DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 2009/72

Nordmine Archives: Part 2. Overview of heavy mineral concentrates and stream sediment samples from Nordisk Mineselskab A/S, including microscopic observations

Bjørn Thomassen

(1 DVD included)

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1. Abstract

After the Blyklippen lead-zinc deposit at Mestersvig was mined out between 1956 and 1962, Nordisk Mineselskab A/S (Nordmine) explored for new deposits in East Greenland between 70° and 74°30'N lat. Geochemical exploration played an important role and in the period 1968–83, a large number of drainage samples were collected, described and analysed, the data being stored in a digital database. After the company's closure in 1991, the Nordmine Archives, including all samples, were stored at the Geological Survey of Greenland, now GEUS.

In the regional exploration, heavy mineral concentrates produced by panning of active stream sediment constituted the most used sample type whereas follow-up work in local areas mainly relied on stream sediment samples representing raw silt from active stream sediments. Most samples were submitted to multi-element analysis. In the laboratory, the heavy mineral concentrates were split into magnetic fractions, scheelite grains were counted under UV light and some samples were investigated microscopically.

Drainage sample material in the Nordmine Archives is stored in the basement of the GEUS building (Øster Voldgade complex) in 73 plastic boxes. In 2009, stocktaking estimated that the material comprised 3,700 heavy mineral concentrates and 1,100 stream sediment samples. They are available for further investigations.

The present report gives an overview of the Nordmine drainage samples including some microscopic descriptions, and presents the results of the stocktaking in four tables on a DVD.

2. Introduction

Nordisk Mineselskab A/S (Northern Mining Company Ltd. or Nordmine), was established in 1952 to investigate and mine the Blyklippen lead-zinc deposit at Mestersvig, central East Greenland. As no Greenland mining law existed at that time, the company was granted the rights by a special law for mineral exploration and mining for 50 years in a *c.* 100,000 km^2 concession area in East Greenland between 70° and 74°30'N lat. Geologically, the region is dominated by the north–south-trending Caledonian fold belt and coast-parallel rift basins with Late Palaeozoic and Mesozoic sediments, as well as Palaeogene igneous rocks (Figure 1, Henriksen *et al.* 2000).

Simultaneously with mining at Blyklippen 1956–1962, summer exploration was performed in the concession area. After 1958, the work concentrated on a major molybdenum occurrence at Malmbjerg, some 25 km south of Blyklippen, and up to 1962 comprehensive investigations in various joint ventures were carried out. However, feasibility studies showed that the indicated resource of 120 million tons with 0.25% MoS_2 was not profitable given the molybdenum price of the time, and it was decided to resume the regional mineral exploration while waiting for a better molybdenum market price. Renewed exploration was carried out in the period 1968–1983 and a large number of new and diverse mineral occurrences were found and investigated. However, the company did not succeed in bringing any of these into production. In 1984, mineral exploration was abandoned and effort was concentrated in a joint venture exploring for hydrocarbons in Jameson Land to the south. This ceased in 1990 without positive results and in the following year the company was liquidated.

During the exploration, a large amount of economic-geological information was collected from this remote part of Greenland and this was documented for each year in company reports. Many of these are in German, as much of the exploration personnel came from the Technical University of Leoben, Austria. Furthermore, the exploration data from 1968–83 were stored in a digital database. A review of the activities and results was published by Harpøth *et al*. in 1986.

After the liquidation, the Nordmine geological archives containing reports, maps, rock- and sediment samples and a copy of the digital Nordmine Database were stored at the Geological Survey of Greenland (GGU), now GEUS. The exploration reports have been made available for the public through the DODEX web facility (www.GEUS.DK/DODEX) and the digital Nordmine Database has recently been published (Thomassen & Tukiainen 2009). This report presents a stocktaking of drainage samples together with mineralogical descriptions of a part of the heavy mineral concentrates.

The report was prepared on contract to the exploration company Avannaa Resources Ltd., Copenhagen.

