

GEUS' Strategy 2020–2023

GEOSCIENCE FOR DEVELOPMENT AND SOLUTIONS





Photo: Peter Warna-Moors

Foreword

With this strategy, the Geological Survey of Denmark and Greenland (GEUS) sets its direction for the years from 2020 to 2023. By providing geological knowledge, our overall goal is to help society develop and solve Denmark's geo-related challenges.

As Denmark's national geological survey, GEUS carries out geoscientific research to create, use and disseminate geoscience information about the materials, processes and relationships that are important for the use and protection of the geological natural resources in Denmark, Greenland and the Arctic.

GEUS' expertise addresses considerable parts of the present global opportunities and challenges. We aim to contribute to meeting the UN's Sustainable Development Goals. Activities and projects at GEUS address several of the Sustainable Development Goals. The following four in particular, depend on geological expertise.

Goal 6 – clean water for all. GEUS will work to establish the best possible monitoring of xenobiotic substances and to obtain information about the water cycle, which constitute the basis of a sustainable water management.

Goal 7 – reliable and sustainable energy for all. We support the transition to sustainable, green energy by mapping the potential of the Danish subsurface for geothermal energy, energy storage and heat storage as well as the possibilities for hydropower in Greenland. As long as it is needed in the transition process, GEUS will also contribute to the best possible exploitation of the oil and gas resources.

Goal 12 – sustainable management and efficient exploitation of the natural resources. GEUS contributes with its know-how in exploration and exploitation of mineral resources – such as sand and gravel in Denmark and metal ores in Greenland – including the aspects of nature protection and the importance of a circular economy in the raw material cycle.

Goal 13 – the climate. GEUS contributes to the international strategies by generating information about future climate change through research into the climate of the past and monitoring the climate effects of today. GEUS also supports the green transition and the Government's goal of 70% reduction in CO₂ emissions by 2030. In addition, we are researching the consequences of climate change and exploring the possibilities of CO₂ storage in the subsurface.

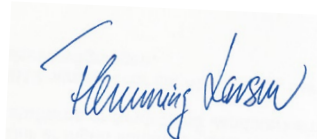
GEUS wants to contribute to all this by generating the required data and information, which form the basis for cooperation with and counselling of ministries in Denmark and Greenland as well as other authorities, companies and institutions, both nationally and internationally. GEUS' strategy for the next four years will have special focus on Denmark, Greenland and the Arctic, but topics such as the climate and resources are not confined by national borders and GEUS will share its expertise and experience across continents. GEUS is active internationally in most of Europe and in more than 20 other countries, e.g. Asia and Africa.

The strategy was adopted by the GEUS board of directors on 10 December 2019



Minik Rosing

Chairman of the board



Flemming Larsen

Managing Director

Vision

It is GEUS' vision to be a central and internationally recognised research and consultancy institution in the fields of geology and geological resources especially in Denmark, Greenland and the Arctic. Our data, information and technology will contribute to development and solutions so that future generations may inherit a better Earth. We will do this by:

- Carrying out independent research at the highest international level
- Being the central, national organisation for geological consultancy and data
- Taking the lead in research, monitoring and mapping of geological resources
- Developing our partnerships with authorities, universities, institutions and companies
- Contributing to education in geology's significance for society, from primary school to decision-makers
- Nurturing and developing our employees and organisation

GEUS' strategy 2020–2023



GEUS is an independent research institution and part of the Danish Ministry of Climate, Energy and Utilities (KEFM). GEUS is a Government institution with its own act, Act no. 536 of 6 June 2007. Our purpose and activities were established in this act with associated orders and in a number of other acts, in which GEUS is tasked with conducting specific activities. GEUS is part of Geocenter Denmark with the geoscientific communities of Aarhus and Copenhagen universities.

GEUS' board of directors determines the general guidelines for the organisation and its long-term activities and development. GEUS' board of directors thus lays down and approves the strategic basis of the institution.

