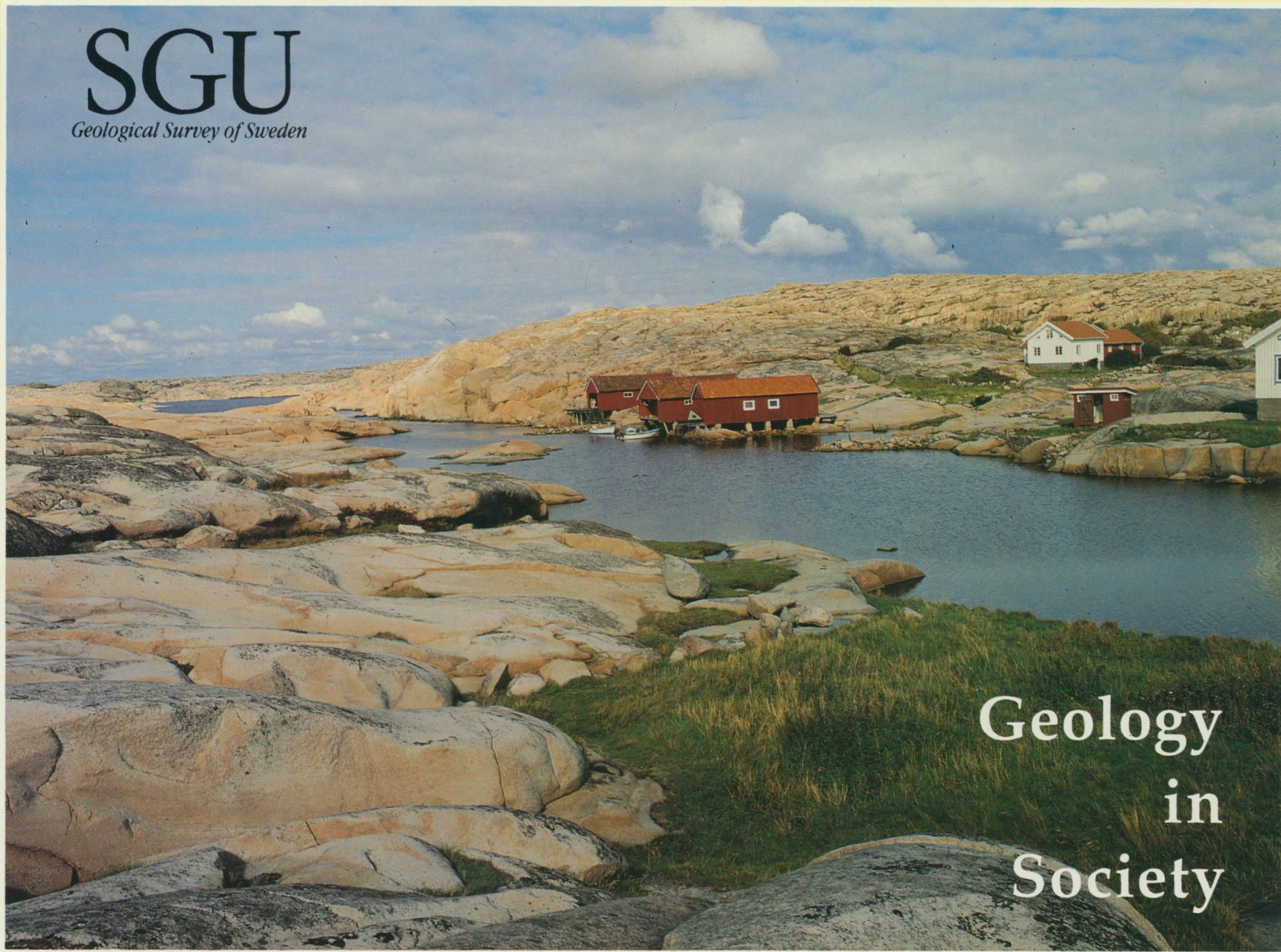


SGU

Geological Survey of Sweden



Geology
in
Society

Produced by the Information Section at
the Geological Survey of Sweden (SGU),
Uppsala, April 1995.

SGU provides expertise, resources and a wide range of products to meet growing demands for geological information from local, regional and governmental authorities, businesses, consultants, universities, colleges and the general public.

Geology in Society

Products and Services
from the
Geological Survey of Sweden

Geology in Society

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Understanding of bedrock, soil and groundwater is of great importance to the whole of our society.

- **Geology**
gives us knowledge of the earth's history, of the formation, composition and alteration of bedrock, soil and groundwater.
- **Geological conditions**
influence to a great degree the environment on the surface of the earth!
- **Geological conditions**
influence the supply and quality of important natural resources!
- **Geological conditions**
influence the natural background levels of various substances!
- **Geological conditions**
influence how pollutants are transported and transformed in the ground!
- **Geological conditions**
influence which land we can use for cultivating or building houses and roads!
- **In short**
geological conditions are vital for life on earth!



Fields of Expertise

Bedrock Geology

Geophysics

Geochemistry

Hydrogeology

Quaternary Deposit Geology

Marine Geology

Mineral Topics

Business Idea

The Geological Survey of Sweden (SGU) is a knowledge-based organization.

We develop, synthesize and market qualified background information concerning bedrock, soil and groundwater for planning and decision-making purposes in a growing number of areas; for example environment and health, physical planning, supply of natural resources, agriculture, forestry and total defence in society.

The Geological Survey investigates, documents and presents information on Sweden's bedrock, soil and groundwater. SGU is also responsible for questions concerning mineral policy.

Environment and Health

Industrialization of our society places great strain on the natural environment in the form of acid rain, industrial pollution and waste products.

The effect of pollution on nature varies according to the geological surroundings. Many environmental problems can be solved or avoided with the help of geological information.

Environmental work in Sweden is changing character from reparative to preventive. More extensive use of geological knowledge is increasingly important in this area.

Bedrock and soils vary in their chemical and physical properties. This is centrally important in, for example, the occurrence

of heavy metals and radon, acidification tolerance and pollution risks for land and groundwater.

Water in the ground carries both valuable substances and pollutants. For this reason, we must understand processes in the ground if we are to solve present and future environmental problems.

Waste products from industry and households can easily pollute groundwater. The waste must be deposited both safely and economically. Knowledge of ground permeability, bedrock fracturing and groundwater movements are essential if we are to handle this situation successfully.





Physical Planning

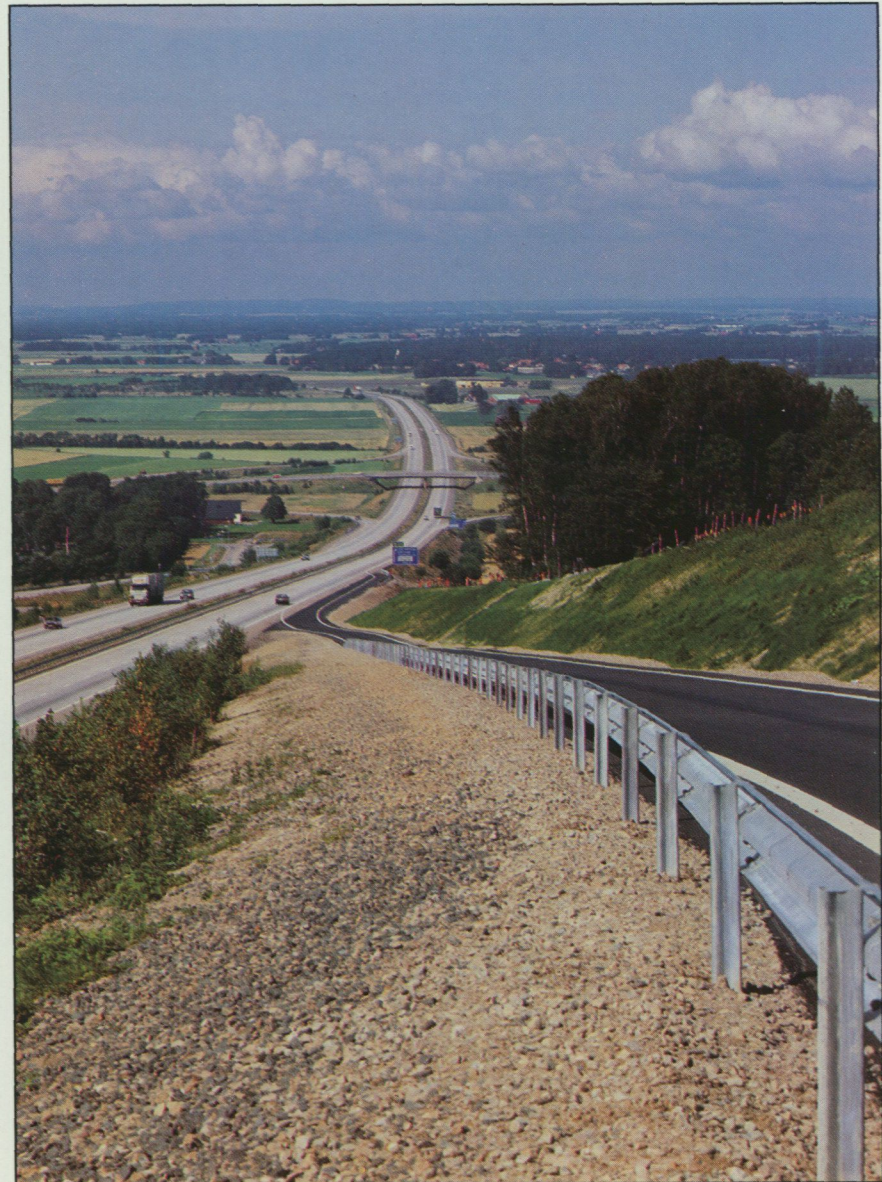
The balance between utilizing land and natural resources and protecting the environment is highly sensitive. Planning authorities require access to information about the properties of bedrock, soil and groundwater in order to make correct decisions.

Localization and construction of buildings, plants, roads and railways above or below ground depend on information about bedrock, soil and groundwater.

Awareness of the vulnerability of the groundwater and the situation of isolated reservoirs or natural springs are important factors in the local and regional planning of the groundwater supply.

High content of ground radon and soils with a tendency to slide are examples of threats to people's life and health. Geological information helps to minimize the risks.

Marine geological knowledge is one of the most important pieces of information for physical planning and environmental monitoring of our coastal and marine regions. SGU is mapping the Swedish continental shelf, which covers roughly 30 % of Sweden's total area. Investigations are carried out from a modern research vessel, "Ocean Surveyor".





Natural Resources

Groundwater

Water is our most important foodstuff, and is essential to the life of humans, animals and plants.

We need a reliable supply of water of good quality for many different purposes. Groundwater is part of the water cycle in nature, and is highly vulnerable in certain regions.

Details of groundwater composition are collected from measuring stations throughout the country and processed by SGU. In this way, the groundwater environment is carefully monitored and any changes are quickly detected.

Groundwater varies in quality and quantity with both time and location. By studying these changes, the processes controlling them and how groundwater is carried from place to place, we gain a better understanding of our environment and its variations.

Maps showing infiltration capacity for harmful substances in the ground and details of water supplies for residential areas, holiday camps, golf courses and private households are increasingly in demand as a basis for decision-making.



