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East Europe Report

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7 October 1983

EAST EUROPE REPORT
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ALBANIA

DATA ON SCIENTIFIC, TECHNICAL INFORMATION AND DOCUMENTATION CENTER

Tirana BASHKIMI in Albanian 13 Jul 83 pp 1, 2

[Interview with Genc Xhuvani, director of the Scientific and Technical Information and Documentation Center: "In the Service of the Scientific Management of Our Economy and Culture"]

[Excerpts] Question: Comrade Genc, would you please inform us about the fields of activity and goals of the Scientific and Technical Information and Documentation Center?

Answer: Some time ago, a national scientific and technical information and documentation system was created in Albania. Now this system consists of the Scientific and Technical Information and Documentation Center, as a scientific institution attached to the Academy of Sciences, and four scientific units under its jurisdiction, which will exercise their activity in the field of the science and technology of geology and mines, agriculture, petroleum, and mechanics in the appropriate research institutions. In the near future, an additional four units will be set up, operating in the fields of the science and technology of energy, metallurgy and ore processing and petroleum technology. They will also operate in the respective research institutes, and as a service to these institutes.

Question: What are the duties of the center?

Answer: A very rich treasury of scientific and technical documentation has been amassed in the nearly 40 years of building socialism in Albania. This wide and rich scientific and technical documentation, which is deposited in the archives of our central and scientific institutions, in our production enterprises and in our libraries, represents thousands of studies, projects and results achieved in the solution of the most varied scientific and technical problems. It should be emphasized that all these successes in socialist Albania have been achieved despite the fierce imperialist-revisionist blockade and the procrastination and sabotage of foreign and domestic enemies. Also, during the years of the party, a rich documentation of foreign science and technology has been collected and organized, in the archives of our scientific institutions and of the production enterprises, in our libraries, etc. This documentation has been continually enriched and it contains millions of publications, monographs, various data, special facts, etc, which reflect

the studies and achievements of contemporary world science and technology in many fields, subdivisions of fields, and on specific subjects.

One of the main duties of the Scientific and Technical Information and Documentation Center and of its dependent units is the organization and maximum and optimum utilization of this treasury which our country has (and is continually enriching) as well as the placing of this information at the disposal of Albanian scholars in scientific research institutions and in production enterprises, of innovators, etc, while continually updating the information with the latest achievements of Albanian and world science and technology, which has been processed, organized and evaluated on the basis of unified scientific and methodical criteria. Only in this way will it be able to serve as very valuable material for our scholars in solving the problems which life presents and which our scientific studies and research set forth, saving a relatively large amount of time which is spent today in collecting data and researching various materials in archives and libraries. The center will be equipped with modern apparatus and equipment which will be used to input into the "memory" of the machines and to continually update the scientific and technical information and documentation, apparatus which is being provided gradually, in accordance with a detailed schedule prepared by the Academy of Sciences.

Question: What has been the best way to organize work and what are some of the results achieved so far?

Answer: Of special importance is the skilled, systematic preparatory work which the scientific cadres of the center and of the units must execute for the selection, organizations, evaluation, and indexing of the scientific and technical documentation which the scientific institutes and libraries have in those fields or subdivisions of fields or on those specific subjects which are connected with the study themes of the institutes included in the national information system. In this direction, good work has been done by the geology and the mining units, in particular. They have organized, evaluated, etc, a relatively large volume of scientific and technical documentation. They have organized consultations with workers of the scientific and teaching institutions and with the production enterprises in regard to the problems which give them the most anxiety and in regard to the supplying of scientific and technical documentation. Of great importance is the interest which directors and, in general, scientific workers of study institutions and cadres of enterprises must show, especially in accelerating the processing and organization of the existing documentation.

Question: What are the duties of the ministries and the other scientific institutions in regard to the center?

Answer: In order for the national scientific and technical information and documentation system to be put into operation as soon and as effectively as possible, it is most important that the directors of the ministries and of the various scientific research institutions show goodwill by making the necessary skilled cadres available to the center and its dependent units. Of course, it is a matter of bringing skilled, experienced cadres into this system. This matter must be properly regarded. The cadres must be trained and

skilled; they must be experienced and must have a mastery of foreign languages; they must be organized in their work and have a desire to follow the developments of science and technology in our country and progress in this field in the world.

CSO: 2102/1

LONG-RANGE OIL-GAS EXPLORATION PROGRAM OUTLINED

Warsaw PRZEGLAD GEOLOGICZNY in Polish No 1, Jan 83 pp 26-30

[Article by Piotr Karnkowski, Zbigniew Korab, Karol Skarbek and Zygmunt Sliwinski: "Findings of Geological Explorations in 1976-80 and a Program for the Current Five-Year Period."]

[Text] For the past five years, geological prospecting and exploration for oil has been undertaken in regions with the highest evaluated prospects for crude oil and natural gas deposits, i.e., in the Carpathian piedmont region, in the overthrust zone of Carpathian flysch formations and the Polish Depression (pre-Sudeten monocline and Western Pomerania) (Fig. 1). Since 1979, the annual production of natural gas from deposits in the Polish Depression has been higher than the output from the Carpathians and the piedmont area. Within this period, 45 natural gas deposits and 6 crude deposits have been discovered. Most are small or medium in size, and one--at Zuchlow--could be classified as a large deposit according to our nomenclature.

Between 1966 and 1970, exploratory drilling of a total length of 2 million m was carried out; the production of gas in the meantime was 14 billion cubic meters. In contrast, while between 1971 and 1975 drilling activity declined to 1.875 million m, the output rose to over 27 billion m³, the tendency becoming even more pronounced in 1976-80. This caused a more rapid exploitation of operative reserves and a lowering of their extraction capacity. The reduction of the extent of drilling in the past five years because of material and technical shortages affected mainly deep exploration bore holes (below 3,500 m), leading to delays in surveys of new territories and beds with good prospects for the discovery of crude and gas deposits, making it impossible to prepare an adequate program of exploratory drilling. The progress of exploration (drilling) and extraction during 1945 to 1980 is illustrated by Figure 2. The diagrams show that with a lag of about five years a decrease in drilling leads to a decline in output.

During the past five years, an increasing number of discovered deposits were found in complicated geological conditions in smaller reserves and well capacities, not always suitable for immediate introduction into operation. Seismic reflection plays a key role in geophysical prospecting (Fig. 3). In 1976-80, oil prospectors performed about 33,000 km of

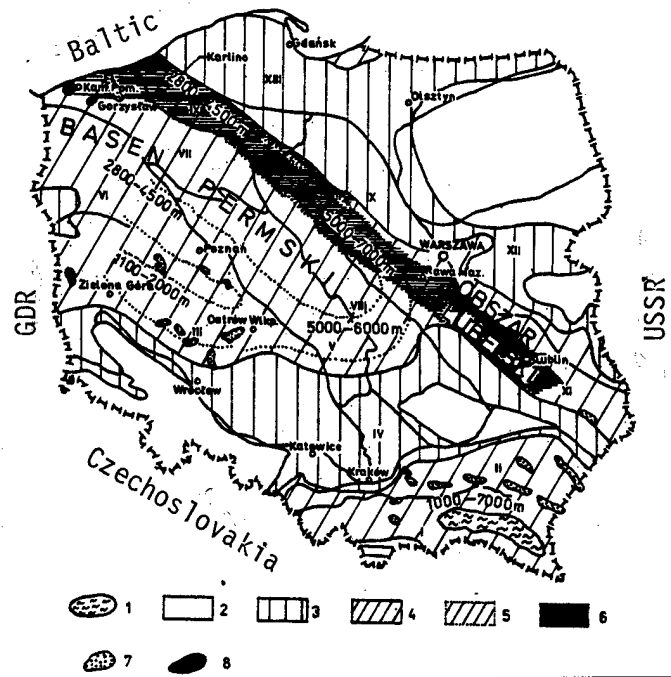


Fig. 1. Sketch map of qualitative estimation of gas and oil potential in Poland. (1) Carpathian oil- and gas-bearing region; (2) unpromising areas; (3) somewhat promising areas; (4) promising areas; (5) areas with major prospects connected with the Rotliegende; (6) prospects for discovery of gas deposits in Carboniferous materials; (7) gas deposits; (8) oil deposits.

regional and exploratory seismic profiles, including about 28,000 km in the Polish Depression, some 4,000 km on the Carpathian piedmont and some 2,000 km in the Carpathian Mountains. Within this time, 120 local structures were prepared for exploratory drilling. Annually, from 8,000 km in 1976 to 5,500 km in 1980 were performed. The drop in exploratory work occurred after 1978. Measurements in situ were mainly conducted (over 80 percent) using digital recording equipment, multiple profile (12-24) methods, with mostly dynamite explosions to induce waves. Two teams applied vibration sources.

Thanks to the introduction of modern methods and technology in registration and processing of data, the effectiveness of seismic studies has been enhanced in terms of greater depth and improved quality of results, both in the Polish Depression when mapping out the boundaries of the Permian and lower beds, as well as in mapping the boundaries of the Miocene, and its substrate in the piedmont area of the Carpathians and under the flysch overthrust of the Carpathians. The degree of geophysical exploration in the nation has grown from 0.47 to 0.69 km/km², and

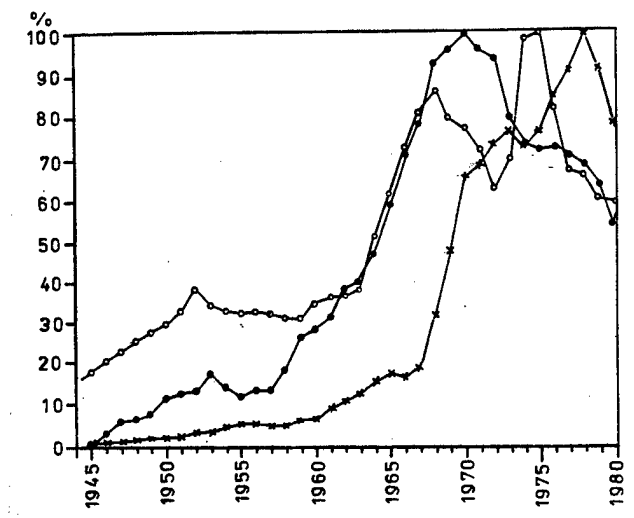


Fig. 2. Developments in geological-prospecting drilling and production of oil and gas in the years 1945-80. (1) metric length of geological-prospecting drilling; (2) production of oil; (3) production of gas.

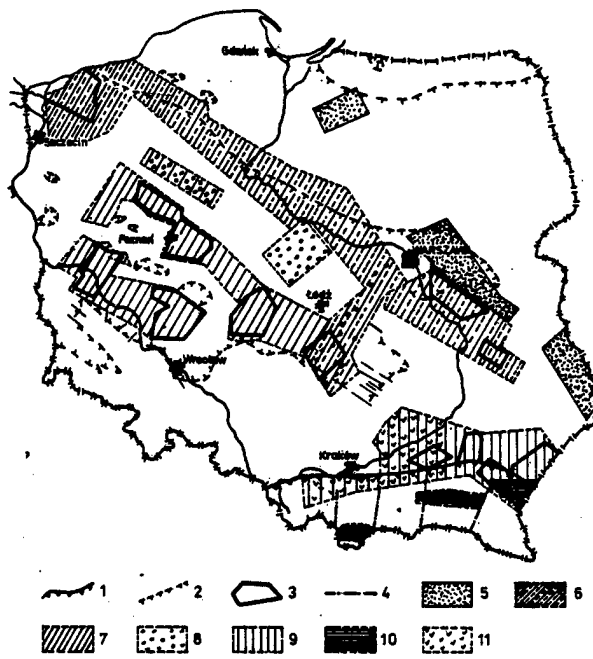


Fig. 3. Sketch map of distribution of designed seismic surveys for the years 1981-85. (1) line of Carpathian flysch overthrust; (2) extent of Rotliegende rocks; (3) area of seismic surveys designed for 1981; (4) designed regional profiles. Prospecting of rocks of: (5) Lower Paleozoic, (6) Carboniferous and Devonian, (7) Permian, (8) Mesozoic, (9) Miocene, (10) Carpathian flysch, (11) Mesozoic and Paleozoic beneath Miocene.

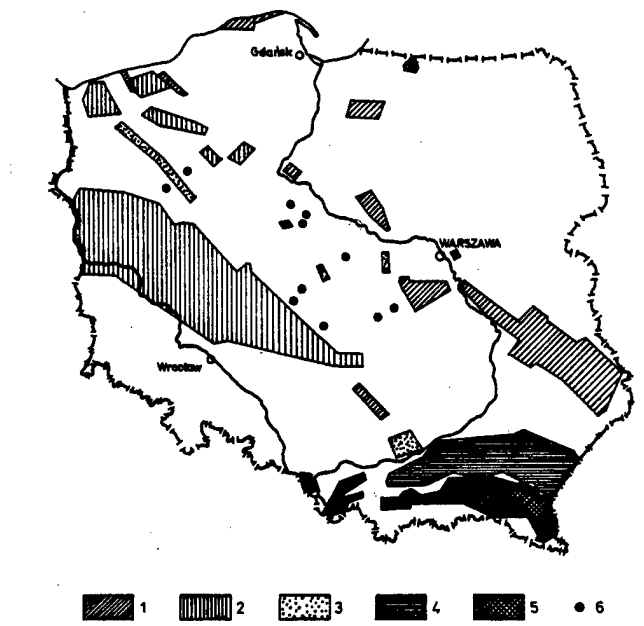


Fig. 4. Sketch map of distribution of prospecting works and research on hydrocarbons for the years 1981-85. Generalized areas in which prospecting is aimed at: (1) Paleozoic occurring beneath Permian, (2) Permian, (3) Mesozoic, (4) Miocene and morphological basement in Carpathian Foredeep and beneath overthrust of Carpathian flysch, (5) Carpathian flysch, (6) deep exploratory drillings (5,000-7,000 m deep).

specifically in the Carpathians from 0.37 to 0.46; in the piedmont exploration has grown from 0.97 to 1.20 and in the Polish Depression from 0.47 to 0.57 km/km².

As regards the degree of seismic survey of the nation, in terms of current tasks posed to seismology by oil geologists, profiles made by using digital recording equipment are of practical importance; they account for hardly 20 percent of the work conducted so far. Refraction wave studies continued reinter-pretation of data from the area of the Pre-Sudeten monocline. In this region, especially in the Carpathian piedmont, experiments with the electromagnetic method (Wega D) were conducted, defining a great number of objects that were classified as worthy of investigation. Gravimetric surveying was continued in the Carpathians, as well as work on tying in the gravimetric network of Poland—German Democratic Republic and Czechoslovakia, and joint work in reinter-pretation of data for the zones along the national border. In 1976-80, the Geological Institute performed, mainly in the Polish Depression, some 4,500 km of seismic profiles, continuing the work of geological studies of the nation. These profiles are also important in oil prospecting.

Seismically, the best studied oil and gas regions are: the Permian Basin (except for its central part) and the Carpathian Foredeep with the adjacent zone of the Carpathian overthrust (Fig. 3). In the Permian Basin the main steps in the exploration of Mesozoic and Permian formations, including the roof of the Rotliegende, have been quite adequate.¹ Zones in which mapping boundaries is particularly difficult in the Zechstein dolomite and other rocks, associated with areas where seismological conditions are particularly unfavorable, are more or less limited. Most of the mapped structural forms have a surface of just a few square kilometers, leading to major difficulties in providing the front of work for exploratory drilling.^{1,3,5-7}

In the Carpathian Foredeep the efficacy of seismic exploration in the Miocene and its substrates down through the roof of the Jurassic is good. In this region, studies of the Mesopaleozoic substrate beneath the Jurassic roof remained difficult. The Miocene lends itself well to survey of local structure, as well as lithologic and combination traps.

Carpathian flysch formations were explored by drilling with a minimum use of seismic preparation. The efficacy of standard seismic prospecting in this region is insufficient. In the Lublin synclinorium, the latest seismic data from the Carboniferous and the Devonian suggest favorable prospects for proper preparation of structures for exploratory drilling in this geologic complex. The discovery of small-amplitude structures in the Cambrian on the border of the Mazur-Suwalki Province is a difficult task, requiring proper correction of effective signal and its isolation from the background. A brief summary of the efficacy of seismic research shows that in the coming years exploration will require further modernization of seismologic equipment and the use of new interpretive methods.

In the geophysical drilling, the use of recently introduced statistical techniques, normalization and other methods resulted in effective interpretation of the Miocene and Rotliegende rocks. Major progress has been achieved with interpretation of the Zechstein coal beds and Mesozoic and Paleozoic substrates of the Carpathian Foredeep. Fairly effective interpretations are also obtained for quite a few Carpathian flysch horizons, as well as for the Middle Cambrian on the East European Platform. Interpretation problems with the Carboniferous and Devonian are more complicated. Saturation of fissured coal-bearing levels and productivity of beds with poor collector properties are still difficult to evaluate.

