

GEO ENeRGY

Promoting *R&D capability* in the service of European Industry

ENeRG welcomes collaboration with EUROGIF

Since its formation in May 1993, ENeRG has paid much attention to the innovation potential of small and medium sized enterprises in the upstream oil and gas business. In particular these SME's and other (large) companies in the service and supply sector represent a work force of up to 750,000 employees in the European Union. It is therefore surprising that this industry, until recently, had not organized itself into one entity for the promotion of their sector towards the European Commission and beyond.

Like ENeRG, which represents the independent R&D research Institutes and Universities, it was not until 1997 that a similar organization was created for the service and supply sector in the upstream oil and gas industry. The

European Oil & Gas Innovation Forum (EUROGIF) has since its start closely co-operated with ENeRG to achieve their joint objectives.

EUROGIF's mission is to represent the European hydrocarbon supply and service industry viz à viz European institutions and non-governmental organizations. The aim is to increase the competitiveness of the industry with particular emphasis on developing innovative high technology solutions for efficient, safe and clean exploitation of hydrocarbon

reserves. EUROGIF has participated in the development of the work programmes in FP5 relevant to the hydrocarbon industry. It also collaborates with Commission Directorates at managing the flow of RTD projects in line with the strategic objectives of these work programmes in order to secure the flow of high quality RTD programs and related funding. Moreover, EUROGIF fosters and crystallises pan-European partnerships with a special emphasis on SMEs in the European service and supply industry to optimise the

quality, efficiency and competitiveness of projects within the current 5th Framework programme.

A major challenge for EUROGIF is to represent the large number of 2650 companies, and identify their common interests. The Forum consists of:

- the core group (the board);
- service and supply association representatives;
- associate member representatives;
- Commission representatives.

The Forum meets twice a year in Brussels, where the permanent EUROGIF office is located. More information can be obtained from Gerhard Otto Krummacker, the office manager in Brussels on +32 2 333 1326. In the course of 1999 EUROGIF will have its own website.



IEA forms Expert Group on oil and gas technology

The International Energy Agency has formed a preliminary group of experts on oil and gas technology. Norway hosted the first meeting of member country representatives last year and at a recently held meeting at the IEA headquarters in Paris the Provisional Advisory Group initiated the process of

drafting the technical foundation upon which its further advisory work towards the IEA member states will be based. This will comprise a working paper reviewing the business needs of the upstream hydrocarbon exploration and production sector.

