The year in focus, 2001

Kai Sørensen
Director

Field activities in Greenland by the Geological Survey of Denmark and Greenland (GEUS) in 2001 were again many and varied. They included economic investigations of crystalline basement and sedimentary rocks in North-West Greenland, and a systematic mapping project combined with resource evaluation in the boundary zone of the Nagssugtoqidian and Rinkian mobile belts of central and southern West Greenland. In addition, studies of the Vendian to Lower Palaeozoic successions in North-East Greenland and of the Palaeogene sediments of central East Greenland were carried out, a major aeromagnetic survey was flown in central West Greenland, and investigations of Holocene lake sediments in southern West Greenland were continued.

In 2001 the proportion of GEUS human resources committed to Greenland activities compared favourably with that in preceding years, although financial resources allocated to Greenland have experienced a marked downward trend over recent years (Table 1). The latter reflects primarily the decrease in Greenland field activities of the Danish Lithosphere Centre (DLC), which is administratively attached to GEUS, as well as a reduction in funding from external sources. Despite their much reduced field activities in Greenland, a significant proportion of DLC's research in 2001 was still related to Greenland. An additional factor influencing the figures for expenditure quoted in Table 1 is of a technical nature in the sense that although aeromagnetic surveys were flown in both 1999 and 2001, the contractual expenses of acquisition were included in the figures for external funding in 1999, but not in the figures for 2001.

The primary source of the Survey's funding is the Finance Law appropriation from the Danish State. The proportion of this grant allocated to Greenland-related activities is based on annual work programmes planned in consultation with the Greenland authorities, in particular the Bureau of Minerals and Petroleum (BMP) of the Government of Greenland. The planned activities are approved by the Board of GEUS, on which BMP is represented.

External sources of funding for Greenland activities in 2001, as in previous years, came primarily from BMP and from Danish and international research foundations of which the most important are the Danish Natural Science Research Council, the Carlsberg Foundation, the Commission for Scientific Research in Greenland and the European Union. DLC is funded by the Danish National Research Foundation.

Regional geology and mapping

Systematic mapping was undertaken in 2001 in the Aasiaat region of central West Greenland, located at the transition between the Rinkian and Nagssugtoqidian

Table 1. Key statistics on Survey resources

RESOURCES	2001	2000	1999
HUMAN RESOURCES			
Permanent staff (man-years)			
GEUS personnel*	346	354	356
Allocated to Greenland work	80	93	87
Greenland field work (persons)			
Total number of participants†	77	92	85
DLC persons involved	3	21	27
FINANCIAL RESOURCES (million DKK)			
GEUS Finance Law appropriation	140	138	135
Of this spent on Greenland activities	32	32	33
GEUS external funding‡	63	77	78
Of this spent on Greenland activities	17	22	28
DLC spending on Greenland activities	8	14	18
Total expenditure on Greenland activities	57	68	79

* excludes DLC staff of *c.* 20.
† includes DLC and external scientists.
‡ excludes DLC funds.
From Annual Accounts 2000/2001 and internal/external sources.

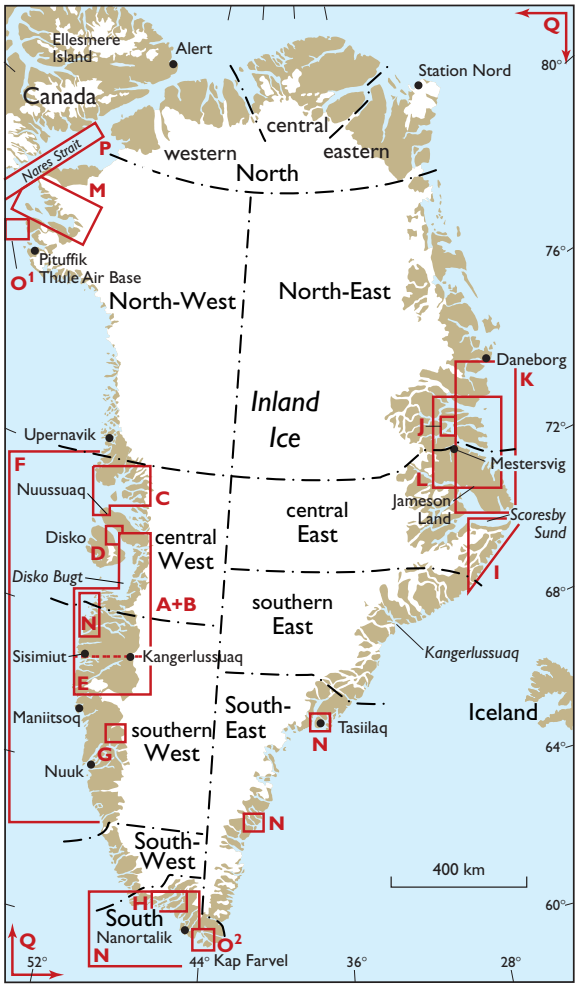

Fig. 1. Map showing the regions in which Survey field activities were carried out in 2001: frames **A–Q**. **Letters** in bold in the list below indicate those regions for which articles are presented in this volume; **numbers** 1–18 in parentheses refer to the articles as listed in the Contents and on the adjoining index map (pages 4 and 5).