Each of these stratigraphic levels is characterized by specific geologic-geophysical conditions requiring appropriate exploration and interpretational methods. Despite accomplishments during years of work, a large proportion of bore holes remains, because of high temperatures (130-180°C), unsuitable for the use of temperature-unstable instrumentation, making it impossible to map reliable geophysical profiles and therefore obtain effective interpretations. The use of instruments that are not calibrated and do not compensate for hole geometry impairs the quality of geophysical data and makes it impractical to use computerized quantitative data interpretation on a large scale. In addition, these difficulties aggravate the shortages of important methods of porosity profiling, such as acoustic compensational profiling, neutron density profiling, etc.

In the past five years, exploration, reconnaissance and prospecting have been conducted mainly on the Polish Depression (some 60 percent of projects) to identify the oil and gas prospects of the Permian formations, as well as in the Carpathian Foredeep and the border zone of the Carpathian overthrust (some 25 percent of projects) to study the gas prospects of the Miocene formations and their Mesozoic subjacent beds. On a smaller scale, research was continued to explore oil and gas prospects of the Carpathian flysch formations.

In the past five years, 1,400 m of exploratory and prospecting drilling was performed, including 55 percent in the Polish Depression, some 20 percent in the Carpathian Foredeep and 25 percent in the Carpathians (mainly in the border zone as reconnaissance of the gas prospects of the Miocene formations). The geologic study of promising areas, measured by the number of meters drilled per km² of area, currently is 20.3 m/km² in the Polish Depression, 114.5 m/km² in the Carpathian Foredeep and 91.5 m/km² in the Carpathians. The degree of geological study in Poland to the depth of 3,000 m is 30 m/km², and beneath this depth just 2 m/km². In the meantime, some 65 percent of predicted reserves occur at depths greater than 3,000 m (according to estimates of 1979).^{3,7}

The largest increment of proven reserves was obtained in 1976-80 in the Polish Depression (some 40 billion m³ of gas and 400,000 tons of crude oil). In the Carpathian Foredeep, the documented increment of natural gas reserves was somewhat lower than the amount expected (18.1 billion m³). In the past five years, the Geological Institute performed 83,605 m of exploratory drilling for regional study of oil and gas prospects of the Permian and sub-Permian beds in the Polish Depression and flysch formations and its Mesopaleozoic substrate in the Carpathians.

The analysis of the geologic prospecting findings suggests that the promising formations for oil and gas reserves have a complicated geologic structure and difficult occurrence settings. These include:

- a great variability of lithologic composition of formations with prospects and generally low collector and filtrational properties;
- strong tectonic interference caused in the Polish Depression by salt tectonics;
- generally small dimensions of local structures, with the likelihood of discovering small and medium sized deposits;
- a relatively great depth of some promising beds on the order of 3,500-7,000 m;
- abnormal deposit pressures (e.g., 1.8-1.9 kG/cm²/10 m) and high temperatures (e.g., 150°C and higher);
- sealed formations (plastic ooze and salt in Zechstein), complicating drilling and making reserves less accessible; and
- great variability of chemical composition of gas in the Permian beds (15-85 percent nitrogen) and hydrogen sulfide content in Zechstein gas.

These factors lower the efficacy of exploratory work compared to other oil and gas provinces of the world, and require greater outlays to ensure proper technological conditions of prospecting work.⁹ With the current world price structure and difficulties in purchasing oil and gas, however, the search for domestic reserves, even those of small dimensions (occurring in complex geological conditions), is nevertheless profitable.

For maintaining the production of crude oil and natural gas at the level of 1976-80, exploration work should be intensified and raised at least to the level it reached earlier in the past five-year period. Therefore, the plan for 1981-85 stipulates as a minimum 1,850,000 meters of exploratory surveying and operation drilling and 25,000 km of seismic profiling, i.e., some 5,000 km annually. To attain this goal and provide the possibility for efficient exploratory work, the volume of exploratory geological drilling should be increased to 450,000 m annually.

The findings of geological exploration in the recent years provided a basis for correcting the estimate of predicted national reserves.⁴ Experts on oil exploration and the Central Geological Administration assign some 60 percent of reserves to the Permian formations in the Polish Depression, 15.5 percent to the Paleogene and Neogene of the Carpathians and Carpathian piedmont area, and some 7.5 percent to the Cambrian beds in the Polish Depression. The remaining stratigraphic entities account at most for 4.5 percent each, with their total around 17 percent of all predicted reserves.^{2,3,7}

The current state of geological knowledge of the nation and estimates of predicted reserves provide grounds for charting the geological exploration activities in the current five-year period. In 1981-85, geophysical work and geological exploration will be intensified in the most promising geological districts (Fig. 4). These are:

- a) the southern area of the pre-Sudeten monocline in the Wschowa-Ostrzeszow zone, prospecting for gas deposits in Rotliegende formations and basic Zechstein limestones. The depth range of drilling will be 1,400-2,000 m;
- b) the southern slope of the Wolsztyn Ridge in the Pniewy-Poznan-Jarocin-Kalisz zone, prospecting for natural gas deposits in the Rotliegende beds and in the Sulecin-Poznan zone for crude oil deposits in main dolomite formations. Depth ranges are 2,500-3,500 m;
- c) the area of the Western Pomerania in Kamien Pomorski-Wysoka Kamienska-Gorzyslaw-Karlino-Bialogard zone, prospecting for crude oil in main dolomite Zechstein beds and for gas in the Rotliegende and the Carboniferous. Depths ranges, 2,500-4,500 m.
- d) the piedmont area of the Carpathians and the adjacent zone of Carpathian flysch overthrust, prospecting for gas deposits in the Miocene and crude and gas in Mesopaleozoic beds subjacent to the Miocene. Depth range, 500-3,500 m; and
- e) the zone of shallow flysch folds of the Carpathians for crude oil and natural gas deposits mainly in Silesia and sub-Silesian areas.

In addition, exploratory work will be continued in order to:

- 1) elucidate the oil and gas prospects of flysch structures occurring deep in the Carpathians in the depth of 5,000-7,000 m;
- 2) investigate the oil and gas prospects of the Permian, Carboniferous and Devonian in the Polish Depression, especially in the provinces: Szczecin-Bydgoszcz-Torun-Sierpc, Kutno-Rawa-Mazowiecka-Mszczonow, Lublin-Belzce. Drilling depth ranges, 4,000-6,000 m;
- 3) investigate oil and gas prospects of the Cambrian near Leba, in the area of Lidzbarek, Warminski and Podlasie using new methods. Depth range, 2,000-3,000 m; and
- 4) study oil and gas prospects of the Mesozoic in the Polish Depression, using special methods to study these formations in near-eruptive and intereruptive zones and lithologic traps. Depth ranges, 3,000-5,000 m.

Of the total volume of exploratory and prospecting drilling, some 40 percent will be devoted to surveying oil and gas prospects of the pre-Sudeten monocline, some 15 percent to study oil and gas prospects of the Permian and Carboniferous in Pomerania and some 25 percent to examine the oil and gas prospects of the Miocene and its subjacent Mesozoic.

Exploratory problems, such as discovery of nonstructural traps beneath the Zechstein screen, identification of lithologic variations and study of deep structural features of Carpathian flysch formations, due to the complexity of the task, require that oil geophysics, which has an experienced cadre of professional researchers to be provided with modern digital seismic equipment (96-channel units) allowing computerized data processing and the use of software for three-dimensional data interpretation, analysis of lithologic variations, occurrence of hydrocarbon deposits and similar tasks. In terms of economics and environmental protection, the use of nonexplosive excitation of waves (vibrators, air cannons) should substitute completely for explosive techniques. With increased depths of bore holes, modernization of geophysical drilling equipment with introduction of multifunctional digital equipment is necessary. Such equipment guarantees reliable registration of data in conditions of high temperatures and pressures, allowing comprehensive interpretation.

Complex conditions of the geological setting (major lithologic variations, unexpected bed reductions, abnormal pressures and temperatures) call for enhanced geological supervision of drilling operation with availability to geological research of Geoservice-type laboratories and installation of additional equipment in permanent laboratories. The huge influx of geologic and geophysical data presses for creation of a data bank and electronic data processing. Continuing specialized geochemical, lithologic-facial and other studies with analysis and comprehensive synthesis of geological information should be continued for proper orientation of exploratory work. In this area, cooperation with research institutes in the framework of other ministries is envisaged. Providing the drilling operations with all the necessary technology, enabling the drilling to reach promising deep beds in the Carpathians and the Polish Depression, especially primary dolomite with abnormally high pressures, which, in addition

to hydrocarbon, contain hydrogen sulfide, as well as drilling of older formations, subjacent to the Zechstein salt series are essential.

BIBLIOGRAPHY

1. Ancupow P.W., Korab Z. et al. "Determination of the Geological Structure and Development of Effective Methods for Prospecting and Exploration of Crude Oil and Natural Gas Deposits in the Biohermal Sediments of Primary Dolomite and Terrigenous Rotliegende Formations in the Polish Depression: Study Under Contract with VNIGNI-Moscow," ARCH. ZOG GN GEONAF TA, Warsaw, 1978.
2. Depowski S. "Problems of Quantitative Evaluation of Forecasts of Oil and Gas Prospects," PRZEGLAD GEOLOGICZNY no 7, 1973.
3. Depowski S. et al. "Estimate of Predicted Reserves of Crude Oil and Natural Gas of the Polish People's Republic: State as of Jan 1 1979," ARCH. INSTITUTA GEOLOGICZNEGO, Warsaw, 1980.
4. Depowski S. "Gas and Oil-Rich Provinces of Poland," PRZEGLAD GEOLOGICZNY, no 5, 1981.
5. Karnkowski P. "Oil Geology of the Polish Depression," PRZEGLAD INST. NAFT. I GAZOWN., no 31, 1980.
6. Karnkowski P., Maksimov S.P. et al. "Findings of Oil and Gas Prospecting in 1976-80 in the Polish People's Republic and Future Tasks," GEOLOGIYA NEFTI I GAZA, no 5, 1982.
7. Skarbek K. et al. "Evaluation of the Predicted Reserves of Natural Gas and Crude Oil in Poland as of Jan 1 1979: Oil Industry Monograph," ARCH ZOG GN GEONAF TA, Warsaw, 1979.
8. Sokolowski J., Deczkowski Z. "Variations of the Structural Systems of the Main Prospect Ridge Formations of Pre-Sudeten Province," NAFTA, no 6, 1977.
9. Znosko J. "Will We Discover Major Oil Deposits in Poland?" PRZEGLAD GEOLOGICZNY, no 1, 1982.

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ARCTIC-ANTARCTIC GEOLOGICAL RESEARCH DESCRIBED

Western Antarctic Polar Research

Warsaw PRZEGLAD GEOLOGICZNY in Polish No 11, Nov 82 pp 582-588

[Article by Krzysztof Birkenmajer, Polish Academy of Sciences: "Polish Geological Research in West Antarctica (1980-1981)"]

[Text] The 1980-1981 antarctic summer was the last season of geological research on King George Island in the South Shetlands archipelago in West Antarctica (Fig 1) as part of the PAN (Polish Academy of Sciences) MR.II.16-MR.I.29 interministerial plan. This work, begun during the Polish Academy of Sciences' Third Expedition to the H. Arctowski Station (1977-1978), was continued through four antarctic seasons (3, 4, 6, 28, 29, 10) which resulted in detailed recognition of the geological structure of King George Island, the largest island in the South Shetlands archipelago. The Fifth Expedition (1980-1981) organized by the PAN Ecology Institute and led by the author of the foregoing article, was comprised of many independently operating scientific groups, four of which represented the earth sciences:

--a geological photo group from the PAN Institute for Geological Sciences: Prof Dr K. Birkenmajer (leader), W. Danowski, and K. Rolnicki, engineer;

--a sedimentological group from the PAN Institute for Geological Sciences: Prof Dr R. Gradzinski and Dr S. Porebski;

--a paleontological group from the PAN Paleobiology Research Center: Dr Andrzej Gazdzicki and Dr R. Wrona;

--a terrain geophysics group from the PAN Geophysics Institute: A. Szymanski (master's degree) and T. Radomyski, engineer.

An Mi-2 helicopter (Polish production), a small research cutter, and rubber boats with attachable motors were used for transportation in the South Shetlands.

Regional Geology

Regional geology research was conducted (K. Birkenmajer) on King George Island and in the eastern part of Nelson Island. The work was done with the help of a helicopter.

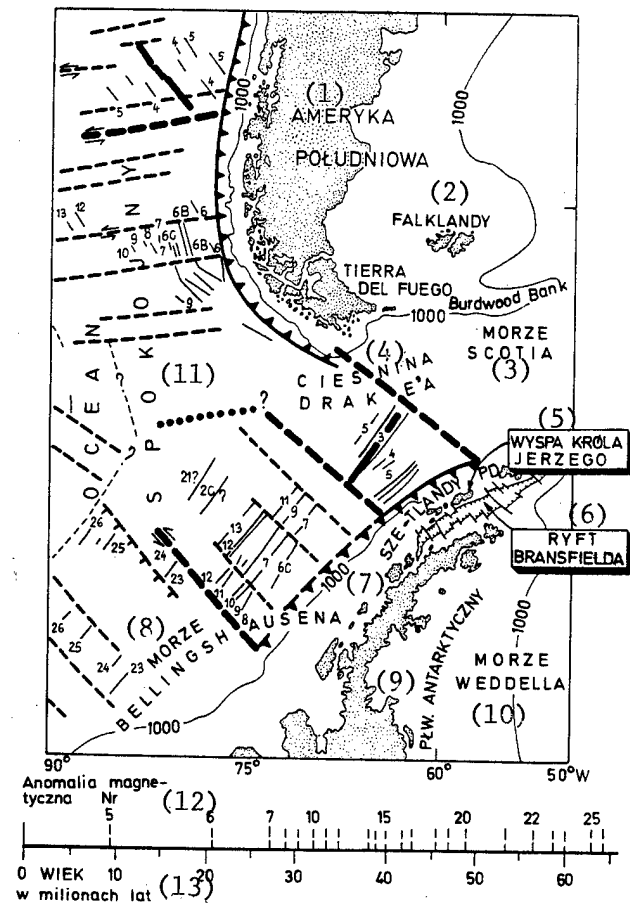


Fig. 1. Position of the South Shetland Islands against plate-tectonic elements of south-eastern Pacific.

Magnetic anomalies, mid-ocean ridges and fracture zones after Herron and Tucholke (cf. 19), simplified. Continental plate margins barbed.

Key:

1. South America
2. Falklands
3. Scoti Sea
4. Drake Passage
5. King George Island
6. Bransfield Strait
7. South Shetlands
8. Bellingshausen Sea
9. Antarctic Peninsula
10. Weddell Sea
11. Pacific Ocean
12. Magnetic anomaly
13. Age (in million years)

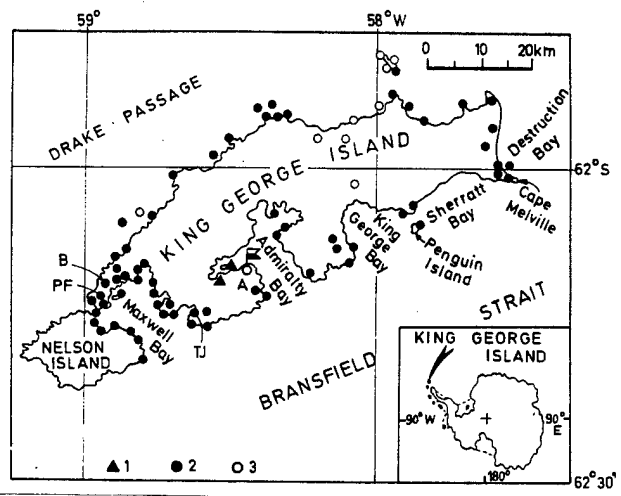


Fig. 2. Main landing sites for geological survey during the Vth Polish Antarctic Expedition to H. Arctowski Station.

1 - landing by boat, 2 - landing by helicopter, 3 - aerial observations, A - Arctowski Station (Poland), B - Bellingshausen Station (USSR), PF - Presidente Frei - Teniente Marsh Station (Chile), TJ - Teniente Jubany Station (Argentina).

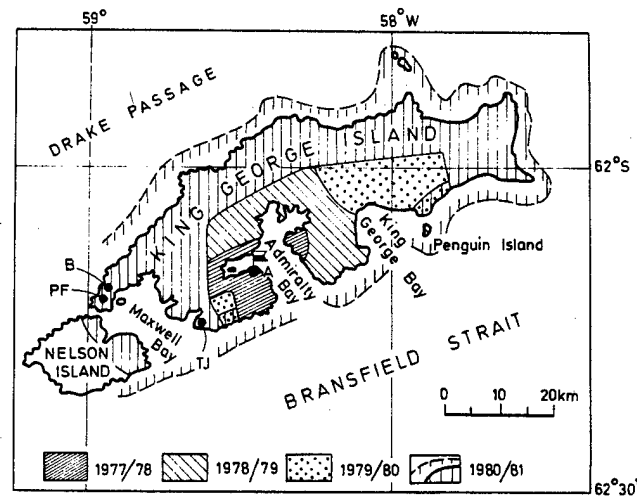


Fig. 3. Areas geologically mapped during the Polish Antarctic Expeditions to H. Arctowski Station, 1977-1981.

A, B, PF, TJ - see Fig. 2.