3. Nordmine drainage samples

The main geochemical exploration method used in the period 1968–83 was collecting of drainage samples from active stream systems. In the regional exploration, collection of heavy mineral concentrates was the most used technique and the whole of central East Greenland is covered with relatively systematically collected heavy mineral concentrates. For follow-up work in local areas, this was supplemented with sampling of stream sediment, soil, moraine and scree. Most of the samples were submitted to multi-element analysis, see Thomassen and Tukiainen (2009).

1. Heavy mineral concentrates (pan samples)
The panned heavy mineral concentrates or pan samples are prefixed W, stemming from the German "Washprobe". The samples were prepared in the field by panning of the fine fraction of 5 l sediments after wet sewing at 0.5 mm (*c*. 35 mesh) and then placed in a plastic bag. The main medium was active stream sediments (prefix W) but also active moraines (prefix WM) and scree fines (prefix WS) were panned.

The handling of the heavy mineral concentrates is illustrated in Figure 2. Note that the split for analysis was collected before magnetic separation. After splitting with a hand magnet into magnetic (mainly magnetite), faintly magnetic (mainly ilmenite) and non-magnetic (most sulphides, among others) fractions, many samples were further separated according to their magnetic susceptibility on a Frantz separator into mineral fractions. Most of the 1974 and 1976 samples were investigated under the microscope. Furthermore, the number of scheelite grains in the non-magnetic fraction was counted under UV light in the laboratory and the number of grains in the original 5 l sample was calculated. An example of an anomaly map based on scheelite grains is shown in Figure 3.

2. Sediment samples
These represent *c.* 500 g raw samples of various sediments stored in paper bags. The present investigation only includes stream sediment samples (prefixed S) representing silt samples from first- and second-order streams. Sample medias not included in this investigation are soils (prefixed SO), moraines (prefixed SM) and screes (prefixed SS). In the laboratory, the sediment samples were dry screened at 80 mesh (*c.* 0.1 mm) and a split of the fine fraction send for analysis. Most samples were just analysed for copper, lead and zinc.

The drainage sample data were used to produce various statistical parameters and diagrams, and geochemical maps in order to outline geochemical anomalies which constituted follow-up targets for the company's exploration work. Some of these data are stored as prints and maps in the Nordmine Archives, others have been published, e.g. Conradsen *et al.* (1976), Hintsteiner (1977), Hallenstein *et al.* (1981), Clausen & Harpøth (1983), Harpøth *et al.* (1986) and Thomassen (1990). Unfortunately, most database outputs were produced in the period 1983–84, i.e. after the mineral exploration had ceased. Examples of geochemical maps are shown in Figures 4 and 5. Sample locality maps with modern topography have been presented by Thomassen and Tukiainen (2009).

4. Microscopic investigations of heavy mineral concentrates

About 543 heavy mineral concentrates collected in 1974 and 1976 were investigated under a binocular microscope by Professor O.M. Friedrich, Leoben. This work is documented in the enclosed report entitled “Microscopic investigations of panned heavy mineral concentrates from central East Greenland” (in German). Detailed investigations of a few samples are also reported on. A standard description comprises:

- Sample number (without year-prefix).
- Locality.
- Collector’s initials.
- Raw sample amount, e.g. 5/0.4 meaning 5 l raw sand and gravel screened at 0.5 mm to 0.4 l fine fraction material.
- Weights of concentrate and split for analysis, and of three to four magnetic fractions produced with a hand magnet: strongly magnetic, (moderately magnetic), weakly magnetic and non-magnetic.
- Descriptions of the minerals observed in each fraction.

5. Stocktaking of Nordmine drainage samples

The drainage samples presently stored in the Nordmine Archives in the basement of the GEUS building (Øster Voldgade complex) comprise heavy mineral concentrates from panning of stream sediments and stream sediment samples representing the silt fraction of raw drainage sediments. The samples are stored in 73 plastic boxes marked W-samples and S-samples. Each box contains a variable number of samples in plastic- and paper-bags, plastic canisters and glass tubes.

In 2009, it was decided to undertake stocktaking aimed at determining the amount of drainage sample material available with a view to future re-analysis. A number of boxes with unsorted return pulps from various laboratories have not been included, and neither have boxes with SO, SM and SS samples (soil, moraine and scree samples, respectively).