A: West Greenland; regional mapping (1, 2, 3)
B: West Greenland; mineral resource assessment (4, 5, 6)
C: Svartenhuk Halvø region; airborne geophysics (7)
D: Nuussuaq region; general geology, landslide investigations (8)
E: Kangerlussuaq area, southern West Greenland; investigations of lake sediments (17)
F: West Greenland; petroleum geology and seismic interpretation (10, 11, 12)
G: Isukasia region; *Isua Multidisciplinary Research Project*, regional geology and geochronology
H: Narsaq region; glaciology (18)
I: Scoresby Sund region; stratigraphy (12, 13)
J: North-East Greenland; stratigraphy and palaeontology (14)
K: North-East Greenland; geochemistry (15)
L: North-East Greenland; *MINEO* and *HyperGreen* projects, hyperspectral ground control
M: *Qaanaaq 2001*; mineral resource assessment, geochemistry and regional geology (16)
N: South, South-East and central West Greenland; ornamental stone investigations
O^1 and O^2: North-West and South Greenland, respectively; environmental history research
P: North-West Greenland; geophysical research
Q: Throughout Greenland; *GLATIS* and *NEAT* projects, geophysical research

Proterozoic mobile belts (Fig. 1, **A**). This project is aimed at the production of two 1:100 000 geological map sheets, and is an extension of the field work in 2000 on the Ussuit map sheet of the Nordre Strømfjord area immediately to the south.

Field work for the *Isua Multidisciplinary Research Project* in the Isukasia area of southern West Greenland, focused on the 'Earth's oldest rocks', was completed in 2001 (Fig. 1, **G**); this was the last summer of a planned series of field seasons involving a large number of Danish and international scientists.

The studies of the Vendian to early Palaeozoic rocks of Ella Ø and surroundings in North-East Greenland were continued in 2001 (Fig. 1, **J**); these are part of a continuing project investigating the passive margin succession of the Laurentian continent. Studies of the Palaeogene sediments of central East Greenland form part of regional petroleum geology investigations, and are described below.

Mineral resources

A field party visited the Qaanaaq region of North-West Greenland (Fig. 1, **M**) in 2001, focused on an assessment of the economic potential in the basement crystalline rocks as well as the overlying Mesoproterozoic sediments of the Thule Supergroup.

A regional aeromagnetic survey financed by BMP was carried out in central West Greenland covering a broad onshore and offshore region centred on Svartenhuk Halvø (Fig. 1, **C**). A total of 70 000 line km of high quality data was acquired. Regional aeromagnetic data coverage now extends from the southern tip

of Greenland northwards along the entire western coast as far as latitude 72°12´N.

In conjunction with the systematic regional mapping programme in the Aasiaat region of central West Greenland, a resource assessment of the region between Nuussuaq and Maniitsoq was undertaken in 2001 (Fig. 1, **B**). Economic studies were carried out by field teams, and included investigations of the kimberlitic rocks in the Sisimiut–Kangerlussuaq region.

Other activities have included sample collections aimed at ground control of the hyperspectral data acquisition carried out in 2000 in central East and North-East Greenland. In addition, localities in South-East, South and southern West Greenland (Fig. 1, **N**) were visited in order to assess the potential for ornamental stone quarrying.

Petroleum geology

Most petroleum geology activities undertaken in 2001 were in preparation for the licensing round planned for mid-2002. The focus was mainly on promotion of the exploration opportunities in the licensing round area between 63° and 68°N, together with the launching of new seismic and geological projects.

Special mapping projects have been directed towards the Palaeogene sediments offshore southern West Greenland (Fig. 1, **F**) and the offshore area with volcanic rocks at the seabed north of latitude 68°N. A geohazard study covering the major part of the offshore licence area between 63° and 68°N was carried out for BMP in 2001.

A major source rock project involving collection and comparison of mid-Cretaceous source rocks from the interior of North America, the Canadian Arctic and the Baffin Bay – Davis Strait region was initiated. This is aimed at advancing the understanding of potential petroleum systems offshore West Greenland.

In continuation of earlier field work in the pre-basaltic, Cretaceous and Paleocene sediments of the Kangerlussuaq region in East Greenland, a field party visited the Kap Dalton and Savoia Halvø areas (Fig. 1, **I**); here the youngest pre-basaltic, and oldest post-basaltic sediments are exposed. Relationships at these localities are of particular importance for the understanding of pre-drift North Atlantic geology.

