Annual Report 2001

GEUS

GEUS Vision

GEUS is the Geological Survey of Denmark and Greenland and by pursuing its vision it contributes to the development of society

Geology for a changing society

GEUS is to be an internationally recognised and in selected areas a leading research and consultancy institution in the fields of environmental geology, water resources, energy and mineral resources.

GEUS is to be the primary consultancy institution for Danish and Greenland authorities in all questions concerning important geological conditions.

GEUS is to be the national geological data centre, on the forefront internationally, which presents reliable and independent information to benefit the public and industry.

GEUS is to be an attractive workplace where ethical standards and social values are the mainstay of the business culture.

GEUS is to play an active part in developing the periphery fields of geology.

GEUS is to set the trend by developing partnerships with other research institutions, industry and international organisations.

GEUS, including its associates in Geocenter Copenhagen, is to be an internationally distinguished research centre attracting visiting researchers and PhD students.

GEUS is to be a visible player in international development assistance concerning the exploitation and protection of natural geological resources.

GEUS is to be visible in society and present geological information to the public in an accessible way.







In 2001, GEUS drew up the vision of the institution for the coming decade. This vision – Geology for a changing society – was drawn up in collaboration between employees, management and the board of directors, and it expresses the identity GEUS is aiming for in 2012.

Foreword

The Annual Report 2001 primarily focuses on GEUS' activities and results of immediate social relevance. Together with the newest international research, GEUS' own research projects form the basis of the consultancy services provided primarily to the Danish Ministry of the Environment, the Danish Ministry of Economic and Business Affairs and The Greenland Home Rule, but also to a number of other ministries, local authorities and the corporate sector.

In the past year, GEUS conducted several hundred scientific projects of which this report describes a few examples for each of GEUS' five programme areas. At the end of 2001, GEUS had approx. 350 employees. Of these about 200 had a scientific education.

GEUS is the national databank for Denmark concerning geological, geophysical and geochemical data about the underground, inshore substrata, the seabed, groundwater, etc., and presents this knowledge to the public. In 2001, efforts were mainly focused on increasing the availability and exploitation of data via electronic media and through popular scientific presentations of Danish groundwater problems.

Ensuring the availability of clean groundwater for the future is a water resource priority. This work primarily includes research and monitoring of the seepage of pesticides from cultivated areas to the groundwater and the impact of varied Danish soil as a basis for decentralised groundwater protection.

GEUS advises government authorities on appropriate exploration and exploitation of the North Sea oil and gas resources and has intensified its research of the particular geological chalk formations holding these riches. However, GEUS also contributed its geological expertise to the potential exploitation of geothermal energy in Greater Copenhagen. Furthermore, GEUS acted as a regular consultant for the Faeroese authorities in connection with oil exploration in that area, including three deep offshore borings.

With a view to developing the raw material sector into a principal industry in Greenland in addition to fisheries, GEUS carried out geological mapping and exploration of mineral resources in West and North Greenland, such as diamonds, gold and zinc. With regard to hydrocarbon, GEUS prepared and marketed, in 2001, the scientific basis for a new licensing round in 2002 off West Greenland to international oil companies.

With regard to nature, GEUS carried out a mapping of onshore and offshore geological conditions, implemented projects to preserve valuable scenic and natural resources and carried out research in natural climate variations. Efforts to understand the negative impact of soil contamination were also in focus in 2001.

Based on its energy, mineral and water resource expertise, GEUS carried out a number of projects for the industrial sector and consulting engineering firms on commercial terms. GEUS also carried out assistance projects in e.g. Vietnam, Ghana and Tanzania financed by DANIDA and the World Bank.

GEUS staff contribute to the training of scientists at the University of Copenhagen, the Technical University of Denmark, the Royal Veterinary and Agricultural University of Denmark and the University of Aarhus. In 2001, 68 researchers co-tutored 63 Master's students and 29 PhD students as well as acted as part-time teachers. This collaboration will be strengthened further when GEUS moves into Geocenter Copenhagen at the University of Copenhagen in the spring of 2002 and by the establishment of three new schools for researchers in collaboration with the universities.

GEUS had a turnover of approx. DKK 225 million of which approx. DKK 150 million was granted under the Finance Act and approx. DKK 75 million came from other sources, including a revenue of DKK 25 million from commercial projects carried out for the corporate sector.

For more detailed information on GEUS' activities and finances, see Virksomhedsregnskab 2001 [Annual Report and Accounts 2001] available in Danish on the GEUS website (www.geus.dk). The Publikationskatalog 2001 [Publication Catalogue 2001], which includes a complete list of the publications of the institution, is also available on the site.

Per Buch Andreasen
Chairman Board of Directors

Martin Ghisler
Managing Director

From the mountains of North-East Greenland to the Danish forest

In 2001, four issues of the popular scientific magazine, Geologi – Nyt fra GEUS [Geology – News from GEUS] were published covering subjects ranging from water resources to fold mountains in North-East Greenland to the Danish natural forest. All issues can be read or downloaded from the GEUS website. Selected issues of the magazine are also available in English. Click the Popular Science Magazine link on the English website.

National geophysical database

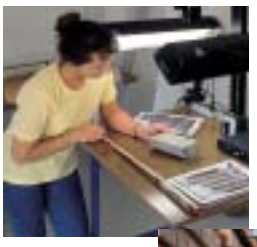
Geophysical methods are increasingly used by local authorities and consultancy firms to survey areas of groundwater and raw material. GEUS operates a national database, GERDA, which gathers the findings of all such surveys. It was developed in close cooperation with the Municipality of Aarhus, the University of Aarhus and leading geophysical consultancy firms. The data amount is constantly growing with the inclusion of new and old data. In 2001, GERDA was developed further to enable it to accommodate new types of geophysical data, and it now comprises data from a wide range of geoelectrical methods and bore hole logs. The Danish-language GERDA website (gerda.geus.dk) contains facilities for map-based searches of geophysical data and graphical presentation. The GERDA database will continue to develop and constitute an important tool for mapping water resources and raw materials in Denmark.

