

GREENLAND MINEX News

GREENLAND MINERAL EXPLORATION NEWSLETTER

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A new national geological survey

reorganisation and address changes

Readers of MINEX should be aware of two address changes made since the last issue. Current addresses for Greenland geoscientific data (GEUS), as well as for legislative and licensing information (MRA), are given at the bottom of this page.

These changes are the result of ministerial reorganisation late in 1994 (reported on in MINEX No. 6, February 1995) and the consequent merger of the Geological Survey of Greenland (GGU) with the much larger Geological Survey of Denmark (DGU), to form a single national geological survey. This new organisation - The Geological Survey of Denmark and Greenland (GEUS) - will be based in north-west Copenhagen, and the movement from the Øster Voldgade complex to the new address will be completed by the autumn.

The name GEUS is derived from the Danish name for a geological survey, namely **GE**ologiske **U**nder**S**øgelse, and this is now the official abbreviation for the new geological survey that in Danish is called Danmarks og Grønlands Geologiske Undersøgelse.

Another change stemming from the reorganisation is the permanent posting in Greenland of GEUS staff. The first geologist started duties in Nuuk, the capital, last

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summer with residence at the Minerals Office of the Government of Greenland.

The reorganisation, and the new national geological survey that will deal with a wide range of geoscientific disciplines, should strengthen Greenland work.

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Geological & exploration briefs

Voisey Bay spin-off activity in Greenland

*search for eastern counterparts gets underway
Diamond Fields Resources joins the play*

The discovery by Diamond Fields Resources Inc. and Archaean Resources Ltd of the large nickel deposit at Voisey's Bay in Labrador in 1994 has had an amazing effect on mineral exploration activity, not only in Canada but in other countries. At least 30 million tonnes of nickel ore at 3.7% grade await exploitation in coastal Labrador. It seems that the total mining costs can be covered by the proceeds from the secondary products copper and cobalt; in effect, the nickel can be treated as extra dividend! That this world-class deposit was found by prospectors looking for diamonds adds to the romanticism of the discovery.

The Voisey Bay find has led to frenzied pegging activity throughout eastern Labrador and this has had a spin-off effect in Greenland as companies look farther afield for corresponding geology and similar mineralisation. The sharp rise in interest in economic potential of western Greenland is seen by the flurry of applications for exploration licences by commercial companies, mostly Canadian-based. One of these, perhaps not surprisingly, is Diamond Fields Resources. As of mid-January this year, nineteen exclusive licences covering some 18 000 km² have been (or are in the process of being) granted in western Greenland in geological provinces that are the most likely to have connections with Labrador (for details of licences, see MRA's section "Regulatory & licensing information").

The ground claimed so far – from Disko Bugt in the north, where Diamond Fields Resources have one of their interests, to the south-east coast of Greenland with Satellite

Holding Ltd – spans 10 degrees of latitude and a stretch of coastline much longer than that of Labrador.

Greenland counterparts: the puzzle

The jackpot questions of course are directed to the whereabouts of potential counterparts. Are there any real candidates in western Greenland? What was the relative position of Labrador and Greenland in the mid-Proterozoic, at the time of formation of the Voisey Bay mineralisation?

Both these questions are difficult to answer and in fact outline a traditional conflict in mineral exploration strategy of how much emphasis to place on empirical versus conceptual evidence. The fact that present exploration for a Voisey Bay equivalent in Greenland spans Precambrian complexes of several ages, indicates that there are important considerations besides the ages of mineralisation and host rocks.

Thus the first question about likely candidates really depends on the nature of the criteria used for the comparison, while assessments from palaeogeography depend on which plate tectonic model is favoured – and here, there is no consensus in the literature.

Using revised seismic reflection data from the Labrador Sea and a sea-floor spreading model that started in the Tertiary at chron 27 time, there remains some 500 km between the Labrador and Greenland coasts in pre-drift reconstructions. The correlation of geological

provinces between Greenland and Canada in northern Baffin Bay, indicates that Greenland did not drift northwards hundreds of kilometres in relation to Canada. Thus, the southern part of the Greenland coast (60° to 62°N) is more likely to be a palaeogeographical counterpart to Voisey Bay than areas farther north.