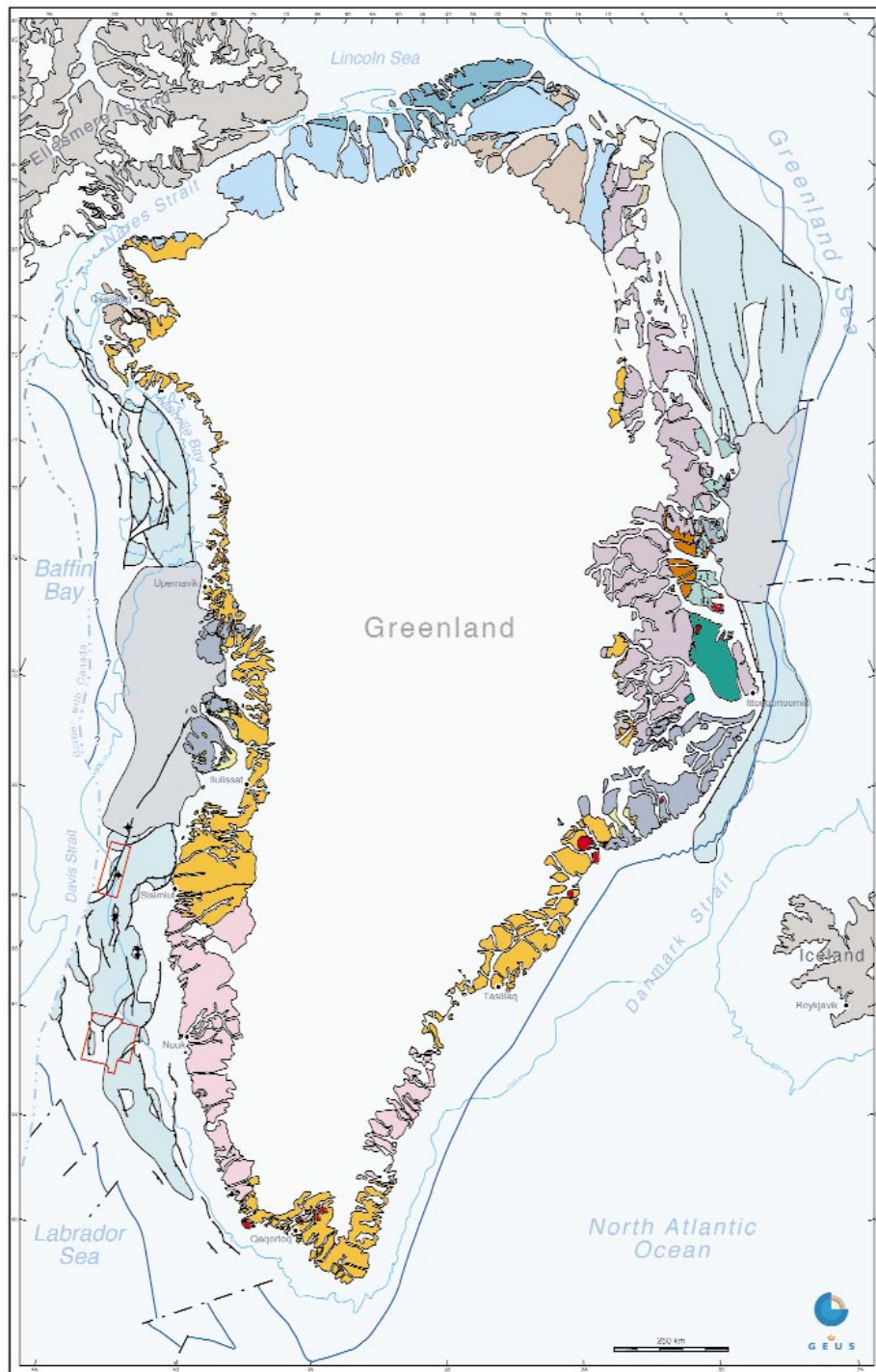
In addition, the Group will assess the scope for increased

collaboration with other organisations and entities. Ties have already been established with ENeRG, which has been active in the area of oil and gas RTD needs for several years.

The IEA was founded in 1974, in the wake of the first oil shock. Members include 24 states, predominantly OECD

countries, and the European Union as an observer. More information about the wide scope of other IEA activities can be found at: www.iea.org

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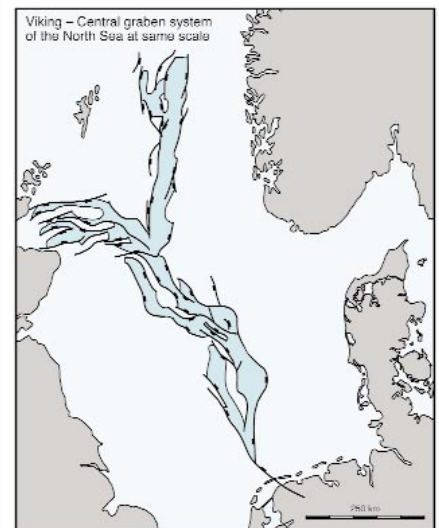


