

# Airborne geophysical surveys in Greenland in 1998

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Airborne geophysical surveying in Greenland during 1998 consisted of a magnetic project referred to as 'Aeromag 1998' and a combined electromagnetic and magnetic project referred to as 'AEM Greenland 1998'. The Government of Greenland financed both with

administration managed by the Geological Survey of Denmark and Greenland (GEUS). With the completion of the two projects, approximately 305 000 line km of regional high-resolution magnetic data and approximately 75 000 line km of detailed multiparameter data (electromagnetic, magnetic and partly radiometric) are now available from government financed projects. Figure 1 shows the location of the surveyed areas with high-resolution geophysical data together with the area selected for a magnetic survey in 1999. Completion of the two projects was marked by the release of data on 1 March, 1999. The data are included in the geoscientific databases at the Survey for public use; digital data and maps may be purchased from the Survey.

The combined electromagnetic and magnetic survey in 1998 completes the five-year project AEM Greenland 1994–1998 that has had the primary objective of stimulating mining exploration activity in Greenland (Stemp & Thorning 1995). During this five-year period, high-resolution electromagnetic and magnetic data have been acquired from selected areas in Greenland (Fig. 1). The surveys cover regions of contrasting topography and geology from the Archaean craton to basalts of the Tertiary igneous province. A complete reference list including publications from the previous surveys is found in Thorning & Stemp (1998).

Contractors for the two projects were selected under EU open tender procedures in 1997, which included options for extending the projects in 1997 to 1998.

## Aeromag 1998

Approximately 71 000 line km of total field magnetic data were acquired in southern West Greenland in the region indicated in Figs 1 and 2. The survey block covers part of the Archaean craton between 63°40'N and 65°45'N, ranging from the permanent ice of the Inland Ice to the Davis Strait. In the northern half of this region,

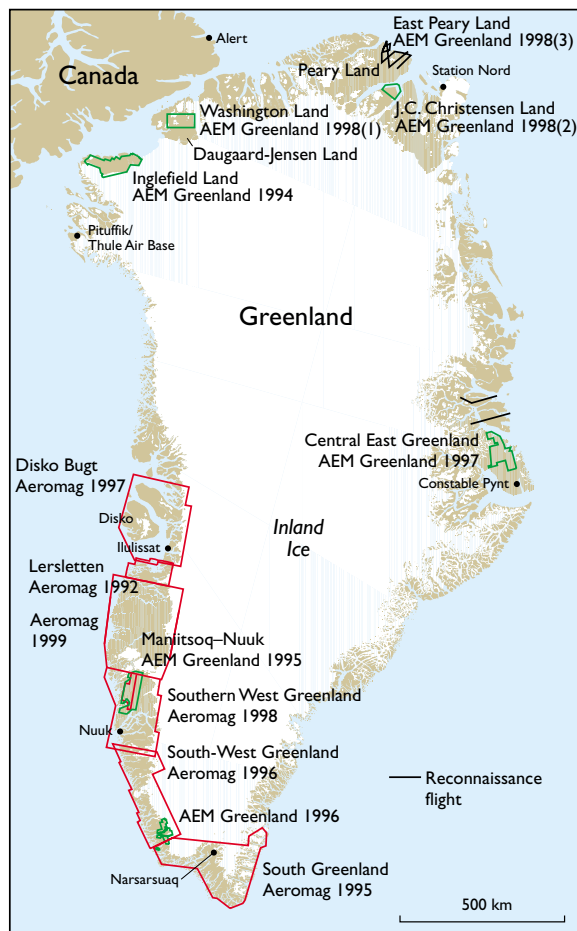


Fig. 1. Locations of high-resolution airborne geophysical surveys carried out in Greenland in the period 1992–1998, and the planned Aeromag 1999 survey in West Greenland.