Geological criteria: the choice

Age

The Voisey Bay deposit is of mid-Proterozoic age, and hosted in a layered gabbro-anorthosite complex of the Nain Plutonic Suite (1350-1290 Ma). The main discovery is in an east-west trending troctolitic dyke. The Greenland counterpart to the multiphase Nain plutonics is the Gardar igneous province of South Greenland (1350-1150 Ma) that outcrops between 60°30' and 61°30'N, thus matching the pre-drift fit. The Gardar province is characterised by alkaline magmatism and rift tectonics. Gabbro-anorthosite rocks are only known from large xenoliths in east-west gabbroic dykes in the central part of the main rift but these have been regarded as indicating appreciable gabbro-anorthositic material at depth.

Ni-Cu-Co mineralisation is not known from the Gardar; the most notable deposit from the province is the now exploited cryolite that was mined for over 100 years. But south of the Gardar rift, a suite of layered hornblende peridotite and gabbro dykes with concentrations of sulphides and platinoids, has attracted recent attention and some of the intrusions are as young as 1335 Ma.

Host rock lithology

Directing attention north of the Gardar rift presents another range of Voisey Bay targets: plutonic suites containing gabbro-anorthosites occur within the Archaean and early Proterozoic provinces throughout western Greenland. For example, between Fiskenæsset

in the south (65°N) and Smithson Bjerger in the Thule district in the north (77°30'N), five main regions containing basic igneous complexes are in focus (see map). Some of these, for example the Fiskenæsset anorthosite complex, with its chromite, have known mineral potential.

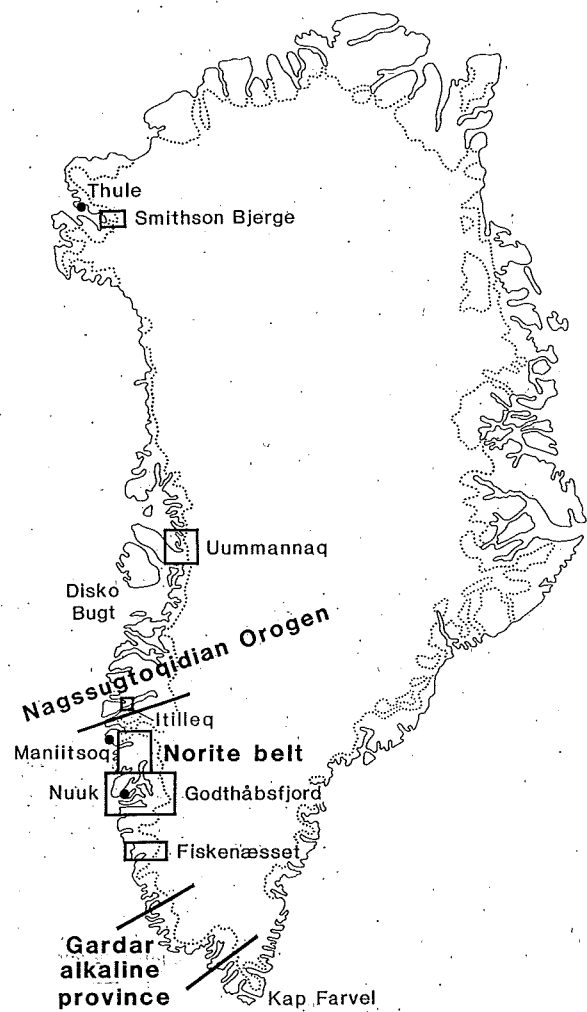


Plate tectonic setting

The basic intrusions hosting the Voisey Bay deposit occur in reworked Archaean gneisses close to the supposed 1800 Ma collision zone between the Nain and Churchill provinces within the early Proterozoic Torngat orogen. This tectonic setting is regarded as the

important control for the mineralisation with the deep suture giving access to a mantle source. The Nagssugtoqidian orogen outcropping north of 66°N is regarded as a possible continuation of the Torngat orogen of Labrador. The southern boundary zone of this orogen is marked by variably reworked Archaean rocks in which the Itilleq plutonic complex is situated (see map). Investigations in 1994 provide new information on the regional tectonics of the Nagssugtoqidian orogen, including the discovery of two provinces of Proterozoic igneous activity, that also include gabbroic rocks.

Ni-Cu mineralisation and geochemistry

Geochemical maps based on stream sediment and water sampling are available for western Greenland between Kap Farvel (60°N) and Ummannaq (70°30'N) – reported on in MINEX, No. 4, February 1994. Samples in which both Ni and Cu have concentrations above 100 ppm (background at 50 ppm) are scattered along the coast, with some of the largest anomalies concentrated in the region of the southern boundary of the Nagssugtoqidian orogen around 66°N, and in its southern foreland. It is noteworthy that the best documented Ni-Cu-sulphide occurrences in Greenland occur in this region within the so-called “norite belt” of the Maniitsoq district (see map).

