

# GEUS' Stratesy

2024-27

# **Preface**

With this strategy, the Geological Survey of Denmark and Greenland (GEUS) sets the direction for the institution's development from 2024 to 2027. The overall goals are for GEUS to contribute knowledge and data to the development of and solutions to society's use of geological resources, as well as to document the role of the underground in the green transition. Here, focus is on initiatives that are launched during the strategy period, while further development of previous initiatives is presented in GEUS' Performance Plan 2024–2027, which forms the framework for the annual work programmes.

As a national geological survey, GEUS aims to conduct geoscientific research with a view to building, applying and disseminating knowledge about the materials, processes and contexts that are important for the utilisation and protection of the geological natural values in Denmark, Greenland and the rest of the Arctic. GEUS will also contribute geological knowledge to support strategic goals for ministries and other government agencies in Denmark and

Greenland. GEUS will take into account environmental conditions and social responsibility in its corporate management.

GEUS' expertise is relevant for a significant number of the globe's current opportunities and challenges, and GEUS aims to contribute to the realisation of the UN's Goals for sustainable development. Areas of work and projects at GEUS relate to several of these goals, but four of them in particular depend on geological expertise:

#### **GOAL 6 - CLEAN WATER AND SANITATION**

GEUS will work to improve water quality and contribute to the sustainable management of water resources under future climate changes, nationally as well as globally.

# GOAL 7 – AFFORDABLE AND CLEAN ENERGY

GEUS supports the green transition by e.g. mapping the Danish underground's potential for geothermal energy as well as the storage of CO<sub>2</sub>, hydrogen and heat and the possibilities for expanding hydropower in Greenland.

# GOAL 12 - RESPONSIBLE CONSUMPTION AND PRODUCTION

GEUS assists with knowledge about exploration and extraction of mineral raw materials – the basic ones in Denmark and the metallic ones in Greenland – also in relation to nature protection and the importance of a circular economy in the resource cycle.

#### GOAL 13 - CLIMATE ACTION

GEUS contributes to the international strategies that intend to combat climate change and its consequences by generating knowledge about future climate change through research into the climate of the past and monitoring the climate effects of today.

To these four world goals, GOAL 17 – PARTNERSHIPS FOR THE GOALS, should be added, as the national and global challenges to whose solutions GEUS contributes, require strategic partnerships. The geoscientific contributions must be supplemented with technical and socio-economic knowledge, which can be provided by GEUS' partners.

GEUS' strategy for the next four years has a particular focus on Denmark, Greenland and the rest of the Arctic, but topics such as climate and resources extend beyond national borders. GEUS shares knowledge and experience across continents and is active internationally, in most of Europe as well as in more than 20 countries in e.g. Asia and Africa.

The strategy has been endorsed by GEUS' board on 7 December 2023

Minik Rosing
Chairman of the board

Mil R.

Flemming Larsen

Managing Director

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# Strategy and vision

GEUS is an independent research institution under the Danish Ministry of Climate, Energy and Utilities. GEUS is a state enterprise with its own law, Act no. 536 of 6 June 2007, and its purpose and operations are laid down in the law with associated orders, as well as in a number of other laws in which GEUS is assigned to solve specific tasks. GEUS is part of the Geocenter Danmark collaboration with Aarhus University and Copenhagen University.

GEUS' board determines the general guidelines for the organisation as well as its longterm operation and development. It is thus GEUS' board of directors that determines and approves the strategic foundation of the institution. GEUS' vision is to be a central and internationally recognised research and consultancy institution in the fields of geology and geological resources in Denmark, Greenland, the rest of the Arctic and globally. With knowledge, data and technology, GEUS will contribute to development and solutions, so that Earth can be handed over responsibly to future generations, by:

- conducting research on the highest international level,
- being the central, national institution for advice and data regarding geological conditions,
- being at the forefront of exploration, monitoring and mapping of geological resources,
- developing GEUS' partnerships with authorities, universities, institutions and companies,
- contributing to educating everyone, from elementary school pupils to decisionmakers, on the importance of geology, and
- nurturing and developing GEUS' employees and organisation.