During the stocktaking, each plastic box was numbered and its contents registered on a spread sheet. The two first digits in the seven-digit NM sample number indicate sampling year. Where these two digits are missing, it is indicated by # #. Various types of sub-numbers appear in the tables. They may indicate sequential sampling in the same stream or fractions of the same sample produced in the laboratory. The results of the stocktaking are presented in Tables 1–4 on the enclosed DVD.

1. Heavy mineral concentrates

Table 1 shows the original stocktaking results from the 56 boxes marked W-samples and Table 2 shows the same data sorted after sample number. The tables contain information about box number and whether or not sample material is present, whether the sample has been split in 1–4 fractions with hand magnet and whether it has been further split in a larger amount of fractions with the Frantz magnetic separator. Finally, the existence of powder, probably laboratory surplus material, is indicated.

The stocktaking resulted in a total of 3,597 samples or, if all sub-numbers are included, 3,886 samples. Some 29 of the samples are very small and for 81 of the sample numbers the packing is empty, i.e. no material is left. This means that an estimated 3,700 heavy mineral concentrates are available for further investigations.

2. Stream sediment samples

Table 3 shows the original stocktaking results from the 17 boxes marked S-samples and Table 4 shows the same data sorted after sample number. The tables contain information about box number and whether or not sample material is present.

The stocktaking resulted in a total of 1,101 sample numbers or, if all sub-numbers and doubles are included, 2,124 samples. However it appears that 954 samples situated in separate boxes have been counted twice – they probably represent the +80 mesh and -80 mesh fractions of the same sample. Furthermore, for 66 of the sample numbers the packing is empty, i.e. no material is left. Thus an estimated 1,100 stream sediment samples are available for further investigations.

6. Acknowledgments

Astrid Appel and Tiffanie Renton are thanked for their energetic work with the stocktaking in the “Bombekælder” at GEUS headquarters, and Peter Dawes is thanked for correcting my English.

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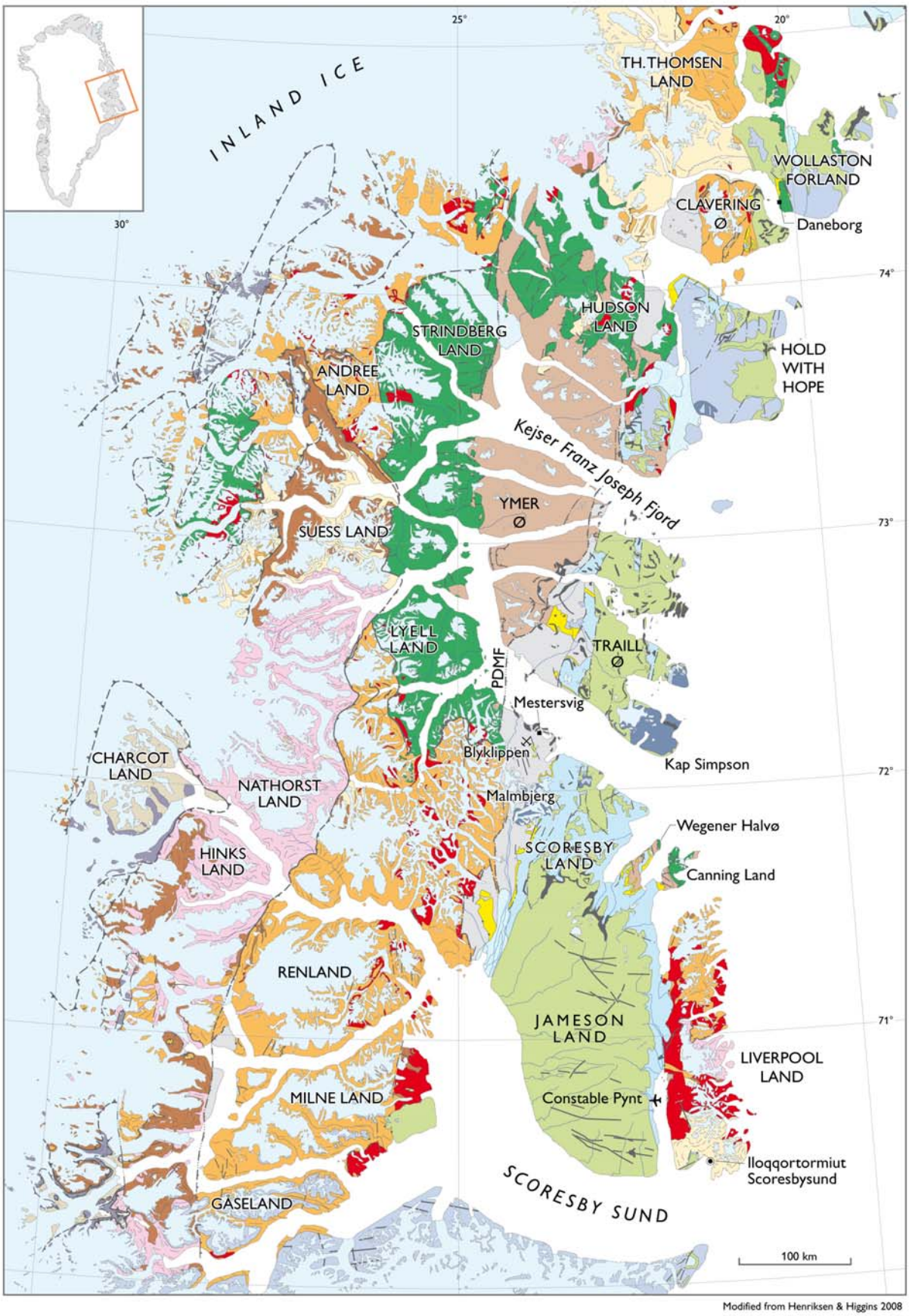