The strategy consists of eight strategic topics all based on the activities laid down in the GEUS Act. A short perspective text here describes each topic followed by the strategic goals for the topic in the strategy period.



Implementing the strategy

This strategy covers four years and contains intermediate and long-term strategic goals for GEUS' main activities and administration on a general level. However, each year the board of directors have the opportunity to reconsider the contents of the strategy, taking into account society's development and emerging new topics.

To ensure a dynamic, strategic management of GEUS, the concept of campaigns is included in the implementation of the strategy. Campaigns are scientific initiatives launched in response to changes in society. Campaigns can be launched during the strategy period, they run for short periods of one to two years and require interdisciplinary cooperation between areas and departments. In some situations, they may provide input to new topics, which can be incorporated in the strategy.

As part of the implementation of the strategy, the following management plans have been prepared that specifically describe the activities to be performed. These plans are only available in Danish but are summarised here:

- **Resultatplan:** *The result plan* covers four years and is based on the strategy goals, but is updated yearly if needed. The board of directors must approve the result plan.
- **Arbejdsprogram:** *The work programme* is prepared annually and operationalises the result plan. It includes important operational goals, projects or political goals management agrees to pursue during the year.
- **Mål- og Resultatplan:** In cooperation with the ministry, and based on the work programme, an annual *goal and result plan*, including elements from the ministry's development strategy, is prepared. The permanent secretary and the chairman of the board approves this plan.

The board of directors are kept up to date in bi-annual reports on the progress of the implementation of the strategic goals.



Photo: GEUS

Society benefits from our geological know-how

Dissemination of data and information and protection of geological natural resources are core activities at GEUS. Our ambition is to share our expertise even more and that GEUS is recognised as a reliable, independent source of geoscientific information for Denmark, Greenland and the Arctic.

GEUS' geological know-how must be further promoted, to the benefit of society and thus to contribute to solving problems within the Kingdom of Denmark and globally. The presentation and availability of new information and data must continue to improve, so their full potential benefits companies, authorities and the public alike. GEUS will also actively contribute with expertise and data in the public debate and provide decision-makers with the best possible foundation on which to make decisions. We also want to give the public the best possible basis to understand and interpret debate and political decisions where geological facts are involved.

The evolution of GEUS' organisation and cultural values must continue towards a higher degree of exposure and expertise sharing. The efforts must focus on the mutual benefit and impact as well as be professional and up-to-date. We will also work on increasing the level of fact sharing internally at GEUS to maintain and develop job satisfaction and the interdisciplinary cooperation.

Increased exposure

To an independent and high profile research institution such as GEUS, it is important that data and results are documented in publications at a high scientific level. In this way, we ensure that GEUS remains an attractive research partner, consultant and grant recipient. GEUS will increase our publication rate and quality, and develop our own publication series so that publication of maps and the accumulated expert knowledge can continue.

GEUS will increase its presence in Danish, Greenlandic and international specialised and mass media by being proactive as well as available. At the same time, we will develop and use other communication channels, such as social media. We will also invite people to events to share our expertise and to network. The efforts must be cost efficient, targeted and add value.

GEUS' contribution to the general public's knowledge about and appreciation of geology takes place via the magazine *Geoviden* (in Danish), a cornerstone in the joint outreach from Geocenter Denmark. The magazine and the online universe provide a supplement to high-school classes and raise interest among students to study geology at university. Furthermore, GEUS will have special focus on dissemination and dialogue in Greenland, where geology has a natural place in the day-to-day life.

STRATEGIC GOALS

- We will increase GEUS' exposure and share our expertise with authorities and companies to ensure the greatest possible benefit to society and contribution to the solution of global challenges.
- We will contribute actively with our professionalism and data to public debate and development to ensure the best possible basis for decisions and to keep the public well-informed.
- We will increase our scientific publication rate and quality to the general benefit of the geoscience community so that GEUS will continue to be an attractive partner.