Energy

Raw materials for energy production such as oil, coal, natural gas, peat, thermal sources from bedrock, soil and groundwater are formed through geological processes.

Development of domestic energy resources in Sweden makes use of the geological expertise at SGU in several ways.

Thematic geological maps for energy production can be pro-

duced from standard products of bedrock, soil and groundwater. These maps are useful in the planning of geothermal energy plants for residential areas and industry.

Our knowledge of sedimentary bedrock in Sweden is valuable in geothermal projects and for oil prospecting on land and at sea. The register of peat resources at SGU includes a catalogue of available peat fuel resources and their quality.

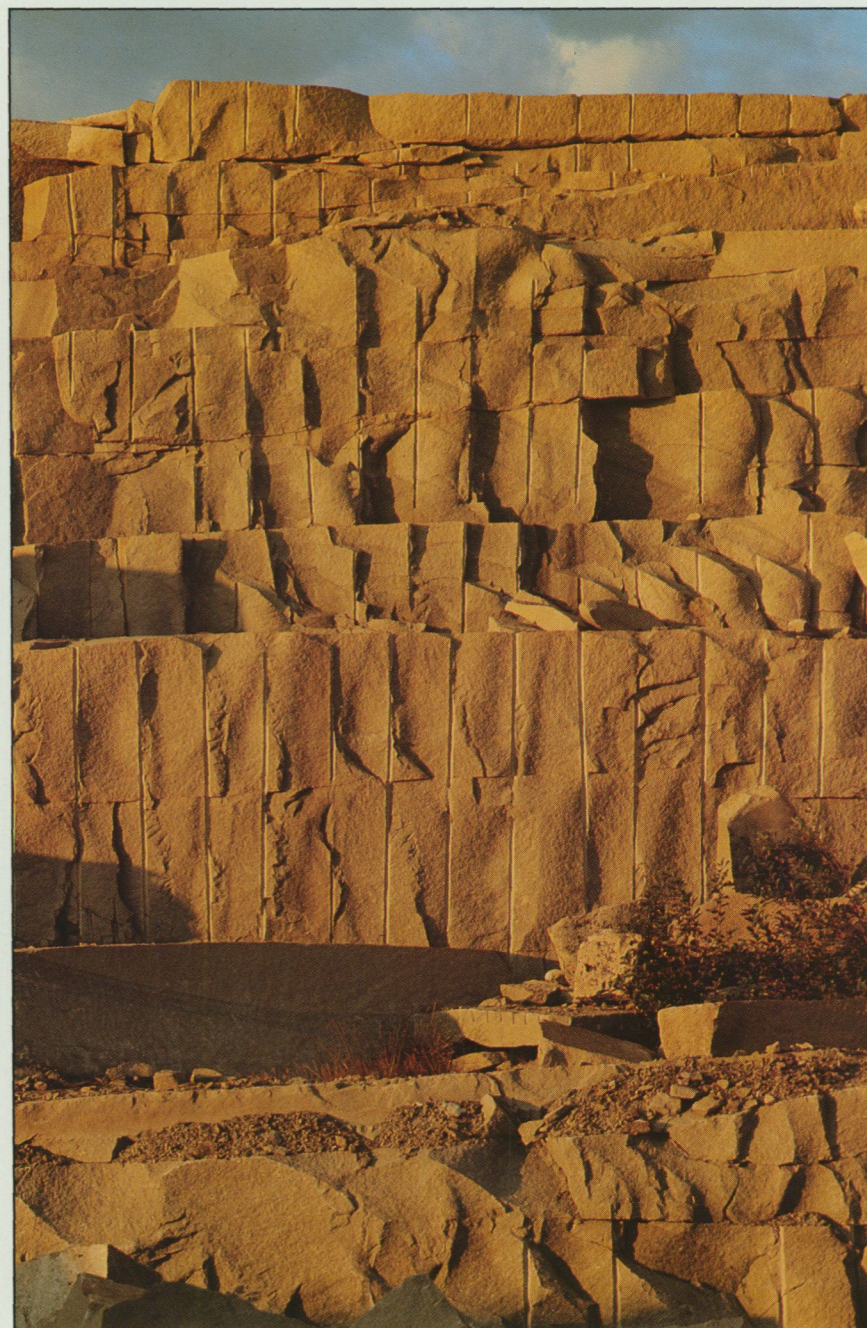


Minerals

Reliable domestic supplies of mineral resources for the construction, mining, metal, engineering, paper and chemical industries are of major importance for Swedish trade and economy.

Information comes from SGU's regional investigations and from prospecting and mining companies, building contractors, universities and technical colleges, as well as from 'mineral hunting' in different areas of the country. The data are processed continuously by SGU, and are used for compiling regional and other summaries.

Information about ores, industrial minerals and rock types in the country are stored in a deposits database, which is used for prospecting, planning and ecological conservation.



Sand and Gravel

Sand and gravel deposits are limited natural resources. Sand and gravel together with crushed rock (aggregate resources) are important for many different and sometimes conflicting interests, such as gravel exploitation, groundwater reservoirs, building construction and open-air recreational activities.

Inventories of aggregates are carried out by SGU. Local and regional authorities can use these in order to plan the management of aggregate resources.

The records show that our eskers are running short and that natural gravel is becoming scarce around many of the larger towns. Demands for crushed rock are thus expected to increase considerably.

All information on sand, gravel and crushed rock resources in Sweden is stored in a database available for purposes of land use planning.



Agriculture and Forestry

The threat to fields and forests from airborne pollutants and ground acidification demands that agriculture and forestry management is aware of the varying ground characteristics.

Forestry relies on geological information in many areas, such as habitat-oriented forestry, ground preparation, liming, passability, acidification status, ditching and ground evaluation, as well as cataloguing marshy forests and peat land.

SGU can provide information concerning groundwater, distribution and permeability of soil types, grain size, nutritional value, buffer capacity, bedrock composition, boulder frequency, weathering properties, gravel and moraine resources and crushable rock.

It is important for agricultural irrigation purposes to know where there is groundwater. The groundwater maps show among other things the quantity and quality of groundwater.





Total Defence in Society

In the area of land use for total defence in society SGU carries the responsibility for questions concerning groundwater, geomagnetism, strategically important metals, sand and gravel, underground installations, passability, excavatability and sea-bed characteristics.

Information concerning variations in the earth's magnetic field is valuable in a number of areas in total defence in society, such as navigation, artillery observation, radio communications and submarine tracking.

The magnetic compass is still an important instrument for land, sea and air navigation. Full awareness of compass deviation is essential for many users.

Another example of the role of SGU in this area may be found in military requirements for maps. SGU has produced specially revised soil maps to show excavatability and passability away from roads.





Products and Services

Data from the basic geological investigations on land and at sea are stored in various databases. The information is presented as maps, descriptions and reports. The work of data collection, storage and presentation is financed by grants to SGU.

The following pages illustrate our standard products, as well as the potential for adapting the huge amount of information stored at SGU to the needs of different customers in order to solve specific problems in society.

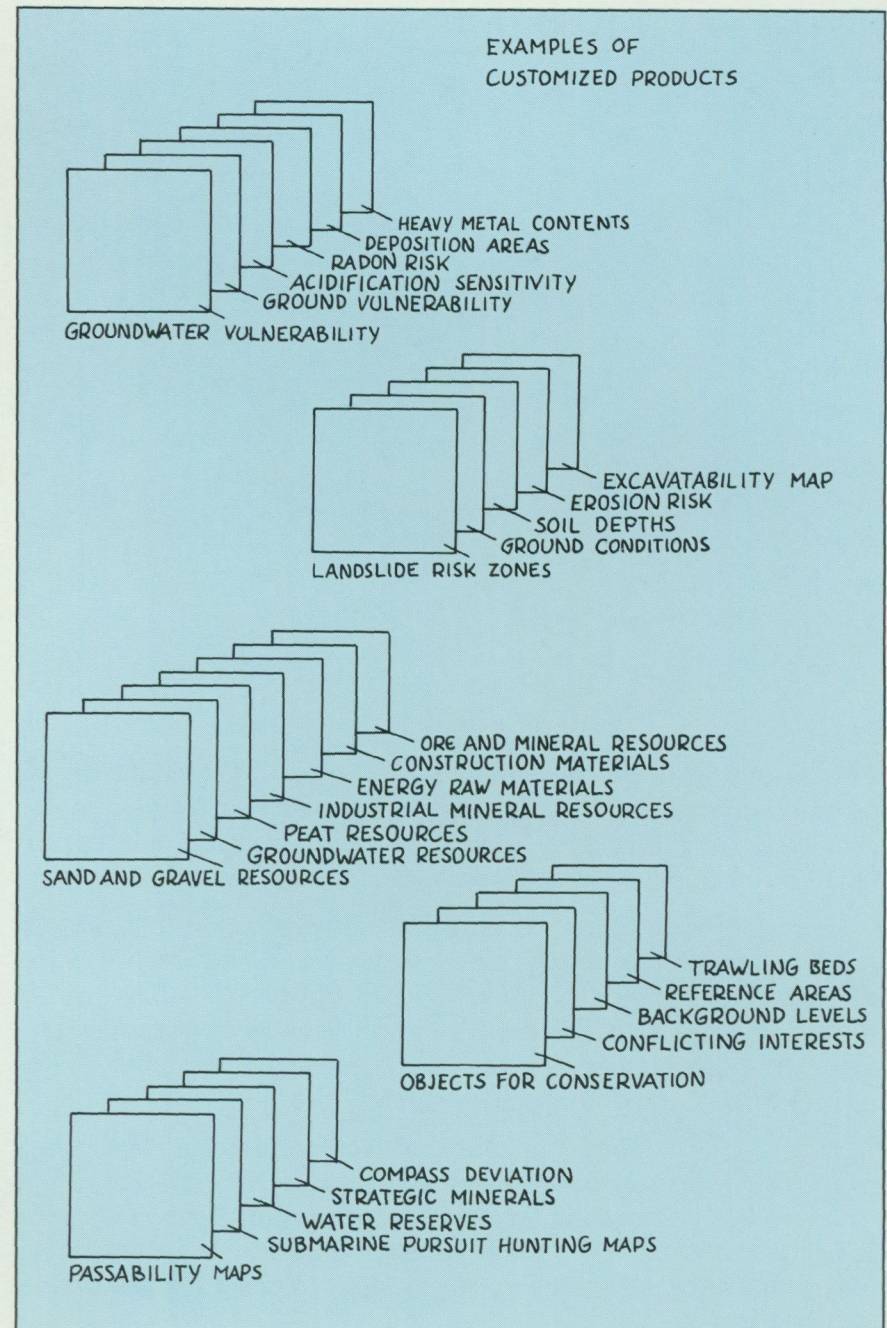
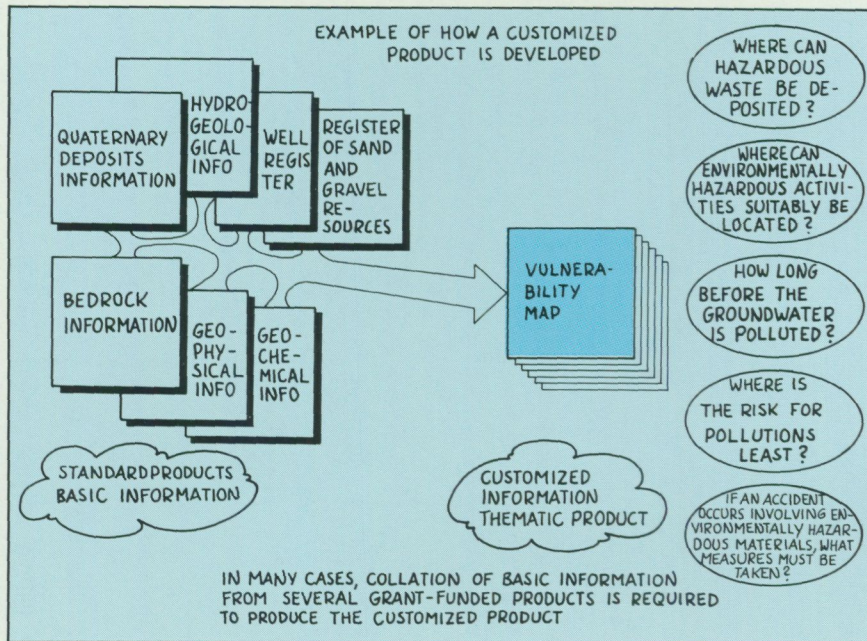