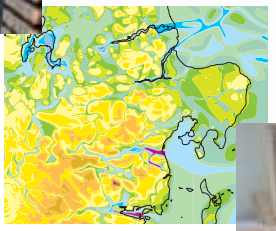
Databanks, information and informat to the

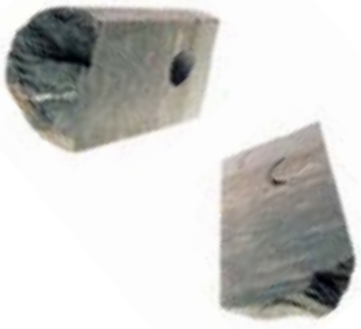
Storage, quality assurance and presentation of geological knowledge and data

Database of Greenland drill cores

The Bureau of Minerals and Petroleum, Greenland Home Rule, operates a drill core archive in Kangerlussuaq holding a selection of approx. 80,000 m drill cores from over 850 exploration borings. In 2001, GEUS started developing the GREENCORE database of valuable drill cores for the Bureau of Minerals and Petroleum. The database contains information about location, time of boring and the mining company that carried out the boring with references to the commercial company reports describing the cores. With this database, commercial users and scientists can get an idea of existing cores and order selected sections for inspection at the archive.







Information to citizens on groundwater

Groundwater pollution is often a subject for discussion in the media. On the new GEUS website there is a link to Viden om Grundvand [Knowledge about Groundwater] with background information about groundwater in Danish. Here, interested citizens may read and quiz their way to information about groundwater. The website contains popular information about the mysteries of groundwater and answers to such questions as: What are the threats to our groundwater? What are we doing to protect our groundwater? How is groundwater generated and how does it flow? Viden om Grundvand is aimed at primary and lower-secondary schoolteachers who may download overheads for their classes on the website. Visit www.geus.dk/viden_om.

Danish landscapes – in pictures

"A highly recommendable book which will look good in any bookcase," wrote the reviewer in the Danish magazine Geologisk Nyt about the new book published in Danish by GEUS: Danske Landskaber – Et billedatlas [Danish Landscapes – a pictorial atlas]. The book takes us on a tour of our beautiful country to visit a selection of Danish landscapes. It can be used as a guide on trips around Denmark or as an inspiration for school outings. The book briefly describes how landscapes were created by ice, water, wind and sea, with pictures illustrating the landscapes. In the back of the book are a number of geological maps of Denmark.

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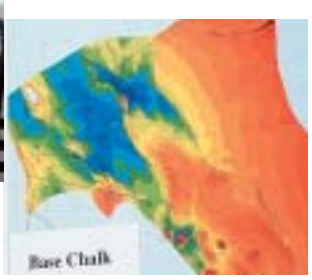
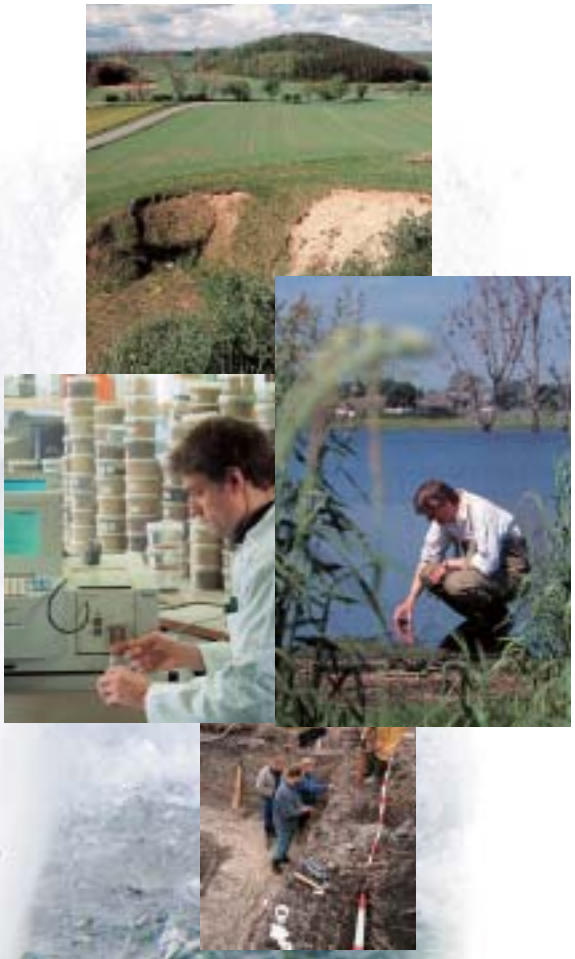


Increased access to boring and groundwater data

The Jupiter database is at the heart of the GEUS environmental information system. It contains information on the geological strata found in borings during the past many years. It also contains information about groundwater chemistry, sounding of groundwater levels, drinking water chemistry and the volume of groundwater resources. In 2001, new facilities were implemented to enter data on groundwater and drinking water quality in the database. For external users of bore data, GEUS developed PC Jupiter, a modern Windows-based program. A GIS module can be added to enable users to search and graphically present bore data. In collaboration with the Danish Water Well Drillers Association, GEUS developed a module to report new borings electronically. Data content grew in 2001, and the amount of bore data now corresponds to the internal Jupiter database. The subscribers count more than 80 external users of PC Jupiter, including county authorities, water well drillers, consultancy firms and educational institutions. The address of the Danish-language PC Jupiter web site is: www.geus.dk/jupiter.



Important groundwater reservoirs in Jutland

Oligocene and Miocene sand strata constitute some of the most important groundwater reservoirs in Jutland, and several Jutland counties have therefore focused on these strata when assessing and protecting groundwater resources. GEUS collaborates with the counties to create a three-dimensional geological model of these deposits based on bore data, geophysical data and strata in coastal cliffs and raw material excavations. The fossil content of boreholes was examined to better understand the stratigraphic correlation. A model of the county of Vejle was created. The model shows that there are three levels in the sequence of strata with potential groundwater reservoirs. In the county of Ribe, a boring at Vorbasse and new seismic data show that there are groundwater reservoirs at two of those levels.

Water resou

Procuring knowledge for optimal management of our water resources

Cheaper and quicker pesticide analyses

The work to develop cheap and quick analysis methods for pesticides in groundwater includes development of immunochemical analyses of a number of pesticides and analysis implementation on a microchip platform. The development work includes the production of modified pesticides with a view to producing pesticide antibodies. Transferring the methods to a microchip has proved successful and it is now possible to analyse concentrations ten times lower than before. At present, it is possible to analyse for two different pesticides on the same platform, which is an important step towards developing a so-called multi-chamber system to analyse for many pesticides in the same process. The work is performed under the SUE programme [cooperation between sector research institutions, universities and the corporate sector] of the Danish Research Agency with the participation of GEUS, Statens Serum Institut, Exiqon A/S and the National Micro- and Nanotechnology Research Center and Environment & Resources DTU.

