

GREENLAND

MINEX News

GREENLAND MINERAL EXPLORATION NEWSLETTER

Greenland MINEX News No. 14

March 1998

The Canada–Greenland geological link in focus again

new carbonate-hosted Zn-Pb-Ag occurrence

In earlier issues of *Greenland MINEX News* we have drawn attention to the close geological links between eastern Canada and Greenland, and the influence that mineral discoveries in Canada have had on mineral exploration in its lesser explored neighbour. Two geological provinces have been highlighted: the Precambrian shield flanking the Labrador Sea and farther north, the Proterozoic – Lower Palaeozoic Franklinian Basin that crosses the northern part of Nares Strait.

The Voisey's Bay nickel-copper-cobalt discovery in Labrador has led to Greenland's largest ever mineral exploration boom, but paradoxically with another commodity – diamonds – now at the centre of the play. The presence of base metal occurrences in the Canadian part of the Franklinian Basin, both in the carbonate platform and in the basinal clastic deposits to the north, stimulated prospecting by Nanisivik Mines Ltd and Platinova A/S in Greenland. The result was the discovery in 1993 of the Citronen Fjord zinc-lead-iron sulphide deposit in northernmost Greenland, some 500 km from the Canadian coast (see map). Last year this deposit was drilled for the 5th successive season.

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Platinova's Citronen Fjord deposit is situated in the starved basin sequence just north of the carbonate platform. While the deep-water rocks in the Greenland part of the basin have been subjected to regional

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commercial exploration, some areas of platform rocks, such as Washington Land, have not received the same interest. The Lower Palaeozoic platform carbonates in Canada are in some areas extensively mineralised, as for example around Cominco's Polaris zinc-lead deposit.

The 1997 field work

With this geological theme in mind, the Geological Survey undertook exploration reconnaissance in Washington Land in 1997. One target was to check a long-reported minor occurrence of sphalerite and galena on the

coast of Nares Strait within a Silurian carbonate build-up (see map); another target was the Cambro-Ordovician carbonate succession in the south and east. A new Zn-Pb-Ag mineralisation was discovered within the latter succession in eastern Washington Land.

The discovery

The Zn-Pb-Ag mineralisation has surface expression in surficial deposits as a dozen or so rusty-weathering patches forming a NE-SW-trending zone about 100 m wide and 2.4 km long. Mineralised dolomitic boulders with sphalerite, galena and pyrite were located in each of the patches. The 23 samples analysed confirmed the high zinc and lead values estimated in the field: the highest values are 25% Zn and 13% Pb, with a maximum value of 170 ppm Ag.

The mineralised dolomitic boulders are judged to be derived from a stratabound mineralisation seen in a 6-8 m thick zone of pervasive dolomitisation within a shallow-dipping Lower Ordovician evaporite-bearing formation. The mineralisation trend appears to be associated with a prominent WSW-ENE regional fault.

Hydrocarbon connection

A working model for the new Zn-Pb-Ag mineralisation is that hydrocarbons could have been involved in its formation. There is clear evidence for regional migration of hydrocarbons, especially in the Silurian reef sections where there are also minor sphalerite-galena-pyrite occurrences, including the long-known showing on the coast of Nares Strait.

Polaris in focus

Quoting from a recent report (cited here) "The decision to look for fault-related,

carbonate-hosted mineralisation in Washington Land arose from consideration of the geological setting of the Polaris deposit. Could similar mineralisation potentially have occurred in North Greenland?"

It is tempting now, much more than before, to answer this positively. The host rocks to the new Zn-Pb-Ag occurrence are not the direct stratigraphic equivalent of the Thumb Mountain Formation at Polaris, but it is known also in the Canadian Arctic Islands that mineralisation is present at several stratigraphic levels.

Apart from the comparable carbonate sequences, other similarities between the two regions are: 1) evaporites – a potential source of sulphate ions – occur in the Ordovician sequence, 2) extensive dolomitisation of the host rocks, 3) traces of bitumen associated with the sulphides, and 4) regional faults that could have played a role in the migration of metal-bearing fluids.

Follow-up geophysics

A follow-up geophysical programme is to be flown over Washington Land this summer; see elsewhere in this newsletter.

Available from the Geological Survey of Denmark and Greenland

Report from 1998: A new carbonate-hosted Zn-Pb-Ag occurrence in Washington Land, western North Greenland by S.M. Jensen & H.K. Schönwandt. Danmarks og Grønlands Geologiske Undersøgelse Rapport 1998/3, 31 pp.
Price: 120 DKK.