Figure 1. *Geological map of central East Greenland. Simplified from Henriksen & Higgins (2008).*

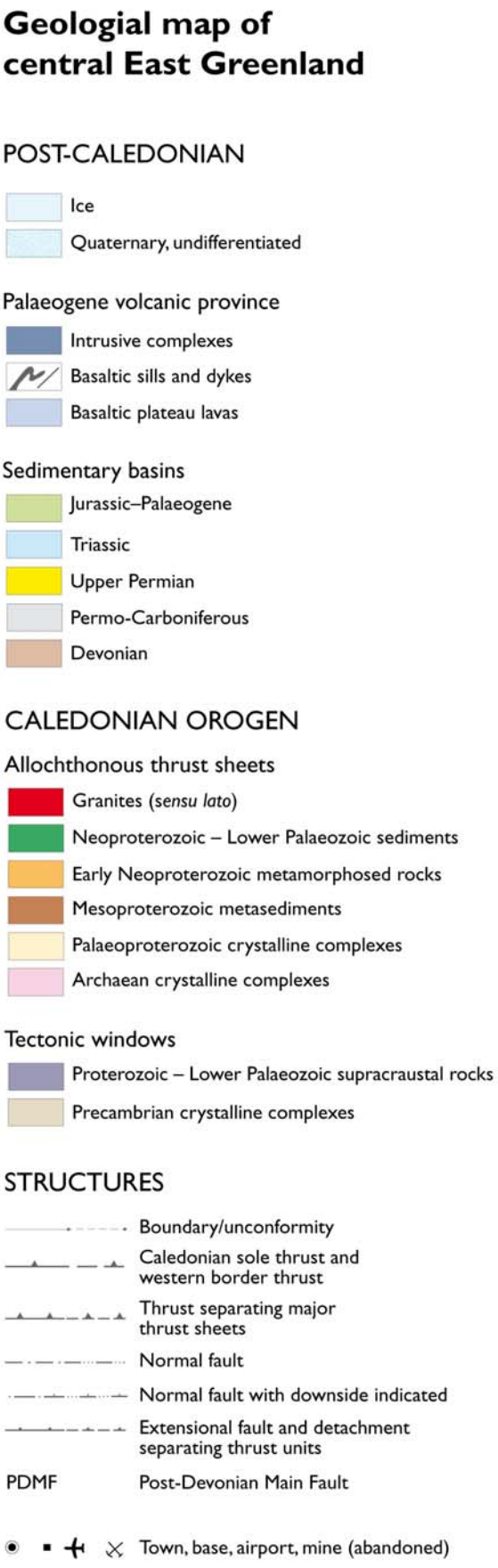

Figure 1. *Legend to the geological