The strategy is built on eight strategic themes, all of which are based on the tasks GEUS has been given in the GEUS Act. Each theme is described with a short text that puts it into context, and it is followed up with the strategic goals for the theme during the strategy period.

#### STRATEGIC THEMES:

**Future GEUS** 

Valuable data

**Knowledge sharing** 

Climate change and adaptation

Green energy and geological storage

Nature all around us

Our drinking water

Mineral raw materials for the future



# Implementing the strategy

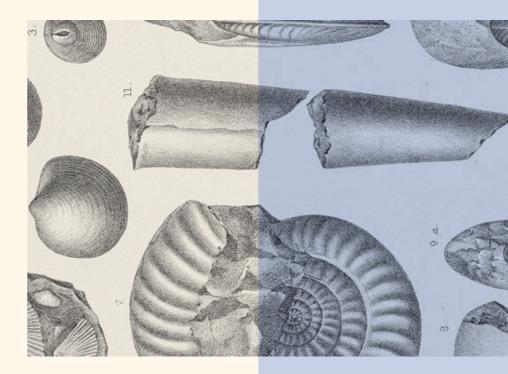
This strategy has a four-year scope and contains medium- and long-term strategic goals for GEUS' core tasks and administration generally, but the board may annually consider the content of the strategy in relation to society's development and new themes. In order to ensure dynamic strategic management at GEUS, the concept of campaigns is included in the implementation of the strategy. Campaigns are initiatives that are launched on the basis of changes in the outside world, which GEUS should act on.

Campaigns can be initiated anytime during the strategy period, they run shorter periods of one to two years, require interdisciplinary cooperation between areas and departments and can in certain situations provide input for a new theme that can be incorporated into the strategy. This ensures that GEUS' work and strategy continuously adapt to society's development.

As part of the implementation of the strategy, the following tools are prepared – they describe the tasks in more detail:

- PERFORMANCE PLAN: The Performance Plan is drawn up for four years and is based on the strategic goals and on initiatives carried over from the previous strategy. During the period covered by the Performance Plan, updates will be made as necessary. The board approves GEUS' Performance Plan.
- WORK PROGRAMME: The Work
  Programme is drawn up annually and operationalises the Performance Plan. It includes significant operational goals, projects or political goals that the management agrees to follow during the year.
- GOAL AND PERFORMANCE PLAN: In collaboration with KEFM, a one-year Goal and Performance Plan is drawn up. It will be based on the Work Programme and will contain elements from KEFM's development strategy. The Goal and Performance Plan is the Managing Director's performance contract for that year, and it is approved by the Permanent Secretary of KEFM, the Chairman of the Board and the Managing Director.

The board will receive half-yearly reports on the progress of the implementation of the strategic goals.



## **Future GEUS**

#### STRATEGIC GOALS

GEUS must be a developing organisation, one which can navigate in relation to changing societal priorities, and where employees and managers thrive and develop, so that their knowledge and skills benefit society.

GEUS will develop its infrastructure, and this includes implementing robust, agile and secure IT that meets the current requirements for cyber security.

GEUS will develop the interaction between research and business to ensure strategic allocation of resources for technological updates. Global society, and thereby Denmark, is in the midst of a shift away from fossil fuels and towards a reduction of the emission of greenhouse gases, sustainable management of water resources and the safeguarding of the planet's biodiversity. GEUS' research and expertise are important when it comes to finding solutions to these challenges. This requires that the organisation quickly picks up, interprets and reacts to signals from the outside world and navigates according to changing priorities in society.

GEUS' knowledge and competences must benefit society and are best put to use if the individual employee has a holistic orientation, outlook and understanding of society. In this strategy period, there is therefore a particular focus on the continuous development and utilisation of GEUS' knowledge and skills, supported by modern infrastructure and strategic resource management.