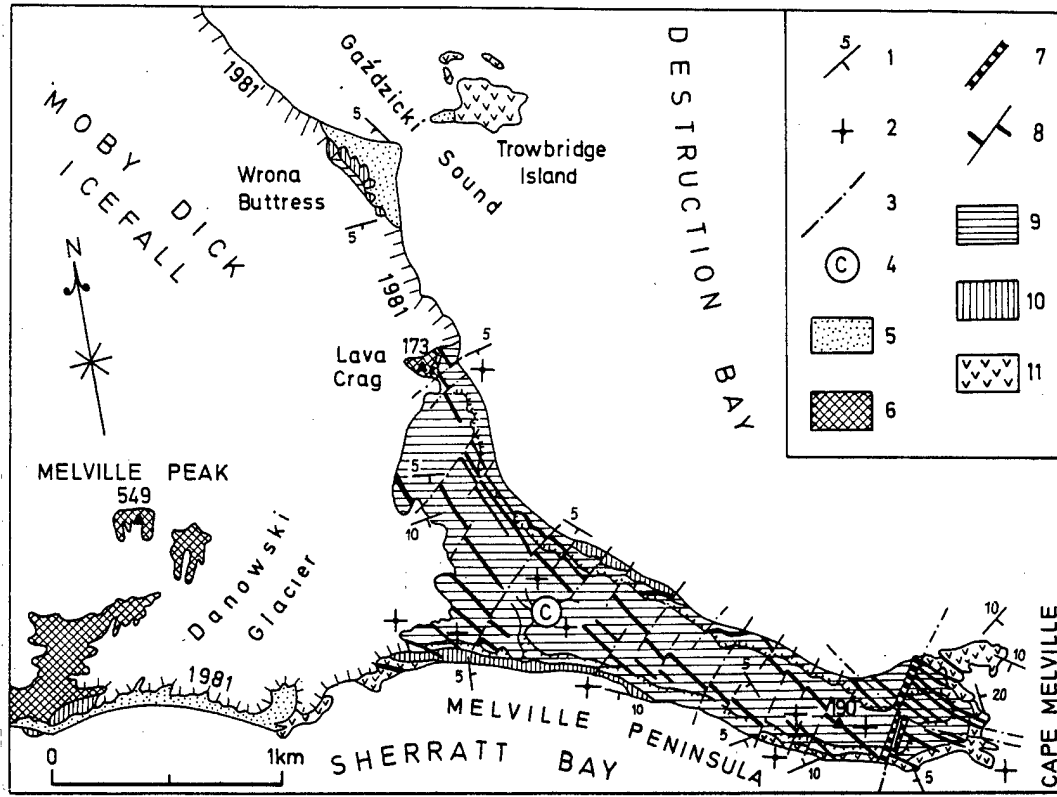


Fig. 4. Geological structure of the Cape Melville area, King George Island. (above)

1 – strike and dip, 2 – horizontal strata, 3 – faults, 4 – main site with fossils (Crab Mound), 5 – Holocene sediments, 6 – Quaternary volcanics of the Melville Peak cone (Penguin Island Group), 7 – younger dykes (Cape Syrezol Group), 8 – older dykes (?Admiralty Bay Group), 9 – Cape Melville Formation, 10 – Destruction Bay Formation, 11 – Sherratt Bay Formation (9–11 – Moby Dick Group).

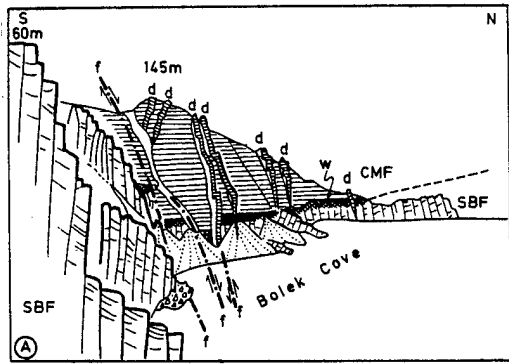
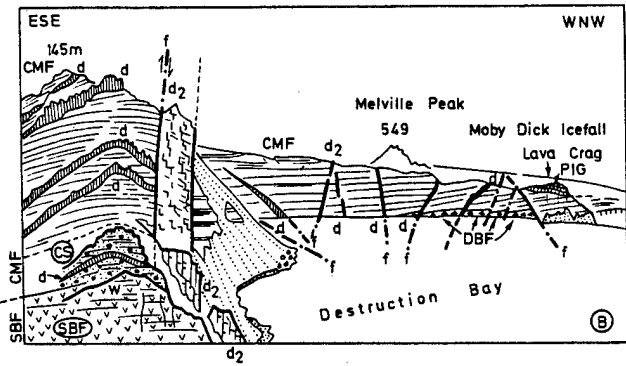


Fig. 5. Perspective views of exposures at Cape Melville (A) and (at left) at Melville Peninsula (B).

Moby Dick Group: SBF – Sherratt Bay Formation (basalt lava sheet, w – weathered upper part of lava), DBF – Destruction Bay Formation (tuffs and psammites with marine fauna), CMF – Cape Melville Formation (glaciomarine sediments with fauna, cs – sandy conglomerate). Intrusions: d – andesite dykes (?Admiralty Bay Group), d₂ – basaltic dykes (Cape Syrezol Group). Quaternary volcanics: PIG – Penguin Group Island, f – faults, talus stippled.



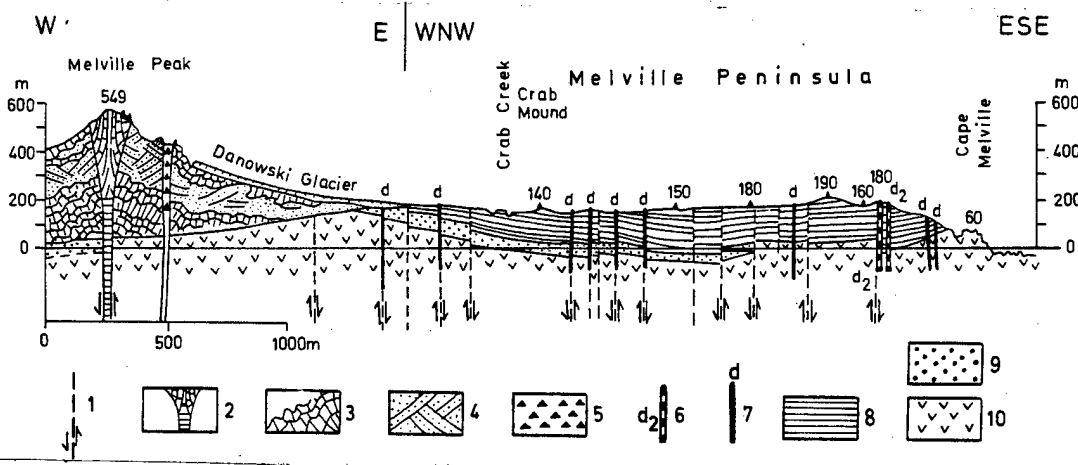
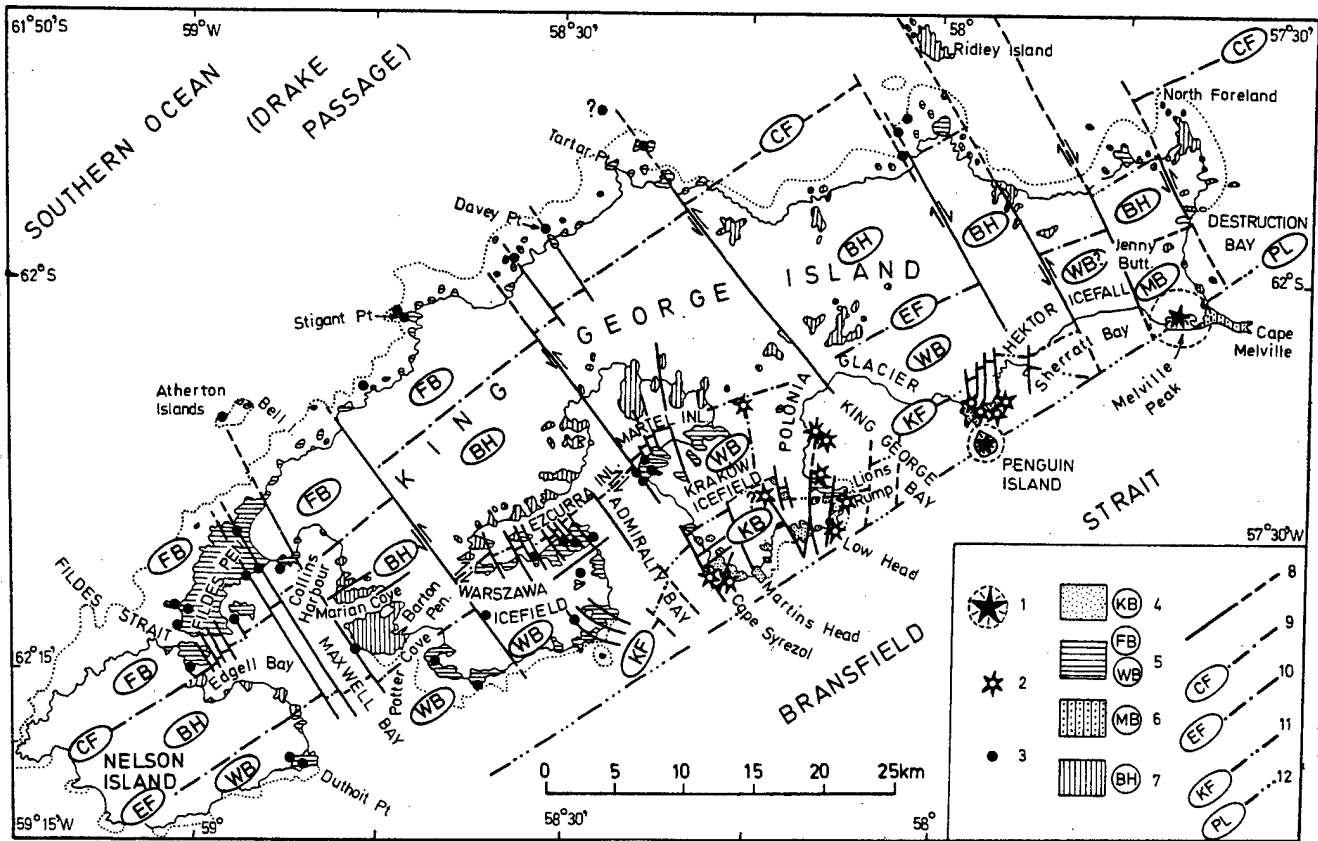


Fig. 6. Geological cross-section along Melville Peninsula. (above)

1 - fault. Penguin Island Group (Quaternary): 2 - basalt plug, 3 - basalt lava flows, 4 - yellow pyroclastics, 5 - red scoriaceous lava and pyroclastic breccias. Intrusions: d_2 - basalt dykes (Cape Syrezol Group), d - andesite dykes (Admiralty Bay Group?). Moby Dick Group: 8 - Cape Melville Formation (glaciomarine sediments), 9 - Destruction Bay Formation (basalt tuffs), 10 - Sherratt Bay Formation (basalt lava).

Fig. 7. Tectonic sketch-map of King George Island. (below)

Volcanic centres: 1 - Penguin Island Group (Quaternary), 2 - Cape Syrezol, Legru Bay and Chopin Ridge Groups (Pliocene - early Pleistocene), 3 - Admiralty Bay Group (Miocene - Pliocene) and King George Island Supergroup (Miocene - Eocene?). Tectonic elements: 4 - Kraków Block, 5 - Fildes Block (FB) and Warszawa Block (WB), 6 - Melville Block, 7 - Barton Horst. Faults: 8 - transversal faults (strike-slip, partly dip-slip), 9, 10 - longitudinal faults, strike-slip (CF - Collins Fault; EF - Ezcurra Fault), 11 - Kraków Fault (dip-slip), 12 - volcanic Penguin Line.



as a means of transport, a reconnaissance party, and by using a research cutter. Geological photos, on a 1:50,000 scale, were made covering an area of approximately 1,000 square kilometers and a coastal zone of islets and reefs about 10 kilometers from land (Fig 2, 3). In addition, several geological maps on a more detailed scale were made of such selected areas as, for example, Cape Melville-Melville Peak (Fig 4) in the eastern part of King George Island, Potter Peninsula, Barton Peninsula in Maxwell Bay, and others.

One of the most interesting discoveries was the recognition, by K. Birkenmajer, of the glaciomarine character of the sediment pile at Cape Melville (10, 12, 16), previously believed, mistakenly by British researchers, to be Quaternary lavas and tuffs (1, 2, 21). The Cape Melville formation distinguished here (Figs 5, 6) furnished proof of the Tertiary glaciation of Antarctica, older than the Pliocene Polonez glaciation (7, 8, 13), which was called the Melville glaciation (10-12). Many erratic blocks appear here in the shallow-marine sediments, often larger than 1.5 meters in diameter, brought in by the drifting icebergs from the antarctic continent. The Cape Melville formation contains a rich marine flora and fauna of a Cretaceous character (20, 11, 25, 24) as well as of a Tertiary character. It appears that the Cretaceous residues are in the secondary deposit of the Tertiary sediment, possibly of the Miocene era (16).

The stratigraphy and tectonics, volcanic forms and ore-bearing mineralization, were recognized in the Cenozoic and Mesozoic complexes of King George Island and Nelson Island. Many transversal and longitudinal faults (strike-slip) were traced and the succession and character of the early-Tertiary fault deformations of this region were recognized (15), Figs 7, 8). The structure was examined and the succession

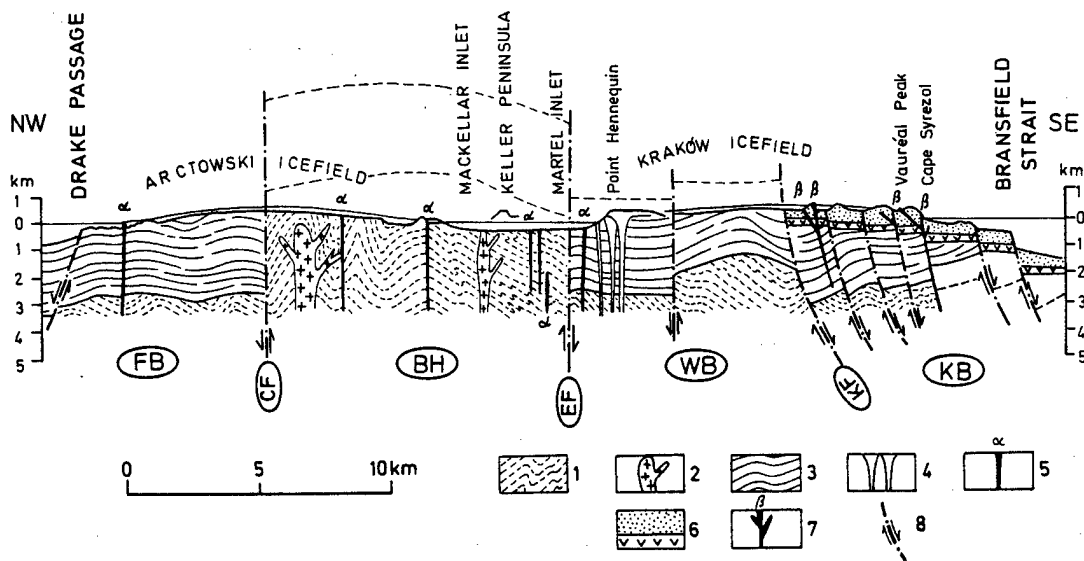


Fig. 8. Schematic geological cross-section of King George Island, middle part.

1 - Martel Inlet Group and Cardozo Cove Group, 2 - Wegger Peak Group (plutons), 3, 4 - King George Island Supergroup (3 - stratiform complex, 4 - vents), 5 - Admiralty Bay Group

(plugs, dykes), 6 - Kraków Icefield Supergroup (with olivine-basalt at the base), 7 - Cape Syrezol Group (plugs, dykes), 8 - faults. Other symbols - as in Fig. 7.

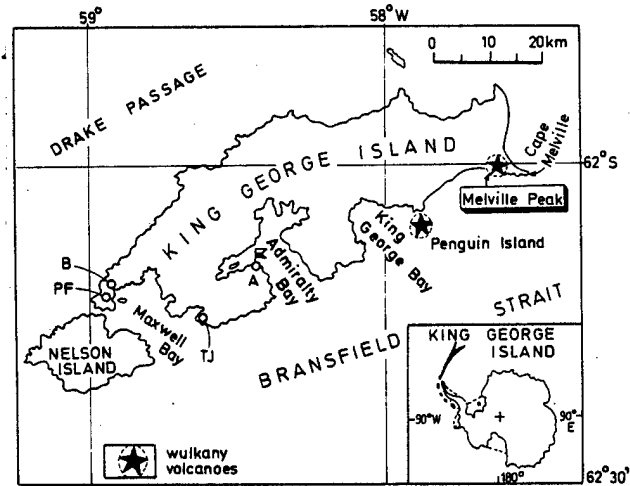


Fig. 9. Quaternary volcanoes of King George Island, along the northern margin of Bransfield Strait: Penguin Island (dormant) and Melville Peak (extinct).

of the volcanic phases of the extinct Quaternary Melville Peak cone were determined (14), Figs 9, 10). Many oriented samples of volcanic lavas and plugs were taken for paleomagnetic examination, as well as samples for petrographic, geochemical and radiometric study.