map of central East Greenland.*

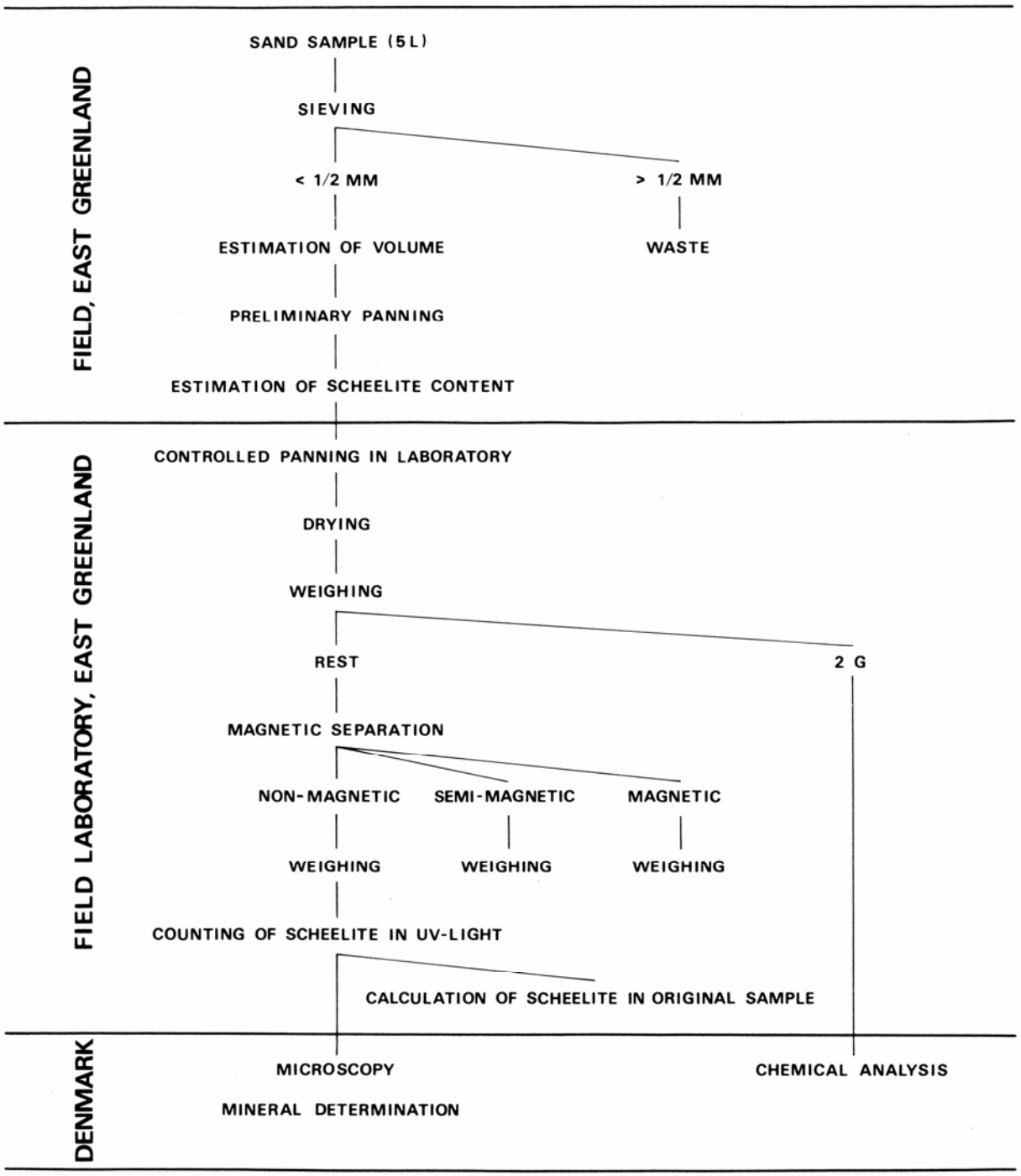

Figure 2. *Flow sheet for treatment of heavy mineral concentrates. From Hallenstein et al. (1981).*