Evaluating Denmark's water resources

The work to develop a national water resource model, the so-called DK model, has come another step closer to completion. In 2001, a root zone model for the entire country was finalised. The model has been used to make calculations to provide a new assessment of the volume of water resources in Denmark. These calculations are to replace the previous simplified estimate made in 1992 by the Water Council. The estimate will form part of a new theme report from NOVA [the national monitoring programme for the aquatic environment] on freshwater circulation in 2002. In 2001, model calculations at catchment area level revealed that there are problems with tallying the water balance as a result of inconsistent use of precipitation and evaporation data. Therefore, an investigation was launched in collaboration with the Danish Meteorological Institute, the National Environmental Research Institute, Denmark, and the Danish Institute of Agricultural Sciences. Experience and knowledge gained from preparing the DK model has also been applied to the implementation the EU Framework Directive in the field of water policy according to which surface water and groundwater are to be regarded and managed as one.

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Identification of pesticide-sensitive areas

The county authorities are currently identifying groundwater protection zones. In this connection, GEUS and the Danish Institute of Agricultural Sciences are developing a method to identify areas which are particularly sensitive to seepage of pesticides to the groundwater – the KUPA project [Concept for Identification of Pesticide-Sensitive Areas]. The focus is on developing a method for areas with sandy soil and to assess the possibility of developing a method for clay soil at a later stage. In 2001, field surveys of 20 out of 24 sand locations were completed with a view to measuring variations in parameters of significance for pesticide seepage. In addition, GEUS evaluated the extent to which geophysical methods may be used to map the unsaturated zone. All geophysical methods and instruments used in Denmark have been evaluated in addition to a number of methods and instruments only used abroad.

Pesticide Leaching Assessment Programme

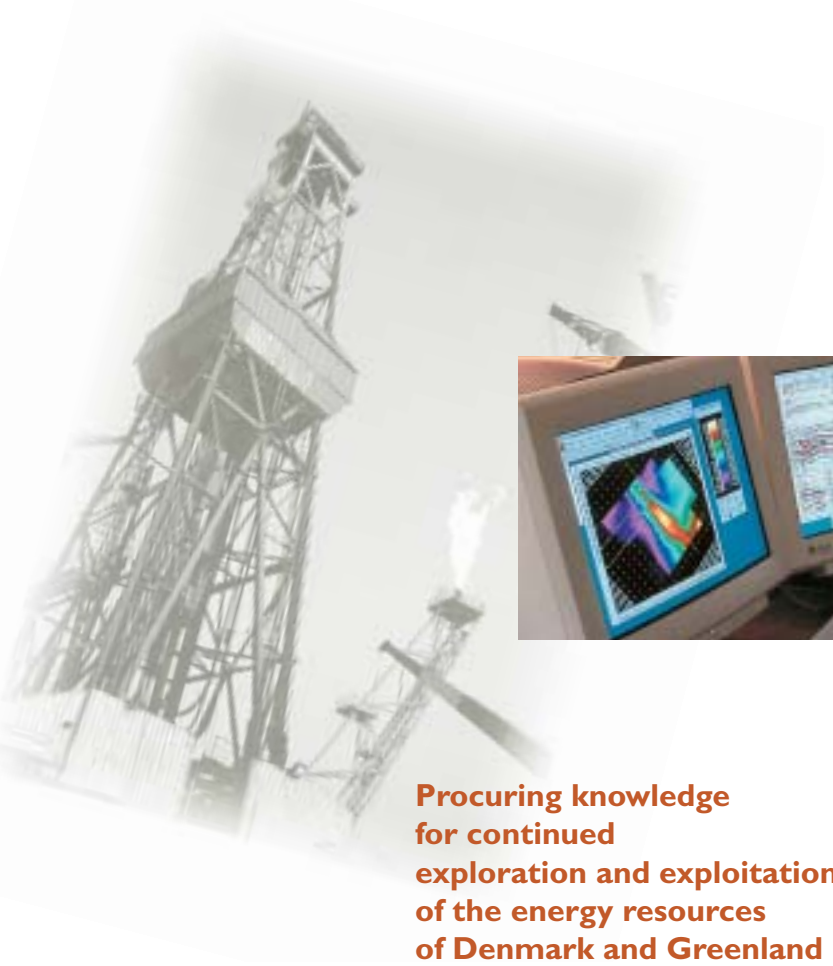
The purpose of the Danish Pesticide Leaching Assessment Programme is to examine whether approved pesticides are leaching into the groundwater by regular use. The system has been fully implemented and data is pouring in from the six experimental fields which constitute the system. It is operated by GEUS, the Danish Institute of Agricultural Sciences and the National Environmental Research Institute, Denmark. Results from 2001 show that the glyphosate pesticide and its decomposition product, AMPA, leach from the root zone in concentrations exceeding the permitted limit value. The new results are from a clay soil experimental field at Estrup near Vejen in Jutland, where glyphosate was used in the autumn in approved quantities as part of common cultivation practice. In 2001, several reports were published containing findings from the first year of operation and an establishment report with a thorough description of soil conditions, geology and instrumentation of the fields in addition to field selection criteria. Visit www.geus.dk

Oil hidden in the North Sea

Oil in the North Sea chalk is not only – as previously presumed – hidden at the top of geological structures where chalk layers have been pushed up. As a result of the constant subsidence of the area, water is pressing very slowly through the chalk. This flow may move the oil to the flanks of pushed-up chalk structures to places where the presence of oil is normally not expected. In 2001, GEUS launched a project to clarify the effects of such processes. The work includes calculations of subsidence and compression of rocks and simultaneous water and oil flows in the chalk. The project is financed by the Energy Research Programme of the Danish Energy Authority.

Water and oil don't mix

That is the general opinion. But GEUS is currently applying all its oil and hydrogeology experience to assess Denmark's oil and groundwater resources. About one third of Danish groundwater is extracted from limestone reservoirs, and Danish production of oil and gas is almost exclusively limestone-based. It is therefore important to obtain a better understanding of the storage and flow of oil and water in limestone. In 2001, GEUS completed an EU project where European universities, oil companies and Geological Surveys collaborated to study water and oil flow in fragmented limestone reservoirs. This work included the creation of a flow model for an oil field in Portugal based on a mapping of fractures and fault zones and their flow characteristics.