Sedimentology

The sedimentological group's (R. Gradzinski and S. Porebski) research was conducted, in part, jointly with the paleontological group. A closer study was made of the sedimentation environment of the Pliocene Polonez glaciation sediments on the Bransfield Strait coast, represented by the Polonez Cove formation. In the floor formations of Polonez Cove (Krakowiak Glacier link), recognized to be bottom moraines and glaciofluvial sediments (7, 9), two main facies were distinguished: solid and stratified mixes. In the overlying glaciomarine formations (Low Head, Siklawka and Oberek Cliff links) types of stratifications were recognized, as well as traces of under-sea erosion, the transport directions of clastic material, etc., which will make it possible to more closely characterize and reconstruct this proglacial environment.

The volcanic agglomerates (lahars) in the land Tertiary complex near H. Arctowski Station (Skua Cliff link, compare 5, 8) were also examined and the conditions for formation of Tertiary flora-bearing sediments and agglomerates on the Fildes Peninsula were identified. In addition, the present-day gravel beaches at Admiralty Bay were examined. The group used a helicopter for transportation.

Paleontology

The research of the paleontological group (A. Gazdzicki and R. Wrona) was conducted in part jointly with the sedimentological group and the geological photo group. Rich collections of marine invertebrates were taken from the Pliocene sediments of the Polonez Cove formation between Admiralty Bay and King George Bay (24). These, together with those previously collected (18) became the basis of many paleontological studies on mollusks, snails, brachiopods, sea urchins and bryozoans (17, 22, 23, 26).

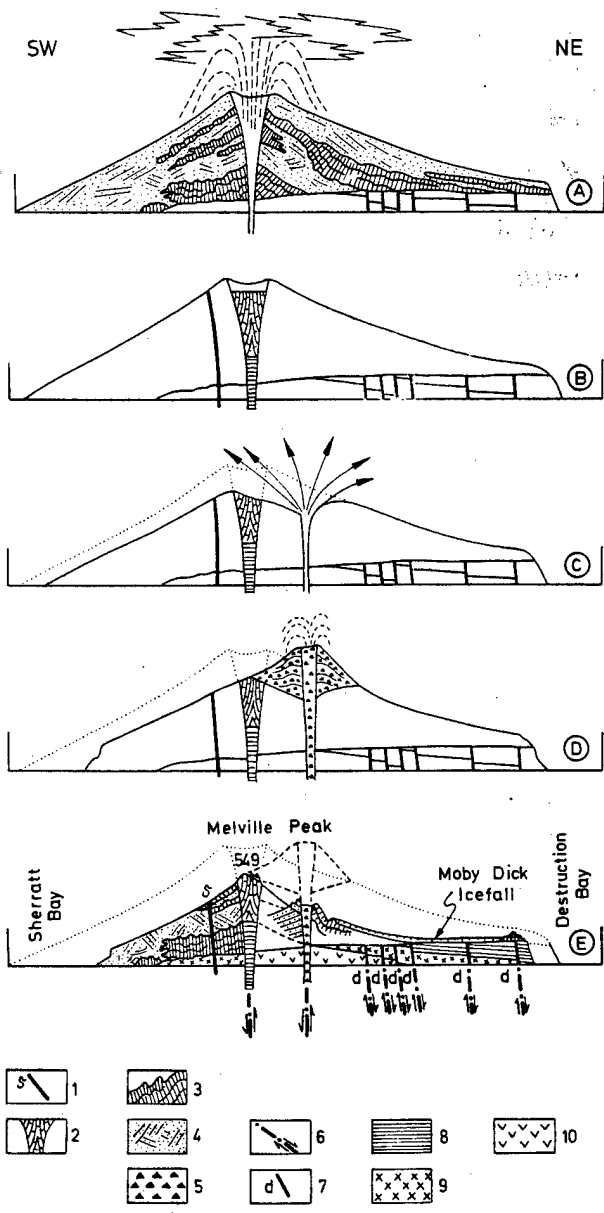


Fig. 10. Stages of formation of the Melville Peak cone (A-E; E - present stage).

First phase products: 1 - basalt dyke, 2 - basalt plug, 3 - black basalt lava flows, 4 - yellow pyroclastics. Second phase products: 5 - red scoriaceous lava and pyroclastic breccia (1-5 - Penguin Island Group), 6 - faults, 7 - older andesite dykes (Admiralty Bay Group ?). Moby Dick Group: 8 - Cape Melville Formation (glacio-marine sediments), 9 - Destruction Bay Formation (basalt tuffs), 10 - Sherratt Bay Formation (olivine basalt sheet).

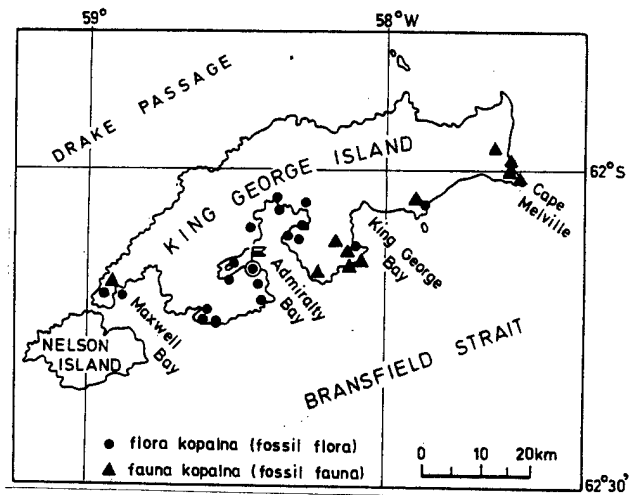


Fig. 11. Sites with fossil flora and fauna on King George Island examined by the Polish Antarctic Expeditions between 1977 and 1981.

Particular attention was devoted to the fossil-rich sediments of the Cape Melville formation, which contain remains of Cretaceous organisms, such as belemnites and coccoliths (20), probably occurring in the secondary deposit (12, 16), and also foraminiferans, polychaetes, mollusks, snails, coral, crabs, echinoderms, fish, and others in situ (24, 25, 16). These sediments formed under marine proglacial conditions during the Melville glaciation (Miocene ?), older than the Pliocene Polonez glaciation. Paleoecological studies were also conducted in these formations.

The collection of Cambrian erratic limestones containing remains of coral-shaped archaeocyathi and other organisms, originating from the glaciomarine sediments of both Tertiary glaciations--Polonez and Melville-- should also be mentioned. These erratics were brought to King George Island by glaciers and drifting icebergs from the interior of the antarctic continent (7, 9, 13, 16, 27).

The collecting of remains of flora fossils (leaves, seeds, wood, samples for pollen analysis) from the sediments of mainly the Tertiary era in Admiralty Bay and Maxwell Bay (Fig 11) was continued. The paleontological group used a helicopter and a cutter for transportation.

Exploratory Geophysics

As part of the land operations of the geophysical group (A. Szymanski and others), proton magnetometric measurements were made transversely of the geological structures, of the shore and glacier profiles between Ezcurra Bay and Bransfield Strait. Particular attention was called to the fault zones and the lava-sediment layer contacts with subvolcanic intrusions (dykes, plugs). A particular model area was selected south of H. Arctowski Station for detailed, magnetic profiling, based on precise, geodesic groundwork (T. Radomyski). A helicopter was used for transportation to geophysical work remote from the station.

Engineering Geology

As part of the work relating to protection of the natural environment, the recognition of geotechnical conditions, and the supplying of potable water to H. Arctowski Station, several shallow drillings were made to determine the depth of permafrost and the solid substrate under the gravel-rubble layers of marine terraces and alluvial cones (W. Danowski and K. Rolnicki). Samples were also taken for soil and geological engineering studies, samples of terrace waters, etc.

BIBLIOGRAPHY

1. Barton, C. M., "The Geology of King George Island, South Shetland Islands," Prel Rept Falkland Isl Dep Surv, 1961 No 12.
2. Barton, C. M., "The Geology of South Shetland Islands. III. The Stratigraphy of King George Island," Sci Repts Brit Antarctic Surv, 1965, 44.
3. Birkenmajer, K., "Polish Geological Research in West Antarctica, 1977-1978," PRZEGLAD GEOLOGICZNY, 1979, No 1.

4. Birkenmajer, K., "Polish Geological Research in West Antarctica, 1978-1979, *ibid.*, No 5.
5. Birkenmajer, K., "Tertiary Volcanic-Sedimentary Succession at Admiralty Bay, King George Island (South Shetland Islands, Antarctica)," *STUDIA GEOLOGICA POLONICA*, 1980, Vol 64.
6. Birkenmajer, K., "Reports on Geological Investigations of King George Island, South Shetland Islands (West Antarctica) in 1978-1979," *ibid.*
7. Birkenmajer, K., "Discovery of Pliocene Glaciation on King George Island, South Shetland Islands (West Antarctica)," *BULL. ACAD. POL. SC. SER. SC. TERRE*, 1980, Vol 27, Nos 1-2.
8. Birkenmajer, K., "Geology of Admiralty Bay, King George Island (South Shetland Islands). An Outline." *POL. POLAR.RES.*, 1980, 1.
9. Birkenmajer, K., "Pliocene Tillite-Bearing Succession of King George Island (South Shetland Islands, Antarctica)," *STUDIA GEOLOGICA POLONICA*, 1982, Vol 74.
10. Birkenmajer, K., "Report on Geological Investigations of King George Island and Nelson Island (South Shetland Islands, West Antarctica), in 1980-1981," *ibid.*
11. Birkenmajer, K., "Late Cretaceous (?) and Tertiary Glaciations of Antarctica; Evidence from the South Shetland Islands," Fourth Int. Symp. Antarctic Earth-Science (Adelaide, 1982), Abstract, 1982.
12. Birkenmajer, K., "Pre-Quaternary Fossiliferous Glaciomarine Deposits at Cape Melville, King George Island (South Shetland Islands, West Antarctica)," *BULL. ACAD. POL. SCI. SER. SC. TERRE*, (1982), Vol 30 (in press).
13. Birkenmajer, K., "Extent and Course of the Pliocene Glaciations in West Antarctica," *ibid.*
14. Birkenmajer, K., "Structural Evolution of the Melville Peak Volcano, King George Island (South Shetland Islands, West Antarctica)," *ibid.*
15. Birkenmajer, K., "Late Cenozoic Phases of Block-Faulting on King George Island (South Shetland Islands, West Antarctica)," *ibid.*
16. Birkenmajer, K., "Geology of the Cape Melville Area, King George Island (South Shetland Islands, Antarctica): Pre-Pliocene Glaciomarine Deposits and their Substratum," *STUDIA GEOLOGICA POLONICA*, 1979 (in press).
17. Bitner, M. A. and Pisera, A., "Brachiopods from "Pecten Conglomerate" (Polonez Cove Formation, Pliocene) of King George Island (South Shetland Islands, Antarctica)," *ibid.*
18. Blaszczyk, J. and Gazdzicki, A., "Paleontological Research on King George Island During the Third Polish Antarctic Expedition of the Polish Academy of Sciences, 1978-1979," *PRZEGLAD GEOLOGICZNY*, 1980, No 5.

19. Craddock, C. and Hollister, C. D., "Geologic Evolution of the Southeast Pacific Basin," *Init. Repts DSDP*, 1976, No 35.
20. Dudziak, J., "Cretaceous Calcareous Nannoplankton from Glaciomarine Deposits of the Cape Melville Area, King George Island (South Shetland Islands, Antarctica)," *STUDIA GEOLOGICA POLONICA*, 1979 (in press).
21. Fleming, E. A. and Thomson, J. W., *British Antarctic Geological Map 1:500,000: Northern Graham Land and South Shetland Islands (Ser. BAS 500 G, Sheet 2, Ed 1)*, Brit. Antarct. Surv, Cambridge, 1979.
22. Gazdzicki, A., "Pliocene Pecten Conglomerate of King George Island (South Shetland Islands, West Antarctica)," *Fourth In. Symp. Antarct. Earth-Sci. (Adelaide, 1982)*. Abstract, 1982.
23. Gazdzicki, A. and Pugaczewski, H., "Biota of the "Pecten Conglomerate" (Polonez Cove Formation, Pliocene) from King George Island (South Shetland Islands, Antarctica)," *STUDIA GEOLOGICA POLONICA*, 1979 (in press).
24. Gazdzicki, A. and Wrona, R., "Paleontological Research of the Fifth Polish Antarctic Expedition of the Polish Academy of Sciences, 1980-1981," *PRZEGLAD GEOLOGICZNY*, 1982, No 2.
25. Gazdzicki, A. and Wrona, R., "Cretaceous Marine Flora and Fauna of King George Island (South Shetland Islands, West Antarctica)," *Fourth Int. Symp. Antarctic Earth-Sci. (Adelaide, 1982)*. Abstract, 1982.
26. Jesionek-Szymanska, W., "Echinoid Remains from "Pecten Conglomerate" (Polonez Cove Formation, Pliocene) of King George Island (South Shetland Islands, Antarctica)," *STUDIA GEOLOGICA POLONICA*, 1979 (in press).
27. Morycowa, E., Rubinowski, Z. and Tokarski, A. K., "Archaeocyathids from a Moraine at Three Sisters Point, King George Island (South Shetland Islands, Antarctica)," *STUDIA GEOLOGICA POLONICA*, 1982, Vol 74.
28. Tokarski, A. K., Paulo, A., Rubinowski, Z., "Report on Geological Investigations of King George Island, South Shetland Islands (West Antarctica) in 1979-1980," *Ibid*, 1981, Vol 72.
29. Tokarski, A. K., Paulo, A. and Rubinowski, Z., "Polish Geological Research in West Antarctica, 1979-1980," *PRZEGLAD GEOLOGICZNY*, 1982, No 2.

Arctic-Antarctic Polar Research

Warsaw PRZEGLAD GEOLOGICZNY in Polish No 1, Jan 83 pp 1-14

[Article by Krzysztof Birkenmajer, Polish Academy of Sciences: "Polish Geological Research in Arctica and Antarctica (50th Anniversary of Polish Polar Research 1932-1982)"]

[Text] Introduction

The scientific and exploratory activities of the Poles pertaining to the geology of the polar regions began long before Poland obtained its independence in 1918. In the nineteenth century, entire generations of Poles--political exiles, increased the knowledge on the arctic geological structure and formation of Siberia, and the pioneer exploratory-scientific research and expeditions outside the polar circle conducted by Aleksander Czekanowski and Jan Czernski gained the greatest renown.

Two illustrious names were added to this polar tradition at the turn of the nineteenth century: Henryk Arctowski, geologist and geophysicist, and Antoni B. Dobrowolski, meteorologist and glaciologist, members of a Belgian expedition to Antarctica in 1897-1899. After our country obtained its independence, groups of devotees assembled around these two learned men, of whom many then became members and leaders of polar expeditions to Bear Island and Spitsbergen (the Warsaw group connected with A. B. Dobrowolski) and to Greenland (the Lwow group connected with H. Arctowski) during 1932-1938, and also continued the polar research after the Second World War.

Arctica

The northern part of the Atlantic Ocean, encompassing the Greenland Sea, Norwegian Sea and the shelf Barents Sea, as well as the adjoining zone of the Arctic Ocean, have long aroused the special interest of geologists because these areas are so young. As early as the end of the nineteenth century it was known that the geological structure of both shores of the Atlantic north of Iceland, the eastern (Scandinavia and Svalbard) and western (East Greenland), shows a great deal of similarity as to nature of deposits, main folding stages, and development of the organic world. The intensive development of geological research which occurred in this area in the early decades of the current century furnished additional arguments, which Alfred Wegener utilized already in 1912 as a basis for his reconstruction of the mutual position of the continents of the northern hemisphere before they were severed and the drift which led to the formation of the Atlantic Ocean basin.

The theory of global tectonics (the Earth's crust ice-float theory) brought new elements into the discussion in the 1960's and 1970's, based on a wealth of new bathometric, geological and geophysical observations on the structure of the ocean's floor and rim.

In the light of this, the problem of the connection of the evolution of the North Atlantic Ocean's floor with the history of the development of the basin's rim in the

shelf zone of West Greenland and Norway and Svalbard. Polish geological research in the Svalbard archipelago, conducted since 1934 (59, 9, 26), and in East Greenland, conducted since 1971, produced a number of important new data which were later used in detailed and summary reports on the evolution of the Arctic-Atlantic basin (10, 16, 19, 28), Fig 1.

Svalbard

Polish geological research in the Svalbard archipelago (Fig 2) began in 1934 with an expedition to Torell Land in Spitsbergen (59, 9, 26). During this expedition S. Z. Rozycki geologically mapped an area of approximately 500 square kilometers, to 1:50,000 scale, in the Tertiary fold chain belt of Spitsbergen and its eastern foreland. He recognized the arrangement of the strata of the early-Paleozoic and Mesozoic formations, and in part also the late-Tertiary formations in this region, as well as a tectonic structure showing many characteristics of Alpine tectonics (59), Fig 7. S. Z. Rozycki's work also furnished much information important for palinspastic reconstruction of the Spitsbergen Alpine fold belt.