Map from 1983: Geological map of Washington Land and Daugaard-Jensen Land. 1:250 000 by H. F. Jepsen, N. Henriksen, J. M. Hurst, & J. S. Peel. Geological Survey of Greenland, 1983.
Price: 50 DKK.

Geological & exploration briefs

West Greenland diamond review and update

winter-spring drilling programme in progress

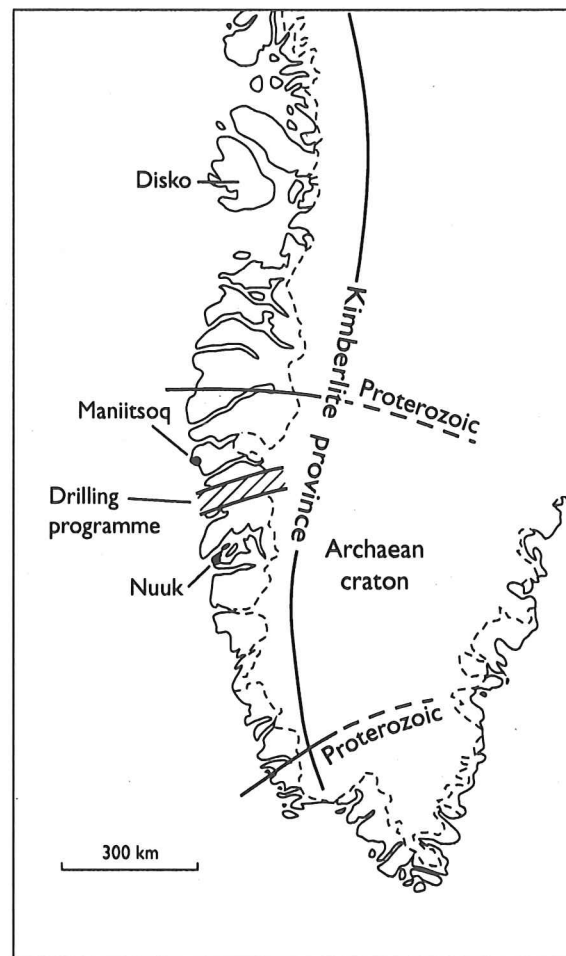
Kimberlite intrusions were discovered in Greenland in the late 1960s; the first microdiamonds were recovered from stream sediments in the early 1970s. By the 1980s a kimberlite province had been defined in West Greenland with over 500 occurrences of kimberlite, lamproite and ultramafic lamprophyres – mainly dykes and sheets, with two small pipes. The Lac de Gras discovery in Canada in 1991 caused a revival of interest in Greenland diamonds, an interest that has turned into a boom of commercial activity triggered by the following three discoveries,

1. diamond indicator minerals in streams emanating from lakes,
2. microdiamonds in boulders at a geophysically pre-defined lake target, and
3. macrodiamonds from *in situ* kimberlite.

As described in the last issue of this newsletter (November 1997) Greenland is now part of the global diamond chase, with most of the Archaean block of West Greenland covered by exploration licences.

Although the history of Greenland diamonds goes back 25 years, exploration is still in its early stages characterised by airborne geophysical surveys and follow-up field sampling of kimberlite for diamond analysis and surficial deposits for indicator minerals. Definition of drill targets has only just begun. The first drilling of geophysical targets over frozen lakes began last year; a winter-spring drilling programme in another region is in progress (see below).

Since our last report, Lexam Explorations Inc, in a joint venture with Platinova A/S, has



announced that a bulk kimberlite sample (792 kg) from a dyke has yielded 41 diamonds, of which all but three are white and transparent, and with 16 classified as macrodiamonds (>0.5 mm on at least one side). The sampled dyke is within the Archaean block of the Sukkertoppen/Maniitsoq area, north of the capital Nuuk and from an area that was subjected to a detailed geophysical survey last year. This survey

defined a number of geophysical anomalies that suggest possible pipe structures, and thus drill targets.

The drilling of some 10 pipe targets is being carried out by Lexam during the period February to April. The targets are all within a zone that is defined by high concentrations of diamond indicator minerals, including

abundant pyrope garnets of the G-10 class, the presence of diamond-bearing kimberlite dykes and boulders, and circular geophysical anomalies that are coincident with lakes and depressions.

Comparisons to Lac de Gras remain in vogue; expectations remain high.