#### BENEFICIAL TO SOCIETY

GEUS will ensure a good framework for career planning and development for all professional groups in the organisation. The individual employee's professional and personal development must be continuously observed, so that the collective skills in GEUS correspond to the demands that society may rightly place on a geological research institution. All managers and employees must be active and competent contributors who take initiative, act from a holistic perspective and play a part with their important experiences and skills. This requires that employees and managers thrive. The foundation for this effort is GEUS' values, on which the underlying policies are based, including the management charter described in GEUS' management foundation, and which are the core of the management group's joint development.

#### MODERN INFRASTRUCTURE

GEUS' infrastructure must be maintained and further developed to meet future requirements. During the strategy period, the main focus will be on the modernisation of laboratories and the upgrading of IT operations to meet the security requirements that society needs to handle challenges in the future. As a research and consultancy enterprise, it is crucial that GEUS has an agile IT infrastructure, which also complies with the high minimum requirements for IT security at national and European level (NIS2 etc.). This development will be ensured in close cooperation with Statens IT.

#### STRATEGIC RESOURCE MANAGEMENT

In order to ensure that GEUS, as a stateowned enterprise, which requires external funding, remains a healthy and well-run institution, it is important to continuously develop and improve business management. GEUS has developed a strong model for basic financial management that ensures sound, transparent and efficient resource management. During the strategy period, GEUS will focus on developing strategic resource management through multi-year budgeting and resource planning.

# Valuable data

#### STRATEGIC GOALS

GEUS will work to ensure that all geological data are collected, managed and made available via common platforms and technologies, so that they can form the foundation for decision-making and create value for decision-makers, authorities and educational institutions as well as private and foreign stakeholders.

Together with relevant institutions and through international collaborations, GEUS will contribute to the development and innovation of new geodata technologies.

Geological data are of great value to society, as they have a wide range of applications in the fields of energy, climate and the environment. The green transition leads to a more versatile use of geological raw materials and the underground for energy utilisation and storage. This places new demands on geological data - not only as a need for data that map hitherto undescribed parts of the subsoil, but also for technological solutions with which the geological data can be exhibited.

As a national geological data centre, GEUS will therefore collaborate with relevant parties to monitor, collect and make authoritative data and knowledge available to decision-makers, authorities, educational institutions and interested private and foreign parties in Denmark and abroad. GEUS will make data available via digital platforms in accordance with the Ministry of Climate, Energy and Utilities' group strategy and the Joint Governmental Digital Strategy.

## VALUABLE DATA ARE COLLECTED. MANAGED AND MADE FREELY AVAILABLE

GEUS will work to ensure that geological data benefit society and create value, by identifying, generating, collecting, storing and handling information in a transparent network of systems, applications and databases. Among other things, sensor technology, automation and data science-based methods will be used - e.g. by involving the Internet of Things (IoT), drones and other mobile devices, virtual reality (VR) and artificial intelligence.

In collaboration with users. GEUS will explore and implement new data display methods and actively participate in open source initiatives. GEUS will base the display of data on open standards to ensure the greatest possible degree of freedom in data use. GEUS will develop a model for displaying authoritative and well-documented data, which can be used as a foundation for decision-making in the public administration. GEUS will also work to give society full insight into how GEUS manages data.

## DEVELOPMENT AND INNOVATION OF **NEW GEODATA TECHNOLOGIES**

In collaboration with both national and international partners, GEUS will focus on development and innovation when it comes to new geodata technologies. GEUS will, for example, utilise new data sources, data types and technologies, e.g. artificial intelligence, machine learning, virtual research environments and other geodata technologies, which make it possible to use new automated processes to obtain knowledge that was previously either not possible, too time-consuming and/or too costly. GEUS will also contribute to the strengthening of the pan-European data platforms and the collaboration with other Nordic and European geological surveys through the exchange of experiences and project development and by spreading the use of the FAIR principles in data dissemination.