Climate change and adaptation

STRATEGIC GOALS

- We will increase the understanding of climate change in the Arctic, engaging in long-term monitoring projects using the newest techniques.
- We will study the processes generating the melting of the Greenland ice sheet and glaciers, the extent of the sea ice, changes of ocean currents and the thawing of permafrost to reduce the uncertainties in the prediction of the effects of climate change.
- We will provide advice and improve our understanding of future climate change based on our knowledge of past climate changes.
- We will contribute to international climate panels such as the IPCC.
- We will continue to develop higher resolution and more accurate models to understand the entire hydrological system under a future climate.

Throughout geological time, the planet has undergone massive climate changes, but during the past decades, human activities have influenced these changes to a degree never seen before. Climate change has drastic consequences such as loss of biodiversity, rising sea levels as well as changes in precipitation, growth conditions and ocean and atmosphere circulation. Through research and monitoring, GEUS will provide improved data and information about climate change and its consequences, so that we can better plan and adapt to a changing climate with the best possible data and information.

Studying and projecting climate change and its effects

GEUS will expand its role as a central operator monitoring and researching within glaciology and the Arctic climate, and GEUS will contribute to developing new technologies and solutions in the field. In addition, GEUS will further develop its interdisciplinary expertise in understanding the role of the oceans in the climate system, especially the oceans surrounding Greenland and in the Arctic region.

It is necessary to reduce the uncertainty of the model predictions of the melting of the Greenland ice sheet, of the extent of sea ice, of the thawing of permafrost and changes in the North Atlantic ocean currents. This is achieved by observations, process studies, modelling and validation against contemporary observations and palaeoclimatic time series that reflect changes from decades to millennia and even further back in geological time. This gives an understanding of the natural variability.

GEUS will also maintain its position as the leading institution for national predictions of the effects of climate change on the hydrological cycle including groundwater and surface water as well as flooding and drought risks.

Adaptation to a changing climate

Society must adapt to climate change, and with its national databases and modelling tools, GEUS can provide scientific data and information about the water cycle that can optimise the adaptation efforts. Especially when selecting agricultural land for land consolidation, rising groundwater level and the climate effect of selecting low-lying land must also be taken into account. We must generate data and information as well as develop models of near-surface groundwater, run-off from streams and urban hydrology. GEUS will uncover opportunities for further development of the National Water Resource Model for this purpose.

Our natural world

A diverse nature in balance requires targeted efforts, and GEUS will continue to enter into collaborations aimed at sustainable management of nature in Denmark and Greenland. This is done in collaboration projects on nature restoration, establishment of national parks and geoparks, coastal erosion prevention, mapping of cultural heritage, environmental habitat surveys and ecosystem-based management. The national databases that GEUS manages form the backbone for our work with nature and the environment and provide a unique opportunity for national monitoring of the importance of geosystems for the state of the environment.

Coast and marine environment

In recent years, there has been increased attention to situations where natural forces affect people's everyday lives, not least as a result of climate change. Especially in the coastal zone, a rising sea level will increase erosion and transport of sediments. Through research, GEUS will contribute to assessing the correlation between geosystems and biological cycles to quantify the environmental goals in Denmark's Marine Strategy II. We want to ensure that bottom sediments are assessed in a dynamic interaction with the seabed's habitat types, as this will contribute to a sustainable use of the living resources in the open sea around Denmark and Greenland.

Groundwater, nature and ecosystems

Denmark's unique nature, ecosystems and habitats depend on receiving the correct quantity of high quality groundwater. Therefore, we need a detailed understanding of the interaction between groundwater and different types of nature to ensure their existence. GEUS will contribute to this knowledge, which is central to the Danish implementation of the EU Water Framework Directive, through further development of field and model studies.

New methods for monitoring and mapping of nature

In the summer of 2017, a natural disaster occurred in Greenland, when a large landslide triggered a tsunami that affected several settlements. Since then, GEUS has been working to identify other vulnerable locations in Greenland, and this will continue into the strategy period. Since these are observations of very large land areas, we must further develop our expertise in for instance advanced use of satellite observations. As a national geological institution, GEUS is responsible for recording and interpreting earthquake events and in the landslide project, we will further develop methods to register seismic activity caused by natural disasters and human activities at the earth's surface and at depth.