Procuring knowledge for continued exploration and exploitation of the energy resources of Denmark and Greenland

Energy resources

Geothermal energy and storage of CO_2

Over the past year, GEUS worked on projects to increase the use of renewable energy and reduce CO_2 emissions to the atmosphere. In Greater Copenhagen, GEUS performed evaluations of six possible geothermal boring locations for the Metropolitan Geothermal Cooperation (HGS). On the basis of this, the geological base for the Margretheholm-1 boring in East Amager, Copenhagen, was prepared for expected implementation in 2002. GEUS' activities concerning geological CO_2 storage cover many areas. The institution continues to participate in the international SACS research project to monitor and model the storage of one million tons of CO_2/year under the Norwegian Sleipner gas field. Furthermore, GEUS is project manager of an EU project (GESTCO) investigating potential geological CO_2 storage capacities in eight EU member states. In Denmark, a geological capacity to store more CO_2 than Denmark's obligation under the Kyoto agreement was identified. GEUS collaborates with both electricity and oil companies in this area. Finally, GEUS participates in projects concerning CO_2 storage in Great Britain and the Canadian Weyburn oil field where CO_2 injection started during the year. GEUS collaborates with the EU on the development of future research programmes in this field and with the International Energy Agency (IEA) and the US Department of Energy on the development of CO_2-free power plants for the future

Preparing oil licensing round in West Greenland

In 2001, there was a high level of activity in connection with the preparation of the licensing round for the offshore areas between 63° and 68°N in West Greenland to be held in the spring/summer of 2002. West Greenland exploration opportunities were presented at several meetings and major conferences, on CD-ROM's, in newsletters and on the GHEXIS web site. In addition, GEUS visited or received visits from over 25 international oil companies. The work involved in reassessing the geophysical and geological findings from the "dry" Qulleq-1 boring, performed in 2000 by the Statoil Group, was completed in 2001 and the findings were incorporated in the marketing of West Greenland. Furthermore, investigations of the Palaeogene sequence of strata in South West Greenland were completed with the creation of a sedimentation model which may be used to describe the distribution of potential reservoir rocks and seals. A new project was launched in the summer of 2001 with the objective of comparing oils and source rocks from West Greenland with selected samples from known oil fields in the eastern, central and arctic parts of Canada and the USA. In addition, a project was launched to compare the content of microfossils and thus the age of geological strata in the area between Greenland and Canada based on five Canadian and six West Greenland offshore borings. The new projects form part of the continued efforts to develop and market new exploration models. .

Increased security of oil and gas extraction

Accidents caused by geological conditions such as slides and mud streams on the seabed may have serious consequences for drilling equipment and sub sea installations and pipelines used in the exploration and extraction of offshore oil and gas. In connection with oil exploration in West Greenland and on the Faeroe Islands, GEUS assessed potential locations for natural offshore accidents. This includes the mapping of sea depths, sea bed gradients, the occurrence of soft and hard sea beds, channels, canyons, plough marks from icebergs and areas with a potentially unstable sea bed, occurrences of sedimentation from mass flows and bedforms indicating strong bottom currents.

Good clay for tile production

Not all Danish clay types are equally suitable for tile production. GEUS conducted therefore a study of a number of Danish clay types and potential alternatives such as fly ash, which are or can be used for tile production. This work included analyses of the distribution of particle sizes, mineralogy and chemistry and a number of tile-technical analyses of drying and storage processes. Furthermore, efforts have been made to find suitable geophysical methods for brick clay mapping. This work was carried out in collaboration with the National Forest and Nature Agency, the Danish Masonry Center and a consultancy firm and funded by the National Forest and Nature Agency, the county of Ribe and two brickworks.

Creating a scientific basis for targeted and environmentally friendly exploitation of minerals in Greenland and Denmark

Mineral resources and

Treasures hiding in the sea

Important raw materials for building and construction work in the form of sand, gravel and stone are hidden at the bottom of the sea. With a view to mapping quantities and qualities of the offshore raw materials, for a number of years GEUS has been collecting seismic data and data showing the surface and structure of the North Sea bed. This mapping work has been a joint effort of GEUS, the Danish Navy, the Royal Danish Administration of Navigation and Hydrography and the Danish Coastal Authority. In 2001, GEUS also collected seismic data, scannings of the seabed and sediment data from borings for the Danish Coastal Authority with a view to planning how best to collect sand for coast reclamation. A map of sand thicknesses and movement was prepared for Horns Rev in addition to findings from the Lodbjerg-Blåvandshuk area in Jutland where similar surveys were conducted from 1998 to 2001. These findings are used by the National Forest and Nature Agency, among others, which has the administrative responsibility of regulating the extraction of raw materials in Danish waters.

Geophysics to attract industry

After a year's break, the airborne magnetic surveys of West Greenland were resumed. In connection with Aeromag 2001, during the summer, magnetic data was collected along a linear distance of 70,000 km in the area between Uummannaq and Upernavik. The purpose of the surveys is to increase industry interest in raw materials exploration with regard to both onshore minerals and offshore oil and gas. This work is financed by the Bureau of Minerals and Petroleum, Greenland Home Rule. More than 100 new maps of magnetic conditions providing new information on geological underground structures have subsequently been produced. The digital data and maps were released in March 2002. To conclude the AEM Greenland programme, a CD-ROM with electromagnetic and magnetic data collected from the air during the period from 1994 to 1998 was also issued. It includes maps from six areas in West, North and East Greenland with an accompanying report describing the data and providing an introduction to the geology of the areas.

New tool for mineral and environmental studies

A new comprehensive geochemical atlas of South and West Greenland was issued on CD-ROM. This atlas is based on chemical analyses from more than 7,000 samples of river sediments collected by GEUS from 1977 to 1998. It contains maps of more than 43 chemical elements, a gamma radiation map and five maps of kimberlite indicator minerals found in river sediments. The atlas also contains a geological and a magnetic map. The maps and data are in Oasis Montaj® format on the CD-ROM which also contains a report and bibliography of geochemical studies carried out over many years.

Greenland mapping

Mineral resources as a principal industry

The summer of 2001 saw the launch of extensive exploration of mineral resources and geological mapping of the area from Maniitsoq to Disko Bay in West Greenland. This work forms part of the efforts to make the exploitation of mineral resources a principal industry in Greenland. The mapping and dating of rocks in the area was started with a view to identifying its general geological conditions, which is essential when assessing the presence of minerals. The mapping activities are conducted jointly by GEUS and geologists from the USA, England and Poland. They also follow up on geochemical and geophysical investigations of previous years. Areas with interesting element discoveries in river sediments and particularly significant magnetic conditions were studied to find out if they are caused by the presence of minerals in the rocks. The studies focused on gold, silver, copper and zinc and the occurrence of potentially diamondiferous source rocks, the so-called kimberlites. Fieldwork led to the discovery of new occurrences of kimberlite dykes and boulders, and the GEUS kimberlite discovery database now contains more than 600 locations in Greenland.

Raw material investigations were also on the agenda in North-West Greenland and East Greenland. Geochemical samples were collected and ore geological reconnaissance carried out in an area of 4,300 km^2 near Qaanaaq/Thule. And in East Greenland samples and spectral data were collected in the field to follow up on the collection in 2000 of advanced airborne hyperspectral surveys. This type of data has been used successfully in mineral exploration in a number of different environments around the world. A new map sheet on a scale of 1:500 000 of the area north of Mestersvig was published as a result of investigations in previous years.