# **Knowledge sharing**

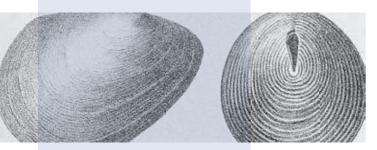
#### STRATEGIC GOALS

**GEUS** will make its many competences visible to the outside world through targeted knowledge sharing and dissemination in Denmark, Greenland and internationally, so that knowledge and data come into play and contribute to solving challenges in the fields of energy, climate and the environment.

GEUS will make its knowledge and data more easily accessible, understandable and usable for specific target groups, so that the outside world does not miss out on valuable knowledge and data.

Knowledge of geological resources and processes is an important prerequisite for solving a large number of society's critical challenges in the fields of energy, climate and the environment. But knowledge only has value if it is useful and reaches the target groups for which it is relevant.

In order for GEUS' knowledge and data to effectively benefit society, form the best possible basis for decision-making and contribute to the public's understanding of geoscience. GEUS will therefore work to make the institution's research, knowledge and expertise visible and share knowledge and data that are easily accessible, understandable and usable for relevant target groups.



#### GREATER VISIBILITY

GEUS will strengthen the visibility of the organisation's knowledge and data through timely and targeted communication to specific media and target groups - e.g. when communicating with the Danish, Greenlandic and international press - through an increased digital presence and by organising knowledge sharing and networking events and by participating in such events.

As part of this effort, GEUS will focus on strengthening the dissemination of geoscience and GEUS' knowledge of and work in Greenland through closer cooperation with Greenlandic partners and stakeholders. Furthermore, GEUS will contribute to the general understanding of geoscience in the public, so that citizens and decision-makers can make informed decisions.

## **EASILY ACCESSIBLE. RELEVANT** KNOWLEDGE

It is not enough that GEUS' competences are known to the outside world - GEUS' knowledge and data must also be used where they are relevant and create value for the many stakeholders in the fields of energy, climate and the environment.

GFUS will therefore work to ensure that knowledge and data are easy to access, understandable and relevant for GEUS' many different target groups, including decisionmakers, educational institutions, authorities, businesses and other stakeholders. GEUS will, among other things, strengthen the user perspective through user surveys and increased dialogue with different target groups. In addition, GEUS will strive to facilitate development and be innovative when it comes to supporting technologies that will ensure users easy access to GEUS' knowledge and data.

# Climate change and adaptation

#### STRATEGIC GOALS

With monitoring, process studies and modelling, GEUS will play a central role in the understanding of climate change in the Arctic and the consequences of the Greenland Ice Sheet's mass loss locally, regionally and globally.

GEUS will contribute knowledge about climate change and its consequences in a geological time perspective, including an understanding of 'tipping points'.

GEUS will play a pivotal role in building and disseminating knowledge about hydrological extremes and their effects. This will be done via monitoring, process studies and modelling for climate adaptation and, in collaboration with Danish partners, warnings in connection with e.g. extreme weather.

Throughout geological time, Earth has undergone major climatic changes, but in recent years, man-made changes have taken on an extent that has not been seen before. and with major consequences.

Improved knowledge of climate change and its effects is essential in order to be able to reduce the uncertainty in model predictions of the development of climate systems. An important topic is whether the climate is moving towards so-called 'tipping points', which can have irreversible consequences, for example for the mass of the Greenland Ice Sheet, sea levels and sea circulation. the thawing of permafrost, biodiversity and ecosystems.

#### MODELS OF CLIMATE CHANGE

GEUS is to expand its role as a leading player in the monitoring of and research into the cryosphere and the polar climate. GEUS will contribute to the reduction of uncertainties in model predictions of changes in the cryosphere and their effects by studying the mass balance of the Greenland Ice Sheet and glaciers, the interaction between ice and sea, and permafrost. GEUS will utilise new technologies and solutions in order to contribute to monitoring efforts and climate assessments at an international level.