Effects on the biosphere

Human influence on the Earth has negative consequences for the environment, climate and oceans and thus also for the biosphere. Ecosystems will change or deteriorate, causing large-scale displacement of species from their original habitats or even extinction. This is not the first time in Earth's long history that the biosphere has become stressed by external influence. By studying the history of the Earth, we can improve our understanding of the mechanisms that influence life on Earth in the short, medium and long term, as well as the consequences of human influence on the biosphere.

STRATEGIC GOALS

- We will strengthen GEUS' research into relationships between geosystems and biological cycles, biotopes and habitats as well as bio- and geodiversity in the marine environment to quantify the environmental goals in Denmark's Marine Strategy II.
- We will further develop our expertise and methods in the fields of landslides, coastal erosion etc. to be able to contribute with advice and knowledge about geology-related natural disasters.
- We will further develop GEUS' scientific understanding of how groundwater's interaction with different environmental settings and ecosystems impacts on the quantity and quality of the groundwater.
- We will contribute to a better understanding of the processes that effect the biosphere by studying the prehistory of life on Earth.

Our water

STRATEGIC GOALS

- We will increase our interdisciplinary process understanding of the water and transport cycle to support the increasing focus on sustainable water resource management.
- We will further develop the National Water Resource Model targeting new management needs, whereby quality and quantity of groundwater and surface water are managed in an integrated way.
- We will contribute to the development of the scientific basis for targeted and differentiated regulation and efforts aimed at reducing nutrient losses from agriculture.
- We will ensure further information about the occurrence of identifying xenobiotic substances in the Danish groundwater and increase the understanding of the geological, hydrogeological, microbiological and chemical processes that determine the occurrence of these substances.

An increased population and intensified land use have added pressure on freshwater resources, a pressure that in many places on Earth will increase as a result of expected climate change. This is also the case in Denmark and the EU, where efforts are made to establish sustainable water management partly to ensure good quality service and drinking water for all and partly to contribute to good environmental conditions. With its expertise in the water sector, GEUS will contribute to this development both nationally and internationally.

Water management in Denmark includes preparation of water plans and assessment of means to increase water quality as well as effects of climate change on surface water and groundwater. GEUS will work towards solving these tasks by developing and using models that integrate chemistry, microbiology, hydrology and geology – among these the nationwide model of the water cycle, the National Water Resource Model (the DK model), which GEUS operates and develops.

Monitoring and protection of water resources

GEUS will make sure that groundwater monitoring and protection of water resources are undertaken on the best professional basis. GEUS will thus develop and implement new methods for identifying xenobiotic substances in the groundwater thereby ensuring an increased level of information and a cost-effective analysis programme.

GEUS makes a significant contribution to the protection of the groundwater with the Danish Pesticide Leaching Assessment Programme (PLAP). To achieve the best possible protection of the water resource, however, we need to know more about the fate of natural and xenobiotic substances in the subsurface and in the water cycle. GEUS will focus its research on the processes – geological, hydrogeological, microbiological and chemical – that determine the occurrence of these substances in the aquatic environment.

Tools to support water resource management

It has been politically decided that a spatially differentiated regulation of the agricultural use of fertilisers should be made so that the efforts are placed where the need and effect are greatest. This requires knowledge about transport and conversion of nutrients between the land surface and the groundwater as well as on to the marine environment. A knowledge and expertise that GEUS has and will bring into play in the development of the scientific basis for future differentiated regulation.

Nationally and internationally, GEUS will expand and disseminate its knowledge of sustainable water resource management, focusing on the interaction between groundwater, surface water and ecological status, as well as on how these elements are affected by factors such as water abstraction, land use and climate change. In addition, GEUS will continue to contribute to the mapping of the relationship between water quality and health and the development of water purification technologies targeted at particularly problematic substances for ground- and drinking water.