Monitoring coasts

Monitoring of coastal changes in Oresund between Denmark and Sweden in connection with the Oresund bridge construction was completed. Several reports describe the monitoring results and give an account of coastal development on the Danish island of Saltholm from 1954 to 2000, including identification of areas which may be influenced by the Oresund Bridge in future. GEUS and the Danish Coastal Authority conducted investigations of coastal development and sediment transport around Ringkøbing Fjord. This work included geological mapping, fjord surveys and borings in and around Holmslands Klit.

Long-term mapping of nutrients in Danish lakes

A new method to map long-term nutrient concentrations in Danish lakes has been developed. Based on planktonic diatom content in lake sediments, it is now possible to calculate phosphorous content in lake water dating back several thousand years. This method is an important tool for managing the aquatic environment in connection with the implementation of the EU Framework Directive in the field of water policy which requires clarification and definition of the natural background conditions of the aquatic environment. This work includes studies of a sedimentary core from Dallund Lake on Funen reflecting developments over the last 6,000 years. Results show a clear connection between the nutrient content of the lake and agricultural activity in the area and that 1,000 years ago there was already a heavy nutrient load on the lake. The studies were conducted under the auspices of the 'Changing Landscapes' project under the Danish Environmental Research Programme (SMP 97).

Increased viability of natural forests

Information about our original forests is essential to the restoration of natural forests. In 2001, GEUS participated in natural forest research in order to plan the establishment of more robust natural forests and the management of forest areas. Based on the report by the Wilhjelm committee, GEUS contributed a scientific abstract in Danish on the research and management status of untouched forests in Denmark – Danske Landskaber og Urørt Skov i Danmark [Danish landscapes and the untouched forest in Denmark]. GEUS also participated in three major EU research projects mapping the trees and plants previously growing in forests and studies of the balance of forests and climate. This work supported the EU directives on sustainable use of forest resources and protection of biodiversity. Finally, GEUS completed its investigations of the windfalls of Draved Forest. They show that natural forests are much more storm resistant than manmade forests.

Ilulissat Ice Fjord on the World Heritage List

The Ilulissat Ice Fjord was recommended for inclusion on the UNESCO World Heritage List. In this connection, GEUS was requested to prepare the recommendation material to be presented to UNESCO. The request must be submitted by 1 February 2003 by the project steering committee consisting of representatives of Greenland Home Rule, the municipality of Ilulissat and the Danish Ministry of Cultural Affairs. Collection of materials began in 2001. This work is funded by DANCEA.

Nature and environment

Identifying the conditions leading to the current climate and environmental situation in Denmark and the North Atlantic in particular

Progress in the soil contamination field

The Danish Center for Biological Processes in Contaminated Soil and Sediment (BIOPRO) carried out wide-ranging activities in the soil contamination field. They demonstrated that it is possible to stimulate the disintegration of tar compounds, the so-called PAH compounds, using the familiar oyster mushroom. In 2001, BIOPRO arranged a major international conference with participation of more than 200 scientists. The conference findings show that old contaminations of topsoil are less accessible to animals, plants and microorganisms than new contaminations, because old contaminations are integrated in the humus compounds of the soil. Future studies will show the extent to which widespread diffuse soil contamination in Danish towns actually constitute a health problem.

Mechanisms causing dramatic rock slide and flood

On 21 November 2000, the village of Saqqaq in central West Greenland was flooded by a giant wave. It was caused by a large rockslide at Paatuut on the steep southern coast of the Nuussuaq peninsula. In 2001, GEUS investigated the cause of the rock slide and wave. The investigations show a very dramatic course of events. An explosive congelifraction occurred in a fracture between the massive basalt rock wall and partly dislodged rock. This caused a major slide where about 90 million cubic metres of massif crashed into the sea from a height of more than one kilometre. At the shore the sliding rocks created a peninsula on the steep seabed. A later breakdown of the unstable peninsula then released a sub sea slide which started the wave. The studies funded by the Bureau of Minerals and Petroleum, Greenland Home Rule, also describe previous slides in the area and identify areas at risk of similar rockslides.

FLASHES OF THE YEAR

Online service for the oil and mining industry

Two new online services for the international oil and mining industry have been launched on the GEUS website. Here, industry and other stakeholders can get information on oil and mineral exploration in Greenland. The website also presents the GHEXIS and MINEX newsletters on oil and minerals, respectively. Furthermore, information is available on licence policies, available data, operational conditions, previous exploration and literature.

Award to Danish oil geologists

Two researchers from GEUS won the award for best scientific article in 2000 published in the internationally recognised journal, Petroleum Geoscience. The two geologists, Ole Valdemar Vejbæk and Lars Kristensen, were presented with the award in Amsterdam in June. Their article describes a new method to map oil deposits in the North Sea chalk. The method was developed in a research project carried out in cooperation with Ødegaard A/S. "The model calculations raise the question of whether we currently know precisely how many resources are held in the North Sea chalk," says Ole Vejbæk, and he continues, "It may well turn out to be a positive surprise for the supply situation in Denmark".

Two new doctors at GEUS

In 2001, two senior research associates from GEUS got a doctor's degree in natural science in subjects essential to oil exploration in Greenland, the North Atlantic and the North Sea. Peter Japsen defended his thesis, "Fra Kridthav til Vesterhav" (From Chalk Sea to North Sea), describing the development of the North Sea Basin based on the speed of seismic waves. The other new doctor, Lars Stemmerik, defended a thesis describing the development of an old sea area which covered the edge of the current North and East Greenland, Svalbard and parts of the East Greenland continental shelf and the Barents Sea.