Final comments

The conclusion, as might be expected, is that there is no short cut to the discovery of a Voisey Bay equivalent. Although Labrador and western Greenland were part of the same plate in the Proterozoic, the search for a corresponding deposit in Greenland, must necessarily be based on a number of approaches involving both observation and theory. It is only through comprehensive multi-disciplinary regional studies, that the correlation between the different provinces of Greenland and Canada can be elucidated and

thereby used in refined metallogenic modelling.

Further reading

Evolution of the Palaeoproterozoic Nagssugtoqidian orogen: DLC investigations in West Greenland by M. Marker, F. Mengel, J. van Gool & field party, 1995. *Rapp. Grønlands geol. Unders.* **165**, 100-105.

Large scale geochemical variation in the Precambrian of West and South Greenland by A. Steenfelt, 1994. *Rapp. Grønlands geol. Unders.* **160**, 41-44.

New evidence on the structure of Labrador Sea/Greenland continental margin by J. A. Chalmers, 1991. *Journal Geological Society, London* **148**, 899-908.

A new anorthosite/gabbro complex at Nūgssuaq, central West Greenland by A. A. Garde & A. Steenfelt, 1989. *Rapp. Grønlands geol. Unders.* **145**, 16-20.

Mid-Proterozoic alkaline magmatism in southern Greenland: the Gardar province by B. G. J. Upton & C. H. Emeleus, 1987. In J. G. Fitton & B. G. J. Upton (ed.), *Alkaline Igneous Rocks, Geological Society Special Publication* **30**, 449-471.

Occurrences of anorthositic rocks in the reworked Archaean basement in the Umanak area, West Greenland by M. C. Andersen & T. C. R. Pulvertaft, 1986. *Rapp. Grønlands geol. Unders.* **129**, 18 pp.

Stratigraphy and structure of Fiskenæsset Complex, southern West Greenland by J. S. Myers, 1985. *Bull. Grønlands geol. Unders.* **150**, 72 pp.

Precambrian gneisses and intrusive anorthosite of Smithson Bjerger, Thule district, North-West Greenland by A. P. Nutman, 1984. *Rapp. Grønlands geol. Unders.* **119**, 31 pp.

Noritic rocks and associated nickel-copper-sulphide occurrences in Sukkertoppen district, West Greenland by K. Secher, 1983. *Rapp. Grønlands geol. Unders.* **115**, 30-34.

Nares Strait and the drift of Greenland: a conflict in plate tectonics by P. R. Dawes & J. W. Kerr (ed.), 1982. *Meddelelser om Grønland Geoscience* **8**, 392 pp.

Composition and classification of chromite in the Fiskenæsset anorthosite complex by M. Ghisler, 1976. *Rapp. Grønlands geol. Unders.* **73**, 61-66.

Anorthosite xenoliths and plagioclase megacrysts in Precambrian intrusions in South Greenland by D. Bridgwater & W. T. Harry, 1968. *Bull. Grønlands geol. Unders.* **77**, 243 pp.

Airborne geophysical surveys

*release of data in March 1996
plans for AEM and AEROMAG surveys 1996*

As reported previously in MINEX (February and March 1995 issues), two major, fixed-wing airborne geophysical surveys were to be carried out in Greenland in 1995, both managed by the Geological Survey of Denmark and Greenland. Phase two of a planned 5-year airborne magnetic and electromagnetic survey programme (Project AEM Greenland 1994-98) was flown in the Maniitsoq-Nuuk region and an extensive magnetic survey was flown over South Greenland (Project AEROMAG 1995) (see map).