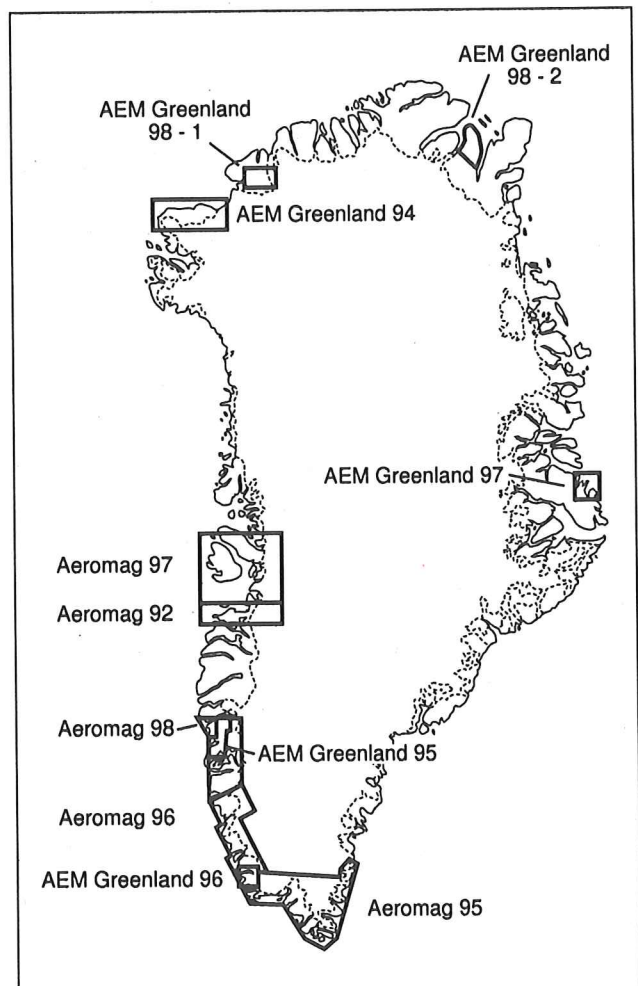
Airborne geophysical surveys in 1998

in focus: diamonds and base metals in West and North Greenland

In Greenland, compared to the rest of North America, the use of regional airborne geophysical surveys as a basic tool in mineral exploration came rather late. In the last decade, government funding from Denmark and Greenland has enabled aeromagnetic and electromagnetic surveys to be carried out in selected areas on all parts of the country (Aeromag and AEM Greenland projects; see map). Participation from industry in these projects has been solicited and some exploration companies joined the surveys. In addition, several companies have undertaken surveys of a similar type, in some cases in adjacent areas to the government-organised activities.

Aeromag and AEM Greenland: status

The present status of the two projects is 300 000 line km of high resolution aeromagnetic data and 74 000 line km of multi-parameter geophysical data collected in the years 1992-1997. The surveys were carried out by commercial geophysical companies under contract to the Geological Survey (GGU, from 1995 GEUS), and data management and distribution have been organised from the Survey's headquarters in Copenhagen. As reported in the last issue of *Greenland MINEX News*, data from the 1997 surveys, flown in central East and central West Greenland, are available for inspection in Copenhagen from



1st March: presentation is also planned at the Prospectors and Developers Association annual convention in Toronto, Canada, the same month.

1998 surveys

In 1998, three areas are focused for geophysical surveys financed by the Government of Greenland (Bureau of Minerals and Petroleum - BMP) and managed by GEUS: an aeromagnetic survey over Archaean rocks in central West Greenland will be flown by Sander Geophysics Ltd, while two electromagnetic/magnetic surveys over homoclinal Proterozoic and Lower Palaeozoic sequences in central North Greenland will be flown by Geoterrex-Digheem Ltd (see map).

Aeromag 1998

The existing regional aeromagnetic coverage of West Greenland will be extended northwards this year to the Sukkertoppen ice cap (see map). The work will be carried out using the airport facilities at Nuuk. The location of this survey is a natural consequence of the present diamond boom in West Greenland (see *West Greenland diamond review and update* in this newsletter) in which the Archaean rocks of the Sukkertoppen/Maniitsoq area play a prominent role, and in which exploration for other commodities is also in progress. The aim is 70 000 line km, flown at approximately 300 m altitude with a gentle drape over varied topography. Parameters will be similar to previous aeromagnetic surveys with 500 m between flight lines and 5 km between control lines.