The green transition

A modern society cannot function without a secure energy supply, and this must in future be more climate neutral. Denmark plans to meet 100% of its energy needs from renewable sources by 2050. GEUS wants to contribute actively to this green transition, including the Government's goal of a 70% reduction in CO₂ emissions in 2030 and a stable energy supply.

Geothermal energy and storage

The Danish subsurface has a large potential for contributing to the green transition. At many locations, it is possible to utilise deep formation water for heat production in geothermal plants, and storage of energy such as heat, natural gas and hydrogen is also viable in many places. In connection with the energy-related use of the subsurface, it is important to think of synergy, for instance between geothermal energy and CO₂ storage. GEUS will focus on the opportunities and contribute with the necessary information by establishing a centre for assessing the possibilities for storage and disposal in the subsurface.

Energy in Greenland

Climate change in the Arctic has increased the melting of the Greenland ice sheet such that the potential for hydropower could surpass earlier estimates, and GEUS will re-evaluate and map the new potential. The expansion of hydropower will help to achieve the goal of an energy supply based on renewable sources in Greenland.

Minerals for a new and greener future

GEUS can also support the green transition through our extensive expertise in mineral raw materials needed for future energy transport and storage. Several of the rare-earth minerals needed for the production of electric cars, wind turbines and LED lights are found in large deposits in Greenland. We will expand and utilise our knowledge about the formation of these mineral occurrences and their value chain from mining to final product. In Denmark, GEUS can map the sand and gravel, which may be necessary to realise the vision of an 'energy hub' in the North Sea including wind energy and hydrogen.

During transition

During the transitional period to green energy, a stable energy supply will still require oil and gas, and GEUS will as long as it is relevant in Denmark and Greenland make available its expert knowledge in this area. This can be in the form of development and use of new exploration models, establishing systematic data about the size of the resources as well as contributions to continued effective, sound and less environmentally harmful use. In connection with the decommissioning of oil and gas fields in the North Sea, storage of CO₂ in the emptied oil fields can be an option. In this case, GEUS could be involved in planning CO₂ injection and calculating its long-term effects.

STRATEGIC GOALS

- We will support the green transition and contribute to the Government's goal of a 70% reduction in CO₂ emissions in 2030 with new information about the possibilities for storing the greenhouse gas CO₂.
- We will contribute to the green transition by generating new information about the subsurface's potential for geothermal energy and for energy storage in the form of heat, hydrogen and other fuels.
- We will contribute to Greenland's green goals by mapping the potential for hydropower, which will continue to increase with climate change.
- We will provide data on mineral raw materials relevant to the green transition.
- We will, as long as it is needed, support a stable energy supply from oil and gas in Denmark and Greenland.

Mineral raw materials for growth

STRATEGIC GOALS

- We will strengthen the data basis for mineral exploration in Greenland, expand the geological mapping and make available data and research results about the formation of the minerals.
- We will contribute to the development of a classification system for the raw materials sand and gravel to optimise resource evaluations and planning for sustainable development.
- We will expand the research-based data and data registration of geological raw materials in Denmark for a sustainable exploitation of the resources as well as to advise authorities and industry.

There is a growing global need for raw materials – both basic raw materials such as gravel, sand and chalk for infrastructure projects and metals for industrial and high-tech production in connection with the green transition. Greenland and Denmark have great opportunities for raw material production, which will strengthen the economy, employment and security of raw material supply.

The primary resources are not renewable. In a sustainable future, it is essential to understand and include a circular economy in the raw material cycle. GEUS aims to generate information about the secondary raw material flows of society and thereby increase the sustainability. And GEUS must provide data and information to authorities, companies and the public about the resource constraints and significance in global, national and regional plans.

Raw materials in Denmark

GEUS wants to be a key player in basic raw materials, such as sand and gravel in Denmark. GEUS will continue to focus on research-based counselling of authorities and the raw material industry, where especially mapping of marine habitats and geology is a central element, but also activities concerning land-based raw materials.