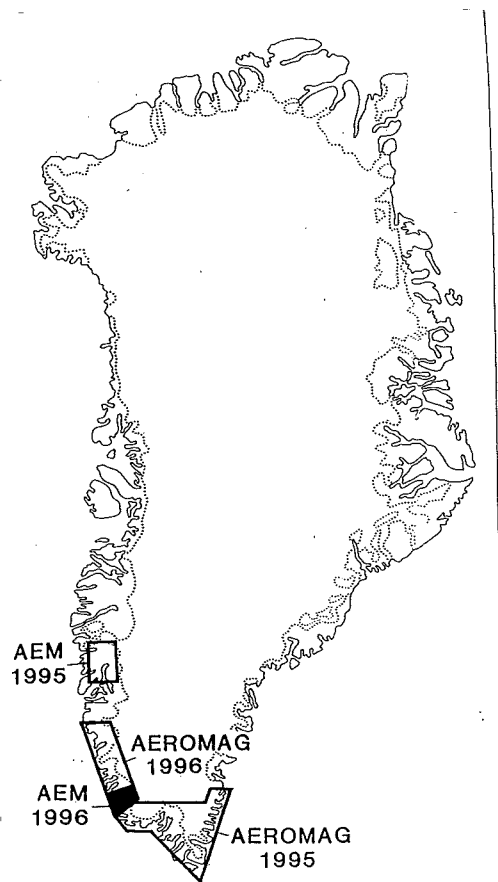
Project AEM 1995 totals approximately 20 000 line km on a survey grid of 200/400 m × 4 km, and an aircraft terrain clearance altitude of 120 m. Project AEROMAG 1995 comprises some 90 000 line km on a 500 m × 5 km grid and at an altitude of 300 m. Both surveys cover regions of Precambrian crystalline rocks. The AEM survey covers the northern part of the Archaean craton that contains important plutonic complexes, including the so-called "norite belt" that is known for its Ni-Cu sulphide mineralisation, while the AEROMAG survey covers the early Proterozoic Ketilidian mobile belt with its contact to Archaean rocks to the north. The Ketilidian is known for its anomalous gold values and widespread supracrustal rocks. The magnetic data, that covers both the south-west and south-east coasts, link up the regional geology across the southern tip of Greenland.

Data from both surveys will be released and available for viewing in Copenhagen on 1st March, 1996 and subsequently in Toronto at the annual convention and trade show of the Prospectors and Developers Association of Canada, between 10th and 13th March. All orders for digital data, maps and Open File reports should be directed to GEUS; further information about the release of the data or

about other aspects of the airborne geophysical programmes, can be obtained by contacting Bob Stemp or Leif Thorning at GEUS's Copenhagen address.

Plans are well advanced for the 1996 phase of both the AEM and AEROMAG projects that will cover the southern part of the Archaean craton of western Greenland (see map). The region includes a number of important supracrustal belts; the blocks making up the AEM survey area cover both Archaean and early Proterozoic belts

Licensing information and a map showing the blocks that make up the AEM 1996 survey area are given on page 10.