Customized Products

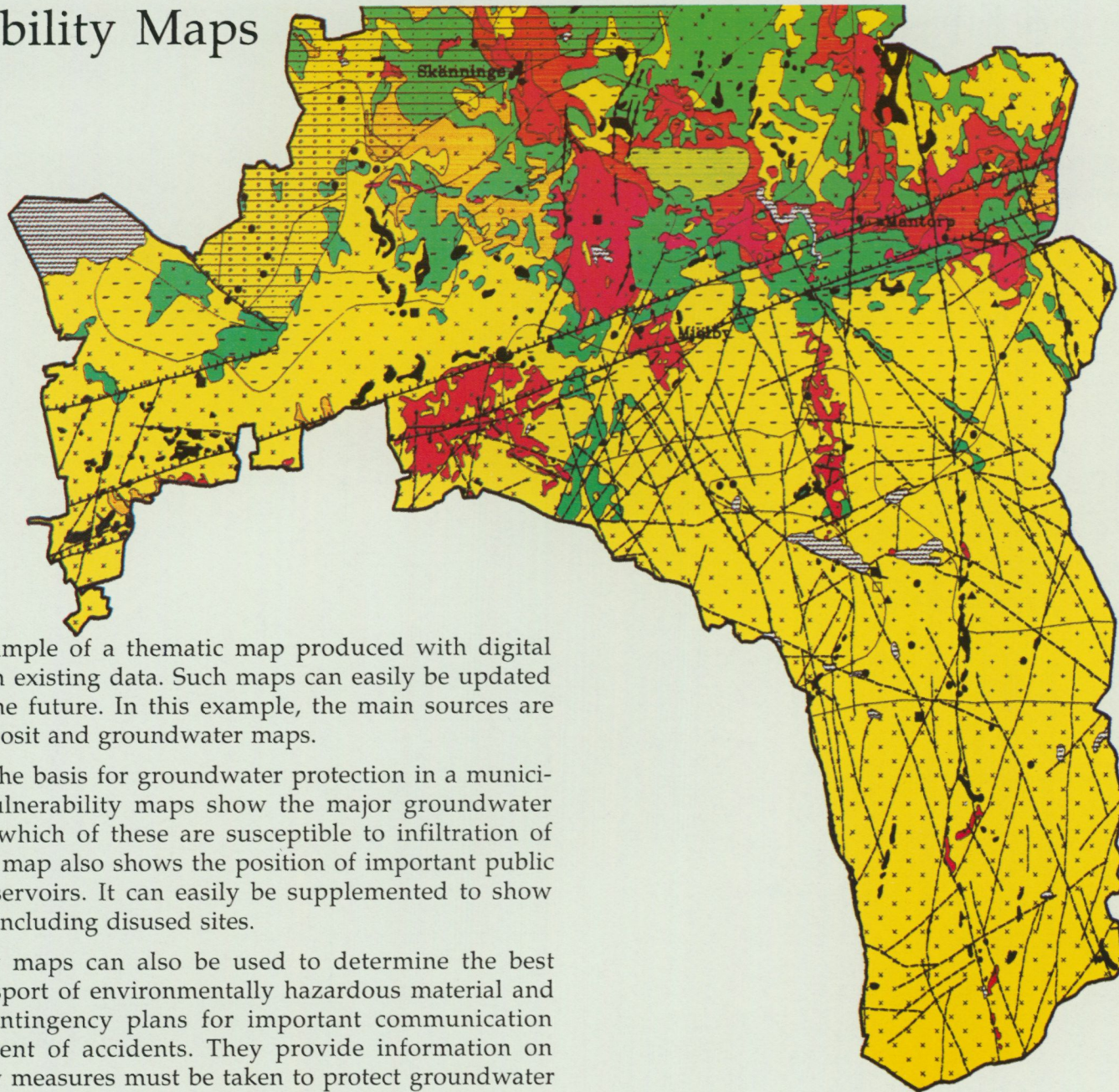
Production of today's maps at SGU is suited to market demands to meet different requirements for geological information in areas like environment and health, physical planning, natural resources, agriculture, forestry and total defence in society.

The customer's requirements cannot always be satisfied using information of one single type, for instance a Quaternary deposit map. Often, information is compiled from several sources, maps and databases.

Information taken from the various maps or data-bases is assembled to produce a large number of customized products such as vulnerability maps for groundwater, acidification sensitivity maps, passability maps or radon risk maps.



Vulnerability Maps



This is one example of a thematic map produced with digital techniques from existing data. Such maps can easily be updated or revised in the future. In this example, the main sources are Quaternary deposit and groundwater maps.

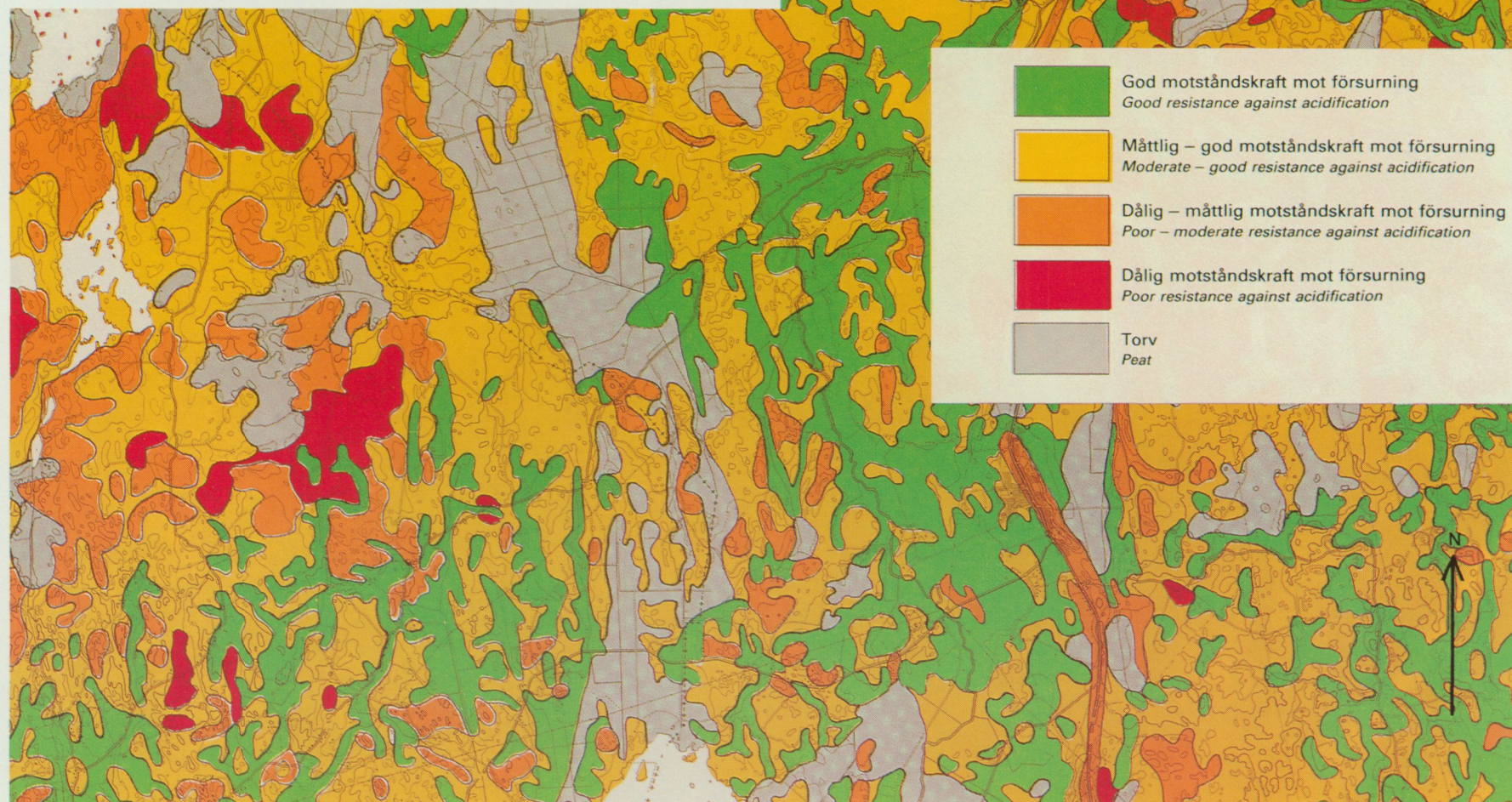
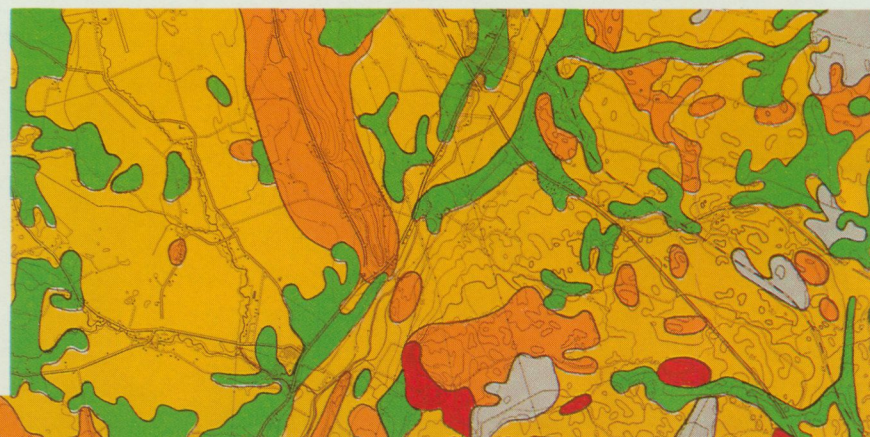
This map is the basis for groundwater protection in a municipality. Such vulnerability maps show the major groundwater resources and which of these are susceptible to infiltration of pollutants. The map also shows the position of important public and private reservoirs. It can easily be supplemented to show refuse dumps, including disused sites.

