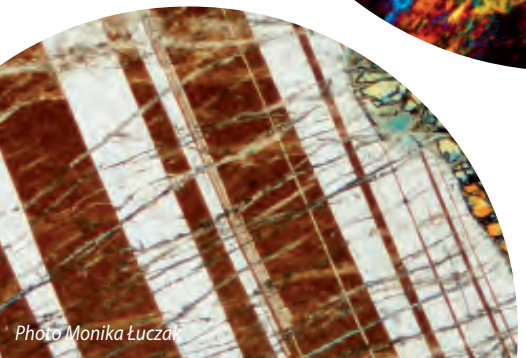


Photo Monika Łuczak

ANALYTICAL LABORATORY

A geologist works in the field – this popular saying was true 100 years ago and still holds today. But very frequently field data require laboratory verification. Therefore, ever since the very beginnings, the basic research is complemented by specialized analytical procedures – chemical, petrological and cathodoluminescence microscopy.

The Central Chemical Laboratory of the Polish Geological Institute is currently the direct descendent of the analytical tradition of early 20ies century and is the largest accredited unit of this kind in Poland. Modern petrological studies conducted at the Institute contribute to advances in other geological disciplines including hydrocarbon geology.

ARCHIVES AND DATABASES

Storage of geological information is one of the statutory tasks of the Polish geological survey. The Polish Geological Institute fulfils the survey's obligations by storing an immense number of geological records in its archives and core depositories. These are well descriptions, economic geological and hydrogeological reports, maps, aerial photographs and satellite imagery, traditional and digital data – recording practically the whole of the achievements of Polish geology. This information, fundamental for the implementation of any geological work in Poland, is accessible directly by terminals from databases such as the Central Geological Database (CBDG) and other thematic databases – Information System for Mineral Resources Management and Protection (MIDAS), System for Landslide Counteracting (SOPO), IKAR and INFOGEOSKARB.

RESOURCES OF THE CENTRAL GEOLOGICAL ARCHIVES

280 213 map sheets

160 354 borehole logs

217 777 text and cartographic documents

635 457 drilling core boxes

Borehole core material gathered during the last 90 years is one of the most valuable sources of information on geology of the country. The largest PGI-NRI borehole core archive, housing 128 551 core boxes, is located at Kielniki near Częstochowa.

Photo Mirosław Rutkowski

Photo Barbara Ruszkiewicz

PUBLICATIONS

Geological publications richly illustrated with maps and fine drawings prove a serious challenge to editors. Every year the Polish Geological Institute publishes numerous books, maps and atlases including successive geological map sheets both as hard copies and in digital form. In addition, we are the publisher of 9 specialized periodicals, among others "Geological Quarterly" indexed in the databases of the Institute for Scientific Information in Philadelphia (*Philadelphia List*). The fine quality of the Institute's publication is due to the effort of experienced editorial teams composed of professional geologists who are also experts on publishing.

Photo Wojciech Morawski

A team of glaciologists on a drifting ice floe in Bellsund, Spitsbergen.

INTERNATIONAL COOPERATION

Geology knows no borders

This statement is particularly true, as the medium we are studying is a global entity. As a member of EuroGeoSurveys (association of European geological surveys) the Polish Geological Institute actively participates in the international exchange of scientific ideas through its contribution to scientific meetings and research projects in every field of the Earth science. Our priority is cooperation with the neighbouring countries and the trans-border areas in particular. Special importance is attached to integration with the European Research Area.

As well as participation in the European Union Framework Programmes, we are one of the first Polish institutions to found the Centre of Excellence – Research on Abiotic Environment. Our geologists work also outside – in Mongolia, Ukraine and Antarctica. In Angola they organize training courses for the staff of the geological institute in Luanda promoting the activities of the local geological survey. The Institute actively participates in the European Union AEGOS project devoted to the geological and mineral resources of "black" Africa.