Previous management of raw materials has been handled by several authorities. This is a challenge that we want to remedy by establishing a national raw materials database at GEUS. With such a tool, GEUS can help provide an overview of the quantity and quality of the basic Danish raw materials.

Development of a harmonised and international classification of basic raw materials is furthermore a necessity, and GEUS will work for this both nationally and internationally.

Raw materials in Greenland

The subsurface of Greenland contains sought-after mineral resources. Increased extraction requires more data and information about the formation of these minerals and thus their occurrence. Another approach is needed for this, and especially the compilation of more data including mineralisation models. In cooperation with the government of Greenland, GEUS will contribute to the geological understanding of relevant mineral systems and support the exploration and extraction industry as well as provide the basis for political decisions. GEUS must therefore continue in its role as the initiator of major, long-term geo-research field projects.

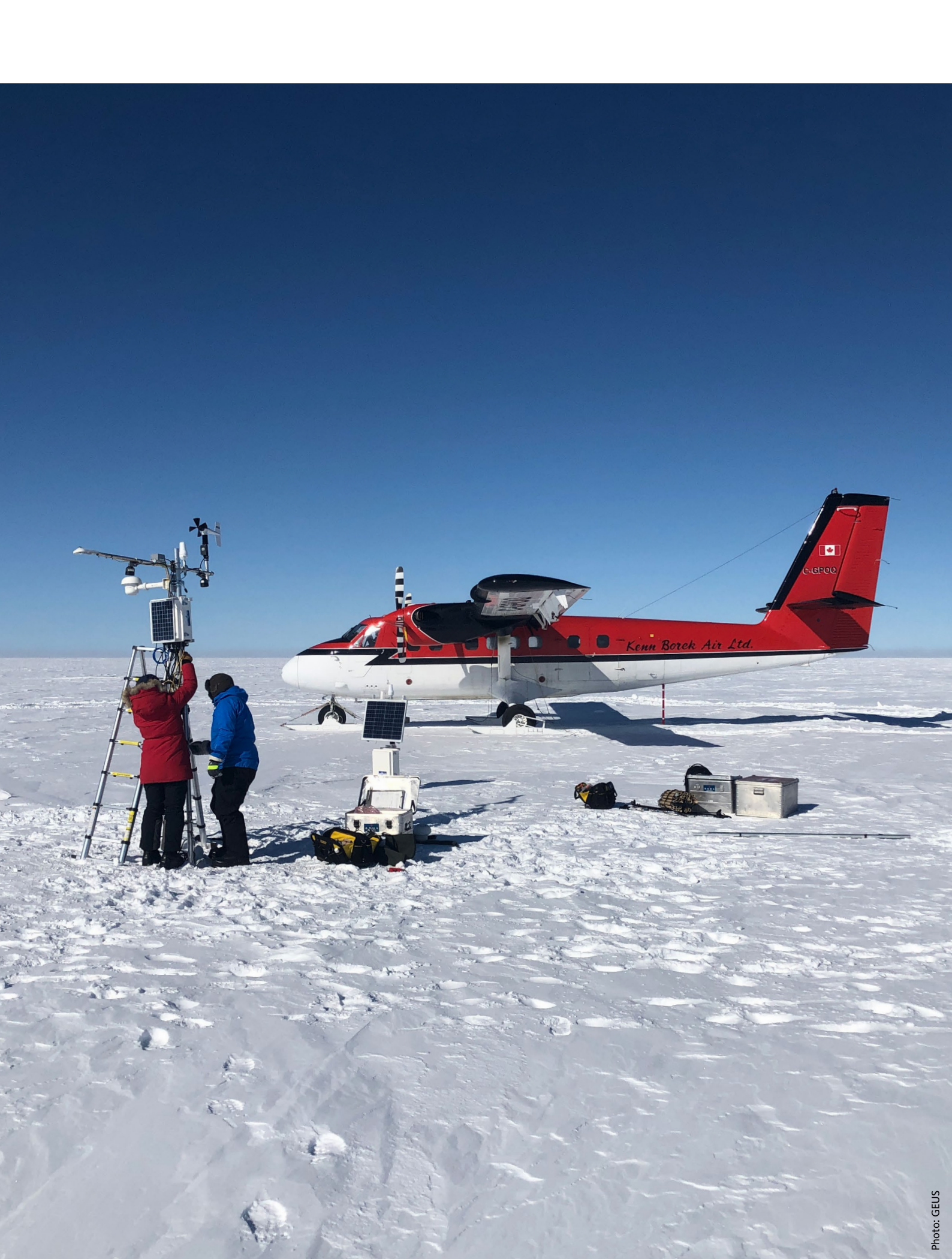


Photo: GEUS

Value-adding data

STRATEGIC GOALS

- We will continue to support research and management in Denmark and Greenland, where geological data are included and increase the volume, quality and availability of data.
- We will create the basis for an efficient management supporting the stakeholder activities in the Danish subsurface, which is constantly challenged by new uses.
- We will further develop our knowledge about and competences in new technologies to better manage great volumes of data for solving complex tasks.
- We will further develop GEUS' leading role as a data provider in the EuroGeoSurveys collaboration to establish stimulating partnerships in the EU.

As a national geological data centre, GEUS makes data and information available to authorities, research institutions, companies, private and foreign players. GEUS strives for the highest possible degree of data digitisation and to give easy access to our data for interested parties on our digital platforms. However, not all data are at present released, so we have to continue the efforts to make all data freely available. This will support the ministry's (KEFM) development and data strategy as well as the Danish Digital Strategy.

Machine learning and artificial intelligence are efficient tools that GEUS will increasingly use to ensure quality control of data and to make large, complex volumes of data more usable, such as those reported to and managed by GEUS.

European cooperation