Polish geological research on Spitsbergen was renewed under the leadership of K. Birkenmajer as part of the expeditions of the Third International Geophysical Year and International Geophysical Cooperation (1956-1962). It was directly related to S. Z. Rozycki's research in 1934. In geologically mapping, to 1:50,000 scale, the southern part of Torell Land, Wedel Jarlsberg Land and the northern part of the Sorkapp (South Cape) Land, K. Birkenmajer made a detailed study of the strata arrangement and tectonics of the metamorphic (pre-Cambrian) and older Paleozoic (Cambrian, Ordovician) Caledonian orogeny of the western shore of Spitsbergen (2, 3, 16, 23, 24, 58), distinguished the local Variscan fold belt (5) and extended the recognition of the Alpine fold belt (10, 11), (Fig 4 [not reproduced], 5, 6, 8), far to the south.

The land studies of the pre-Cambrian metamorphic complex, conducted successively by W. Smulikowski (in 1959 and 1960) and W. Narebski (in 1959), supplemented by laboratory research, made it possible to reconstruct the petrogenesis of this complex (32, 64, 65, 55). Stratigraphic and sedimentological studies in the Devonian, carboniferous, Permian and Mesozoic (Triassic-Cretaceous) complex, conducted by K. Birkenmajer (in 1958 and 1960), S. Siedlecki (in 1958-1962), A. Siedlecka (in 1960) and S. Czarniecki (in 1960), supported by laboratory research in Poland, made it possible to more closely determine the era and conditions in which these deposits formed (5, 7, 8, 15, 18, 40, 60, 61, 62, 63). The collected Cambrian, early-Paleozoic and Mesozoic fauna, as well as the spore-pollen study samples, were studied in Poland and abroad by specialists (28, 30, 31, 36, 38, 40, 41, 44, 47, 49, 63). The ore-minerology of the Hornsund area (J. Wojciechowski in 1959) was also studied (39).

During 1962-1970 geological research in Svalbard was conducted by Poles as part of the Norwegian expeditions. K. Birkenmajer (in 1962, 1966 and 1970) studied the stratigraphy and geological structure of the eastern part of Torell Land and the South Cape Land, preparing a 1:50,000 scale map there, and worked also on Tertiary and Mesozoic formations, and in part also on Paleozoic and pre-Cambrian formations (1, 10, 12, 28, 31, 33, 35). S. Siedlecki (in 1964 and 1965) studied early-Paleozoic formations in the Van Mijenfjorden (Spitsbergen) region and the Bear Islands--Bjornoya. The fauna fossils he collected were studied by specialists in Poland (42, 50).

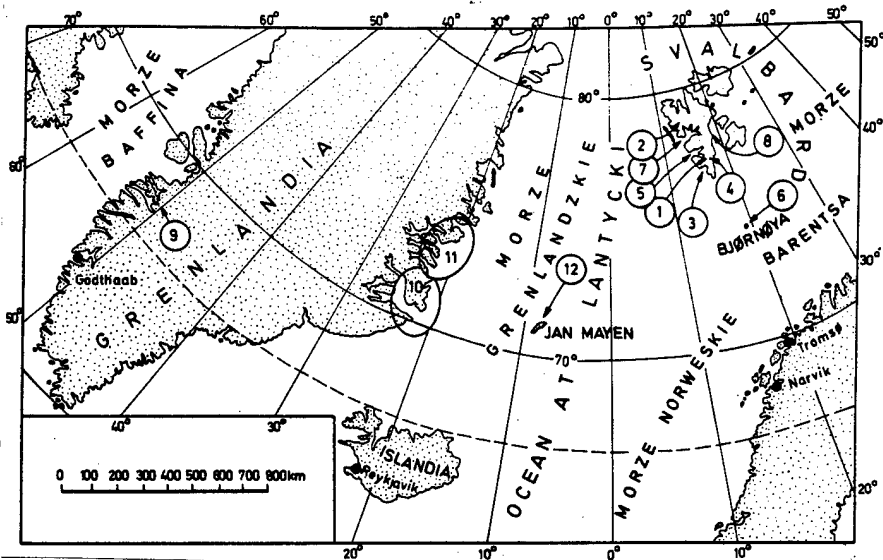
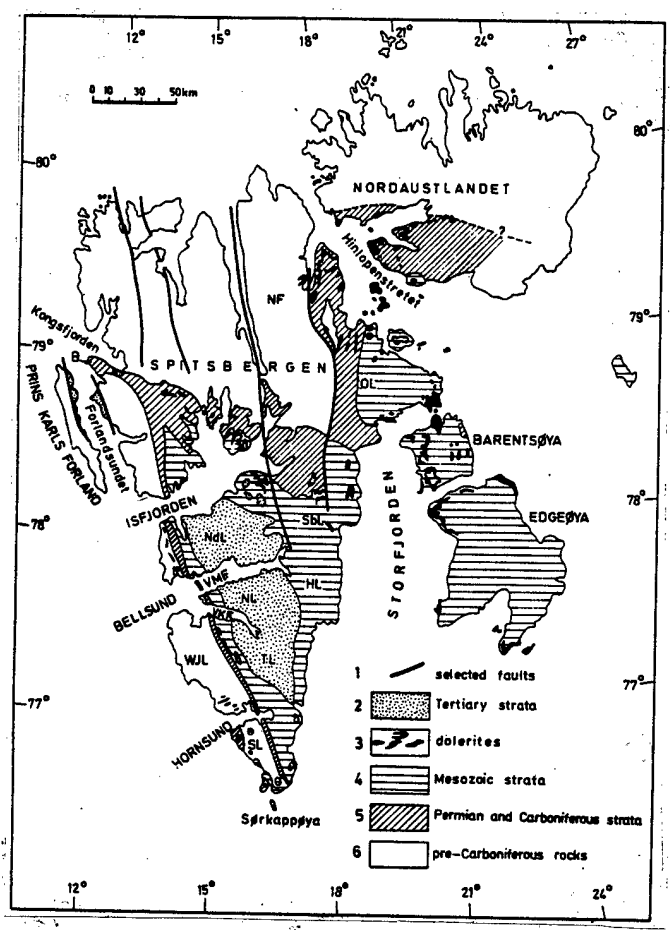


Fig. 1. Areas of Polish geological investigations in the Arctic (above)
 1 - NW Torell Land (1934); 2 - Oscar II Land (1938, 1978); 3 - Hornsund (since 1956 - up to present); 4 - E Torell Land (1962, 1966, 1970); 5 - Bellsund (1962, 1964, 1976, 1979); 6 - Bjørnøya (1965); 7 - Isfjorden (1960, 1976, 1979); 8 - Agardhbukta (1977); 9 - Arfersiorfik (1937); 10 - Scoresby Land and Jameson Land (1971); 11 - Kong Oscars Fjord to Clavering Ø (1976); 12 - Jan Mayen (1970)



B - Brøggerhalvøya; HL - Heer Land; NdL - Nordenskiöld Land; NF - Ny Friesland; NL - Nathorst Land; OL - Olav V Land; TL - Torell Land; SbL - Sabine Land; SL - Sørkapp Land; VKF - Van Keulensfjorden; VMF - Van Mijenfjorden; WJL - Wedel Jarlsberg Land

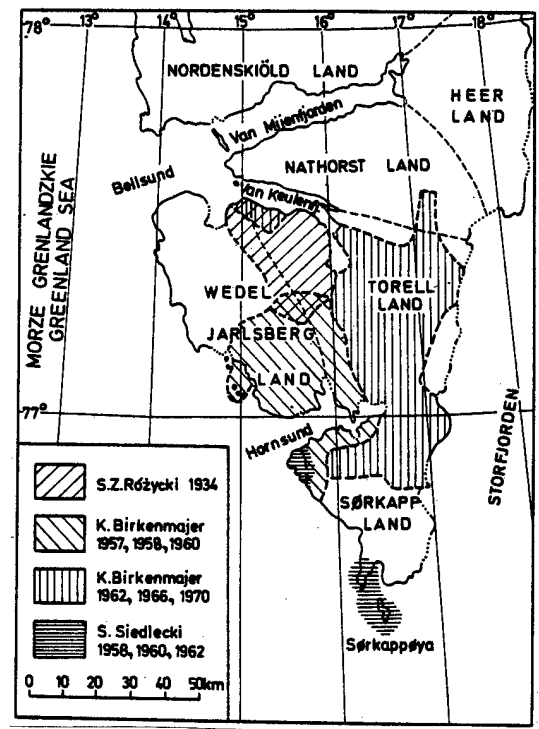


Fig. 3. Areas in Spitsbergen geologically mapped to 1:50,000 scale by Polish geologists

Fig. 2. Post-Caledonian platform cover in Svalbard (27)

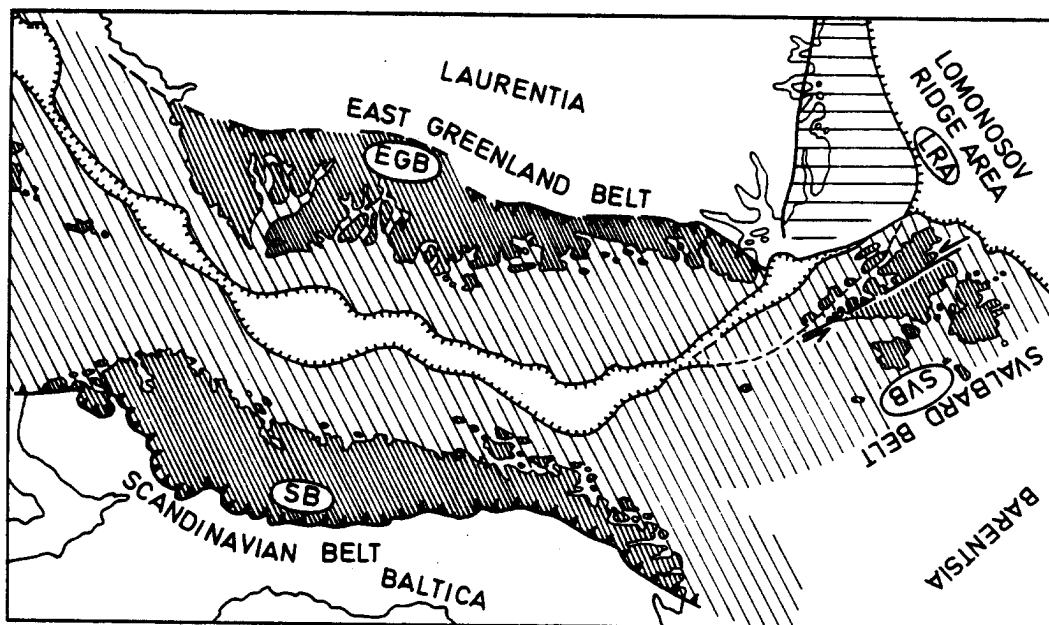


Fig. 5. Palinspastic reconstruction of the circum-Atlantic Caledonian mountain system (obliquely shaded) prior to continental drift in late Cretaceous time (after Birkenmajer, 16)

Heavy dentated lines denote edges of Caledonian thrusts; vertical shading indicates Variscan mountain system; thin dentated lines denote margins of continental blocks

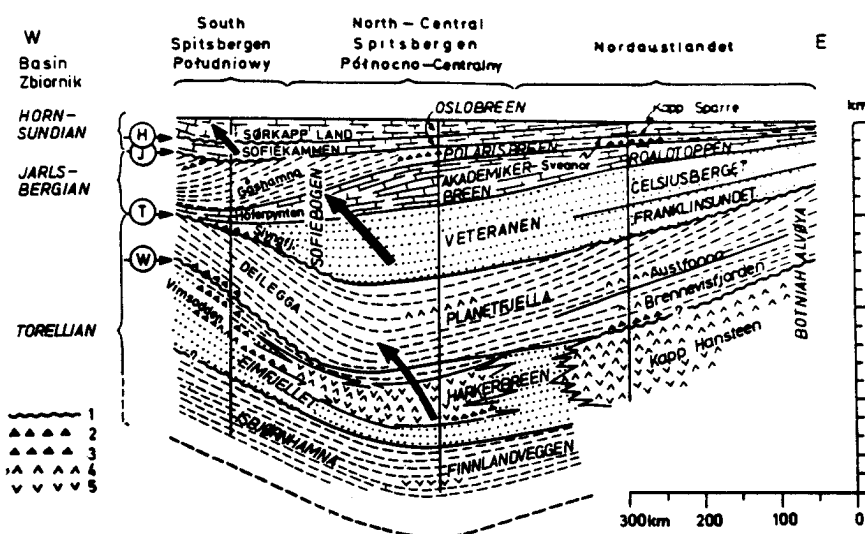


Fig. 6. Reconstruction of the Hecla Hoek geosynclinal trough in Svalbard (after Birkenmajer, 16)

1 - unconformity; 2 - tillite; 3 - tilloid (conglomerate); 4 - acid volcanism; 5 - basic volcanism. Thick arrows denote migration of basin axis (polarity of geosyncline)

The three next paleontological expeditions to Spitsbergen, organized by the PAN (Polish Academy of Sciences) Research Center for Paleozoology (now Paleobiology) in 1974 (K. Birkenmajer, leader), 1975 (H. Szaniawski, leader) and 1976 (G. Biernat, leader) dealt with studies of invertebrate fossils and the paleoecology of certain carboniferous-Permian, Triassic and Jurassic deposit formations, and, in part, Paleozoic (Cambrian and Ordovician) (43, 45, 46, 51, 52, 56, 66, 68). Furthermore, early pre-Cambrian algal structures were studied. Area work was conducted in the Hornsund fiord area (in 1974 and 1975) and in Bellsund and at the mouth of the Isfjord (in 1976).

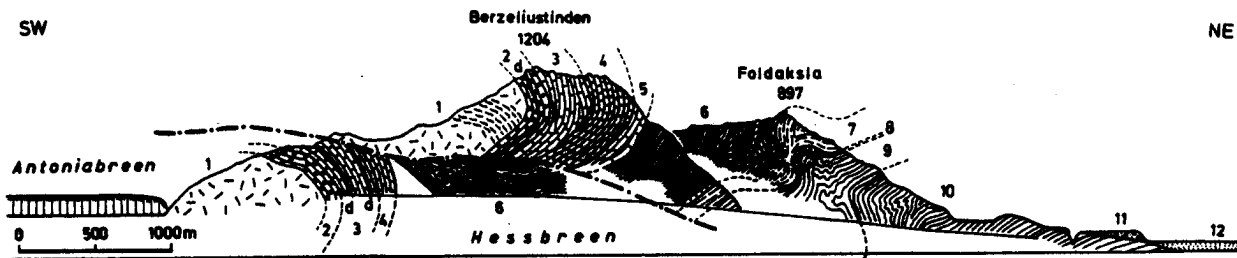


Fig. 7. Geological cross-section through Tertiary fold belt of Torell Land, Spitsbergen (after Różycki, 59)

1 - Hecla Hoek Succession; 2 - Culm; 3 - Upper Carboniferous; 4 - Permian; 5 - Lower Triassic (lower part); 6 - Upper-Middle Triassic and upper part of Lower Triassic; 7 - Rhaetian-Lower Liassic; 8 - Upper Liassic; 9 - Callovian-Lower Kimmeridgian; 10 - Volgian-Valanginian; 11 - moraines; 12 - raised marine terraces; d - dolerites

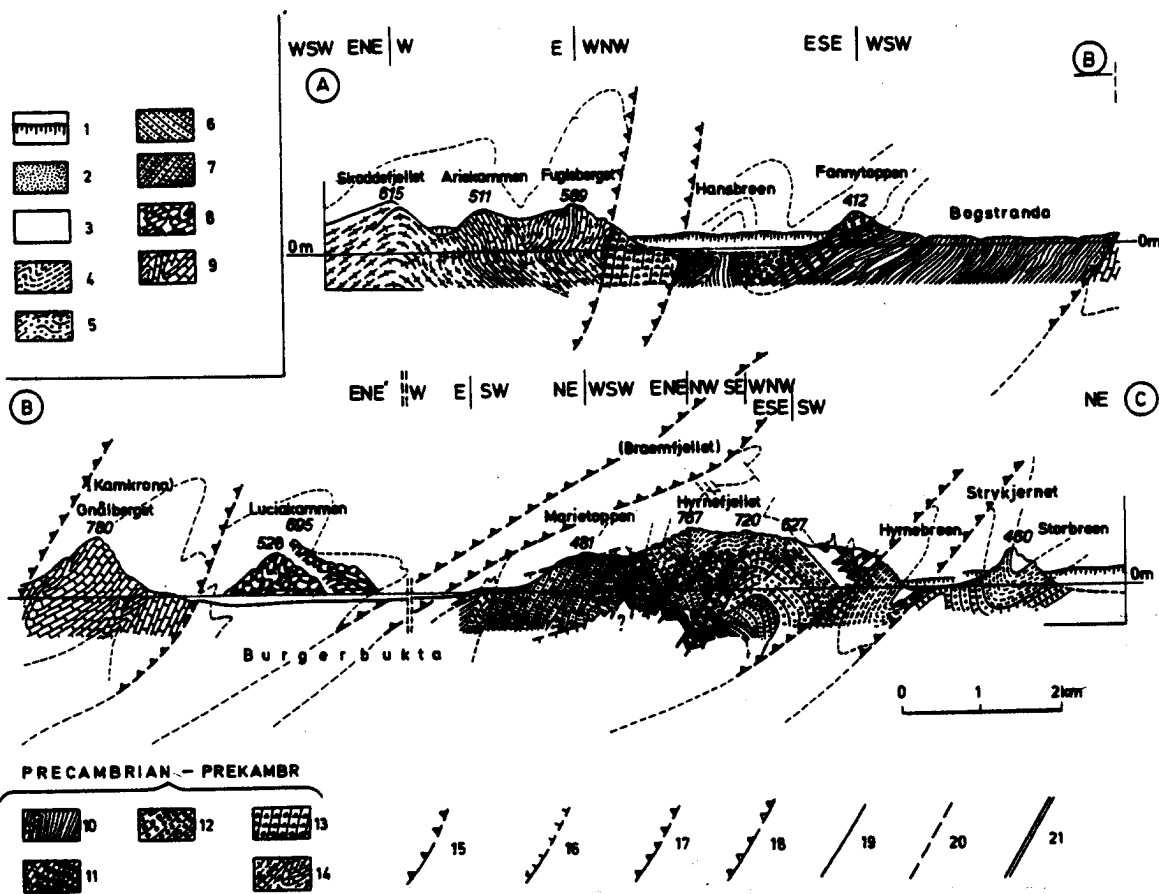


Fig. 8. Caledonian, Variscan and Alpine structures in south Spitsbergen, Hornsund area (after Birkenmajer, 11)