Vulnerability maps can also be used to determine the best routes for transport of environmentally hazardous material and to establish contingency plans for important communication lines in the event of accidents. They provide information on where and how measures must be taken to protect groundwater and reservoirs.

Acidification Sensitivity Maps

This map shows the buffering capacity of ground and ground-water against acidification. Quaternary deposit and bedrock maps form the main sources of information.

The map is based on several parameters including bedrock acidity, content and stratigraphy of rock types, content of calcium carbonate in the soil and the groundwater level.



Passability Maps

This thematic map is based on Quaternary deposit data, and shows ground with low carrying capacity and boulders which may restrict passability in the terrain.

The illustration shows how information from a Quaternary deposit map can be transferred to a topographical map, thereby revealing areas with restricted access.



The topographical map shows which areas are forested and reveals areas with markedly reduced passability for a range of vehicle types.

1. Open water.
2. Areas periodically covered by water. Probably greatly reduced passability as a result of low carrying capacity.

The Quaternary deposit map shows additional areas with reduced passability.

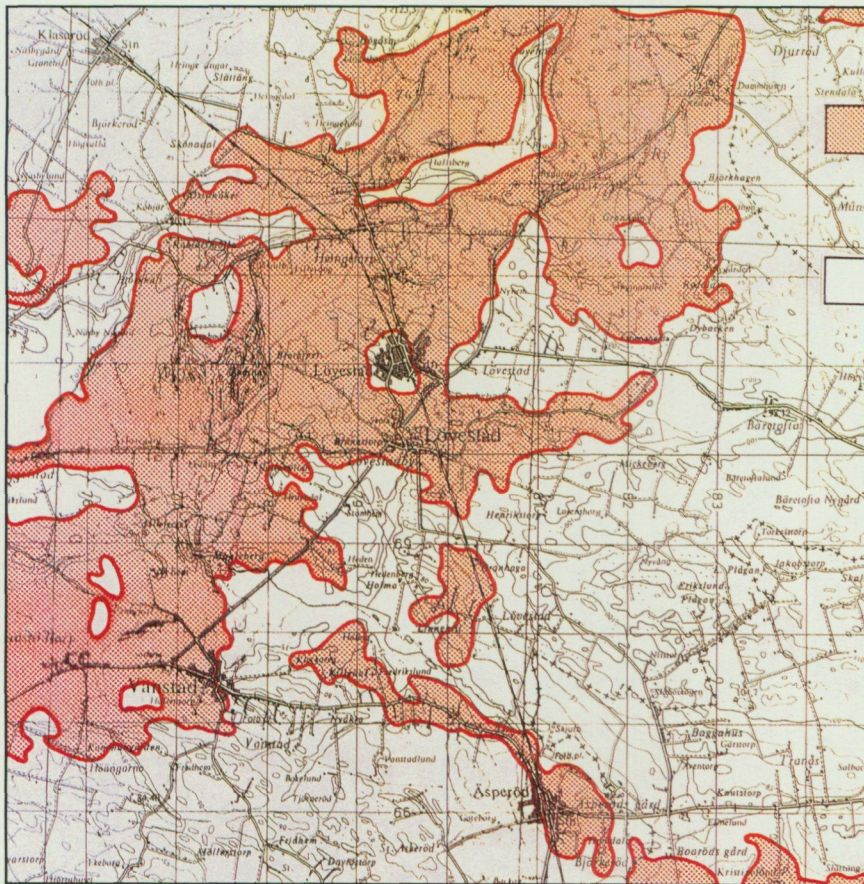
3. Large boulder moraine. Greatly reduced passability as a result of surface roughness.
4. Boulder-rich moraine. Passability may be reduced locally as a result of surface roughness.
5. Peat land. Reduced passability as a result of low carrying capacity. Observe that post-glacial clay can also have low carrying capacity.

The result of the mapping study can be summarized:

-  Low passability (as a result of surface roughness).
-  Low passability (as a result of low carrying capacity).



Radon Risk Maps

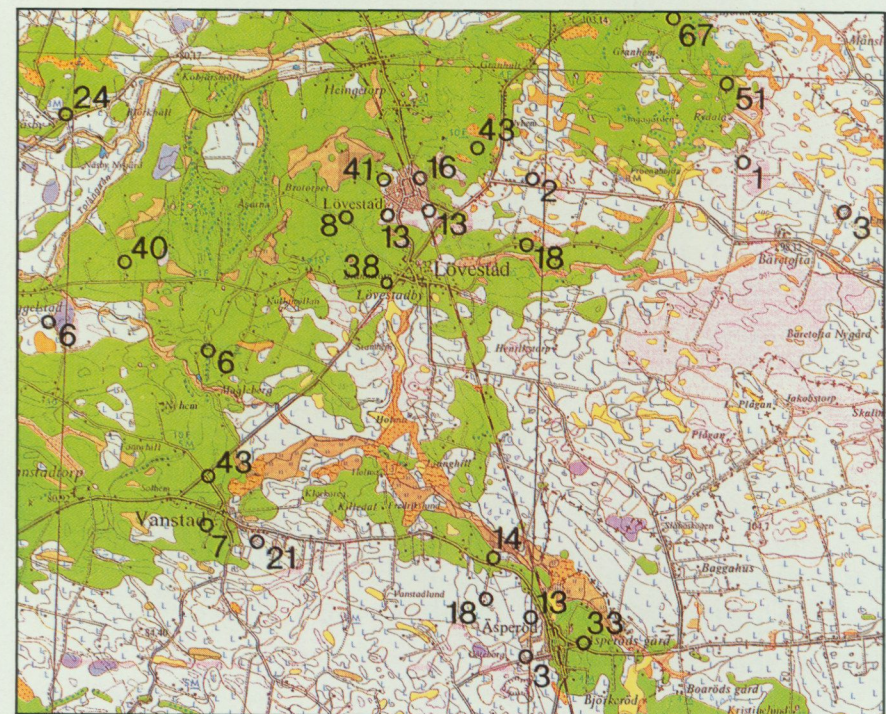


SGU can compile data for geological factors which affect the occurrence of ground radon.

This example shows the radon content in soil-bound air (1000 becquerel per $m^3 = kBq/m^3$). Green areas are composed of sand and gravel with a high content of uranium-bearing alum shale. Blue regions are moraine which lack alum shale.

High-risk area:
More than $50 kBq/m^3$ in soil-bound air.

Normal and low-risk area:
Less than $50 kBq/m^3$ in soil-bound air.



The soil lies on top of clay shale with a very low uranium content. Local geology and measurement results indicate that the sand and gravel area should be regarded as a high-risk area (more than $50 kBq/m^3$).

Standard Products

Bedrock Maps

These maps are useful in the search for various natural resources including metallic and non-metallic minerals and crushable rock as a replacement for natural gravel resources.

Bedrock maps are also the basis for planning of building and plant construction, and are used increasingly in environmental conservation contexts.

Several kinds of bedrock maps are produced at various scales and with various levels of detail. The maps are provided with separate descriptions.

Bedrock Map, scale 1:50,000

A bedrock map at 1:50,000 shows the bedrock over the whole area, not only where it is exposed. The map is an interpretation of the bedrock distribution on the surface of the ground and at depth. Relative ages, composition, characteristics and distribution of the different rock types are shown.

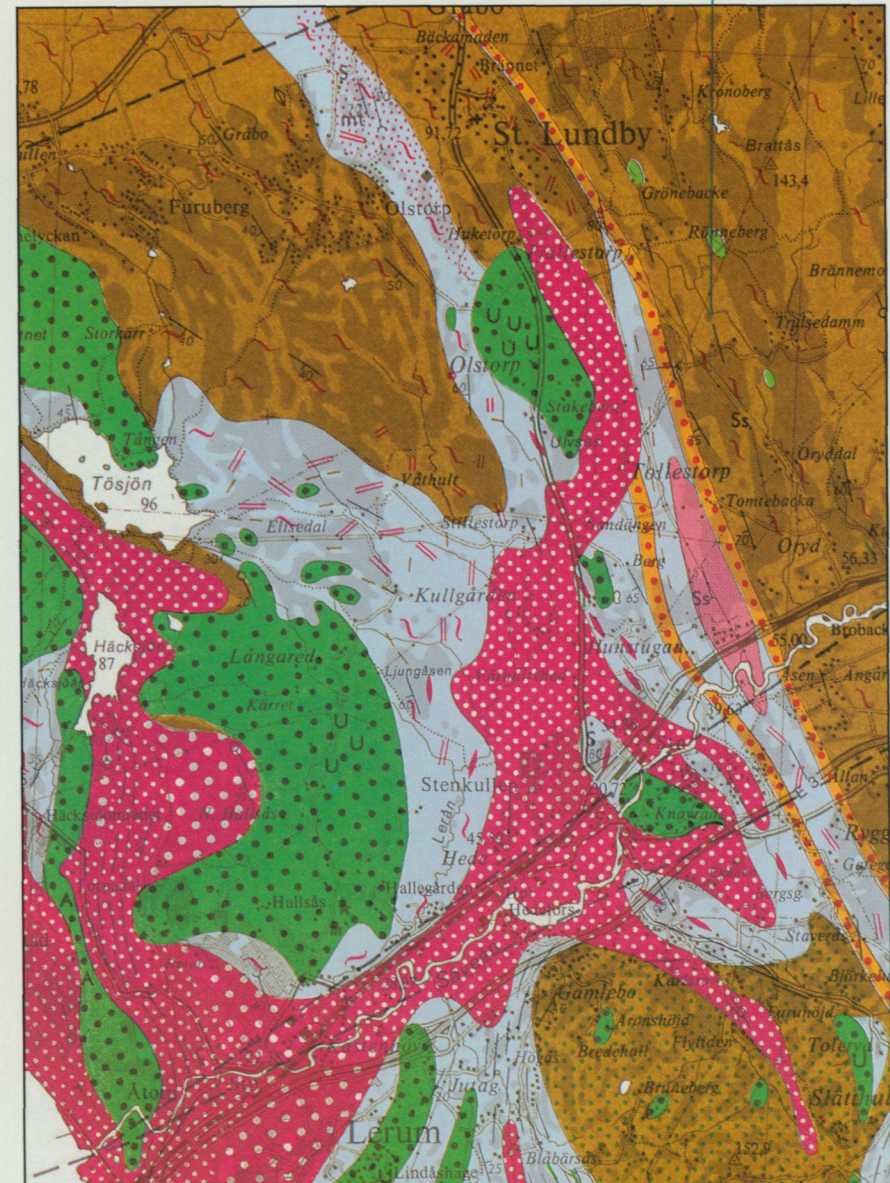
The three-dimensional bedrock structure is illustrated by profiles. A separate description gives details of bedrock geological conditions such as petrology, structural geology and metamorphism including various analyses.