#### RESEARCH INTO 'TIPPING POINTS'

GEUS is to further develop its interdisciplinary expertise in the role of the oceans in the climate system and the consequences of climate change, especially in the seas around Greenland and in the Arctic and North

Atlantic (the Gulf Stream). This will be done via process studies and modelling based on contemporary observations and palaeoclimatic time series that reflect changes from decades to millennia and even further back in geological time. Through this, an understanding of natural variability and of 'tipping points' is achieved.

#### CLIMATE ADAPTATION

GEUS will expand its position as one of the leading players when it comes to national predictions of the effect of climate change on the hydrological cycle, including groundwater and surface water as well as the risk of flood and drought. These predictions can be used to optimise climate adaptation efforts.

# Green energy and geological storage

#### STRATEGIC GOALS

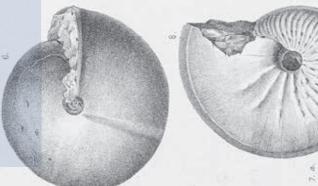
GEUS will contribute to the green transition by providing data on storage options for CO2, hydrogen and energy and a green energy utilisation of the underground under safe conditions.

GEUS will contribute with knowledge about the possibilities for and implementation of sustainable energy in Denmark and Greenland.

GEUS will expand its geophysical mapping capacity and, through research and in collaboration with other stakeholders. contribute to geological knowledge in order to use geology actively in the green transition.

CO2 capture and storage (CCS) in Denmark is crucial if we want to fulfil the political ambition of reducing greenhouse gas emissions by 70 percent by 2030. And this must be done in an environmentally and technically safe manner.

In addition, the underground can contribute to the green transition by e.g. storage of hydrogen and utilisation of warm water in the subsurface for geothermal energy.



#### CO2 STORAGE

The Danish underground holds great potential for the storage of considerable amounts of CO2. GEUS continues the mapping and data collection of structures potentially suitable for CO<sub>2</sub> storage on land and at sea. GEUS will expand its research efforts to understand the geochemical processes that can occur in the subsoil during geological storage of CO2. And GEUS will develop numerical geomechanical models that, together with reservoir models, will be used to establish requirements for the safe injection of CO2 so that the integrity of self-sealing formations will stay intact and seismic activity is not induced.

GEUS will also contribute to the identification of the risks of CO<sub>2</sub> storage as well as to the development and implementation of monitoring systems and procedures aimed at the stability of the underground and monitoring of groundwater resources and the external environment.

In addition, GEUS will investigate and support options for storing CO<sub>2</sub> in other ways than geological storage in the Danish underground - e.g. in biochar - including possible side effects of various alternative CO2 storage concepts on nature and the environment.

## GEOTHERMAL ENERGY AND **ENERGY STORAGE**

It is possible in several places in the Danish underground to utilise deep-lying formation water for heat production in geothermal plants and for storing energy such as heat, hydrogen and natural gas. During the strategy period, GEUS wants to contribute to the development of new geothermal technologies that overcome the challenges of traditional geothermal technologies. GEUS will strengthen the understanding of the potential and risk of energy storage in Denmark in order to be able to advise authorities and private players in connection with the prioritisation of the underground for various purposes.

# Nature all around us

#### STRATEGIC GOALS

GEUS will contribute to knowledge about the quantitative and qualitative importance of groundwater for the maintenance of natural areas and ecosystems.

GEUS will provide new knowledge of the geological and hydrogeological impact on the carbon and nitrogen cycles, including emission of greenhouse gases from carbon-rich peat soils and agricultural land and the interaction between carbon and nitrogen turnover and water quality in the hydrological cycle.

GEUS will contribute with research into and knowledge of the importance of geosystems for the biological cycle, biotopes and habitats as well as bio- and geodiversity in the marine environment.