AEM Greenland 1998

The two areas chosen for GEOTEM/magnetic surveys are 600 km apart in western and eastern North Greenland (see map). Logistics for the western operation (Washington Land) will probably be based at the Canadian base Alert in northern Ellesmere Island, with access to the eastern area (J. C. Christensen Land) through Station Nord.

Washington Land

A new carbonate-hosted Zn-Pb-Ag mineralisation in Lower Palaeozoic carbonate rocks is reported in the leading article of this newsletter. The main showing is within superficial deposits and the immediate region is poorly exposed. Little mineral exploration has been carried out in Washington Land and high-resolution geophysical data are totally lacking.

The planned work is about 9 500 line km GEOTEM transient electromagnetic and magnetic survey with an aircraft altitude of about 120 m. Line separation will be 400 m, with 4 km between control lines.

J. C. Christensen Land

The geology of J. C. Christensen Land, central North Greenland, is dominated by three homoclinal undeformed successions: Mesoproterozoic sandstones and mafic volcanic rocks are overlain on the north-east by Neoproterozoic and Lower Palaeozoic sedimentary successions. Reports in the early 1970s by the Canadian company Greenarctic Consortium of copper sulphides in the volcanics (Zig-Zag Dal Formation), were followed by Geological Survey mapping during the course of which copper showings were located in both Proterozoic successions. A geochemical drainage survey and a heavy mineral sampling programme have also outlined a number of anomalous copper subareas.

Geological reconnaissance in 1995 in J. C. Christensen Land has demonstrated several sandstone-hosted copper showings within a 800 × 60 m area. Analyses are promising, for example one composite grab sample has returned 3% copper and 105 ppm silver. Chalcocite and bornite occur on bedding planes and as disseminations, veinlets and fracture coatings. The showings are related to a regional zone of NW-SE and E-W-trending faults. Spectral processing of Landsat TM data has delineated a pattern of iron-oxide alterations along the faults that in places coincides with geochemical Cu anomalies.

It is this combination of direct and indirect observations that lends optimism for a regional distribution of Cu mineralisation within the area of the geophysical survey. In the wider context, regional correlations with Cu mineralisation within Proterozoic successions in Arctic Canada come to mind, for example, the basalts of the Coppermine River area and the sediments of the Amundsen Embayment. The chosen GEOTEM/magnetics survey is aimed to collect 4 500 line km with similar parameters as those for the Washington Land survey.

For information on the airborne geophysical surveys Aeromag and AEM Greenland (1992-1998), please contact the Department of Economic Geology, Geological Survey of Denmark and Greenland, at the address on the front of the newsletter, or the Government of Greenland, Bureau of Minerals and Petroleum, Box 1015, DK-3900 Nuuk, Greenland. Phone (299) 323000; Fax (299) 324302.

National mineral hunt

Ujarassiorit = "go and look for rocks"

results now available to industry

Ujarassiorit is the name of a national mineral hunt funded by the Government of Greenland. It was initiated in 1989 with the aim of involving the population actively in some aspects of exploration work and at the same time create a positive attitude towards the mining industry. The government puts up prize money each year to stimulate the collection of geological samples that on face value seem interesting from an economic point of view. The competition is open to all permanent residents of the country. Samples are sent, with documentation about collection and geographical location, to the Bureau of Minerals and Petroleum (BMP; previously the Minerals Office) in the capital Nuuk.

The broader perspective behind the competition is the government's policy to define the economic mineral potential of the country. An important facet of this is to create public awareness of this potential; through *Ujarassiorit* the public has direct participation in mineral exploration.

1000 samples per year

The annual haul is about 1000 samples and from these the most promising are selected for



chemical analysis, usually about 30%. An important aspect is that many of the samples come from poorly known areas in which there has been little mineral exploration. Apart from the economic mineral aspect, such samples have provided important geological knowledge about these areas.

Awards

The total prize money in 1997 was 76 000 DKK (11 000 US\$). The first prize of 25 000 DKK went to the sender of a sample of massive sulphides from the Palaeoproterozoic Julianehåb Batholith of South Greenland, a sample that returned 3.4% Cu, 0.12% Mo, 35 ppm Ag and 0.1 ppm Au. The next two prizes were awarded for anomalous samples with arsenic-gold and copper-zinc parageneses from Palaeoproterozoic rock suites in South-West and central West Greenland respectively.