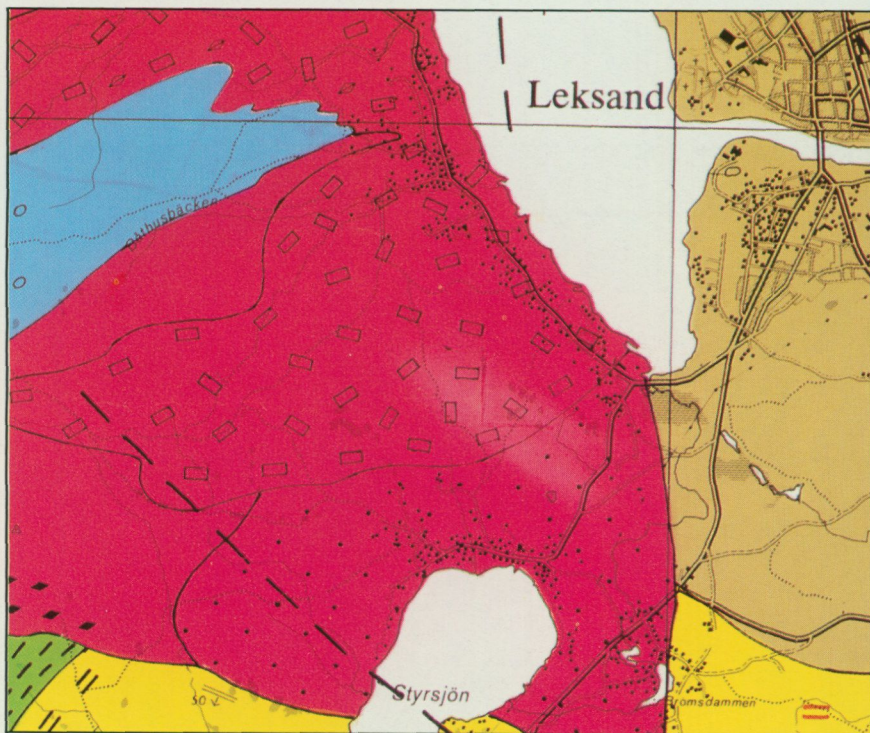
Regional Map, Bedrock, scale 1:50,000

These maps are adjusted primarily for mineral exploration purposes. The map shows the distribution and relative ages of the different rock types.

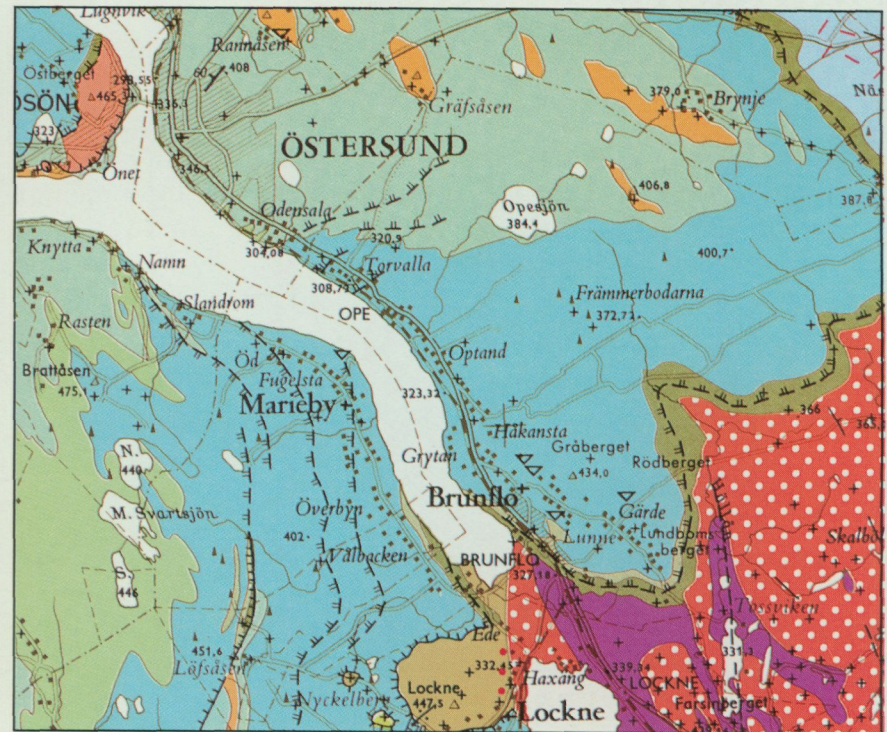
The regional maps show less detail than bedrock maps. Interpretation of geophysical data plays an important role. Profiles are used to illustrate the three-dimensional structure of the bedrock.

Bedrock map, scale 1:50,000 (Series Af)





Regional map, bedrock, scale 1:50,000 (Series Ai)

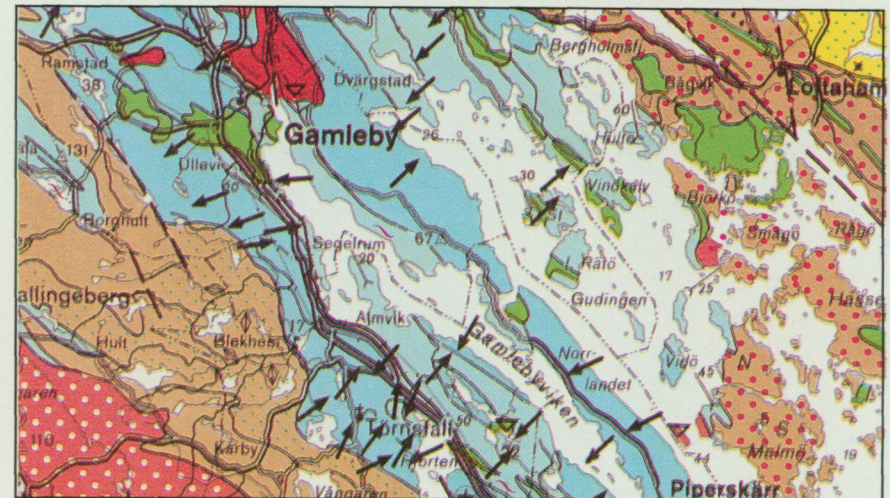


County map, scale 1:200,000 (Series Ba, Ca)

**County Map, scale 1:200,000 and
Provisional General Map, scale 1:250,000**

County and general maps show basically the same information as the bedrock maps at 1:50,000 but with less detail. They provide a general geological picture of the distribution and extension of different rock types. The provisional general map is often a compilation of older geological information.

Provisional general map, scale 1:250,000 (Series Ba)



Quaternary Deposit Maps

Important uses for Quaternary deposit maps are in physical planning for building and plant construction, environmental conservation contexts, searching for gravel and groundwater, localization of environmentally hazardous activities, cable and pipe-laying, assessment of excavatability and passability.

Quaternary deposit maps are available at 1:50,000 and 1:100,000. Separate descriptions are provided with each map. County maps are also available at 1:200,000 – 1:400,000.

Quaternary Deposit Map, scale 1:50,000

A Quaternary deposit map shows the division between rock and soil and the distribution of soil types in a surface layer about 50 cm thick. A number of Quaternary deposit maps are produced today using digital techniques, which simplifies the preparation of various thematic maps. This kind of map covers the south of Sweden.

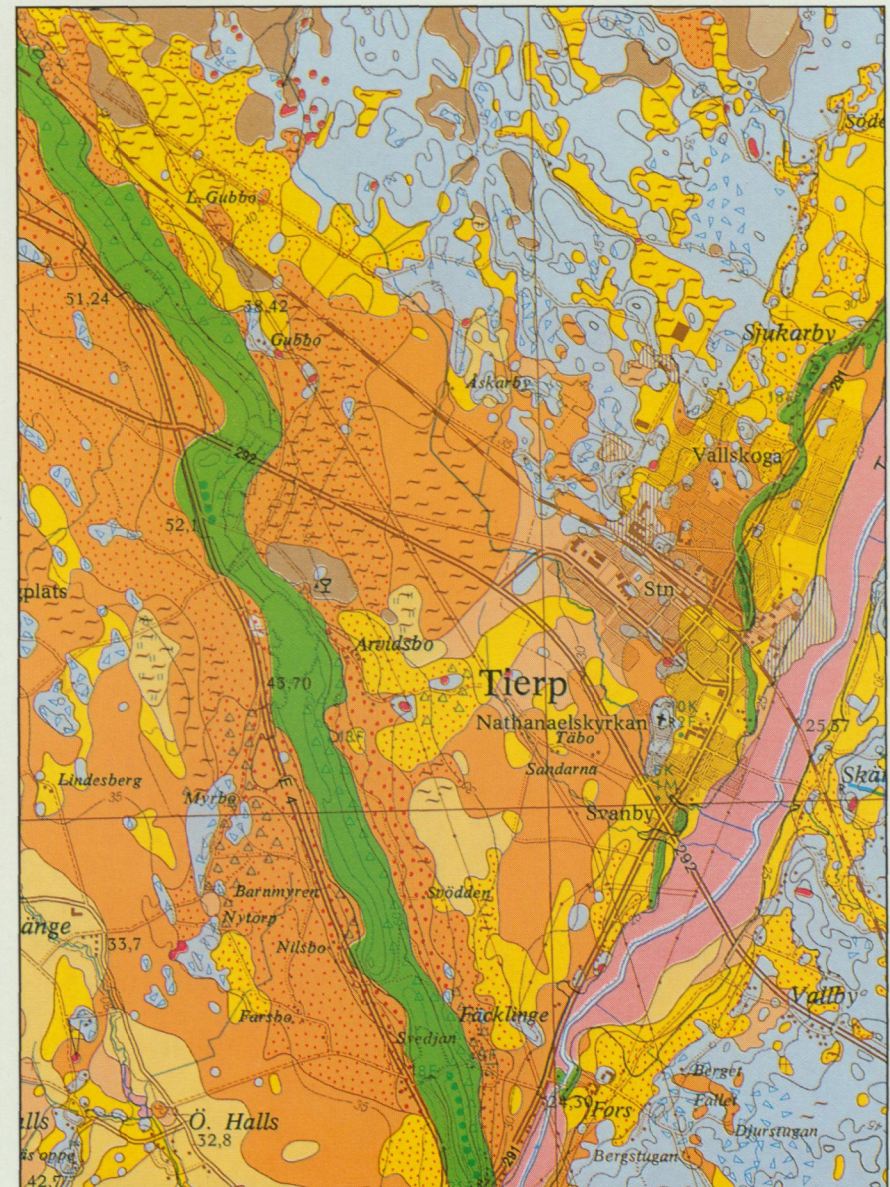
Regional Map, Quaternary Deposits, scale 1:100,000

The north of Sweden is covered by more general Quaternary deposit maps at 1:100,000. These are based on interpretation of aerial photos and field mapping along roads. Investigations in machine excavations are also used.