On a European level, the aim is to restore 20 percent of nature on land and at sea by 2030. In Denmark, restoration of nature will largely be a question of future land use, which in turn will affect the management of the freshwater system in a changing climate.

Other instruments for the restoration of nature will be the establishment of forests. and wetlands, establishment of national parks and geoparks, prevention of coastal erosion and establishment of rock reefs and marine ecosystems. As a basis for this management-orientated effort, GEUS will conduct research into the understanding of natural processes that govern e.g. the formation of different types of ecosystems.

## GROUNDWATER, NATURE AND **ECOSYSTEMS**

Many of Denmark's unique natural areas, ecosystems and habitat areas depend on receiving the right amount of good quality water. Detailed knowledge of the interaction between groundwater, surface water and various natural areas is necessary to ensure their existence. GEUS will contribute by further developing field and model studies and using geological information such as geophysical data from satellite systems and new sensor technology. This will ensure that decisions in Danish and international collaborations are well-informed and based on knowledge and data obtained from models and monitoring. It is also pivotal to the Danish implementation of the EU's Water Framework Directive.

#### THE CARBON AND NITROGEN CYCLE

In a time when there is a large focus on both climate change and changed land use for e.g. establishing groundwater parks, pinpointing carbon-rich peat soils etc., an understanding of the impact of the basic processes behind the carbon and nitrogen cycle is of particular importance to the quality of both groundwater and surface water. In order to increase the understanding of the groundwater system and the importance of groundwater

for the circulation of nutrients and pollutants in the hydrological cycle, GEUS will establish new knowledge of the carbon and nitrogen cycle. It is already known that the location and dynamics of the groundwater table are of decisive importance for greenhouse gas emissions from carbon-rich peat soils. GEUS will therefore increase the understanding of the hydrological cycle in carbon-rich peat soils to form a strong knowledge basis to support the Danish targets for the emission of greenhouse gases, as per the Danish climate targets for 2030.

#### MARINE HABITATS AND ECOSYSTEMS

Increased activity in the marine area, including raw material extraction and wind farms at sea, identification of nature protection areas and the marine plan's stricter requirements regarding land use, create a need for more detailed knowledge of the seabed if we want to preserve bio- and geodiversity, seabed habitats and ecosystems and sustainably use Denmark's marine territory.

In collaboration with partners, GEUS will contribute to fulfilling this need for knowledge through data collection and mapping, which can form part of the necessary basis for decision-making for politicians and others.

# Our drinking water

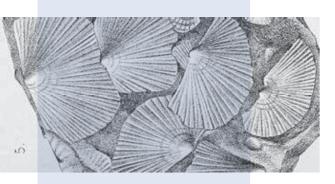
#### STRATEGIC GOALS

GEUS will contribute with methods to identify groundwater-forming areas in Denmark and the geostatistical uncertainty associated with this.

GEUS will contribute to creating reliable knowledge about the man-made impact on the freshwater system's quantitative and qualitative condition in Denmark and internationally.

Intensive land use in Denmark and the global population increase have increased the pressure on our freshwater resource, quantity as well as quality.

In Denmark, there is a political desire for sustainable management of groundwater, partly to ensure good quality drinking water for everyone, partly to contribute to a healthy environment. With its water expertise, GEUS will contribute to this development nationally and internationally.



## PROTECTION AND MONITORING OF THE GROUNDWATER

Since the Danish water supply is based on pumping up groundwater, a safe drinking water supply for future generations requires the protection of groundwater-forming catchments against seepage of water with an undesirable chemical composition. In collaboration with partners, GEUS will identify areas where the groundwater is formed and work out methods to quantify uncertainties in the geographical identification of infiltration areas that can be laid out as groundwater parks. The ambition is that this is implemented for the whole country during the strategy period.