Reports

The practical aspects of *Ujarassiorit* were taken care of from 1989 to 1995 by Nunaoil

A/S; results were compiled as reports in Danish which were available on request. Since 1996 the Government of Greenland has organised *Ujarassiorit* and it is now planned to release annual reports in English giving the results of each year's collecting. The first report describing the programme in general terms and providing the results of the 1996 campaign is cited below.

Available from the Geological Survey of Denmark and Greenland

Ujarassiorit 1996. Public minerals hunt programme in Greenland by P. Erfurt and T. Tukiainen. Danmarks og Grønlands Geologiske Undersøgelse Rapport **1997/88**, 8 pp + appendices. Price: 155 DKK.

Thematic and standard map sheets in digital form

available from the Geological Survey in 1998

The Geological Survey of Denmark and Greenland has been working towards the release of standard geoscientific maps and associated data in digital format. Receiving strong financial support from the Government of Greenland, several projects have been initiated, including the digitalisation of the thematic map series and the 1: 500 000 Geological map of Greenland (bedrock) series. The first products of these two series will be available this spring.

Thematic maps

Four issues of thematic maps (*Thematic Map Series Grønlands Geologiske Undersøgelse*) were released between 1990 and 1996 covering areas of South, West and North-West Greenland. The first CD-package will be based on the most recent compilations of maps, viz. 51 maps from Inglefield Land, North-West Greenland, that were released in

printed form in 1996. The CD-package, that is arranged for Arcview and Arcinfo users, will contain topographical, Landsat TM, geological, geophysical and geochemical maps, as well as data pertaining to mineral occurrences, exploration licenses and rock/stream sediment geochemistry.

Standard geological map sheets

The Geological map of Greenland at 1: 500 000 consists of 14 sheets; 11 of these maps are available in printed form. These maps have been scanned and will be released in CD-ROM format with a special viewer. Where a map description is available, an Acrobat Reader version will be supplied. The maps and accompanying explanatory information can be viewed on-screen without the use of additional software. The scanned maps are not vectorised but they can be exported as images and used in GIS systems.

Regulatory & licensing information

Mineral Resources Administration to be transferred to the Greenland Home Rule Government from July 1, 1998

On January 8, 1998 the Danish Government and the Greenland Home Rule Government signed an agreement on the transfer of the administration regarding mineral resources in Greenland to the Greenland Home Rule Government.

The transfer of the administration is planned to be effected as of July 1, 1998. The transfer will cover both minerals and hydrocarbons. The transfer will imply that the Mineral Resources Administration for Greenland (MRA), which is an agency under the Danish Ministry for Environment and Energy, will be abolished and a new Bureau of Minerals and Petroleum will be established under the Greenland Home Rule Government to handle the present tasks of MRA.

The transfer implies that the political responsibility for the administration, including the granting of licences under the Mineral Resources Act for Greenland, which presently lies with the Danish Minister of Environment and Energy, after the transfer will rest with the Greenland Home Rule Government. Thus, the basic principle of the transfer is that the roles for the two parties within the Mineral Resources System for Greenland will be reversed.

Apart from the transfer of the administration the Mineral Resources System for Greenland will remain unchanged. This includes:

- a. the joint decision-making competence of the two parties implying that all fundamental

decisions, including the granting of licences under the Mineral Resources Act, are made jointly by the two parties;

- b. the Danish/Greenland Joint Committee on Mineral Resources in Greenland; and
- c. the division between the two parties of public revenues from mineral resources activities in Greenland.

Likewise, the contents of licences granted under the Mineral Resources Act will remain unchanged.

Implementation of the transfer will require the passing by the Danish Parliament of the necessary amendments to the Mineral Resources Act for Greenland.

The Bill on the transfer was endorsed by the Greenland Parliament in February and is expected to be processed by the Danish Parliament during the spring of 1998.

The texts of the agreement (of January 8, 1998) and the Bill (of February 1998) are available in Danish from MRA. Unofficial English translations of the texts are being prepared by MRA and will be available later.

Until the transfer has been effected all tasks in relation to applicants and licensees will continue to be handled by MRA, and all inquiries regarding licences under the Mineral Resources Act are to be made to MRA as usual.