1 - glacier; 2 - Barremian; 3 - Hauterivian to Callovian; 4 - Liassic and Triassic; 5 - Permian and U.-M. Carboniferous; 6 - Lower Carboniferous; 7 - Devonian; 8 - Lower Ordovician; 9 - Cambrian; 10 - Gåshamna Formation; 11 - Höferpynten Formation; 12 - Slyngfjellet Formation; 13 - Eimfjellet Group; 14 - Isbjørnhamna Group; 15 - Alpine overthrusts; 16 - Variscan overthrusts; 17 - Caledonian overthrusts; 18 - Caledonian overthrusts modified by Alpine deformation; 19 - Alpine faults; 20 - Variscan faults; 21 - Caledonian faults

The paleomagnetic research conducted through the cooperation of the PAN Geophysics Institute (M. Jelenska) and St. Louis University in the United States (22, 67) has been important in reconstructing the geographic location of Svalbard in past geological eras. Rock samples for this research were collected during the expeditions led by K. Birkenmajer in the Hornsund region (in 1974) and Agardhbukta on the eastern coast of Spitsbergen (in 1977), and also under the leadership of M. Jelenska in Isfjord and Bellsund in Spitsbergen (in 1979). During these expeditions new Jurassic and Cretaceous geological profiles were prepared and fossils were gathered in the Agardhbukta region (25, 37).

As part of the so-called central expeditions to Spitsbergen, organized under the sponsorship of the PAN Polar Research Committee in the PAN Geophysics Institute beginning in 1978, the region surrounding the Polish scientific station in Hornsund became the new work location of the following Polish geologists: S. Cieslinski (Quaternary problems in 1978-1979), J. Kopik (Mesozoic fossils and Jurassic stratigraphy, in 1979), I. Lipiarski (study of Carboniferous formation, in 1979), A. Laptas and G. Haczewski, (pre-Cambrian, Ordovician and Carboniferous sedimentological research, in 1980). The paleontological group from the PAN Research Center for Paleobiology concentrated its work in the Isfjord and Bellsund region (in 1979, under the leadership of G. Biernat) and in the Hornsund region (in 1980). The introduction, in 1981, of studies on sedimentation in today's Hornsund fiord, became a new item of research and is being continued during the present expedition (1982-1983). Geological and paleontological research is being conducted within the framework of the interministerial plan (MR.II.16, now MR.I.29) of the Polish Academy of Sciences, coordinated by the author of the foregoing article.

It should be mentioned that geological groups from Polish Spitsbergen expeditions also worked on some problems relating to coast geomorphology, Tertiary glaciation and deglaciation, and isostatic movements of Svalbard both in the region of Hornsund fiord (4, 6, 34, 48) and Van Keulenfjorden (53, 54).

The main results of Polish geological research in the Svalbard archipelago are published in the *STUDIA GEOLOGICA POLONICA* series. The 1934 research results (S. Z. Rozycki) were published in 1959 (59). Research results beginning with the expeditions of the Third International Geophysical Year are published under the editorship of K. Birkenmajer. Thus far 12 volumes have been published: Part I (1960), Part II (1960), Part III (1964), Part IV (1965), Part V (1965), Part VI (1968), Part VII (1975), Part VIII (1977), Part IX (1978), Part X (1979), Part XI (1980), and Part XII (1981). The later ones are in the process of publication. The results of paleontological research conducted since 1974 will be published in *PALEONTOLOGIA POLONICA*; thus far Vol I (1982) has appeared under the editorship of G. Biernat and W. Szymanska. In addition, many articles have appeared in other Polish and foreign publications (see "Arctica" in the bibliography).

Jan Mayen and East Greenland

K. Birkenmajer's brief visit (in 1970) in the Jan Mayen Island, located in the middle of the Atlantic Ocean north of Iceland (Fig 1, 9 [Fig 9 not reproduced], occurred immediately after the eruption of the Beerenburg volcano, which had been dormant for centuries. The island is in an important fault belt which transforms the Atlantic

Fig. 11. Position of the Polish scientific stations in Antarctica: Arctowski Station (King George Island) and Dobrowolski Station (Bunger Hills)

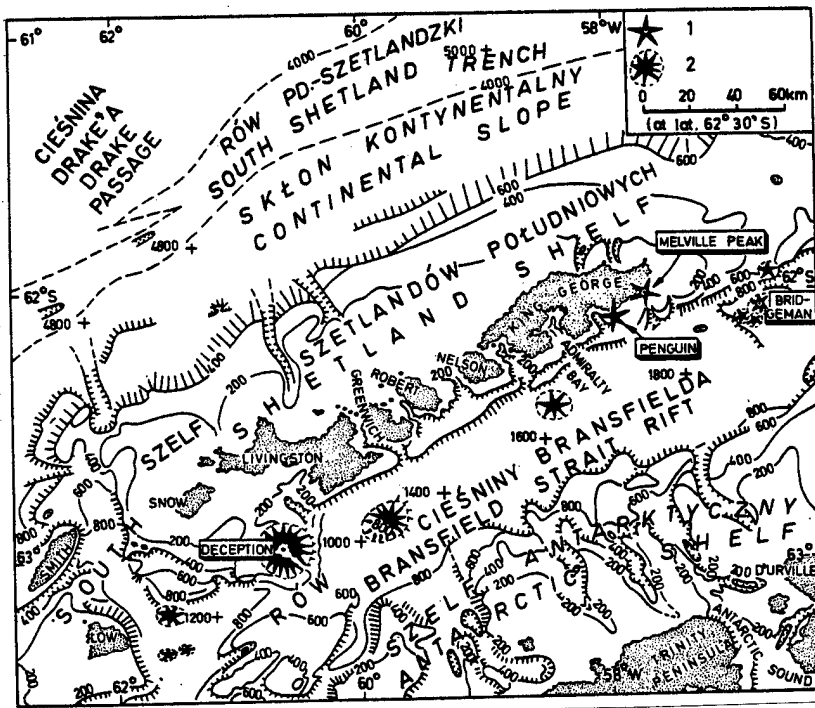
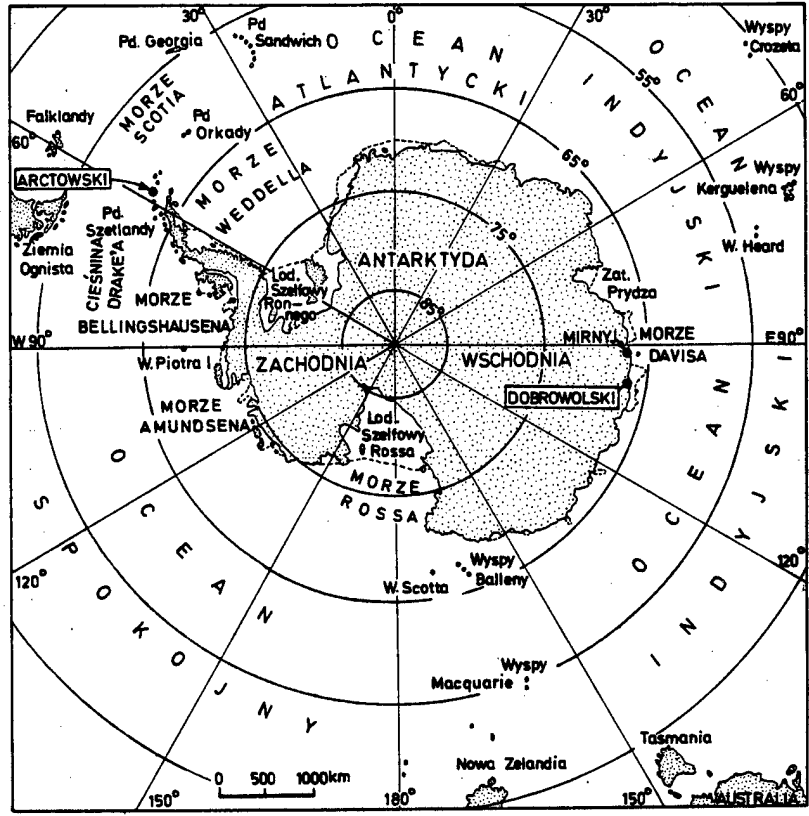


Fig. 12. Bathymetric sketch of the South Shetland Islands Area, with surficial (1) and submarine (2) volcanoes indicated. After Ashcroft, 1972, modified and supplemented (89)

Ocean bottom, along which the mid-Atlantic ridge was shifted eastward by about 200 kilometers. An article (13) on this subject discusses the course and the geotectonic aspects of this eruption.

In East Greenland (Fig 1) K. Birkenmajer worked during 1971 and 1976 as a member of Danish expeditions studying a coastal area approximately 500 kilometers long between Scoresby Sund (about 70 degrees N) and Clavering O (about 74 degrees N). He geologically mapped, to 1:50,000 scale and more detailed scales, a large area there, examined the stratigraphy and tectonics, conducted sedimentological studies on the Devonian, Permian, Triassic and Jurassic formations, and also in the Tertiary basalt-deposit layers (14, 17, 20, 21, 29, 57), Fig 10 [not reproduced].

West Greenland

A. Gawla conducted geological research in the region of the Arfersiorfik fiord and Disco Island in 1937, as part of the Polish West Greenland expedition. Some material on this has been published in Poland.

Antarctica

From the geological standpoint, Antarctica, which encompasses the Antarctic Continent and adjoining island archipelagoes (Fig 11), is the least-known area of the world. Henryk Arctowski, regarded as the father of Antarctica geology, during a Belgian expedition on the ship "Belgica", conducted, in 1898-1899, the first geological research in the history of this continent. The research covered the area along the western coasts of the Antarctic Peninsula, from the South Shetlands to Bellinghausen and Amundsen Seas. This part of Antarctica is a direct continuation of the South American Andes, and its Mesozoic-Tertiary mountain chains are named Antarcands after Arctowski.

The South Shetland Islands adjacent to the continent, where the H. Arctowski PAN Scientific Station is located (on King George Island), are separated from the Antarctica Peninsula by a young oceanic strait, the Bransfield Strait, and on the north they are bordered partially by a South Shetlands oceanic trough, filled with deposits (Fig 12). This trough, during the Mesozoic and Tertiary periods, was the place of the subduction of the oceanic crust of the southeast Pacific under the ice-floe of continental Antarctica; on its northern border at that time the South Shetlands volcanic arc was being formed (Fig 17).

This region, thus, creates an exceptional opportunity for model studies (both time and space) on the volcanic island arc, which is of extreme general importance in testing the theory of global tectonics (the theory of lithospheric ice-floes), and it also facilitates recognition of the possibility of mineralization and the potential of hydrocarbon deposits on the antarctic shelf.

The eastern part of Antarctica is a counterpart of the crystalline shields and their deposit layers of South Africa, South America, India and Australia, with which Antarctica once formed the supercontinent Gondwanaland (Fig 13). The marginal zone of East Antarctica is bordered by narrow shelves suggesting that hydrocarbons may be there, and among the crystalline rocks of the pre-Cambrian shields and their Paleozoic-Mesozoic deposit layers the presence of beds of useful minerals has been ascertained.

West Antarctica

Polish geological research in West Antarctica, which began in 1977 as part of the interministerial plan PAN (MR.II.16, now MR.I.29), led by K. Birkenmajer, has thus far encompassed four seasons of the antarctic year: 1977-1978 (K. Birkenmajer), 1978-1979 (K. Birkenmajer, J. Blaszyk, A. Gazdzicki, A. K. Tokarski), 1979-1980 (A. K. Tokarski, A. Paulo and Z. Rubinowski) and 1980-1 (K. Birkenmajer, W. Danowski, A. Gazdzicki, E. Gradzinski, S. Porebski and R. Wrona) (71, 77, 90, 93, 99). As a result of this research, all of King George Island and half of Nelson Island in the South Shetlands has been geologically mapped to a 1:50,000 scale (mainly K. Birkenmajer, partly A. K. Tokarski, A. Paulo and Z. Rubinowski) and a number of geological maps more detailed have been prepared of regions that are of special scientific or raw-materials interest. The stratigraphy of Quaternary, Tertiary and pre-Tertiary formations and the tectonics of the area have been recognized (71-100).

K. Birkenmajer introduced new lithostratigraphic schematics for rock Tertiary and Mesozoic formations (72-74, 78, 80-82, 86) and discovered previously unknown traces of large Tertiary glaciations: Pliocene Polonez glaciations (Fig 14), Legru (74, 80, 84), and the probably-Miocene Melville glaciation (82). The volcanic cycles were recognized and the evolution of the South Shetlands island arc was reconstructed (Fig 15-17) in the Tertiary (K. Birkenmajer, W. Narebski and co-workers, 88, 89), and Quaternary (75, 83, 85). For the first time in the South Shetlands the moraines of the early-Pleistocene glaciation called the Warszawa Glaciation (79) were distinguished and the sequence of iceberg oscillation in the early Holocene (76, 79) was established.

The area of the King George and Nelson Islands is relatively undisturbed tectonically, mainly by faults (Fig 18-89), and to a lesser degree, by fold structures. During the Miocene, large, strike-slip faults occurred here, passing parallel to the axis of the islands. The largest of these, the Ezcurra fault (strike-slip), was identified over a length exceeding 80 kilometers, and probably continues for a distance of at least 300 kilometers across the length of the entire Shetlands archipelago. This fault probably occurred as a result of the revolution of the antarctic continent around the axis convergent with the position of the geographic South Pole in a counterclockwise direction. The sliding movement lengthwise of the fault ceased at the Miocene and Pliocene boundary when, due to a change in the stress field it was intersected by transversal faults of a meridional direction (8, 18, 85). A closer examination of these deformations was made with the help of measurements of small tectonic structures (97, 98).

In view of the low amount of deposits in the geological construction of the South Shetlands, sedimentological studies (R. Gradzinski, S. Porebski) primarily covered the glaciomarine Polonez glaciation complex. Zones of sulfur and oxygen mineralization of copper and iron (72, 77, 81, 99) were also recognized in the area studied. Rich Tertiary and Mesozoic fossils were collected and erratics from Cambrian fossils (mainly K. Birkenmajer, A. Gazdzicki, J. Blaszyk and R. Wrona), which in part have already been reported on by specialists in Poland (87, 90-93, 94, 96, 100).