SEDIMENTARY BASINS OF GREENLAND

Geological Survey of Denmark and Greenland
1998

LEGEND

- Inland ice
- Lower Tertiary basalts
- Cretaceous–Lower Tertiary sediments of West Greenland (Nuussuaq Basin) and East Greenland (Kangerlussuaq Basin)
- Carboniferous–Lower Tertiary sediments of the Wandel Sea Basin of eastern North Greenland
- Carboniferous–Cretaceous sediments of North-East Greenland basins
- Carboniferous–Cretaceous sediments of the Jameson Land Basin in East Greenland
- Devonian Basin of North-East Greenland
- Shell
- Trough
- Middle–Upper Proterozoic sediments and volcanic rocks
- Caledonian orogenic belt
- Lower Proterozoic orogenic belts
- Archaean craton
- Intrusive complexes, Lower Tertiary in East Greenland, Middle Proterozoic in South Greenland
- Offshore basins with substantial thicknesses of sediments (>–3km)
- Offshore basins where deeper sedimentary successions concealed by Lower Tertiary basalts
- Landward limit of proven oceanic crust
- Extensional fault
- Compressional fault, thrust
- Transform fault
- Site of exploration well



Sedimentary basins of Greenland

Total area of sedimentary basins with petroleum prospectivity exceeds 350 000 km² (135 000 square miles). Total seismic data base c. 100 000 km, but coverage uneven. Only 5 ofshore wells and 1 onshore wells drilled, all in West Greenland. Large areas still untested.

Onshore basins

West Greenland basin (Cretaceous-Tertiary)

More than 6km Cretaceous-Tertiary sediments overlain to the west by Lower Tertiary basalts. Extensive oil impregnation in vesicular basalts. Wet gas in marine Upper Cretaceous. Source rocks not exposed. Fluvio-deltaic and slope turbidite sandstones provide potential reservoirs.

Jameson Land Basin, central East Greenland (Upper Palaeozoic-Mesozoic):

More than 16 km Devonian, Cretaceous syn- and post-rift sediments. High quality source rocks in Upper Carboniferous (lacustrine), Upper Permian (marine) and Lower Jurassic (lacustrine). Respective reservoirs are syn- rift fluvial Carboniferous sandstones, Upper Permian carbonate build-ups, and Lower Jurassic deltaic sandstones.

North-East Greenland rift basins (Upper Palaeozoic-Mesozoic):

Thick Devonian-Cretaceous syn-rift sediments. Lacustrine Upper Carboniferous, marine Upper Permian, and marine Upper Jurassic oil source rocks. Several good reservoir intervals. Exhausted palaeo-oil field in mid-Jurassic sandstone.

Franklinian Basin, North Greenland (Lower Palaeozoic):

Platform carbonates passing northwards into classic trough. Lower-Middle Cambrian and Lower Silurian marginal marine source rocks. Basal Cambrian sandstone and Silurian reef reservoirs. Extensive bitumen showings.

Offshore basins

Melville Bay basins:

Major grabens and half-grabens. More than 13 km of syn- and post-rift sediments of Cretaceous (?and earlier) to Recent age. Suggested source rocks in the Germanian, Turonian and Paleocene. Syn-rift sandstones likely to provide excellent reservoirs.

Southern West Greenland:

Rifted margin with passive margin cover; more than 8 km sediments of Early Cretaceous to Recent age. Suggested source rocks at base of Germanian/Turonian-Maastrichtian mudstone unit and also in Paleocene. Syn-rift deltaic and fan sandstones are main reservoir targets.

Central East Greenland:

South of 70°N, more than 4km of Tertiary sediments overlie Lower Tertiary basalts. North of 70°N, even thicker Tertiary successions unconformably overlie faulted and tilted Upper Palaeozoic-Mesozoic Sediments.

North-East Greenland shelf:

Aerimagnetic and regional seismic data show presence of large sedimentary basins; by analogy with adjacent onshore area and the west Norwegian shelf, prolific source rocks and several reservoir intervals of Late Palaeozoic and Mesozoic age are anticipated. On strike with major oil province of northern North Sea. Access extremely difficult.

NEW FRONTIER BASINS: EXPLORATION OPPORTUNITIES IN WEST GREENLAND

In the last few years there has been renewed interest in hydrocarbon exploration in West Greenland. The first ofshore well for more than 20 years will be drilled in year 2000 on one of the very spectacular structures in the Fylla area by a group of companies headed by Statoil.