MRA meets the exploration industry on the Web

a new home page presenting the Greenland licence database at www.mra.dk or www.rfg.dk

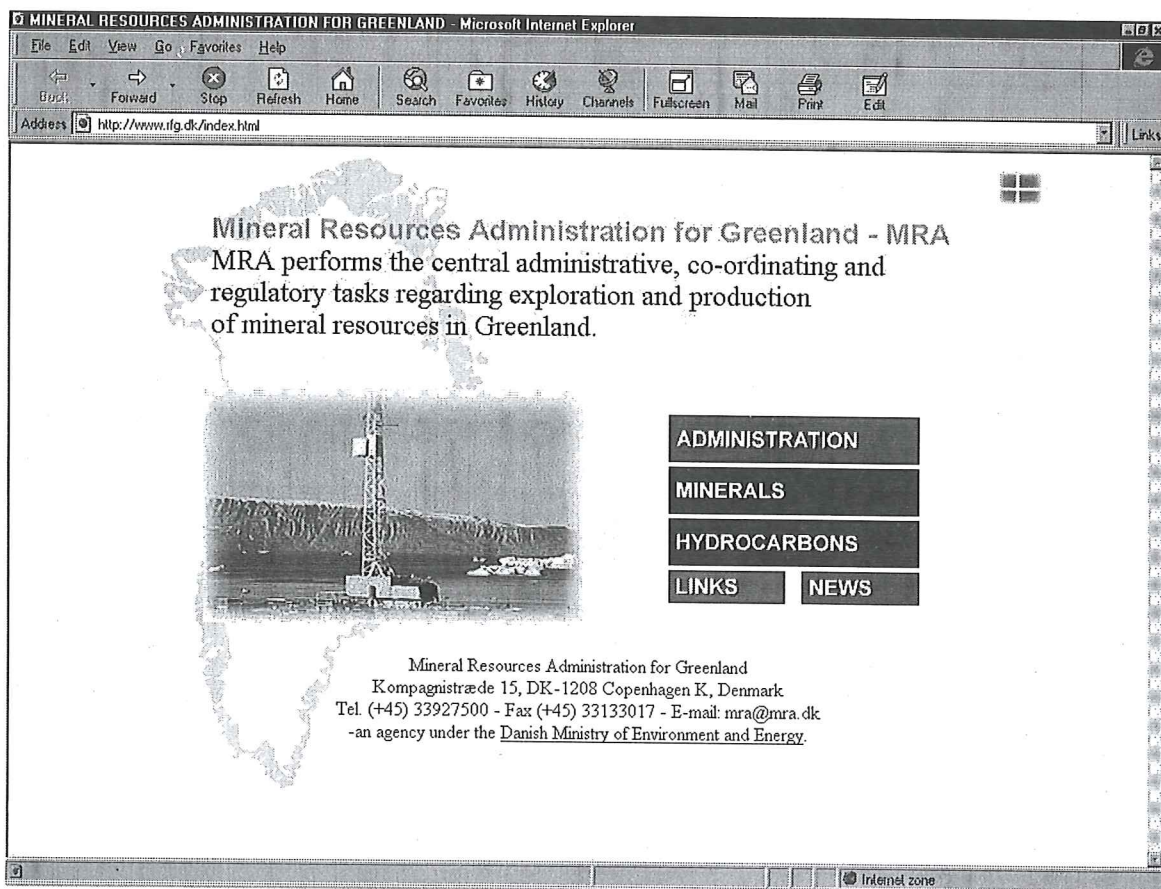
On January 20, 1998, MRA introduced its home page which includes access to MRA's licence database. The database contains detailed information on mineral and petroleum licences in Greenland including information on licence areas defined by co-ordinates and indicated on maps. The licence database includes:

- Licences in force;
- Applications being processed

The licence database is easily accessed from the main headings MINERALS or HYDROCARBONS through the "Map of Greenland" or the "Database Inquiry" boxes.

The home page also provides information on licence terms and application procedures, as well as exploration history, newsletters, news releases, annual reports and publications.

This service on www.mra.dk provides you with direct access to relevant information on mineral resources in Greenland.



Exclusive licences as of March 1, 1998

Map on page 12

Index Map 1

21/95 Major General Resources	210 km ²
22/95 Major General Resources	214 km ²
23/95 Softrock Minerals Ltd	63 km ²
24/96 Texas Energy Corporation N.L	49 km ²
04/97 Nunaoil A/S	365 km ²
10/97 Tertiary Gold Limited	441 km ²
11/97 Highwood Resources Ltd.	15 km ²
16/97 Minerals Development Int'l A/S	53 km ²
29/97 Goldcorp Inc.	10 km ²
31/97 Quadrant Resources Pty. Ltd.	105 km ²