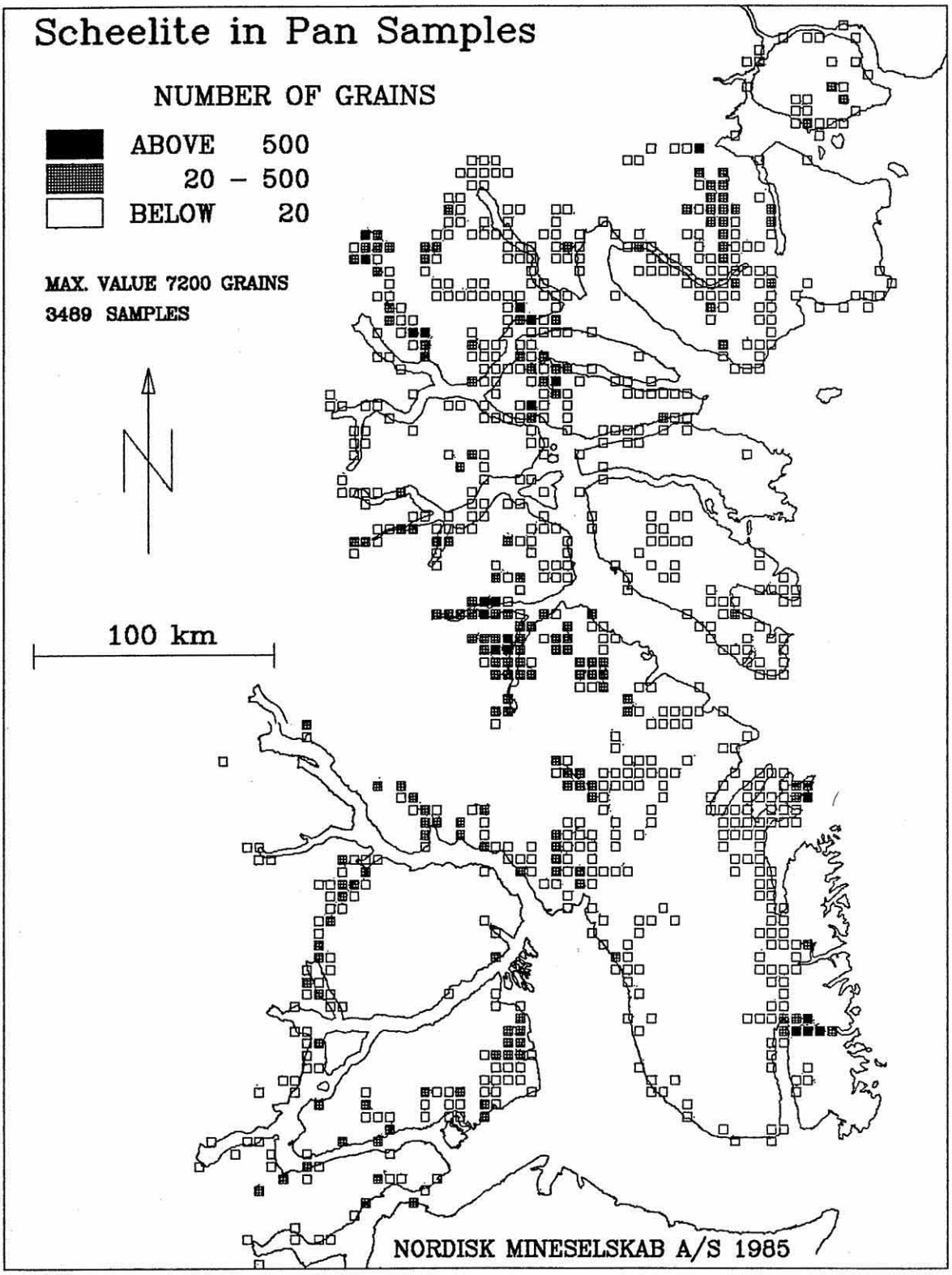

Figure 3. *Tungsten anomaly map of central East Greenland based on number of scheelite grains in heavy mineral concentrates. Grid size is 4 x 4 km. From Harpøth et al. (1986).*