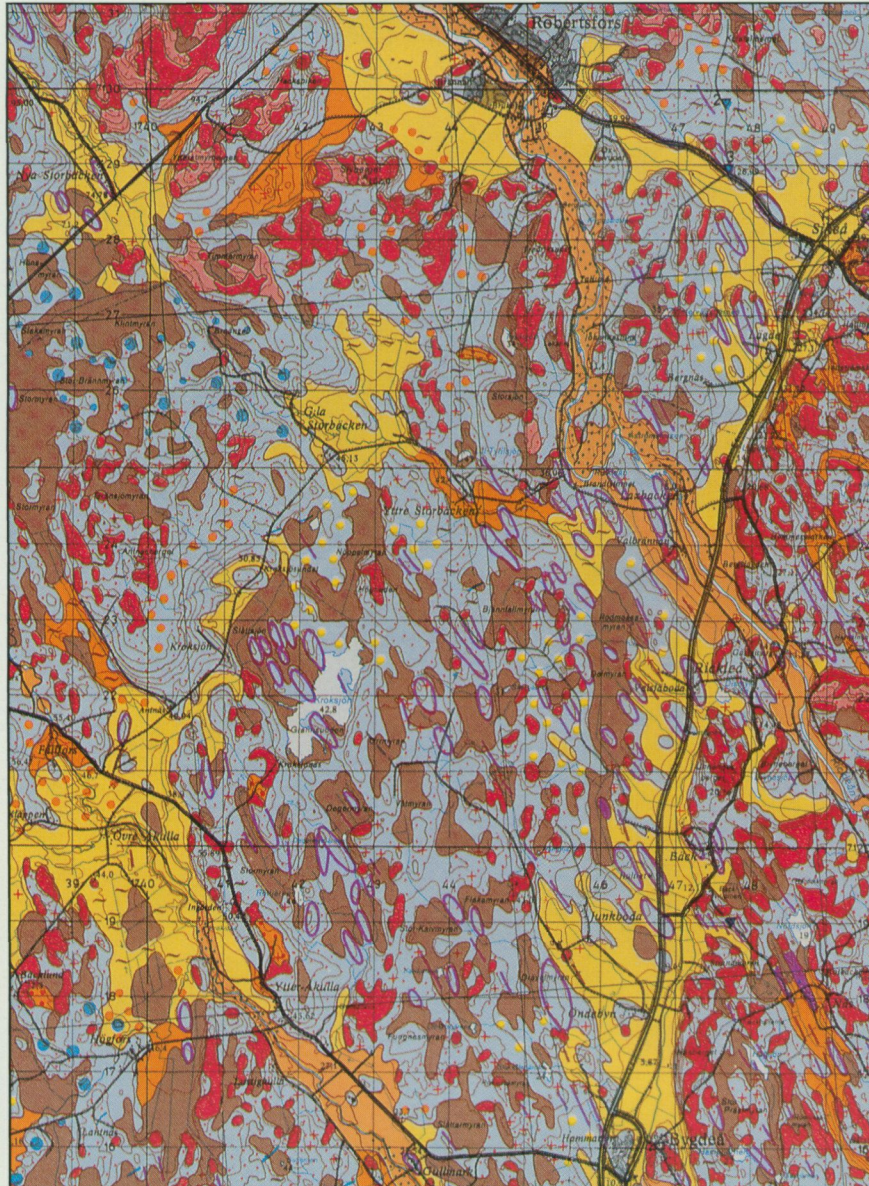
County Map, scale 1:200,000

County maps show basically the same information as the Quaternary deposit maps at 1:50,000 but with less detail. These maps are also based on aerial photography and field mapping along roads.

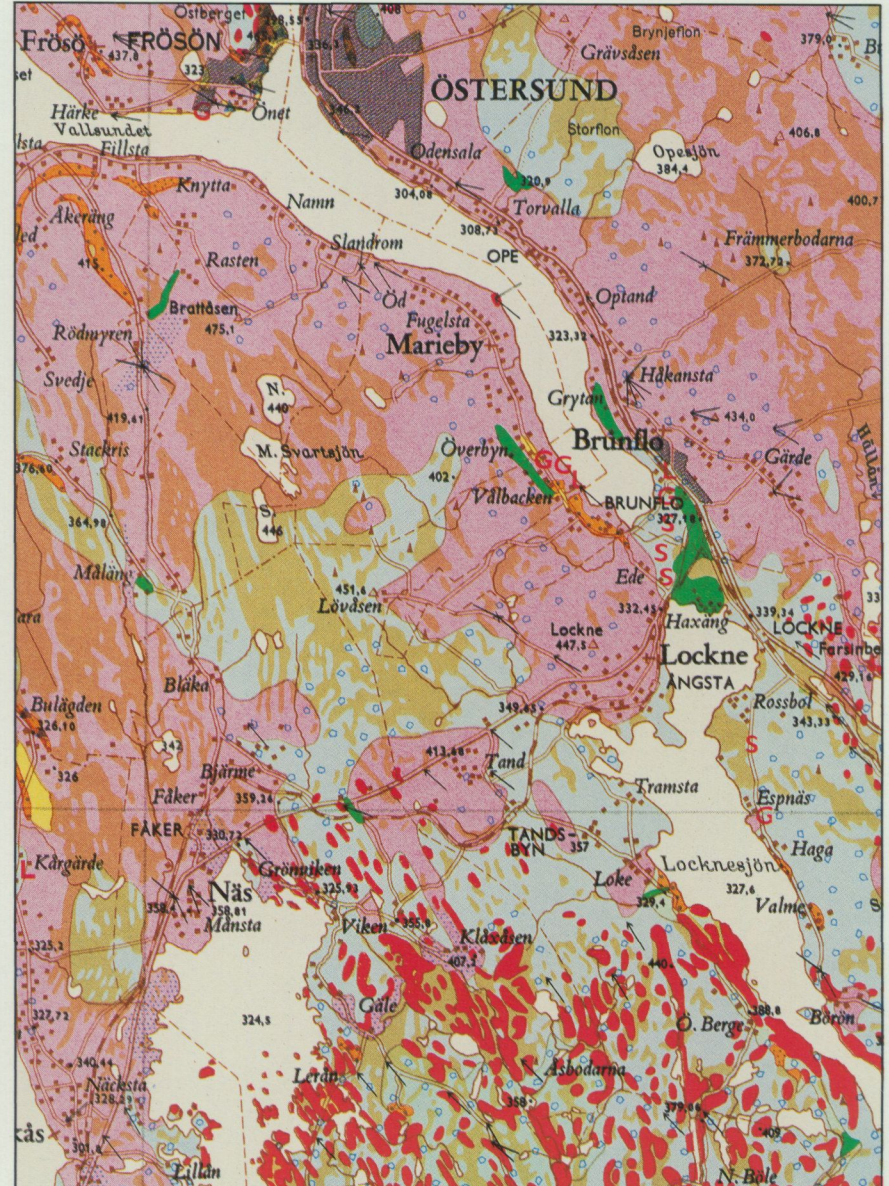
Quaternary deposit map, scale 1:50,000 (Series Ae)



Regional map, Quaternary deposits, scale 1:100,000 (Ser Ak)



County map, scale 1:200,000 (Series Ca)



Groundwater Maps

Groundwater (hydrogeological) maps form a basis among other things for water planning and for establishing groundwater protection measures. They are available at 1:250,000 and 1:50,000. Separate descriptions are provided with each map.

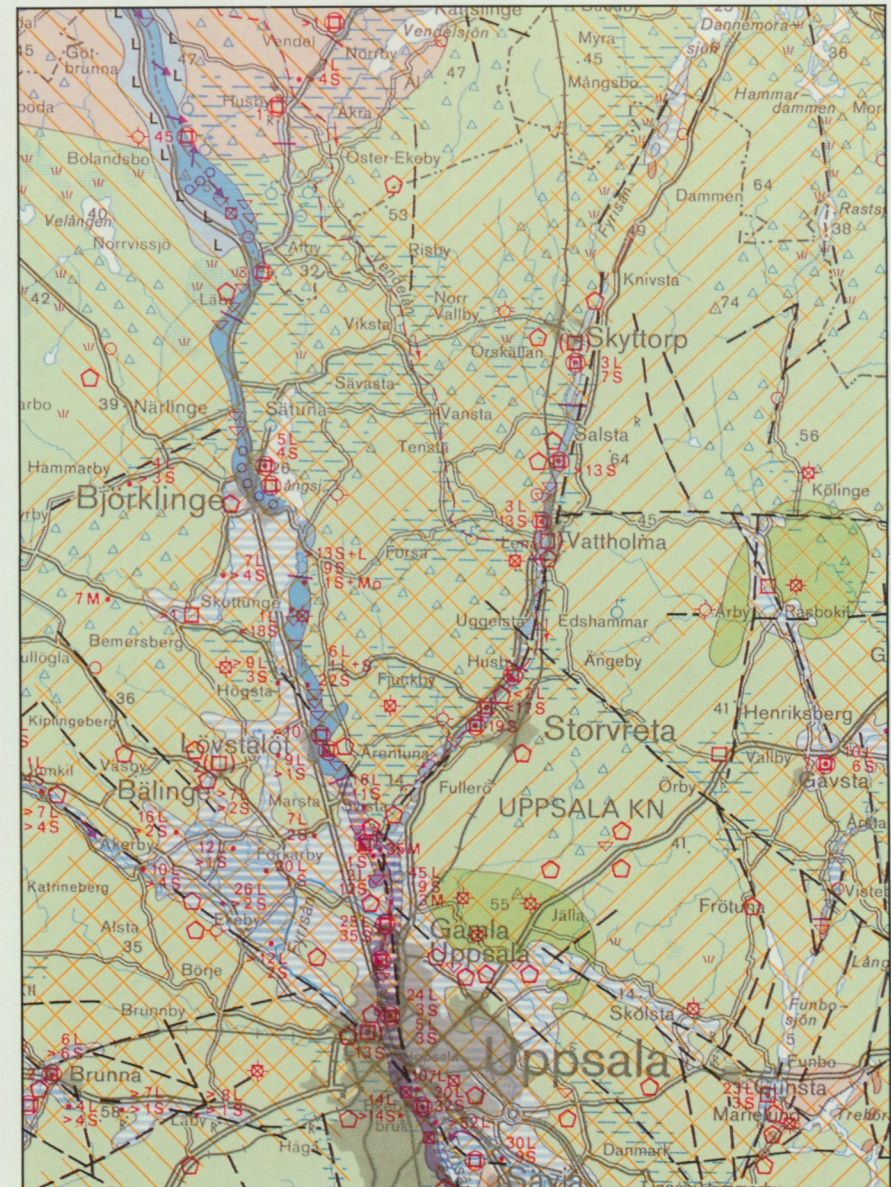
General Hydrogeological Map, scale 1:250,000

Groundwater maps at this scale show in general terms where groundwater is contained in bedrock and soil. This shows for instance how much water can be pumped from wells drilled in rock, and how much groundwater is held in sand and gravel deposits.

The map also shows major reservoirs, watersheds, refuse tips, soil and rock quarries, fault systems, regions with risk for salt groundwater and high fluoride content.

A bedrock map at 1:250,000 and in some cases maps showing pollution sensitivity are provided with the groundwater map.

Map descriptions include statistics for well capacity, information about springs, water management decisions, consultants' reports and details of groundwater quality. Details of precipitation, drainage and evaporation are also included.



General hydrogeological map, scale 1:250,000 (Series Ah)

Hydrogeological Map, scale 1:50,000

These maps are more detailed than the general maps, showing in addition to natural reservoir volumes the groundwater level and the distribution of various geological features.

Special maps are also produced for groundwater quality, well sitings, geological stratification profiles and groundwater levels.