Index Map 2

18/94 Valhalla Mining Ltd.	168 km ²
16/95 Platinova A/S	112 km ²
25/95 New Millenium Resources N.L.	127 km ²
08/96 Quadrant Resource Pty. Ltd.	206 km ²
14/96 Nunaoil A/S	330 km ²
28/96 Platinova A/S	5310 km ²

Index Map 3

08/94 Nunaoil A/S	168 km ²
09/94 Nunaoil A/S	81 km ²
14/94 Rio Tinto Mining and Exploration Inc.	71 km ²
02/95 Nunaoil A/S	326 km ²
04/95 Platinova A/S	3500 km ²
10/95 Ujarak Minerals Aps.	5 km ²
15/95 Platinova A/S	1522 km ²
02/96 Ujarak Minerals ApS	77 km ²
11/96 Quadrant Resources Pty. Ltd	521 km ²
20/96 Quadrant Resources Pty. Ltd	399 km ²
21/96 Quadrant Resources Pty. Ltd	170 km ²
29/96 Platinova A/S	11900 km ²
36/96 Quadrant Resources Pty. Ltd	169 km ²
13/97 Nunaoil A/S	83 km ²
32/97 Ujarak Minerals Aps.	14 km ²

Index Map 4

12/96 Quadrant Resources Pty. Ltd.	381 km ²
13/96 Quadrant Resources Pty. Ltd.	289 km ²
19/96 Quadrant Resources Pty. Ltd.	219 km ²
25/96 Texas Energy Corporation N.L	104 km ²
31/96 Fjordland Minerals Ltd.	196 km ²
32/96 Fjordland Minerals Ltd	519 km ²
37/96 Quadrant Resources Pty. Ltd.	170 km ²
38/96 Quadrant Resources Pty. Ltd.	241 km ²
01/97 Softrock Minerals Ltd.	294 km ²
17/97 Quadrant Resources Pty. Ltd.	2675 km ²
18/97 Quadrant Resources Pty. Ltd.	2048 km ²
19/97 Quadrant Resources Pty. Ltd.	2335 km ²
20/97 Quadrant Resources Pty. Ltd.	3525 km ²

Index Map 5

03/95 Nunaoil A/S	317 km ²
21/97 Quadrant Resources Pty. Ltd.	2075 km ²
26/97 Quadrant Resources Pty. Ltd.	385 km ²