General scientific activities

Sampling of Holocene lake sediments has been carried out for a number of years in West Greenland, with the objective of assessing the influence of increased global warming on the sensitive Arctic ecosystems. These activities were continued in 2001, with sampling in southern West Greenland (Fig. 1, **E**). Strong local climate gradients exist between the coast and the Inland Ice, and the lakes preserve important signals relating to Holocene environmental conditions.

In order to investigate indications of thinning of the Inland Ice in South Greenland, GEUS has installed instrumentation to monitor one of the major outlet glaciers (Sermilik Bræ) from the Inland Ice in the Narsaq region (Fig. 1, **H**).

A field team collected samples of frozen peat on Carey Øer in order to study the early dispersion of heavy metals in North-West Greenland (Fig. 1, **O^{1}**). The same team collected submarine lake sediments in South Greenland, as part of a project to evaluate sea-level changes (Fig. 1, **O^{2}**).

In November 2000, a major rock fall occurred on the south coast of Nuussuaq near Paatuut (Fig. 1, **D**). It was registered on seismic stations in West Greenland and at Summit on the Inland Ice, and triggered a tsunami in the Vaigat strait which caused damage at coastal settlements, but no loss of life. The Survey undertook studies of the geometry and volume of this rock fall, and assessed the risk of additional rock falls in the region.

DLC carried out seismological research in southern Nares Strait in North-West Greenland as part of a German–Canadian geoscience cruise (Fig. 1, **P**) and continued the *GLATIS* and *NEAT* projects including the monitoring of 11 temporary broad band seismological earthquake stations located throughout Greenland (Fig. 1, **Q**).

GEUS and higher education

The Survey, together with DLC, plays an active role in earth science university education with GEUS staff scientists and research professors being involved in student training for higher degrees. Close co-operation with Danish and foreign universities and research institutions is fostered, and students involved in Greenland/North Atlantic-oriented projects often take part in Survey-sponsored field work. In 2001, dissertations on Greenland-related subjects were submitted to the Universities of Copenhagen and Aarhus, Denmark for degrees at M.Sc. (Danish cand.scient.) and Ph.D. levels (see list of publications concluding this volume).

Publications

A complete list of geoscientific publications on Greenland issued by the Survey is found in the *Catalogue of Greenland publications and data*, which is also available on the web (for web address, see below). A data directory specifying the range of data and services available at the Survey covers various databases, map, sample and drill-core archives, bibliographic and library facilities, including unpublished maps and reports from the Survey's own activities and those of industry. Indexes covering projects, authors and selected topics are included in the catalogue.

The main part of the Survey's Greenland publications is printed in three series: a peer-reviewed bulletin series (Geology of Greenland Survey Bulletin), a peer-reviewed map series (Geology of Denmark and Greenland Map Series) and an open-file report series in English or Danish (Danmarks og Grønlands Geologiske Undersøgelse Rapport) that is not subject to outside refereeing or central editing. During 2001, two bulletins and 23 reports relating to Greenland geoscience were released to the public (a small number of reports are classified). In addition, two geological map sheets in the national map sheet series were published as well as two special maps. The two bulletins published are multi-article volumes containing 33 papers; in half of these GEUS staff members are authors or co-authors. About 50 scientific papers on Greenland and surrounding seas were published in 2001 in external outlets. These international publications document the results of extensive GEUS field investigations and associated activities in Copenhagen, including those of DLC and research partners in surveys and geological institutes elsewhere in the world (see list of publications concluding this volume).

An important role of the Survey is to provide up-to-date geoscientific and legislatory information to the petroleum and mining industries. Hence two newsletters, the GHEXIS Newsletter and MINEX, launched over a decade ago, are published jointly by GEUS and BMP. One issue of GHEXIS and three issues of MINEX were published in 2001.

The demand for digital versions of geoscientific data is increasing rapidly, and the Survey is meeting this challenge by releasing geological information, maps and data on CD-ROM. Three CD-ROMs were issued in 2001. The GHEXIS and MINEX newsletters have been available on the GEUS and BMP websites for several years; however, two new sites were developed in 2001, GHEXIS Online and MINEX Online (for web addresses, see below). GHEXIS Online is fully developed and now provides information on licensing policy, geology, hydrocarbon potential, available data, and operational conditions in connection with the licensing round offshore West Greenland in 2002, in addition to the GHEXIS Newsletter. MINEX Online also provides information on licensing policy and operational conditions.

The Survey's publication web addresses are:
GEUS publications online service – www.geus.dk/publications/publ-uk.htm
Catalogue of Greenland publications – www.geus.dk/publications/cat-publ-greenland-uk.htm
GHEXIS Online – www.geus.dk/ghexis
MINEX Online – www.geus.dk/minex

Author's address

Geological Survey of Denmark and Greenland, Øster Voldgade 10, DK-1350 Copenhagen K, Denmark. E-mail: *ks@geus.dk*