County course

During the past year, GEUS arranged two courses in groundwater modelling for county employees working with groundwater. The courses were a mixture of lectures, hands-on computer modelling and exchanging experience. They were arranged in cooperation with the Technical University of Denmark and DHI, Institute for Water and Environment. The counties provided financial support to the preparation of course materials, i.a. a guide to groundwater modelling ("Ståbi grundvandsmodellering") which can be downloaded in Danish from www.vandmodel.dk

GEUS measures satisfaction

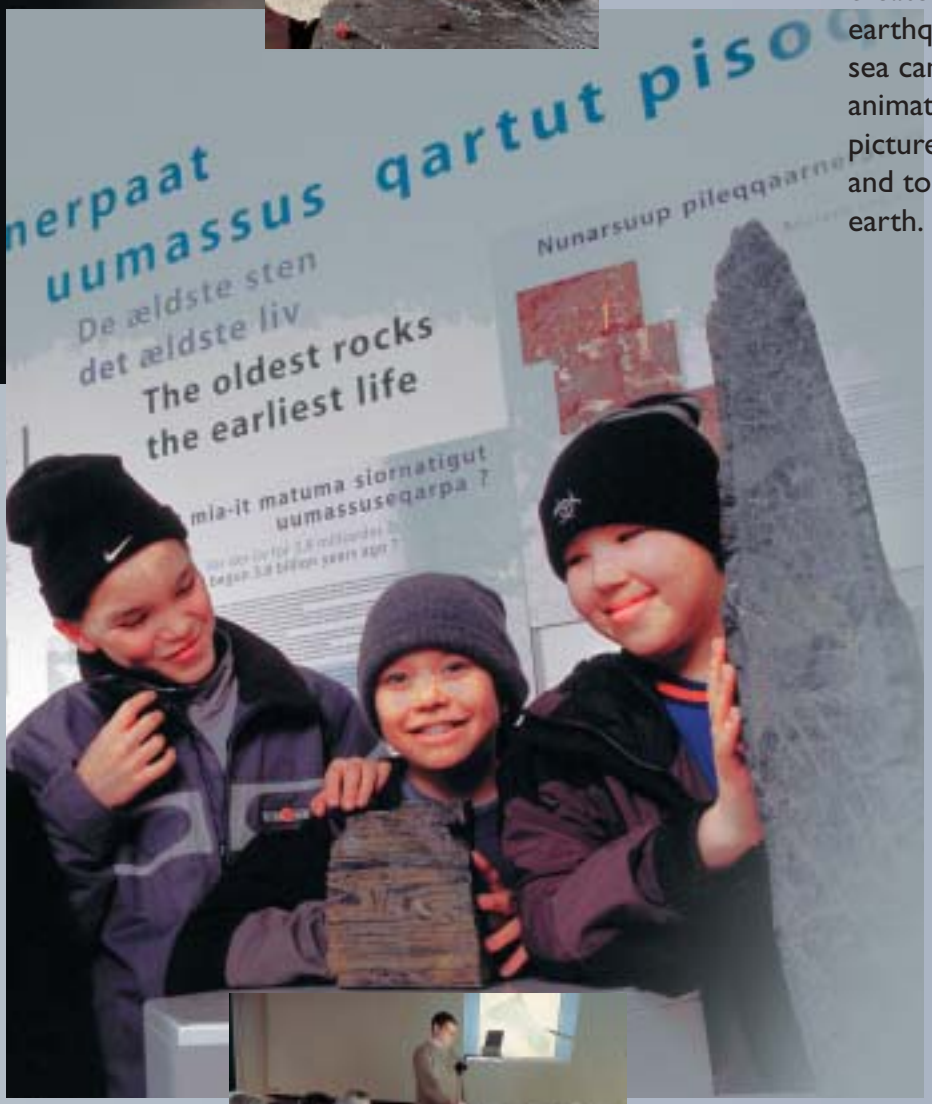
In 2001, GEUS asked its users if they were satisfied with the services provided by the institution. Questionnaires regarding groundwater were submitted to counties, municipalities, advisers and researchers. In addition, the GEUS web site was scrutinised in a user inquiry. On the home front, an inquiry was made to determine the level of job satisfaction of employees working at GEUS. All inquiries were managed by external consultants.

GEUS hosts international research conference

In August, GEUS hosted the 53rd meeting of the International Committee for Coal and Organic Petrology (ICCP), which also included a programme for The Society of Organic Petrology (TSOP). The conference, which was held at Geocenter Copenhagen, was well-attended with 71 participants from 20 different nations. More than 30 lectures or posters were presented, covering the subjects of organic petrography and geochemistry. GEUS has published extended abstracts of the contributions. The meeting was sponsored by Energi E2.

A dramatic story

Thus the press described the exhibition "The oldest rocks – the earliest life" opened to the public in the spring at the National Museum and Archive of Greenland in Nuuk. The exhibition was produced by GEUS and financed by the Bureau of Minerals and Petroleum, Greenland Home Rule. Here, visitors are told the dramatic story of the time when the oldest rocks on earth was created and life began. Volcanic eruptions, earthquakes and mudflows in the primeval sea can be experienced through computer animations, video clips, images and wall pictures, and guests are also allowed to see and touch some of the oldest rocks on earth.



Bore data archive celebrates anniversary

75 years

On October 1st, the GEUS bore archive celebrated its 75th anniversary. This archive contains useful information about clean drinking water in Denmark, gravel, sand, clay and limestone for construction, industry and agriculture. Since 1926, information about 270,000 holes bored in the surface of Denmark has been filed here. Over the years, the bore data archive has been an important source of information about geology, groundwater and major environmental research projects in Denmark, e.g. the disposal tip project in the 1980's and the SMP (strategic environmental research programme) projects in the 1990's. Today, the archive data is used in connection with, e.g., major zoning and detailed mapping of groundwater resources work. In connection with the bore data archive, GEUS provides a consultancy telephone service allowing water well drillers and other users to phone in and get information on soil and water.

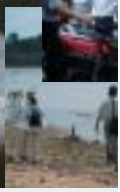
Building oil expertise in Vietnam

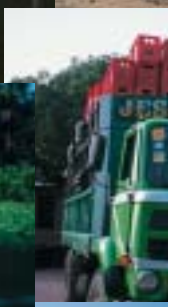
Oil and gas constitute an important sector in Vietnamese society. About 20 per cent of national revenue is generated by oil and gas and this sector employs many Vietnamese. In 2001, GEUS started a joint project with the Vietnam Petroleum Institute (VPI) to strengthen Vietnam's ability to assess its oil and gas resources. This project is financed by the Danida ENRECA programme and includes participants from the Geological Institute of the University of Copenhagen and Hanoi University of Mining and Geology. At the end of September 2001, the project agreement was signed at a ceremony in Hanoi. Training of Vietnamese scientists will consist in solving a specific research project with the purpose of understanding the geological development and the potential for finding oil and gas in the Phu Khanh Basin. While training students to create geological models, the project is aimed at a wide range of geosciences as the models may also be used by geologists trying to ensure optimal exploitation of Vietnam's water resources.