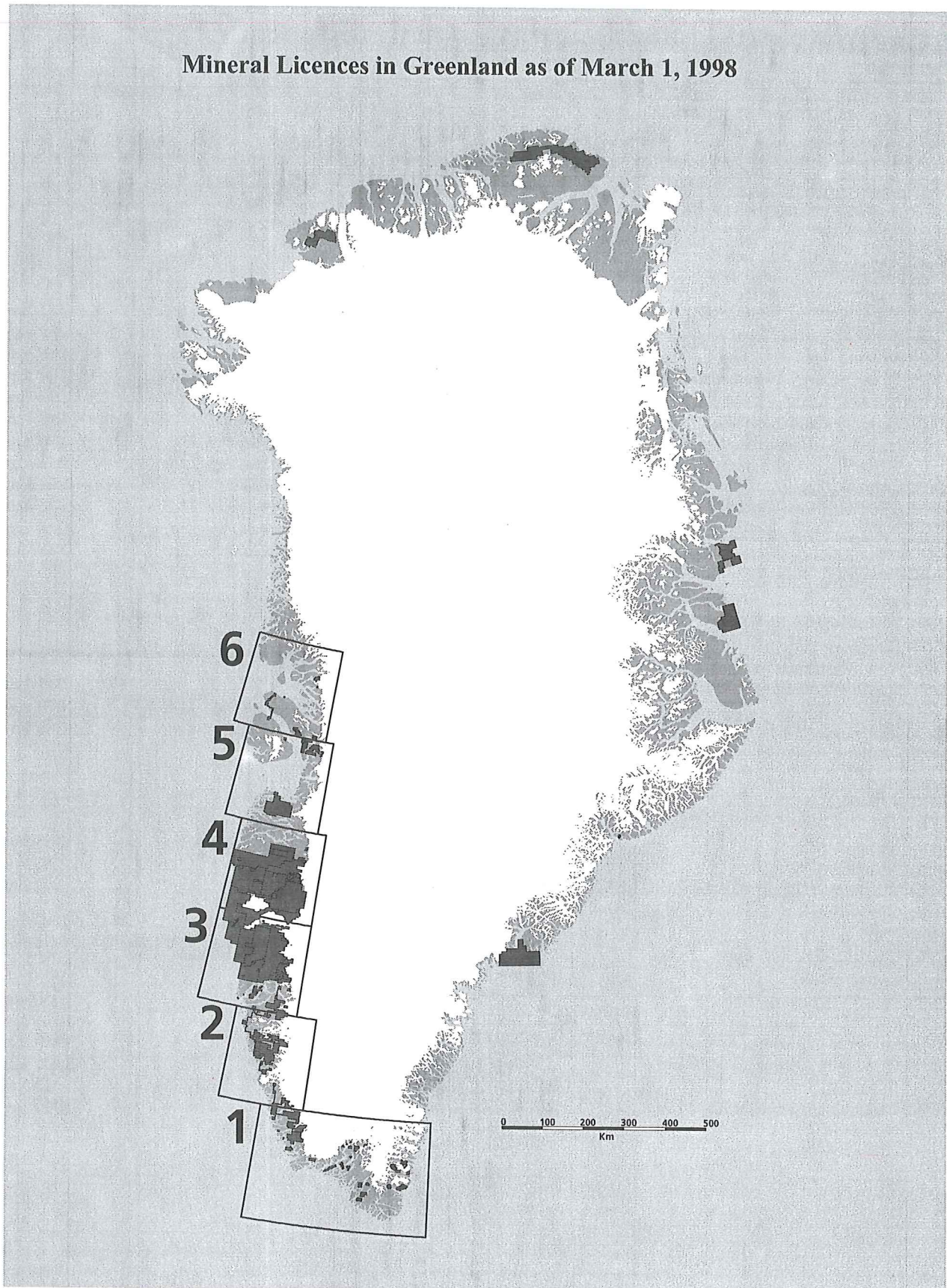
Index Map 6

15/97 Falconbridge Greenland A/S	338 km ²
28/97 Platinova A/S	14 km ²
30/97 Platinova A/S	110 km ²

North and East Greenland

05/95 Platinova A/S	6 km ²
03/96 Tertiary Gold Ltd.	1011 km ²
06/96 Platinova A/S	5010 km ²
15/96 Nunaoil A/S	2100 km ²
14/97 Platinova A/S	29 km ²
27/97 Inco Ltd.	1017 km ²

Mineral Licences in Greenland as of March 1, 1998



Licence information

Applications under processing

Several applications for new licences and amendments to licences are under processing covering a total of approximately 10.000 km².

Amendments to existing exploration licences

The areas of the following licences were reduced, and the new areas of December 31, 1997 are as follows:

08/94 Nunaoil A/S	168 km ²
09/94 Nunaoil A/S	81 km ²
03/95 Nunaoil A/S	317 km ²
04/95 Platinova A/S	3500 km ²
15/95 Platinova A/S	1522 km ²
16/95 Platinova A/S	112 km ²
21/95 Major General Resources Ltd.	210 km ²
22/95 Major General Resources Ltd.	214 km ²
23/95 Softrock Minerals Ltd.	63 km ²
03/96 Tertiary Gold Ltd.	1011 km ²
08/96 Quadrant Resources Ltd.	206 km ²
14/96 Nunaoil A/S	330 km ²
24/96 Texas Energy Corporation N.L.	49 km ²
28/96 Platinova A/S	5310 km ²

32/96 Fjordland Minerals Ltd.	519 km ²
11/97 Highwood Resources Ltd.	15 km ²
14/97 Platinova A/S	29 km ²

Terminated licences

The following exploration and prospecting licences were terminated December 31, 1997:

01/93 Nunaoil A/S
03/93 The Municipality of Tasiilaq
05/93 BHP Minerals Ltd.
06/93 BHP Minerals Ltd.
09/93 Quadrant Resources Ltd.
15/93 Cominco Ltd.
14/95 Platinova A/S
24/95 Softrock Minerals Ltd.
26/95 Platinova A/S
09/96 Quadrant Resources Ltd.
10/96 Quadrant Resources Ltd.
16/96 Inco Ltd.
18/96 Quadrant Resources Ltd.
22/96 Quadrant Resources Ltd.
23/96 Quadrant Resources Ltd.
30/96 Fjordland Minerals Ltd.
33/96 Fjordland Minerals Ltd.
34/96 Fjordland Minerals Ltd.
35/96 Fjordland Minerals Ltd.
39/96 Quadrant Resources Ltd.