The purpose of the groundwater monitoring is to document whether the areas zoned for the protection of groundwater have the desired effect. During the strategy period, GEUS will work to establish greater knowledge of the connection between the spread of pollutants and the age of the groundwater in order to find out whether measures for groundwater protection works. In addition, GEUS will further develop and expand

grundvandsstanden.dk, which is an online system that monitors groundwater in real

## CERTAIN KNOWLEDGE OF GROUND-WATER CHEMISTRY

In recent decades, several environmentally harmful substances in the groundwater and drinking water, which no-one has previously analysed for, have been detected. During the strategy period, GEUS will contribute to the development of new methods that may determine environmentally harmful substances in groundwater and to the implementation in society as a whole of these methods. The new analysis methods are so-called 'non-target' methods, which aim at relevant substance groups in water samples. GEUS will use this knowledge to carry out targeted research into the processes that determine the occurrence of the most relevant natural and non-environmental substances in the water environment. This will be done in order to ensure better knowledge of the chemical state of the Danish groundwater and its use as drinking water.

# Mineral raw materials for the future

#### STRATEGIC GOALS

By drawing up a classification system and mapping Danish raw materials on land and at sea. GEUS will contribute to the development of a national strategy for Danish raw materials.

In collaboration with Greenlandic partners, GEUS will carry out geological and geophysical mapping in Greenland to support the localisation of deposits of critical minerals for the green transition.

GEUS will maintain a knowledge base on global primary and secondary raw material flows and the raw materials' supply chains.

In Denmark, the EU and globally, there is an increased recognition of the importance of mineral raw materials for the green transition. The current global political situation has made it clear that a secure supply of the necessary mineral raw materials is challenged in complex supply chains.

A national strategy will be developed for the sustainable utilisation of Danish raw materials for infrastructure projects as well as metals for industrial and technological production. In the new marine plan, areas designated for raw material extraction will be smaller, and it is necessary to reduce the uncertainty in relation to the identification of these areas.

#### RAW MATERIALS IN DENMARK

For the national strategy for the Danish raw materials stone, gravel, sand, clay and lime, GEUS will contribute to the development of a classification system that includes the raw materials both on land and at sea. During the strategy period, this work will result in a national strategy for the utilisation of geological raw materials in the Danish area and registration of utilisation and reserves in a national database. In its research-based advice to authorities and the mineral industry, GEUS will improve the seismic collection of marine data, so that the geographical uncertainty in the designation of areas for mineral mining can be reduced.

#### MINERAL DEPOSITS IN GREENLAND

Greenland's subsoil contains many critical mineral raw materials. In collaboration 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 a knowledge base for political decisions. GEUS will continue to develop and incorporate new technology in the solution of tasks and will continually strengthen its leading role when it comes to geological mapping and exploration in Greenland. In collaboration with the Government of Greenland, GEUS will initiate larger, longterm research field projects that can provide new knowledge and data.

### A KNOWLEDGE BASE ON THE SUPPLY CHAINS OF MINERAL RAW MATERIALS

GEUS will establish knowledge about the importance of global supply chains for the Danish raw material supply of minerals. In addition, knowledge must be established about society's secondary raw material flows, including how a circular economy can be incorporated into the raw material cycle in order to ensure sustainable utilisation of Earth's resources. Well-functioning supply chains of mineral raw materials are crucial for the implementation of the green transition, and GEUS' Center for Minerals and Materials (MiMa) will draw up a Danish model for criticality (i.e. the economic and societal importance of raw materials combined with the degree of security of supply) concerning the supply of raw materials for industrial production in Denmark.

# Geological Survey of Denmark and Greenland (GEUS)

Øster Voldgade 10, 1350 Copenhagen K Phone: +45 3814 2000 Mail: geus@geus.dk www.geus.dk

#### **GEUS Aarhus**

Universitetsbyen 81 6th floor, room 622 8000 Aarhus

#### **GEUS Nuuk**

c/o Greenland Institute of Natural Resource: PO Box 570 3900 Nuuk Grønland

#### **GEUS CORE STORE**

Hørsvinget 1 2630 Taastrup