A very large horseshoe-shaped row of moraine hills cut by the Nysa River valley. This is one of the most beautiful examples of piled up front moraines in the world. Pressure of ice-sheet here resulted here in plastic deformation of bedrock series including brown coal seams. This is the country of pictoresque lakes, historic water mills and brickyards and abandoned mining works now overgrown by rich vegetation.

PROMOTION OF THE EARTH SCIENCE

Photo Peter Radl

Geotourism

Examples of many countries demonstrate that even in seemingly unattractive landscapes geological knowledge can create fascinating recreational offers attracting crowds of tourists and bringing considerable income.

Currently Europe boasts 34 geoparks that is protected areas with the most valuable geological sites. None of them is empty. The Polish Geological Institute actively supports the foundation of Polish geoparks as well as geological trails and geotouristic sites. The outcome of a joint effort of scientists and local authorities is the Mużaków Arch (Łuk Mużakowa) geopark which in 2009 was the first one in Poland to be granted the status of national geopark.

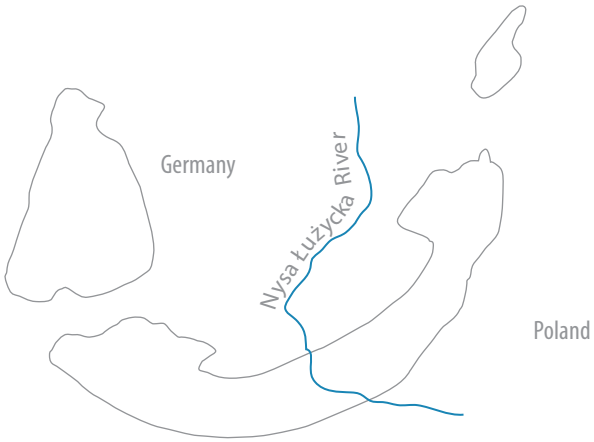


Photo Jacek Kośma

PROMOTION OF THE EARTH SCIENCE

„Earth Treasures" painting by Monika Pluta, pupil of the Elementary School no. 22 in Jaworzno

Dissemination of geological knowledge and education

Both education and popularization lie within the scope of the Institute's statutory tasks. Our museums show the fascinating history of our planet – the chain of evolution which began milliards of years ago but is still vivid and far from completion. Geological knowledge is spread also outside the Institute through on-line classes, geological summer schools, competitions for children and youngsters and outdoor exhibitions.

We participate in all events promoting Earth science – the Day of the Earth, Polish Science Festival, Scientific Picnic and in fairs devoted to geology and environmental protection. Our educational publications concentrate on geological processes and objects which might otherwise have gone unnoticed on touristic trails or on holidays spent in various parts of the country.

Second „Geological Picnic" at Olsztyn near Częstochowa, organized jointly by the Institute and local self-government in July 2010. A pile of fossiliferous rocks, especially arranged for that event, turned to be a special attraction for young fossil collectors

Photo Arkadiusz Rabiński

Photo Piotr Angiel

THE POLISH GEOLOGICAL SURVEY

The Minister responsible for the environment will entrust carrying out of the tasks of the Polish geological survey to the Polish Geological Institute.

Geological and Mining Law, Act of the 4th of February 1994, Art.102 A

GEOLOGICAL CARTOGRAPHY

- ...compilation of digital geological series maps for the entire Polish territory
- ...geological studies aimed at identifying sites for large-scale constructions, including nuclear power plants
- ...exploration for geological formations and structures for a safe storage of fuels and waste
- ...recognition of thermal conditions to promote the development of renewable energy

GEOLOGICAL INFORMATION

- ...Central Geological Archives – acquisition and providing access to archival geological collections (rock samples, documents, maps)
- ...Central geological and hydrogeological data bank – acquisition, updating and providing access to digital geological data
- ...Balance of mineral resources – listing of data on the state of development, magnitude and production
- ... Register of mining areas – updating and providing access to information on mining areas

ENVIRONMENTAL PROTECTION

- ...monitoring and counteracting natural hazards (landslides, ground settlement, karst, marine erosion)
- ...monitoring the condition of the natural environment including human-induced soils and ground pollution
- ...geodiversity protection