Fig. 13. Reconstruction of the Gondwana supercontinent in late Jurassic times about 160 Ma (after Lovering and Prescott, 1979)

PC - Precambrian orogenes; P - Palaeozoic orogenes; M - Mesozoic orogenes

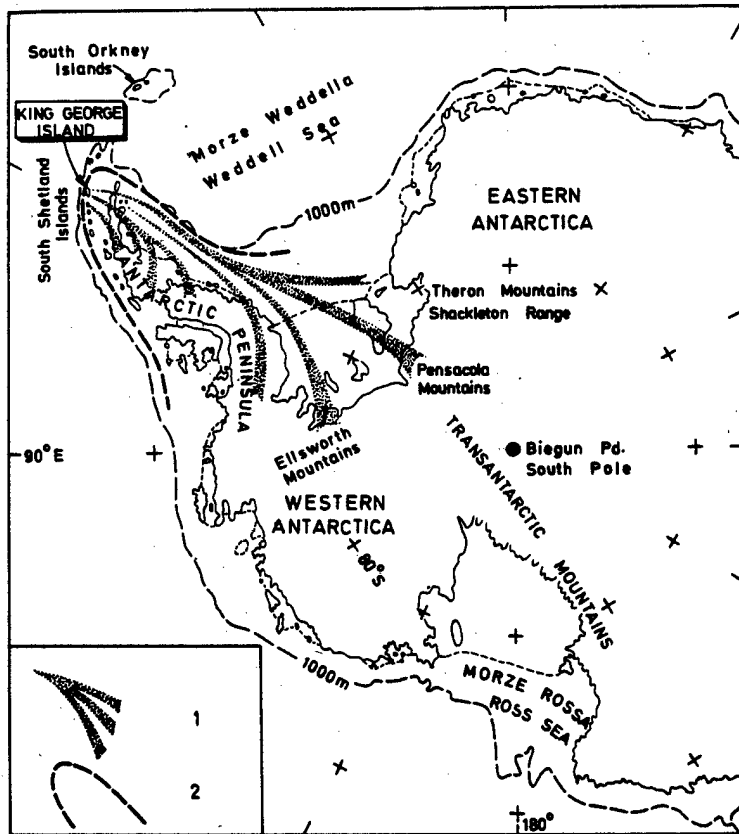
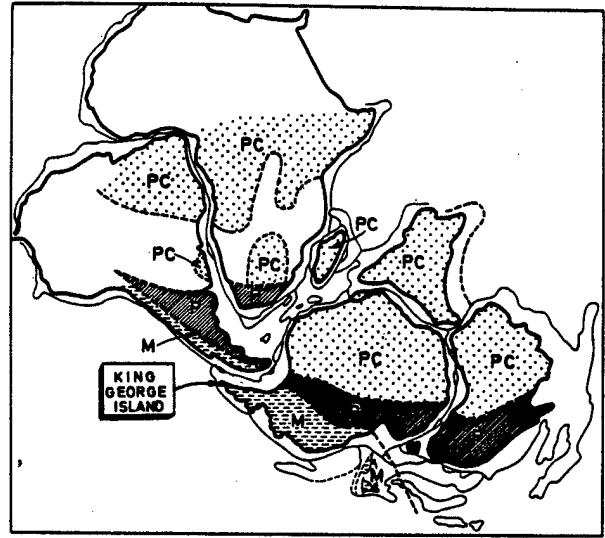


Fig. 14. Maximum extension of the Pliocene Polonez Glaciation in West Antarctica (after Birkenmajer, 80)

1 - main ice-streams; 2 - probable maximum extension of ice-sheet

The main results of Polish geological research in Antarctica are published in *STUDIA GEOLOGICA POLONIA*, under the editorship of K. Birkenmajer. Thus far three volumes have appeared: Part I (1980), Part II, 1981), Part III (1982); the fourth volume is in print and the later ones are in the process of publication. Many articles have also appeared in other Polish and foreign periodicals.

East Antarctica

Geological research on Quaternary formations--raised marine terraces and periglacial structures, was conducted by S. Z. Rozycki (95) in 1959 during a reconnaissance expedition to the A. B. Dobrowolski Station in the Bunger Oasis (East Antarctica). Research on the geology and geomorphology of the deposits in the marginal zone of the continental glacier was continued in this region by E. Wisniewski (1978-1979).

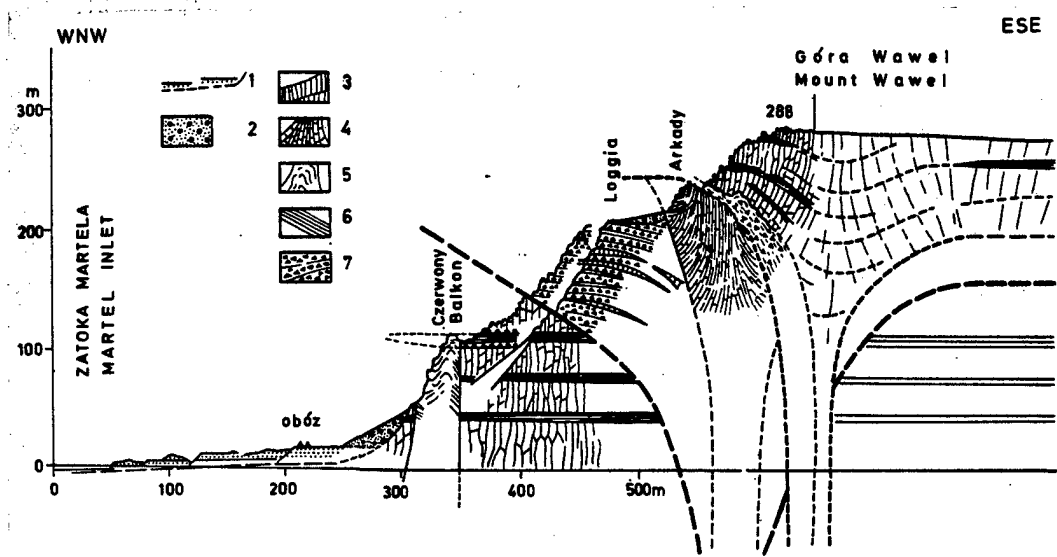


Fig. 15. Tertiary volcanic centre (Point Hennequin Group) at Mount Wawel, Admiralty Bay, King George Island (after Birkenmajer, 1981)

1 - raised marine terraces; 2 - talus; 3 - andesite lavas; 4 - andesite plug; 5 - rhyolite plug; 6 - tuff; 7 - agglomerate

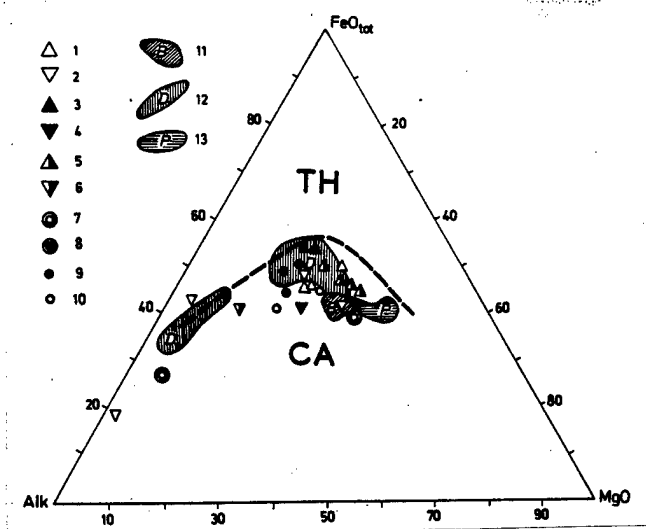


Fig. 16. Distribution of Tertiary and Quaternary volcanics of King George Island and Bransfield Strait in the Alk ($Na_2O + K_2O$) - FeO_{tot} - MgO diagramme (after Birkenmajer and Narebski, 88)

1-6 - King George Island Supergroup; 7-10 - Admiralty Bay Group; 11 - Bridgeman Island volcano; 12 - Deception Island volcano; 13 - Penguin Island volcano; TH - tholeiitic field; CA - calc-alkaline field

Fig. 17. Plate-tectonic model for the Cenozoic volcanic island-arc of the South Shetland islands (after Birkenmajer and Narebski, 88)

1 - upper mantle; 2 - oceanic crust; 3 - continental crust;
4-6 - Cenozoic volcanic cycles; 7 - mantle diapir; 8 - Ezcurra Fault; 9 - Quaternary sediments

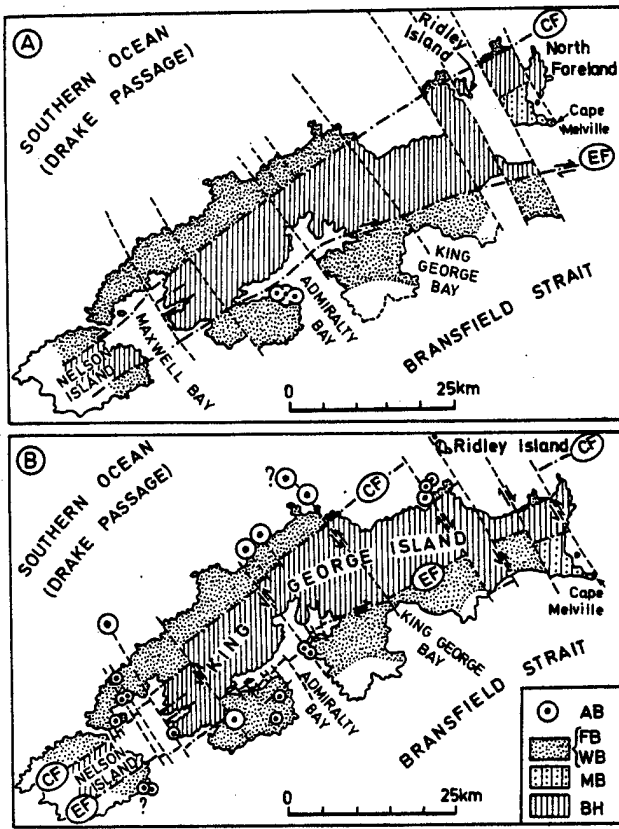
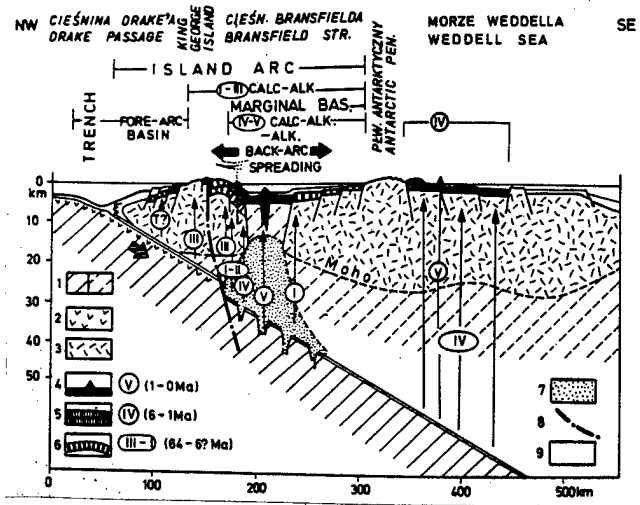


Fig. 18. Palinspastic reconstruction of King George Island during the Ezcurra Phase (A) and during the Admiralty Phase (B). After Birkenmajer (85)

AB - volcanic centres of the Admiralty Bay Group; FB - Fildes Block (northern); WB - Warszawa Block (southern); MB - Melville Block; BH - Barton-Horst; CF - Collins Fault; EF - Ezcurra Fault

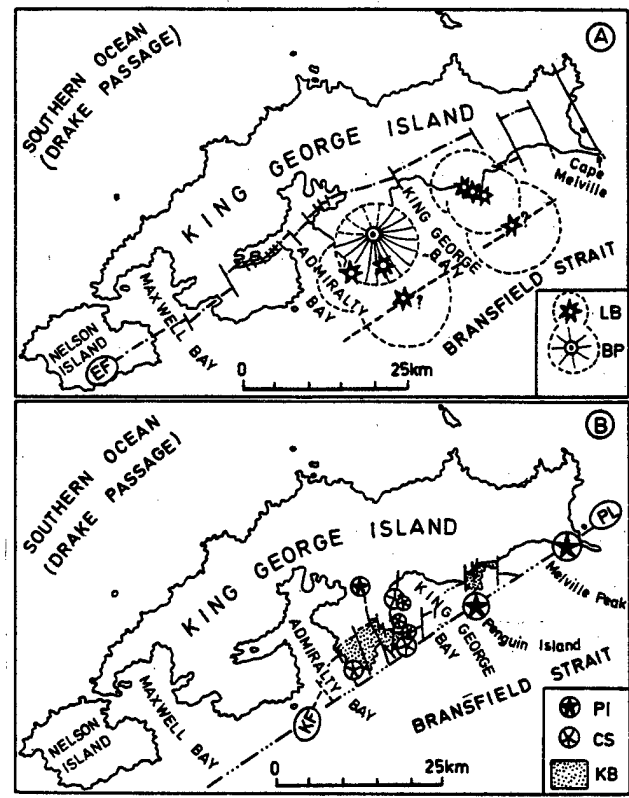


Fig. 19. Location of volcanic centres on King George Island during Pliocene (A) and Plio-Pleistocene (B). After Birkenmajer (85)

Volcanic centres: LB - Legru Bay Group; BP - Boy Point Formation (Chopin Ridge Group); PI - Penguin Island Group; CS - Cape Syrezol Group. Other symbols: KB - Kraków Block; KF - Kraków Fault; EF - Ezcurra Fault; PL - Penguin Line

Conclusions

1. Geological research of Antarctica, conducted by Polish expeditions for almost half a century (1934-1982), established the high international standing of Polish science in this field among such countries as Norway, Denmark, Sweden, the USSR, the United States, Canada, the FRG and France, which traditionally conducted geological research in this region of the world.
2. Polish geologists made an important research contribution to the recognition of the regional geological construction of Svalbard and Greenland, to the development of modern theories on the formation of our globe, including the evolution of the North Atlantic Basin and northwestern Eurasia, and also to the understanding of the paths of evolution of the organic world in this region during the last 600 million years.
3. Polish geological research of the Svalbard region may form the basis for Polish industrial interest in the Svalbard shelf and land belt.
4. Polish geological research of West Antarctica in the South Shetlands region, although conducted only 5 years, has already brought many achievements of world rank, particularly as concerns the theory of the evolution of island arcs and a geodynamic model of this region of the world, and also for the re-creation of the paleoclimate and evolution of the biosphere of Antarctica during the Mesozoic and Cenozoic. The fact that Poland has a second antarctic research station, in East Antarctica, promises that comparative research in this region of the world is also possible.
5. Geological recognition of part of the South Shetlands in West Antarctica, conducted by Polish geologists, serves as a basis for Polish participation in negotiations pertaining to the antarctic shelf and continent and its possible raw-materials resources, within the framework of the 1959 Antarctic Treaty.
6. The scientific materials gathered in Spitsbergen and Antarctica have been and continue to be the basis for the obtainment of doctoral degrees in geology and paleontology. Geological and paleontological scientific research in the polar countries is of great training importance for young workers in science, and at the same time creates opportunities for scientific discoveries of world note.
7. Taking the above into account, Polish geological and related research in Arctica should be continued, especially in the Svalbard archipelago, and the area of research in Antarctica should be expanded, particularly in the region of the Antarctic Peninsula and adjacent island archipelagoes, and in East Antarctica.

SELECTED POLISH BIBLIOGRAPHY

Arctica

1. Biernat, G., Birkenmajer, K., "Permian Brachiopods from the Base of the Kapp Starostin Formation at Polakkfjellet, Spitsbergen," *STUDIA GEOLOGICA POLONICA*, 1981, Vol 273.

2. Birkenmajer, K., "Preliminary Report on the Stratigraphy of the Hecla Hoek Formation in Wedel-Jarlsberg Land, Vestspitsbergen," BULL. ACAD. POL. SCI., SER. CHIM. GEOL. GEOGR., 1958, No 2.
3. Birkenmajer, K., "Relation of the Cambrian to the Precambrian in Hornsund, Vestspitsbergen," 21st Int. Geol. Congr., Norden (Copenhagen), 1960, part 8.
4. Birkenmajer, K., "Raised Marine Features of the Hornsund Area, Vestspitsbergen," STUDIA GEOLOGICA POLONICA, 1960, Vol 5.
5. Birkenmajer, K., "Devonian, Carboniferous and Permian Formations of Hornsund, Vestspitsbergen," Ibid, 1964, Vol 11.
6. Birkenmajer, K., "Quaternary Geology of Treskelen, Hornsund, Vestspitsbergen," Ibid.
7. Birkenmajer, K., "Some Sedimentological Observations in the Old Red Sandstone at Lykta, Vestspitsbergen," Norsk Polarinst. Arb., 1963: 137-150, 1965.
8. Birkenmajer, K., "Lower Cretaceous Tidal Deposits of Central Vestspitsbergen," Ibid., 1964: 73-85, 1966.
9. Birkenmajer, K., "Geological Investigations of the Polish Spitsbergen Expeditions, 1957-1960," Pol. Spitsb. Exped., Summ. Sci. Res. (K. Birkenmajer, Ed.), Warsaw, 1968.
10. Birkenmajer, K., "Tertiary History of Spitsbergen and Continental Drift," ACTA GEOL. POL., 1972, No 2.
11. Birkenmajer, K., "Alpine Fold Belt of Spitsbergen," 24th Int. Geol. Congr. (Montreal), 3: 282-292, 1972.
12. Birkenmajer, K., "Cross Bedding and Stromatolites in the Precambrian Hoferyntem Dolomite Formation of Sørkapp Land, Spitsbergen," Norsk Polarinst. Arb 1970: 128-145, 1972.
13. Birkenmajer, K., "Geotectonic Aspects of the Beerenberg Volcano Eruption 1970, Jan Mayen Island," ACTA GEOL. POL., 1972, No 1.
14. Birkenmajer, K., "Report on Investigations of Tertiary Sediments at Kap Brewster, Scoresby Sund, East Greenland," Rapp. Grønl. Geol. Unders., 48: 85-91, 1972.
15. Birkenmajer, K., "Jurassic and Lower Cretaceous Sedimentary Formations of SW Torell Land, Spitsbergen," STUDIA GEOLOGICA POLONICA, 1975, Vol 44.
16. Birkenmajer, K., "Caledonides of Svalbard and Plate Tectonics," BULL. GEOL. SOC. DENM., 24: 1-19, 1975.
17. Birkenmajer, K., "Middle Jurassic Near-Shore Sediments at Kap Hope, East Greenland," Ibid., 25: 107-116, 1976.