In addition to the national work, GEUS' data are included in European resource evaluation projects to support a wide range of EU directives and initiatives. GEUS must actively participate in this development through our commitment to the European organisation EuroGeoSurveys (EGS) and use our strong competences to develop common European digital data platforms.

Development of 3D geological models

In several European countries, initiatives have been taken in recent years to develop national, digital geological 3D models of the subsurface. The need for efficient management of the subsurface has arisen due to the intensified use of deep geothermal energy, storage of energy, disposal of radioactive waste and CO₂ storage as well as increasing focus on sustainable water resource management and groundwater protection.

During the strategy period, GEUS will work for a similar development in Denmark. Establishing a national database and a geological 3D model will support the work of the authorities and act as a starting point for contractors and consulting engineers in the planning of their work in the Danish subsurface. It is the intention in Greenland that geological 3D models are developed for locations with special requirements for a detailed knowledge of the nature of the subsurface.

Future GEUS

In a knowledge-based organisation such as GEUS, human resources are the predominant driving factor of our productivity and therefore it is crucial to optimise the organisation of human resources to successfully achieve our goals. A cornerstone of GEUS management is to adopt a dynamic approach to strategy and activities – a fast-acting organisation that quickly identifies, interprets and responds appropriately to signals in our environment.

Supporting the organisation and creating the best setting for solving the core tasks require a strong focus on business support activities. Developing GEUS as a modern, attractive and financially viable organisation encompasses many aspects ranging from developing the management and staff, optimising digital procedures and administrative systems to state-of-the-art laboratories and equipment. This is in line with the ministry's (KEFM) development strategy, which has 'opportunities in the organisation and work methods' as one of two focus areas.

Developing competence and leadership, and managing talent

Management of the employees at GEUS is crucial to achieving the strategic goals. During the strategy period, the recommendations of the Ledelseskommissionen (management commission) and the operational initiatives from the Government's proposal 'A public sector prepared for the future' provide a starting point to strengthen and develop the management at GEUS. This can be done by continued and active contribution to the collaboration in the ministry (KEFM) and through processes at GEUS including setting up a joint management basis as well as the individual managers' work with 'Your personal leadership' as per the management commission's recommendations.