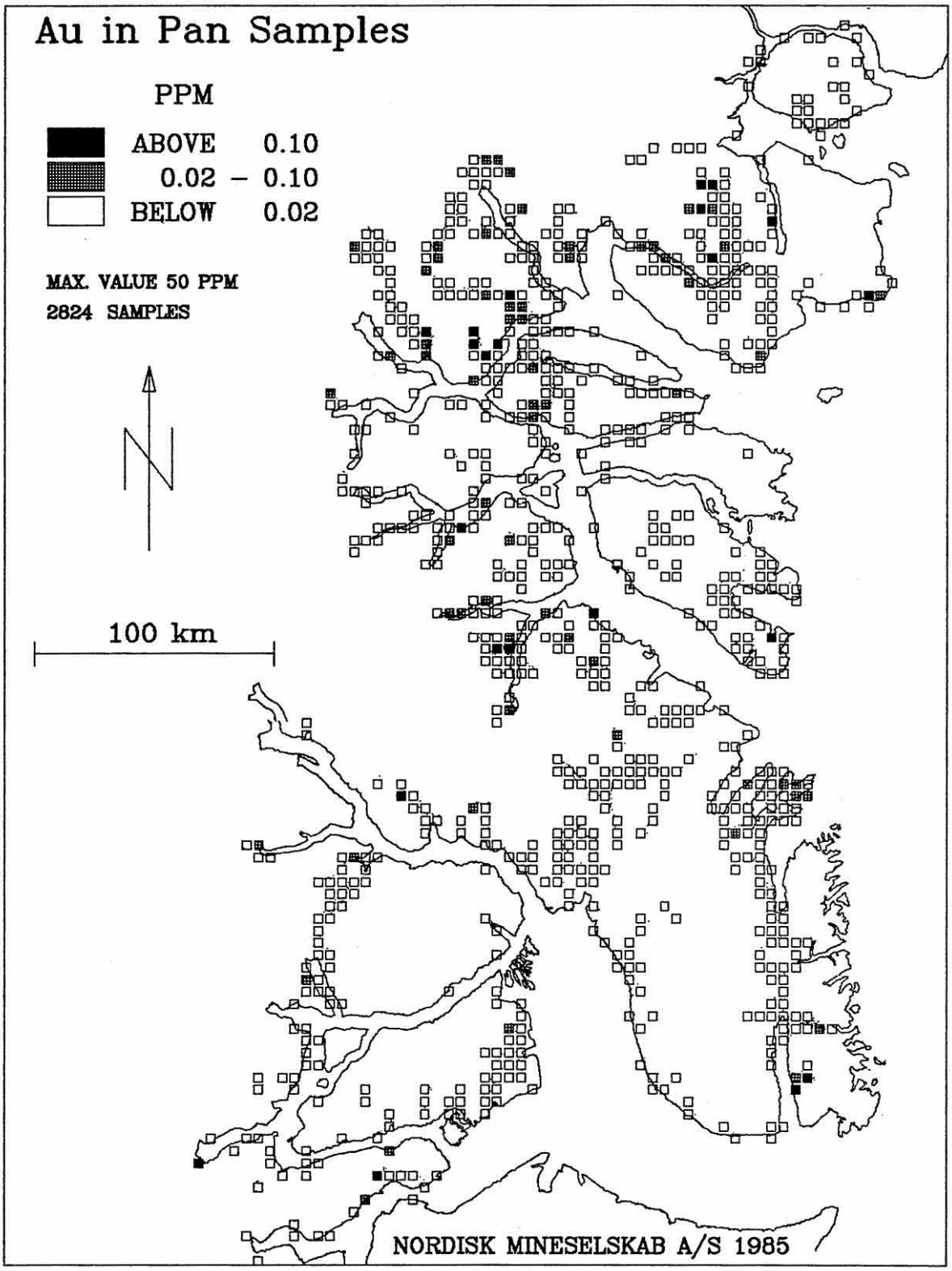

Figure 4. *Geochemical map of central East Greenland showing gold concentrations in heavy mineral concentrates. Grid size is 4 x 4 km. From Harpøth et al. (1986).*