Regulatory & licensing information

Exclusive licences

status

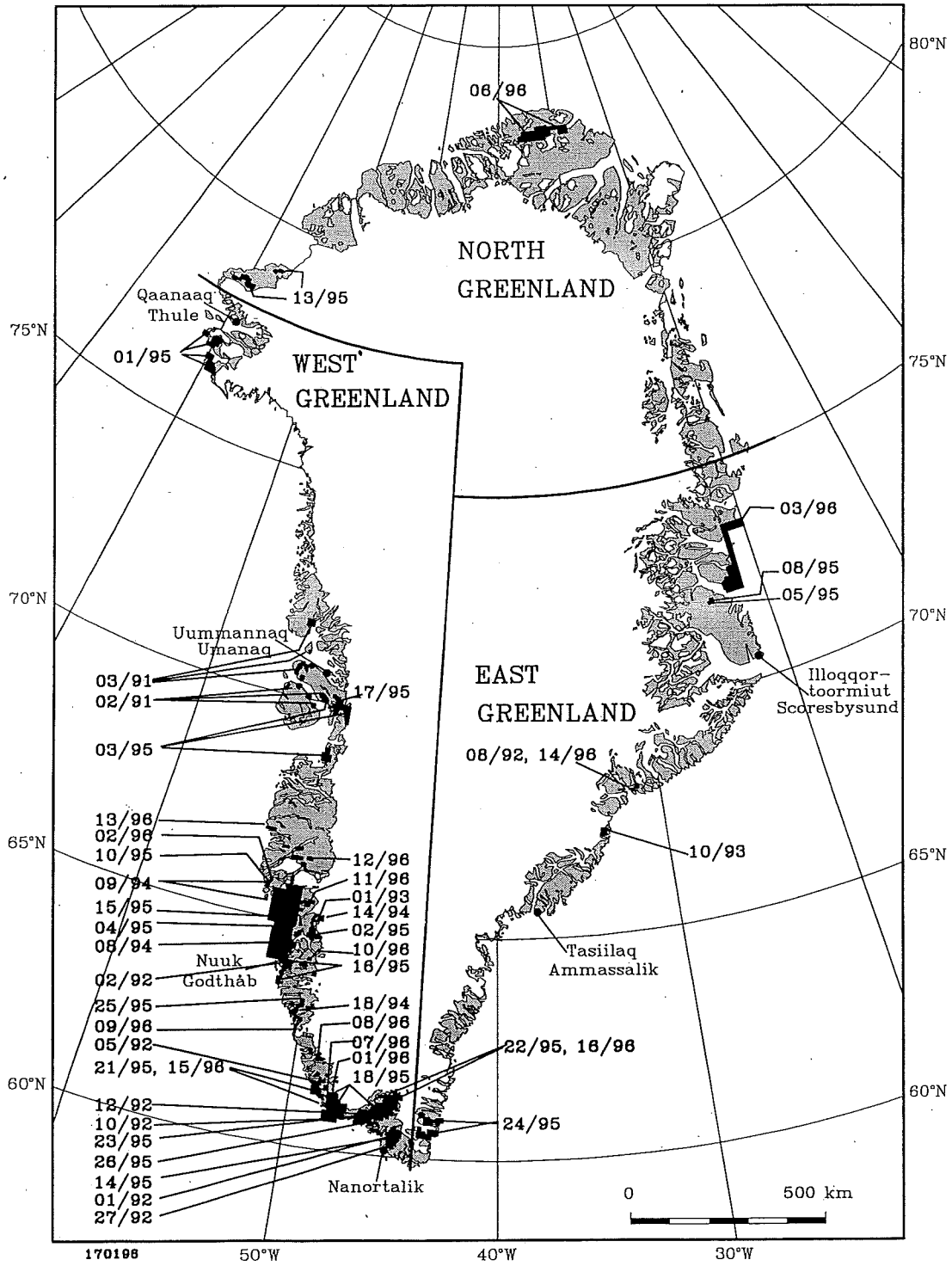
Exclusive licences location map page 7

Licences	Area	Licences	Area
02/91: Falconbridge Greenland A/S	345 km ²	05/95: Platinova A/S	6 km ²
03/91: Falconbridge Greenland A/S	671 km ²	08/95: Platinova A/S	104 km ²
01/92: Nunaoil A/S	376 km ²	10/95: Ujarak Minerals ApS	5 km ²
02/92: Nunaoil A/S	83 km ²	13/95: Nunaoil A/S	684 km ²
05/92: Nunaoil A/S	175 km ²	14/95: Platinova A/S	402 km ²
08/92: Platinova A/S	29 km ²	15/95: Platinova A/S	3,390 km ²
10/92: Highwood Resources Ltd.	34 km ²	16/95: Platinova A/S	510 km ²
12/92: Mineral Development International A/S	58 km ²	17/95: Diamond Fields Resources Inc.	296 km ²
27/92: Nunaoil A/S	232 km ²	18/95: Diamond Fields Resources Inc.	2,245 km ²
01/93: Nunaoil A/S	178 km ²	21/95: Quadrant Resources Pty. Ltd.	904 km ²
10/93: Quadrant Resources Pty. Ltd.	26 km ²	22/95: Quadrant Resources Pty. Ltd.	583 km ²
08/94: Nunaoil A/S	316 km ²	23/95: Softrock Petroleums Ltd.	349 km ²
09/94: Nunaoil A/S	181 km ²	24/95: Softrock Petroleums Ltd.	1,102 km ²
14/94: RTZ Mining and Exploration Limited	71 km ²	25/95: Satellite Holdings Limited	193 km ²
18/94: Valhalla Mining Limited	168 km ²	26/95: Platinova A/S	291 km ²
01/95: Nunaoil A/S	1,201 km ²	01/96: Diamond Fields Resources Inc.	777 km ²
02/95: Nunaoil A/S	326 km ²	02/96: Ujarak Minerals ApS	77 km ²
03/95: Nunaoil A/S	1,332 km ²	03/96: Tertiary Gold Limited	1,288 km ²
04/95: Cominco Resources International Ltd.	4,332 km ²		

Licences under processing (u.p).

Licences	Area	Licences	Area
06/96: Platinova A/S	1,929 km ²	12/96: Not to be identified until the granting	291 km ²
07/96: Ivittuut Minerals A/S	5 km ²	13/96: Not to be identified until the granting	258 km ²
08/96: Not to be identified until the granting	383 km ²	14/96: Not to be identified until the granting	59 km ²
09/96: Not to be identified until the granting	153 km ²	15/96: Not to be identified until the granting	148 km ²
10/96: Not to be identified until the granting	167 km ²	16/96: Not to be identified until the granting	162 km ²
11/96: Not to be identified until the granting	441 km ²		