18. Birkenmajer, K., "Triassic Sedimentary Formations of the Hornsund Area, Spitsbergen," *STUDIA GEOLOGICA POLONICA*, 1977, Vol 51.
19. Birkenmajer, K., "Structural Evolution of the Arctic-Atlantic Basin in the Cenozoic," *PRZEGLAD GEOLOGICZNY*, 1977, No 5.
20. Birkenmajer, K., "Relation of the Upper to Middle Devonian Continental Deposits in Southern Wegener Halvø, Central East Greenland," *RAPP. GRØNL. GEOL. UNDERS.*, 85: 98-102, 1977.
21. Birkenmajer, K., "Erosional Unconformity at the Base of Marine Lower Triassic at Wegener Halvø, Central East Greenland," *Ibid.*, 103-107.
22. Birkenmajer, K., "Polish-American Paleomagnetic Research in Spitsbergen During 1974-1977," *PRZEGLAD GEOLOGICZNY*, 1978, No 8.
23. Birkenmajer, K., "Cambrian Succession in South Spitsbergen," *STUDIA GEOLOGICA POLONICA*, 59: 1-46, 1978.
24. Birkenmajer, K., "Ordovician Succession in South Spitsbergen," *STUDIA GEOLOGICA POLONICA*, 1978, Vol 59.
25. Birkenmajer, K., "Jurassic-Lower Cretaceous Succession at Agardhbukta, East Spitsbergen," *Ibid*, 1980, Vol 66.
26. Birkenmajer, K., "45 Years of Polish Geological Research (1934-1979) in the Svalbard Archipelago," *PRZEGLAD GEOLOGICZNY*, 1980, No 11.
27. Birkenmajer, K., "The Geology of Svalbard, the Western Part of the Barents Sea, and the Continental Margin of Scandinavia." In: *Ocean Basins and Margins* (A.E.M. Nairn, M. Churkin, Jr., F. G. Stehli, Eds), 5 (The Arctic Ocean): 265-329, Plenum Press, New York, 1981.
28. Birkenmajer, K., Fedorowski, J., "Corals of the Treskelodden Formation (Lower Permian) at Triasnuten, Hornsund, South Spitsbergen," *STUDIA GEOLOGICA POLONICA*, 1980, Vol 66.
29. Birkenmajer, K., Jednorowska, A., "Foraminiferal Evidence for the East Greenland Current During the Oligocene," *RAPP. GRØNL. GEOL. UNDERS.*, 85; 86-89, 1977.
30. Birkenmajer, K., Jerzmanska, A., "Lower Triassic Shark and Other Fish Teeth from Hornsund, South Spitsbergen," *STUDIA GEOLOGICA POLONICA*, 1979, Vol 60.
31. Birkenmajer, K., Logan, A., "On the Fauna and Age of the *Canocrinella* Limestone (Permian) at Kopernikusfjellet, Vest Spitsbergen," *NORSK. POLARINST. ARB.*, 1967: 28-45, 1969.
32. Birkenmajer, K., Narebski, W., "Precambrian Amphibolite Complex and Granitization Phenomena in Wedel Jarlsberg Land, Vestspitsbergen," *STUDIA GEOLOGICA POLONICA*, 1960, Vol 4.

33. Birkenmajer, K., Narebski, W., "Dolerite Drift Blocks in Marine Tertiary of Sørkapp Land and Some Remarks on the Geology of the Eastern Part of this Area," *NORSK POLARINST. ARB.*, 1962: 68-79, 1963.
34. Birkenmajer, K., Olsson, I. U., "Radiocarbon Dating of Raised Marine Terraces at Hornsund, Spitsbergen, and the Problem of Land Uplift," *Ibid.*, 1969: 17-43, 1971.
35. Birkenmajer, K., Orłowski, S., "Olenellid Fauna from the Base of Lower Cambrian Sequence in South Spitsbergen," *Ibid.*, 1976: 167-180, 1977.
36. Birkenmajer, K., Pugaczewska, H., "Jurassic and Lower Cretaceous Marine Fauna of SW Torell Land, Spitsbergen," *STUDIA GEOLOGICA POLONICA*, 1975, Vol 44.
37. Birkenmajer, K., Pugaczewska, H., Wierzbowski, A., "The Janusfjellet Formation (Jurassic-Lower Cretaceous) at Myklegardfjellet, East Spitsbergen," *PALAEONT. POL.*, 1982, No 43.
38. Birkenmajer, K., Turnau, E., "Lower Carboniferous Age of the So-Called Wijde Bay Series in Hornsund, Vestspitsbergen," *NORSK POLARINST. ARB.*, 1961:41-61, 1962.
39. Birkenmajer, K., Wojciechowski, J., "On the Age of Ore-Bearing Veins of the Hornsund Area, Vestspitsbergen," *STUDIA GEOLOGICA POLONICA*, 1964, vol. 11.
40. Czarniecki, S., "Sedimentary Environment and Stratigraphical Position of the Treskelodden Beds (Vestspitsbergen)," *PR. MUZ. ZIEMI*, 1969, No 16.
41. Fedorowski, J., "Lower Permian Tetracoralla of Hornsund, Vestspitsbergen," *STUDIA GEOLOGICA POLONICA*, 1965, Vol 17.
42. Fedorowski, Jr., "On Some Upper Carboniferous Coelenterata From Bjørnøya and Spitsbergen," *ACTA GEOL. POL.*, 1975, No 1.
43. Fedorowski, Jr., "Coral Thanatocoenoses and Depositional Environments in the Upper Treskelodden Beds of the Hornsund Area, Spitsbergen," *PALAEONT. POL.*, 1982, No 43.
44. Kielan, Z., "On Two Olenellid Trilobites from Hornsund, Vestspitsbergen," *STUDIA GEOLOGICA POLONICA*, 1960, Vol 4.
45. Gazdzicki, A., Trammer, J., "The Sverdrup Zone in the Lower Triassic of Svalbard," *ACTA GEOL. POL.*, 1977, No 3.
46. Gazdzicki, A., Trammer, Jr., "Tidal Deposits in the Lower Triassic of Svalbard," *N. JB. PALEONT. MH.*, 6: 321-331, 1977.
47. Kopik, J., "Remarks on Some Toarcian Ammonites from the Hornsund Area, Vestspitsbergen," *STUDIA GEOLOGICA POLONICA*, Vol 21.

48. Luczkowska, E., "Middle Holocene Foraminifera from Hornsund, Spitsbergen," *Ibid.*, 1975, Vol 44.
49. Malecki, J., "Permian Bryozoans from the Tokrossoya Beds, Sorkapp Land, Vestspitsbergen," *Ibid.*, 1968, Vol 21.
50. Malecki, J., "Permian Bryozoans from Souther Spitsbergen and Bjørnøya (Svalbard)," *Ibid.*, 1977, Vol 51.
51. Malkowski, K., "Development and Stratigraphy of the Kapp Starostin Formation (Permian) of Spitsbergen," *PALAEONT. POL.*, 1982, No 43.
52. Malkowski, K., Hoffman, A., "Semi-Quantitative Facies Model for the Kapp Starostin Formation (Permian), Spitsbergen," *ACTA PALAEONT. POL.*, 1979, No 2.
53. Marcinkiewicz, A., "Raised Marine Terrances of the South Coast of Bellsund and Van Keulen Fiord Beween Recherche and Hess Glaciers (West Spitsbergen)," *GEOLOGY BULLETIN*, Warsaw University Geology Dept., 1961, Vol 1, part 1.
54. Michalska, Z., "Geomorphological and Geological Research in the Frontal Zone of Penck Glacier on the Southern Coasts of Van Keulen Fiord," *Ibid.*
55. Narebski, W., "Geochemistry of the Iron Group Elements in Amphibolites of the Hecla Hoek Formation in Wedel Jarlsberg Land (West Spitsbergen)," *ARCH. MINER.*, 1966, Vol 26.
56. Nowinski, A., "Some New Species of Tabulata from the Lower Permian of Hornsund, Spitsbergen," *PALAEONT. POL.*, 1982, No 43.
57. Perch-Nielsen, K., Birkenmajer, K., Birkelund, T., Aellen, M., "Revision of Triassic Stratigraphy of the Scoresby Land and Jameson Land Region, East Greenland," *BULL. BRØNL.GEOL. UNDERS.*, 109: 1-51, 1974.
58. Radwanski, A., Birkenmajer, K., "Oolitic-Pisolitic Dolostones from the Late Precambrian of South Spitsbergen; Their Sedimentary Environment and Diagenesis," *ACTA GEOL. POL.*, 1977, No 1.
59. Rozycki, S. Z., "Geology of the Northwestern Part of Torell Land, Vestspitsbergen," *STUDIA GEOLOGICA POLONICA*, 1959, Vol 2.
60. Siedlecka, A., "Lithology and Sedimentary Environment of the Hyrnefjelle Beds (Late Palaeozoic) at Trekelen, Hornsund, Vestspitsbergen," *Ibid.*, 1968, Vol 21.
61. Siedlecka, A., "Investigations of Permian Cherts and Associated Rocks in Southern Spitsbergen," Parts I, II. *NORSK POLARINST. SKR.* 147: 1-86, 1970.
62. Siedlecki, S., "Culm Beds of the SW Coast of Hornsund, Vestspitsbergen," (Preliminary Communication). *STUDIA GEOLOGICA POLONICA*, 1960, Vol 4.
63. Siedlecki, S., Turnau, E., "Palynological Investigations of Culm in the Area of Hornsund, Vestspitsbergen," *Ibid.*, 1964, Vol 11.

64. Smulikowski, W., "Petrology and Some Structural Data of Lowest Metamorphic Formations of the Hecla Hoek Succession in Hornsund, Vestspitsbergen," *Ibid.*, 1965, Vol 48.
65. Smulikowski, W., "Some Petrological and Structural Observations in the Hecla Hoek Succession Between Werenskioldbreen and Torellbreen, Vestspitsbergen," 1968, Vol 21.
66. Szaniawski, H. Malkowski, K., "Conodonts from the Kapp Starostin Formation (Permian) of Spitsbergen," *ACTA PALAEONT. POL.*, 1979, No 2.
67. Vincenz, S. A., Cossack, D., Duda, S. J., Birkenmajer, K., Jelenska, M., Kadzialko-Hofmokr, M., and Kruczyk, J., "Paleomagnetism of Some Late Mesozoic Dolerite Dykes of South Spitsbergen," *GEOPHYS. JRL R. ASTR SOC.*, 67: 599-614, 1981.
68. Wierzbowski, A., Kulicki, C., Pugaczewska, H., "Fauna and Stratigraphy of the Uppermost Triassic and the Toarcian and Aalenian Deposits in the Sassenfjorden, Spitsbergen," *ACTA PALEONT. POL.*, 1981, No 3-4.
69. Wojcik, C., "Geological Observations in the Eastern Part of the Forlandsundet Graben Between Dahlbreen and Engelsbukta, Spitsbergen," *STUDIA GEOLOGICA POLONICA*, 1981, Vol 73.
70. Zastawniak, E., "Tertiary Plant Remains from Kaffioyra and Sarsoyra, Forlandsundet, Spitsbergen," *Ibid.*

Antarctica

71. Birkenmajer, K., "Polish Geological Research in West Antarctica (1977-1978)," *PRZEGLAD GEOLOGICZNY*, 1979, No 1.
72. Birkenmajer, K., "Tertiary Volcanic-Sedimentary Succession at Admiralty Bay, King George Island (South Shetland Islands, Antarctica)," *STUDIA GEOLOGICA POLONICA*, 1980, Vol 64.
73. Birkenmajer, K., "A Revised Lithostratigraphic Standard for the Tertiary of King George Island, South Shetland Islands (West Antarctica)," *BULL. ACAD. POL. SCI., TERRE*, 27: 49-57, 1980.
74. Birkenmajer, K., "Discovery of Pliocene Glaciation on King George Island, South Shetland Islands (West Antarctica)," *Ibid.*
75. Birkenmajer, K., "Age of the Penguin Island Volcano, South Shetland Islands (West Antarctica), by the Lichenometric Method," *Ibid.*
76. Birkenmajer, K., "Lichenometric Dating of Glacier Retreat at Admiralty Bay, King George Island (South Shetland Islands, West Antarctica)," *Ibid.*

77. Birkenmajer, K., "Polish Geological Research in West Antarctica (1978-1979)," PRZEGLAD GEOLOGICZNY, 1980, No 5.
78. Birkenmajer, K., "Geology of Admiralty Bay, King George Island (South Shetland Islands). An Outline," POL. POLAR RES., 1: 29-59, 1980.
79. Birkenmajer, K., "Raised Marine Features and Glacial History in the Vicinity of H. Arctowski Station, King George Island (South Shetland Islands, West Antarctica)," BULL. ACAD. POL. SCI., TERRE, 29: 109-117, 1981.
80. Birkenmajer, K., "Pliocene Tillite-Bearing Succession of King George Island (South Shetland Islands, Antarctica)." STUDIA GEOLOGICA POLONICA, 1982, Vol 74.
81. Birkenmajer, K., "Mesozoic Stratiform Volcanic-Sedimentary Succession at Admiralty Bay, King George Island (South Shetland Islands, Antarctica), Ibid.
82. Birkenmajer, K., "Pre-Quaternary Fossiliferous Glaciomarine Deposits at Cape Melville, King George Island (South Shetland Islands, West Antarctica), BULL. ACAD. POL. SCI., TERRE, 30 (in press).
83. Birkenmajer, K., "Structural Evolution of the Melville Peak Volcano, King George Island (South Shetland Islands, West Antarctica), Ibid.
84. Birkenmajer, K., "Extent and Course of the Pliocene Glaciations in West Antarctica," Ibid.
85. Birkenmajer, K., "Late Cenozoic Phases of Block-Faulting on King George Island (South Shetland Islands, West Antarctica)," Ibid.
86. Birkenmajer, K., "Geology of the Cape Melville Area, King George Island (South Shetland Islands, Antarctica): Pre-Pliocene Glaciomarine Deposits and Their Substratum," STUDIA GEOLOGICA POLONICA, Vol 79 (in press).
87. Birkenmajer, K., Gazdzicki, A., Wrona, R., "Cretaceous and Tertiary Fossils in Glaciomarine Sediments at Cape Melville, Antarctica," NATURE, London (in press).
88. Birkenmajer, K., Narebski, W., "Tertiary Calc-Alkaline Island-Arc Volcanic Suite of the South Shetland Islands (West Antarctica), BULL. ACAD. POL. SCI., TERRE, 28: 291-302, 1981.
89. Birkenmajer, K., Narebski, W., Skupinski, A., Bakun-Czubarow, N., "Geochemistry and Origin of the Tertiary Island-Arc Calc-Alkaline Volcanic Suite at Admiralty Bay, King George Island (South Shetland Islands, Antarctica)," STUDIA GEOLOGICA POLONICA, 1981, Vol 72.
90. Blaszyk, J., Gazdzicki, A., "Paleontological Research on King George Island During the Third Polish Antarctic Expedition of the Polish Academy of Sciences, 1978-1979," PRZEGLAD GEOLOGICZNY, 1980, No 5.

91. Gazdzicki, A., Pugaczewska, H., "Biota of the "Pecten Conglomerate" (Polonez Cove Formation, Pliocene) from King George Island (South Shetland Islands, Antarctica), Ibid.
93. Gazdzicki, A., Wrona, R., "Paleontological Research of the Fifth Polish Antarctic Expedition of the Polish Academy of Sciences, 1980-1981," PRZEGLAD GEOLOGICZNY, 1982, No 2.
94. Morycowa, E., Rubinowski, Z., Tokarski, A. K., "Arcaeocyathids from a Moraine at Three Sisters Point, King George Island (South Shetland Islands, Antarctica)," STUDIA GEOLOGICA POLONICA, 1982, Vol 74.
95. Rozycki, S. Z., "Changements Pleistocenes de l'Extension de l'Inlandsis en Antarctide Orientale d'Apres l'etude des Anciennes Plages Elevees de l'Oasis Bunger (Queen Mary's Land)," BUIL PERYGLC, 1961, No 10.
96. Stuchlik, L., "Tertiary Pollen Spectra from the Ezcurra Inlet Group of Admiralty Bay, King George Island (South Shetland Islands, Antarctica), STUDIA GEOLOGICA POLONICA, 1981, Vol 72.
97. Tokarski, A. K., "Structural Events in the South Shetland Islands (Antarctica). I. The Polonez Cove Formation (Pliocene)," Ibid.
98. Tokarski, A. K., "Structural Events in the South Shetland Islands (Antarctica) II. Tertiary Volcanics and Sediments South of Ezcurra Fault, King George Island," Ibid., Vol 79 (in press).
99. Tokarski, A. K., Paulo, A., Rubinowski, Z., "Report on Geological Investigations of King George Island, South Shetland Islands (West Antarctica) in 1979-1980," Ibid., Vol 72.
100. Zastawniak, E., "Tertiary Leaf Flora from the Point Hennequin Group of King George Island (South Shetland Islands, Antarctica)," Preliminary report. Ibid.

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