Although the sedimentary basins of offshore southern and central West Greenland are larger than the entire Viking-Central Graben system of the North Sea, West Greenland is only one of many potentially petroliferous regions around Greenland (see Figure). Only six wells have been drilled, five of them in the 1970s and one in 1996. The total seismic coverage is only around 60,000 line-kms of 2-D data, and of these, 37,000 km are of mid-1970s vintage. Thus, the region is still under-explored.

Break-throughs in the 1990s occurred with the discovery in the Fylla area of very large structures containing Direct Hydrocarbon Indicators (DHI's) in the form of flat-spots. At nearly the same time, oil seeps were found in the Nuussuaq area farther north. Both discoveries have attracted the oil industry to a new era of exploration in West Greenland.

Previous history

Exploration originally started in areas of southern West Greenland in the early 1970s, and licences were awarded in 1975 to six groups headed by Amoco, Chevron, ARCO, Mobil, Total and Ultramar. A total of nearly 40,000 km of seismic data were acquired and five wells were drilled in 1976 and 1977. However, all wells were declared dry at that time and the industry left the region in late 1978.

A re-evaluation by the Geological Survey in the late 1980s and early 1990s showed that all of the previously drilled prospects were in some ways flawed. New regional studies also showed that the extent of continental crust – and thereby the boundary of prospective areas – was much further seaward than previously realized.

New seismic data with DHIs

In an attempt to attract the industry to look again at West Greenland, the authorities decided to fund new regional seismic surveys. During 1990–92, the Geological Survey acquired more than 6000 km of seismic data of offshore and HGS (now Western Geophysical) acquired additional speculative data.

A licensing round was initiated in 1992 for part of the basin, but no applications were received by the deadline in January 1993. Unfortunately, one of the Geological Survey's seismic lines that showed not only very large tilted fault blocks but also prominent DHIs in the form of flat spots, was acquired too late to be available to the industry in time for the deadline. This line was collected in the area that later became known as the Fylla Structural Complex.

In 1994, an open-door policy was introduced for both on- and offshore areas south of 70°30'N. Under this policy, the Authorities would accept applications for exploration licences at any time.

The Greenlandic-Danish state-owned company Nunaoil acquired speculative seismic data in the Fylla area in 1994. These data confirmed the existence of the flat spots found two years earlier, and allowed mapping of their extent. Considerable industry interest in the seismic data over the Fylla area was followed by the award of a license in late 1996 to a group of four companies: Statoil (operator), Phillips, DOPAS and Nunaoil (carried partner in the exploration phase).

Interpretation of the Geological Survey's seismic data over the whole basin has indicated other potentially prospective areas, and a new license, Sisimiut West, was granted in the summer of 1998 to the same group of companies with Phillips as operator. Additional seismic data were acquired in the summers of 1995–98 by the Geological Survey, Nunaoil, FugroGeotem and by the two licensing groups. The many new data show that there are a number of different play types in the basin. The most promising include tilted fault-blocks in a large area around the Fylla Structural Complex, compressional features in the Sisimiut West area, syn-tectonic fans along the Kangamiut ridge, and Paleogene sediments containing bright spots farther to the north.

Seepage onshore

New petroleum geological studies on the Cretaceous-Tertiary sediments on Nuussuaq were also started in the early 1990s. The main goal by the Geological Survey was to develop new models describing the distribution of potential source and reservoir rocks in the neighbouring ofshore basins. It was therefore very exciting when oil seepage was discovered in volcanic rocks overlying the

sediments. Oil seeps have now been found over an extensive area (at least 50 x 150 km) and geochemical studies have revealed five different oil types with source of Cretaceous and Paleogene age.

A small Canadian company, *grønArctic Energy Inc.*, was granted a license in May 1995. A ~3 km deep exploration well (GRO#3) was drilled in 1996 on southwestern Nuussuaq. The well was declared dry by the operator and, due to problems in raising finance for their later exploration commitments, *grønArctic* had to relinquish their license in early 1998.