Exclusive licences



New licences

Since June 30, 1995 the following new exploration licences (exclusive) have been granted or are in the process of being granted:

- Licence no. 01/96 to Diamond Fields Resources Inc. for an area at Kobberminebugt in South-West Greenland (777 km²).
- Licence no. 02/96 to Ujarak Minerals ApS for an area at Evighedsfjorden north of Maniitsoq in West Greenland (77 km²).
- Licence no. 03/96 to Tertiary Gold Limited for an area at Trail Island in Central East Greenland (1,288 km²).
- Licence no. 06/96 to Platinova A/S for 2 subareas at Frederick E. Hyde Fiord in North-East Greenland (1,929 km²). Licence in continuation of Licence no. 07/93.
- Licence no. 07/96 to Ivittuut Minerals A/S for an area at Ivittuut in South-West Greenland (5 km²). Licence in continuation of licence no. 11/92.

Surrendered licences

The following exploration licences have been surrendered or have expired:

- Licence no. 09/92 at Kap Irminger in East Greenland.
- Licence no. 15/92 at Karrat Fiord in West Greenland.
- Licence no. 16/93 at Frederick E. Hyde Fiord in North Greenland.
- Licence no. 19/93 at Kronprins Christian Land in North-East Greenland.
- Licence no. 12/94 at Karrat Isfiord in West Greenland.
- Licence no. 17/94 at Keltie Bay in North Greenland.
- Licence no. 11/95 at Inglefield Land in North-West Greenland.

Amendments of existing exploration licences

By relinquishment the following exploration licence areas were reduced at the end of 1995:

- Licence no. 10/93 at Kruise Fiord was reduced from 216 km² to 26 km².

New Application Procedures for Mineral Licences

As of January 1, 1996 new Application Procedures for Mineral Licences in Greenland have been adopted by the Greenland Government and the Danish Minister for Environment and Energy.

The new procedures attach more weight to the date when a correct application has been received by MRA than the former procedures. Thus the concept of a Registered Date of Application is introduced and a batch processing of applications will be used.

The new procedures are indicated in chapters A and B in MRA's publication "Application Procedures and Standard Terms for Exploration and Prospecting Licences for Minerals in Greenland" (of January 1996) which has replaced the former publication "Principles and Procedures for the granting of Prospecting Licences and Exploration Licences for Minerals in Greenland.

The licence texts and Standard Terms (of November 25, 1992) are unchanged.

The main components of the new procedures are directed at applications for (exclusive) exploration licences and may be summarized as follows:

- a. A Registered Date of Application is defined as the date when a correct application is received by MRA. A correct application is further defined in the text.
- b. Batch processing of applications for exploration licences will be used. Each batch of applications will consist of the applications registered within either the first half of the month or the last half of the month. All applications within one application batch are processed by the political authorities prior to initiation of the processing of applications in the next application batch.
- c. An application cannot be registered if it
 - comprises areas which are covered by existing licences or by applications in former application batches. Information on these areas is available from MRA, however without indication of the identity of applicants.
- d. A competing application is defined as an application in an application batch in which the licence area applied for overlaps another licence area applied for within the same application batch.
- e. At the processing of an application the authorities will in particular attach weight to:
 - the technical and financial capabilities of the applicant;
 - the authorities' assessment of the applicant's former activities, if any, in Greenland under exploration and prospecting licences.
- f. At the processing of competing applications the authorities will in addition in particular attach weight to:
 - the applicant's previous experiences from activities in Greenland under exploration and prospecting licences, if any;
 - possible previous field work carried out by the applicant under a prospecting licence within the licence area applied for;
 - possible offers by the applicant with respect to training and employment of Greenland labour in field work in the specific exploration project;
 - the registered date of application within an application batch.

(continued next page)

- g. Applications which are received in the period from July 1 to August 31 shall be part of one application batch, but will not be processed by MRA within this period.
- h. Moderate application fees are introduced. In case of the licence applied for being

granted the application fee will be deducted from the existing general fee at the granting of the licence. In case of the licence applied for not being granted or the application being withdrawn the application fee will not be refunded.

AEM Greenland 1996 Programme

The Government of Greenland has announced that the survey area of the AEM Greenland 1996 Program has been chosen as an area in South-West Greenland. The areas within which the survey is planned are indicated on the map. A helicopter borne magnetic and electromagnetic survey is planned to be carried out mid 1996. The AEM Greenland 1994-98 program is carried out by the Geological Survey of Denmark and Greenland.

The area is open for applications, however it cannot be expected that one exploration licence will be granted for the entire survey area.