The accompanying descriptions include information on the amount of groundwater in soil and bedrock, water analyses and fluctuations in the groundwater level.



Hydrogeological map, scale 1:50,000 (Series Ag)

Marine Geological Maps

These maps show the marine geology and provide answers to questions concerning dynamic sea-bed conditions, availability of certain industrial minerals and environmental monitoring. They are also an important source of information for biological inventories, aquaculture, fisheries and defence.

Marine Geological Map, scale 1:100,000

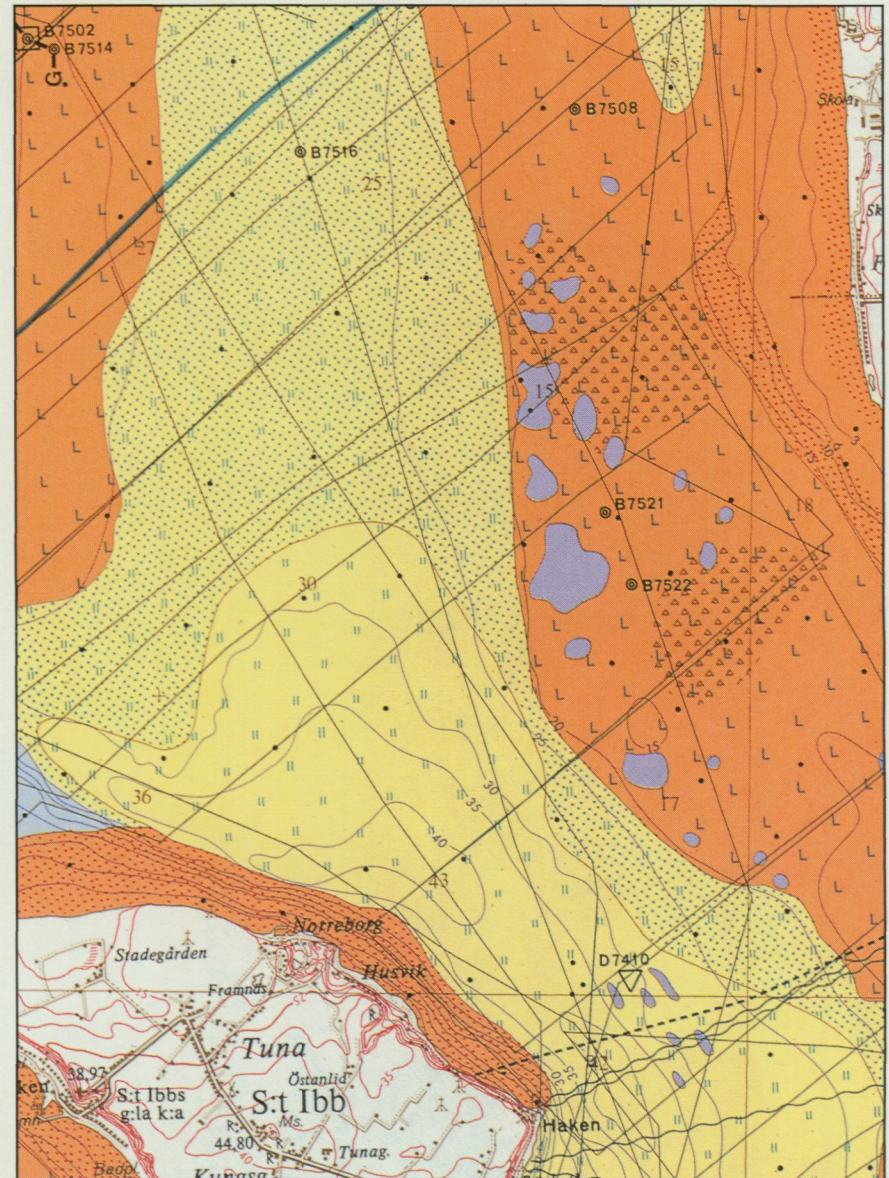
This map (see next page) shows suitable areas for environmental monitoring samples, or where clean dredging mass can be dumped.

Dredging mass is required to remain in place where it is dumped. Mass, which is deposited on eroding beds will be redispersed and cloud the water, which in turn limits fishing and biological production.

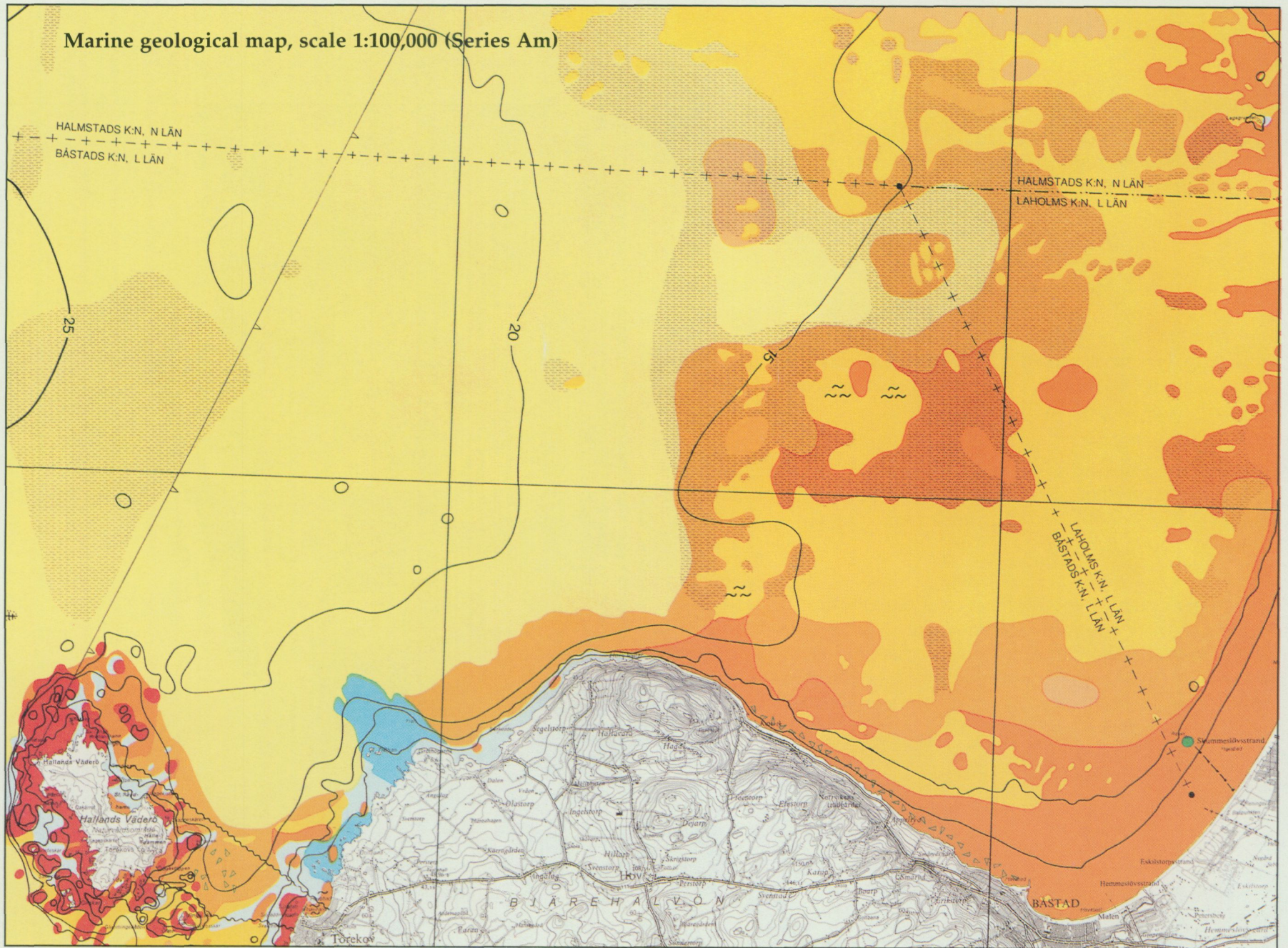
Fish farms should be sited in erosional areas where water circulation is good. Poor circulation, as in deposition areas can lead to oxygen deficiency in the water, with bottom death and eventually fish death in the farms as a result.

The marine geological maps are accompanied by maps showing the structure of the sea-bed in the area concerned. The profiles show sediment stratigraphy down to the bedrock. This information is important for dredging, laying cables, marine construction and exploitation of natural resources.

Marine geological map, scale 1:50,000



Marine geological map, scale 1:100,000 (Series Am)



Geochemical Maps

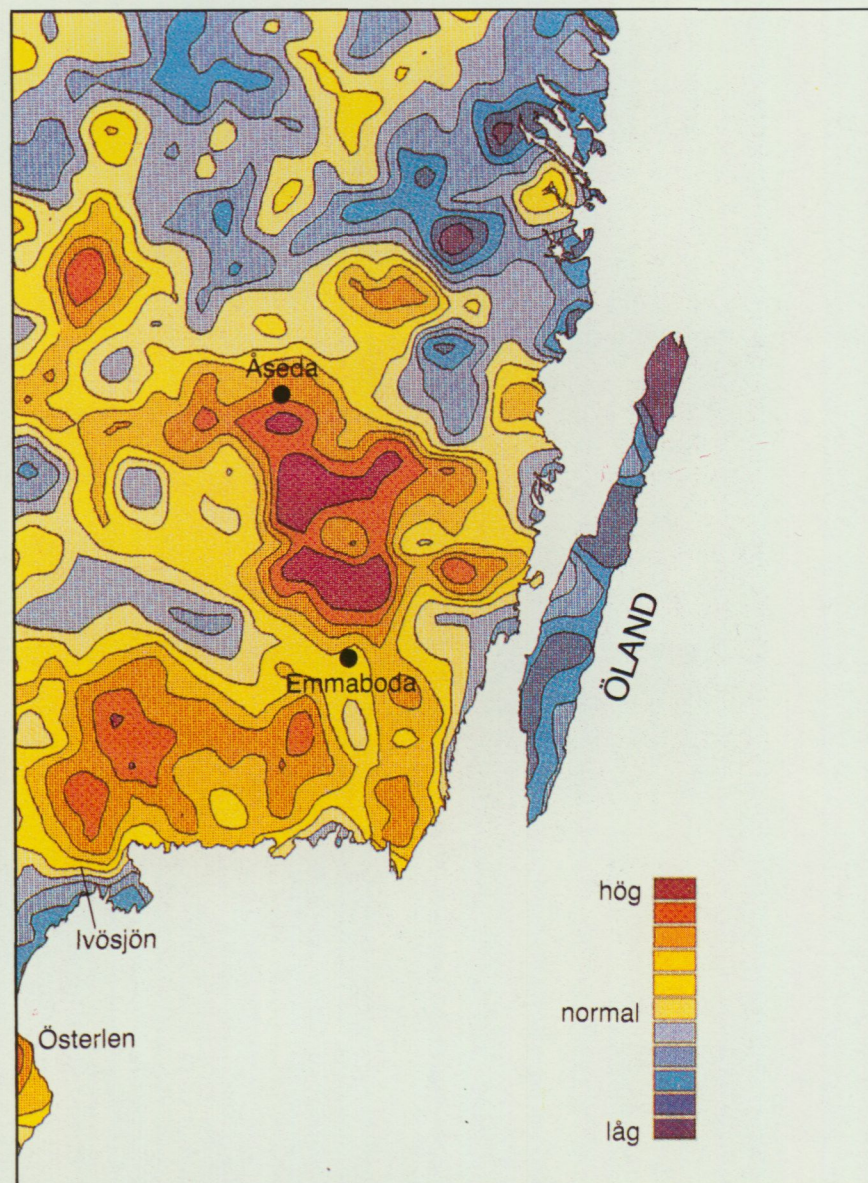
SGU supplies two kinds of geochemical maps, biogeochemical and soil geochemical, at standard scales of 1:1,000,000 and 1:250,000. Special reports are provided with the 1:1,000,000 maps. Geochemical maps at any desired scale can be ordered.