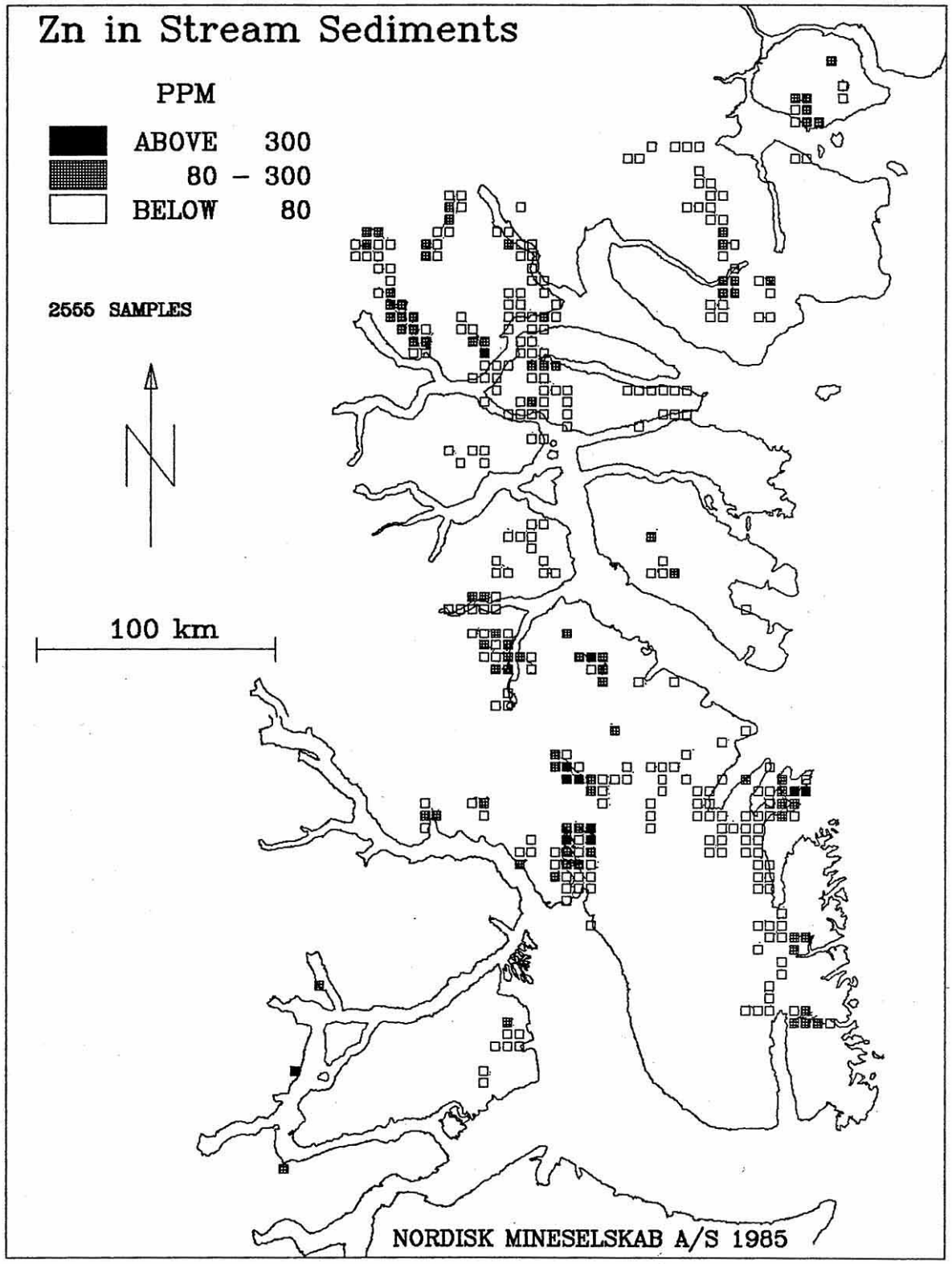

Figure 5. *Geochemical map of central East Greenland showing zinc concentrations in stream sediment and soil samples. Grid size is 4 x 4 km. Unpublishede, from the Nordmine Archives.*