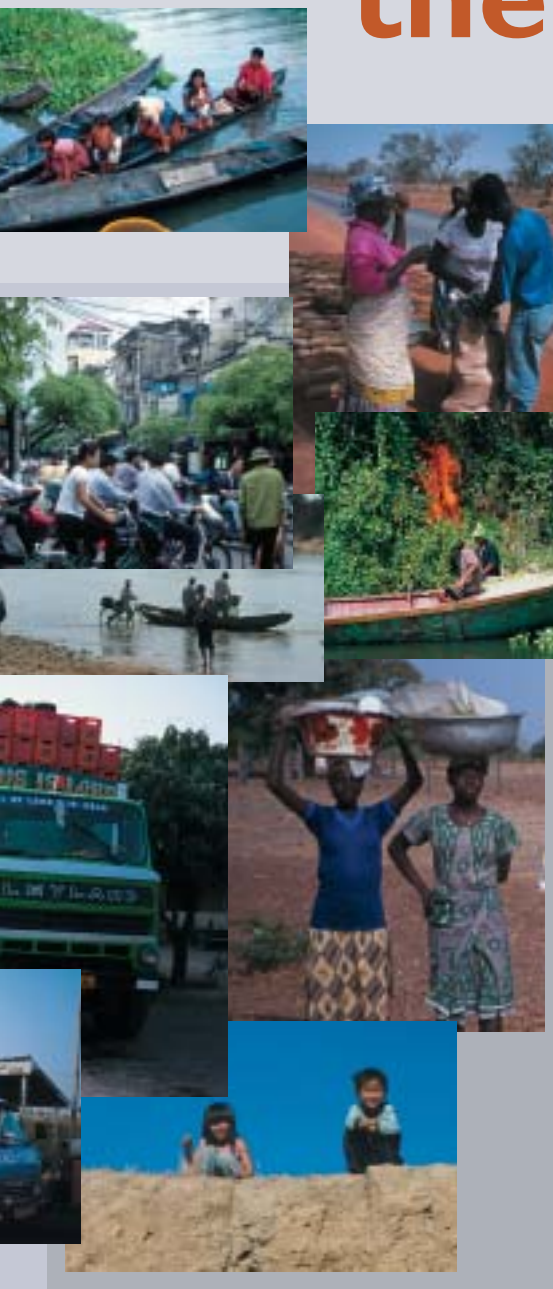



Climatic conditions and tropical diseases in Uganda

In many tropical countries humans and livestock alike are suffering from tropical diseases such as malaria, sleeping sickness and plague. It is a well-known fact that climatic conditions impact the spread of disease, but there is increasing awareness of the fact that climatic change may lead to the outbreak of disease. In 2000 and 2001, GEUS implemented a pilot project in western Uganda to clarify the correlation between the climate, human activity and disease. Sedimentary cores from the bottom of two lakes reveal that there have been great variations in the biological, chemical and physical conditions of the lakes over the past 700 to 1.200 years, reflecting changes caused by both human impact and the climate. The man-made impact is visible throughout the period, but is clearest in the last few decades. Studies also indicate that from the beginning of the 20th century there seems to be a connection between historically documented outbreaks of sleeping sickness and the agricultural changes and cultural break-up revealed by the sediment cores. Results show that by developing the method further, it will be possible to map the history of disease much further back than the more recent historical records, thus providing insight into future development. This work was carried out in cooperation with Makerere University, Uganda and the London School of Hygiene & Tropical Medicine and financed by the Council of Development Research (RUF).

Knowledge building in developing countries through research and consultancy services

GEUS around the world



Restructuring in Ghana

Ghana has many well-educated geologists, but the Geological Survey Department (GSD) needs assistance to arrange for systematic mapping of the country, data analyses and creation of databases with a view to improving the exploitation of its mineral resources. In 2001, GEUS launched a project in Ghana with the aim of helping the director of GSD draw up a plan to restructure the institution. The project focuses on establishing systematic mapping methods, laboratories and archives. It is financed by the Nordic Development Fund.

Modernisation of the Rumanian mineral sector

Rumania is rich in minerals, but both industry and the authorities need to adjust to modern Western methods and standards. GEUS is participating in a major programme financed by the World Bank with the objective of establishing and modernising the mineral sector in Rumania. The purpose of the project is to develop a cadastral reference system for mines with related databases and procedures complying with Rumanian mining legislation. This work is conducted jointly with two international firms – Landmark EAME, England, and Intergraph Inc., Rumania.

A time bomb under the Ukraine

The Chernobyl disaster is not the Ukraine's only headache. The Donbass region, which is the most heavily industrialised region of the Ukraine, is threatened by huge environmental problems, the main reason being a rise in the water level after uncontrolled closures of deep coalmines in the area. Flooding, gas explosions, growing instability of buildings and extensive contamination of surface and groundwater are examples of the consequences of the closures. GEUS has been in charge of a DANCEE-funded project, which has forecast for the first time various scenarios as a result of closing down the mines. The forecasts were generated using a computer model developed in connection with the project. This work was carried out in collaboration with the Institute of Geological Sciences of the Ukraine and the State Geological Information Fund under the Ministry of Environment and Natural Resources.

Key figures

More detailed key figures for GEUS' activities are found in "Virksomhedsregnskab 2001" (Report and Accounts 2001) available in Danish from GEUS and on www.geus.dk

Number of employees: **354, including the Danish Lithosphere Centre (22)**
Number of scientific projects: **390**

ACCOUNTS 2001*

Amounts in million DKK.

Revenue:	**225.4**
Net figures (appropriation)	140.0
Operating revenue	76.2
Aktstykkemidler** brought forward from 2000	9.2
Expenditure	**223.5**
Salaries	134.0
Other operating expenditure	89.5

* ***The accounts include the Danish Lithosphere Centre - a research centre financed by the Danish National Research Foundation.***

** ***Supplementary funding appropriated by the Danish Finance Committee.***

PRESENTATION ACTIVITIES

Long-term knowledge building

Articles in international scientific magazines/publications	124
Articles in own scientific series	37
Other scientific publications	28

Ongoing scientific task solution, consultancy and presentation

Publicly available reports	154
Confidential reports	45
Memoranda, opinions, reviews, etc.	77

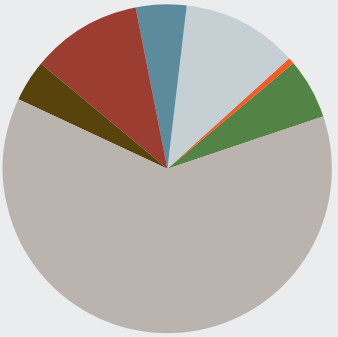
General presentation

Institution reports (annual report, etc.)	6
Popular science articles	45
Lectures, exhibitions, etc.	38

TRAINING OF SCIENTISTS

PhD students	29
PhD graduates	7
Master's students	63
Completed theses (MSc graduates)	19

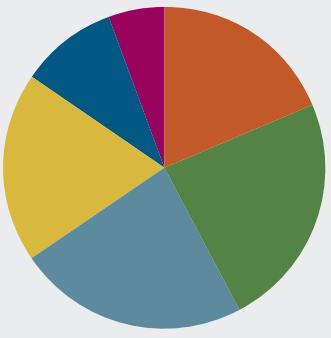
Revenue broken down by sources of revenue



Amounts in million DKK.