The management and the employees must at all times possess the competences that enable them to implement this strategy. GEUS will ensure that there is a correlation between GEUS' goals and strategy and recruitment as well as developing the competences of management and staff. First of all, this requires identification of the competences needed to meet the set goals, not just in the short term but also in the future.

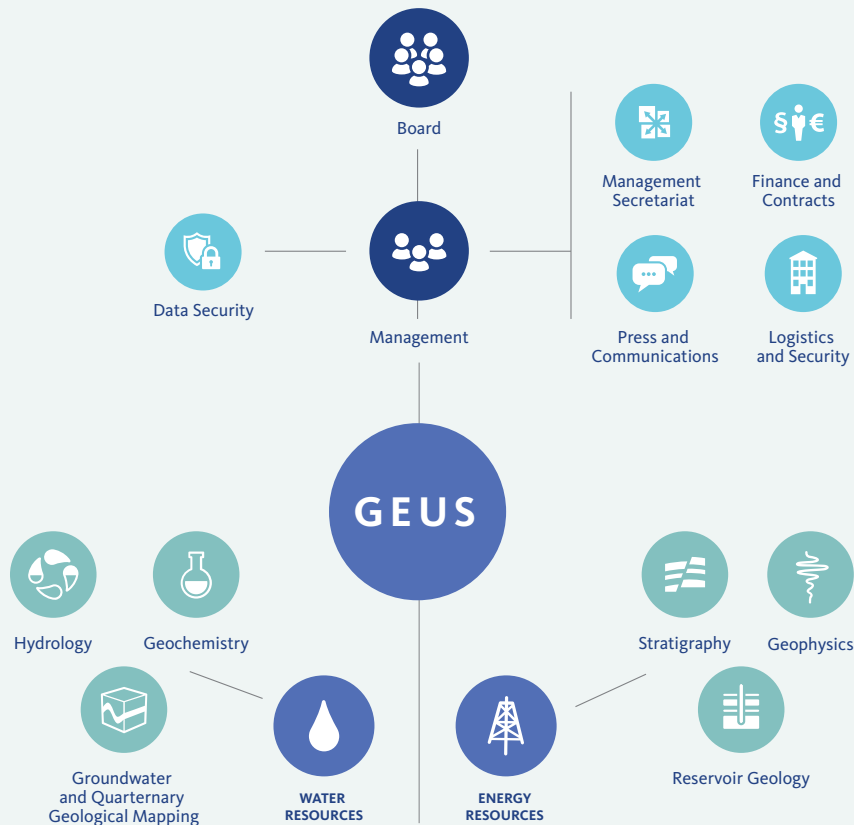
Development of systems, processes and laboratories

During the strategy period, GEUS will transition to the new governmental administrative finance and HR systems, just as a transition to the Agency for Governmental IT Services will also have to be implemented. In changing over to the new administrative systems we will focus on elements that make processes more efficient, that use digitised procedures as far as possible and that can ensure efficient workflows and simplify administrative work.

GEUS has been allocated funds to modernise its laboratories, thus further promoting GEUS as a leading player in methods and equipment in several fields internationally. This will increase our chances of being awarded projects and expand the circle of national and international partners.

STRATEGIC GOALS

- GEUS must constantly evolve as a dynamic organisation, where employees and management thrive.
- We must continue and expand the interdisciplinary cooperation and ensure value-adding interaction between the administrative functions and scientific output.
- We will ensure that GEUS, through the further development of both managers and employees, is equipped for the tasks of the future and the demands made by society.
- We will develop our specialist laboratories with a focus on supporting future needs.



PROGRAMME AREAS



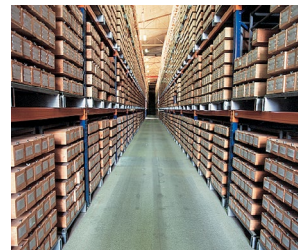
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