Subsequent log-interpretation by the Geological Survey suggests that the upper, untested part of the well has high hydrocarbon saturations in thick sandstone units. These data (now released) together with recent information on structures, source rocks and oils make Nuussuaq an interesting exploration target. To ensure that interested companies will have time to evaluate the potential of the region, the authorities have decided to modify the open door policy for these onshore areas. Thus, all applications for licences received before 1 October 1999 will be treated simultaneously.

New licensing strategy

In July 1998, the administration of mineral and petroleum resources was transferred from the Danish Ministry of Environment and Energy to the Bureau of Minerals and Petroleum under the Government of Greenland in Nuuk. In order to stimulate petroleum exploration activities around Greenland, the Greenlandic and Danish governments decided to develop a new exploration strategy.

A working group consisting of members from the authorities is presently making recommendations on the best ways to stimulate exploration of the various regions on- and offshore Greenland. The work has included discussions with the seismic industry and exploration companies. Subsequent political considerations will take place in the near future and the new strategy is likely to be published in the summer of 1999.

For further information contact the Bureau of Minerals and Petroleum, att. Martin Sønderholm (mso@gh.gl) or the Geological Survey of Denmark and Greenland, att. Fleming G. Christiansen (fgo@geus.dk).

SLEIPNER CO₂ STORAGE STUDY WELL UNDERWAY

In 1996 deposition of CO₂ separated from natural gas production at the Norwegian Sleipner field was initiated. Storage takes place through a long horizontal well injecting the CO₂ into saltwater bearing sand layers at depths below 800 meters, well above the hydrocarbon reservoir. Annually, some 1 million tonnes of CO₂ is injected.

After a brief review study last year, a consortium of companies and research institutes, undertook an EU THERMIE Programme for the first phase of a ground-breaking project. The overall objectives of the Saline Aquifer CO₂ Storage (SACS) project are to:

- demonstrate modelling and monitoring techniques;
- verify safe injection and long term storage stability;
- facilitate transfer of experience to other areas and other applications.

Data and results of the work can be made available to interested parties for scientific uses. The first phase scheduled for completion this year focuses on reservoir modelling and geochemistry, while the second phase will include acquisition time-lapse seismic data.

Led by Statoil, the Sleipner field operator, the consortium also includes industry partners BP Amoco, Norsk Hydro, Exxon Mobil, Saga Petroleum and Vattenfall (major Swedish power company), as well as six research institutes from 5 European countries. This initiative also complements the IEA Greenhouse Gas R&D Programme which considers global activities within the field of CO₂ storage.

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EU 5TH FRAMEWORK PROGRAMME UPDATE

There has been much activity in the FP5 arena. With the call for proposals being made in March, later than we expected because of the EC Commissioner crisis, there has been plenty of activity by ENERG members in preparing proposals.

The response from Members with Preliminary Notices of Intent has been

disappointing and the anticipated level of interaction has not been achieved. There is probably a need to refocus on this issue at a future date.

The first call for proposals closed on the 15 June 1999 but the second call is open until 4 October 1999 and includes projects that address:

- the cost effective and more efficient exploration and production of hydrocarbons;
- deepwaters, marginal fields and new frontiers including the Arctic.

Further information is available on the EC's Cordis facility (www.cordis.lu/) and CMPT's website www.cmpt.com.

ENeRG Secretariat

Over the last six months work has concentrated on improving the contact database, assisting the finding of partners for proposals and distributing preliminary notices of intent, providing advice on the EU 5th Framework Programme and setting up the web site.

The following pages are now available on the ENeRG web site.

- About the ENeRG network
 - ENeRG News
 - Geo Energy Newsletters
 - Membership
 - ENeRG Contact Information
 - Secretariat Information
- Aims, objectives, etc
 - Partners for proposals
 - CMPT's Guide to the 5th Framework
 - Concise paper on oil and gas R&D for the 5FP
 - Newsletters 1 to 6 on line
 - First and Second Circle Members
 - President, Past President, Secretariat

For further information, the ENeRG web site is available on www.energnat.com. Alternatively, contact Jane Kennedy on j.kennedy@cmpt.com.

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