Budget appropriation:	140.0
Aktstykkemidler brought forward from 2000:	9.2
Programme and external funds:	24.5
Other co-financed contract research:	11.2
Commercial contracts and sale of data:	25.7
Other revenue:	1.4
Danish National Research Foundation to the Danish Lithosphere Centre:	13.4

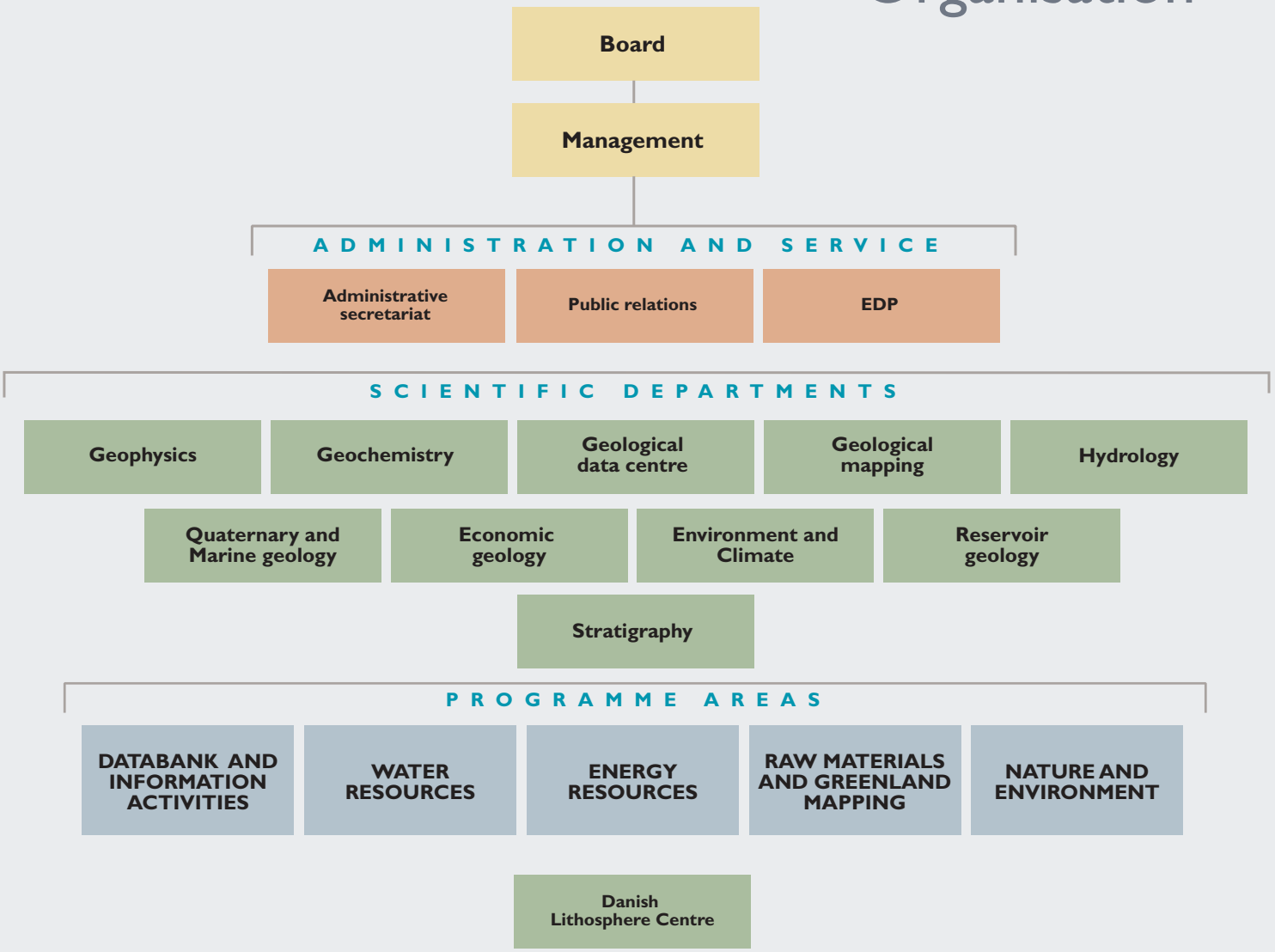
Expenditure broken down by programme areas



Amounts in million DKK.

Databanks, information technology and information to the general public:	41.6
Water resources:	52.9
Energy resources:	51.9
Mineral resources and Greenland mapping:	42.7
Nature and environment:	21.9
Danish Lithosphere Centre:	12.6

Organisation



GEUS has ten research departments and three administrative/service departments. In addition, the Danish Lithosphere Centre (DLC) under the Danish National Research Foundation is administratively attached to GEUS. Scientific activities are conducted in five programme areas with projects implemented in project groups of varying sizes.

Programme area:
Databanks, information technology and information to the general public
Archiving and data processing in connection with statutory reporting of geodata to GEUS. The objective is to ensure that data and sample collections are on a quality level allowing them to be used to implement projects in the areas of monitoring, emergency preparedness, consultancy and research. In addition, the programme area includes IT projects to develop efficient and modern IT tools for GEUS and presentation of data to the scientific community and the public.

Programme area: Water resources
Procuring the necessary basis on which to manage our water resources. Activities are aimed at water circulation, the volume and quality of water resources, groundwater protection and transportation of substances injurious to the water environment with special emphasis on groundwater. Activities form the basis of consultancy services to government and local authorities.

Programme area: Energy resources
Procuring and contributing the basis for continued exploration and sustainable exploitation of the energy resources of Denmark and Greenland. Activities include own research projects and international cooperation in the areas of oil/gas and alternative energy. The knowledge retrieved forms the basis of GEUS' consultancy services to government and local authorities and to some extent projects carried out for the corporate sector.

Programme area: Mineral resources and Greenland mapping
Procuring the scientific basis for targeted exploration and environmentally friendly exploitation of raw materials and minerals in Greenland and Denmark. Activities include geological mapping and exploration of mineral resources in Greenland and official processing and consultancy services for Greenland Home Rule. In addition, studies are conducted regarding raw materials and construction work in Denmark and internationally.

Programme area:
Nature and environment
Defining the processes in time and space leading to the current climate and environmental condition in Denmark and the North Atlantic region in particular. One objective is to improve the prospect of distinguishing between natural and man-made environmental changes. This programme area also includes mapping of onshore and offshore geological conditions.

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