Biogeochemical Map, scale 1:1,000,000

Biogeochemical maps show variations in heavy metal concentration in the environment. They reveal areas with high heavy metal content, resulting either from natural geological conditions or from human activities.

The maps also show the reverse situation, i.e. areas with low heavy metal content. Such areas may be 'clean' in terms of poisonous heavy metals or 'deficient' from the viewpoint of biologically essential metals.

This geochemical map shows the distribution of lead in the ground. Notice the high lead content in some areas. This is in part a result of the concentration of glass industries in the area, using lead in the production of crystal. We must avoid such areas when locating new industrial concerns which may further increase the ground lead content.



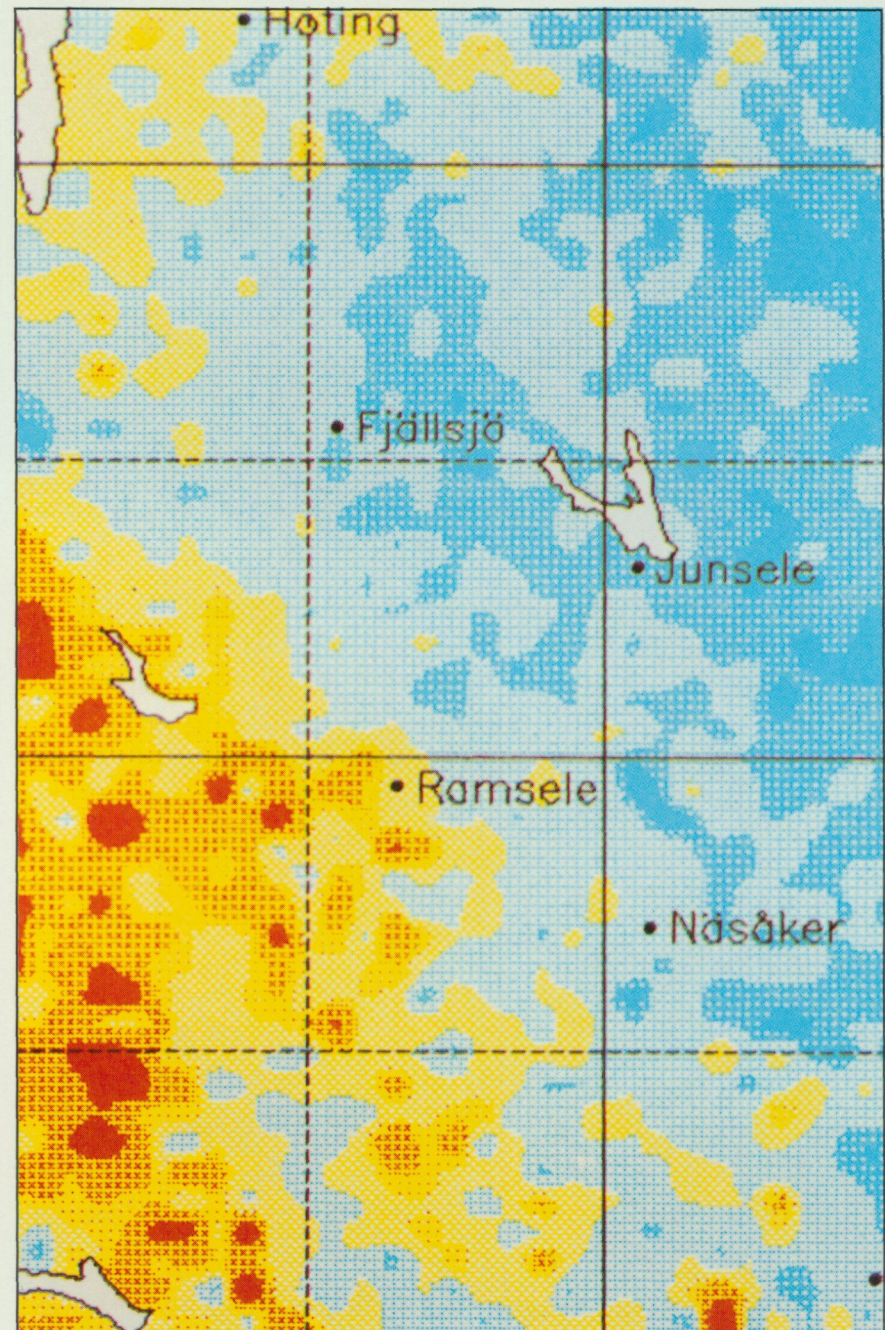
Biogeochemical map (lead), scale 1:1,000,000

Soil Geochemical Map, scale 1:1,000,000

Soil geochemical maps show pH and natural occurrence of elements in till. They are used to show surplus and deficiency areas for nutrients and trace elements, as well as state of acidity.

Other areas of use include information on acid neutralizing capacity, assessment of soil fertility, prospecting purposes and correlation between environment and environment-related diseases in people and animals.

The map shows the occurrence of manganese in till. Manganese is an essential trace element for all life, but is poisonous in higher amounts. In chalky soil, on the other hand, manganese deficiency can occur in plants.



Soil geochemical map (manganese), scale 1:1,000,000

Geophysical Maps

SGU produces several kinds of geophysical maps. These provide information on geological structures, rock type distribution, depth profiles for rock types, crush zones and faults.

They are used primarily as a basis for geological bedrock mapping, prospecting for natural resources and planning purposes.

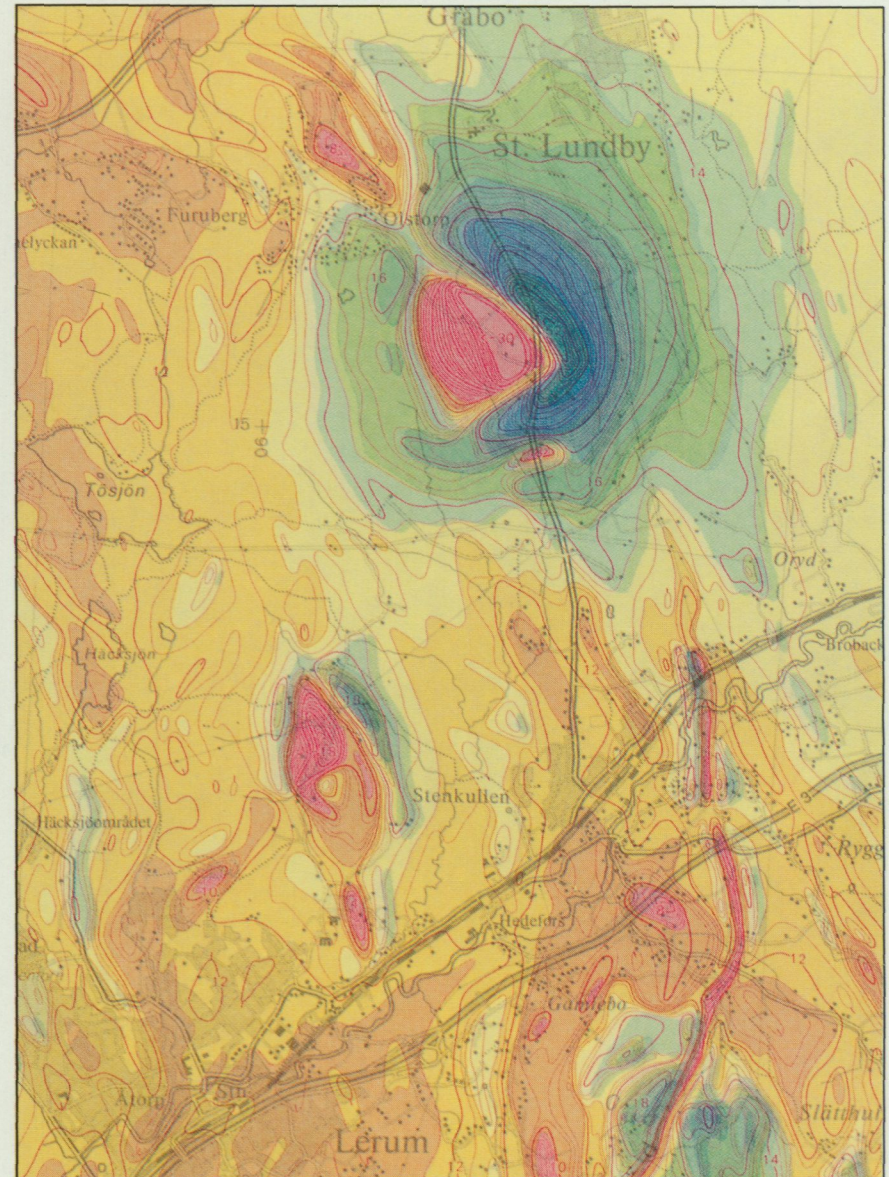
Geophysical data are stored in a digital form, which allows maps to be produced easily at any scale.

The map to the right is an **aeromagnetic map**, which shows deviations from the normal magnetic field.

Geophysical maps also include **radiometric maps**. They show the natural radioactivity in the earth surface layers. Such maps are valuable for example in assessment of radon risks.

Electromagnetic maps reflect the electrical conductivity in the bedrock. These maps are used among other things in searching for groundwater.

Different types of **gravity maps** are also produced, showing mass distribution in the bedrock.



Aeromagnetic map, scale 1:50,000 (Series Af, Ai)

Pictures:

Cover, front page	Axel Ljungquist/N	Page 11 (right)	Alf Linderheim/N
Page 3	Tore Hagman/N	Page 12	Staffan Arvegård/N
Page 4 (left)	Lennart Mathiasson/N	Page 13	Ulf Risberg/N
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The Geological Survey of Sweden (SGU) is a governmental authority under the Department of Industry.

SGU was founded in 1858. The original purpose, a full coverage of Sweden's soil and bedrock, was regarded as a limited project - hence the name.

The work was found to be far more extensive than originally envisaged, and the Geological Survey of Sweden became an established organization.

SGU has been restructured several times as the demands for expert and modern geological information in society has increased. The head office moved from Stockholm to Uppsala in 1979.

Today, SGU is a modern knowledgebased organization for more than 200 employees. The majority of these work at the head office in Uppsala. The remainder is employed at regional offices in Göteborg, Lund and Malå. In 1993 a Mineral Resources Information Office was established in Malå

SGU is also the principal authority for the Mining Inspectors, with two districts, one in Falun and the other one in Luleå.



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