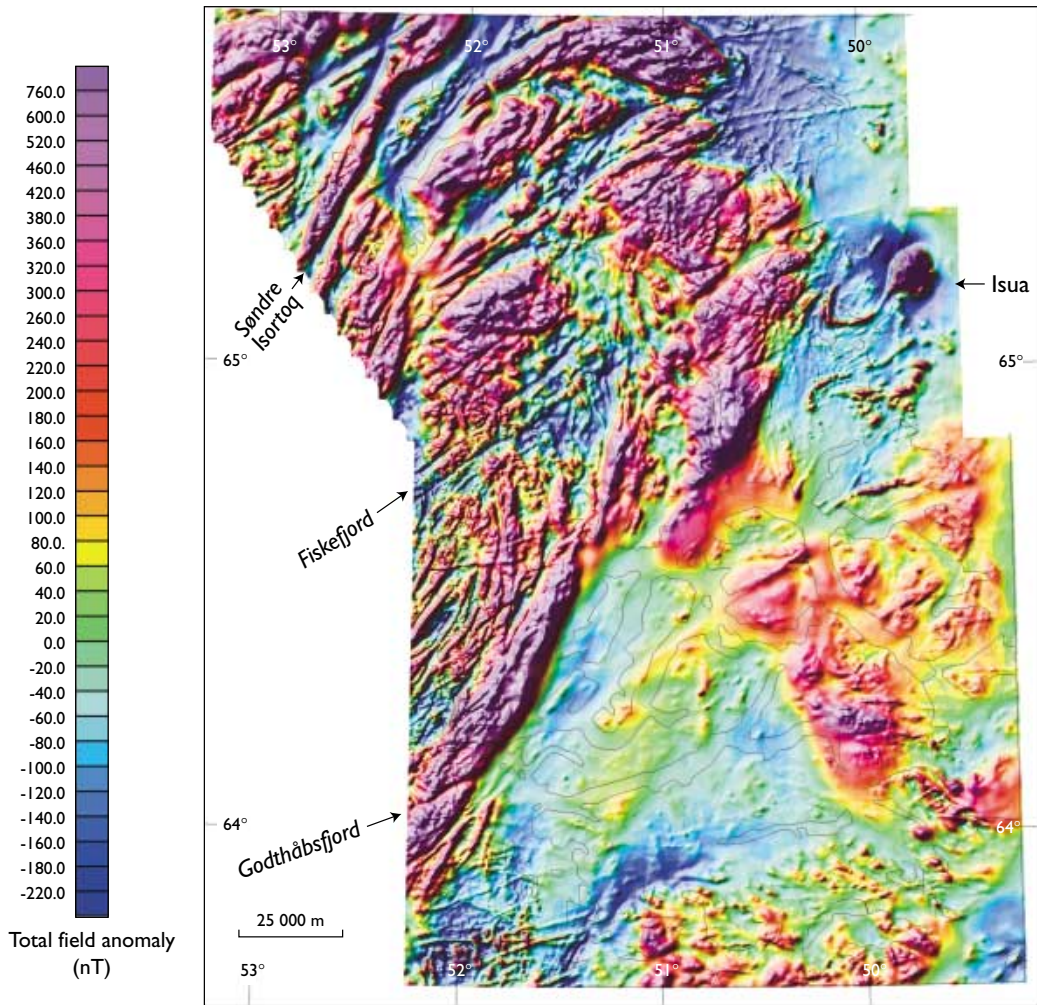


Fig. 2. Magnetic total field intensity with shadow for the area in southern West Greenland covered by project Aeromag 1998. For location see Fig. 1.

an irregular shaped area between 51°W and 52°W was excluded because of coverage by an existing data set obtained in 1995 by project AEM Greenland 1995 (Stemp 1996). In Fig. 2 the two surveys are merged to give a homogeneous data set for the entire region. The measurements were carried out by a fixed-wing aircraft following a gentle drape surface 300 m above the ground. The survey lines with a separation of 500 m were aligned in a N-S direction. Orthogonal tie-lines were flown with a separation of 5000 m.

Sander Geophysics Ltd., Canada flew the survey between 31 March and 13 July, 1998, using two geophysically equipped Cessna Grand Caravan aircraft operating out of the airport in Nuuk. The magnetic base

station utilised for correction of magnetic diurnal variations was placed adjacent to the runway. Diurnals were quite active throughout the entire period of the survey. Further details of the survey operation and equipment can be found in a report by Sander Geophysics Ltd. (1998), which is supplied with a digital data package that can be purchased from GEUS

Maps at scales of 1:250 000 and 1:50 000 have been produced from the data. The total magnetic field anomaly data provide a wealth of structural information, as can be seen in Fig. 2. Among the most spectacular anomalies in the area is the 20 000 nT anomaly in the Isua area. Differences in magnetic properties of those parts of the crust dominated by granulite facies rocks

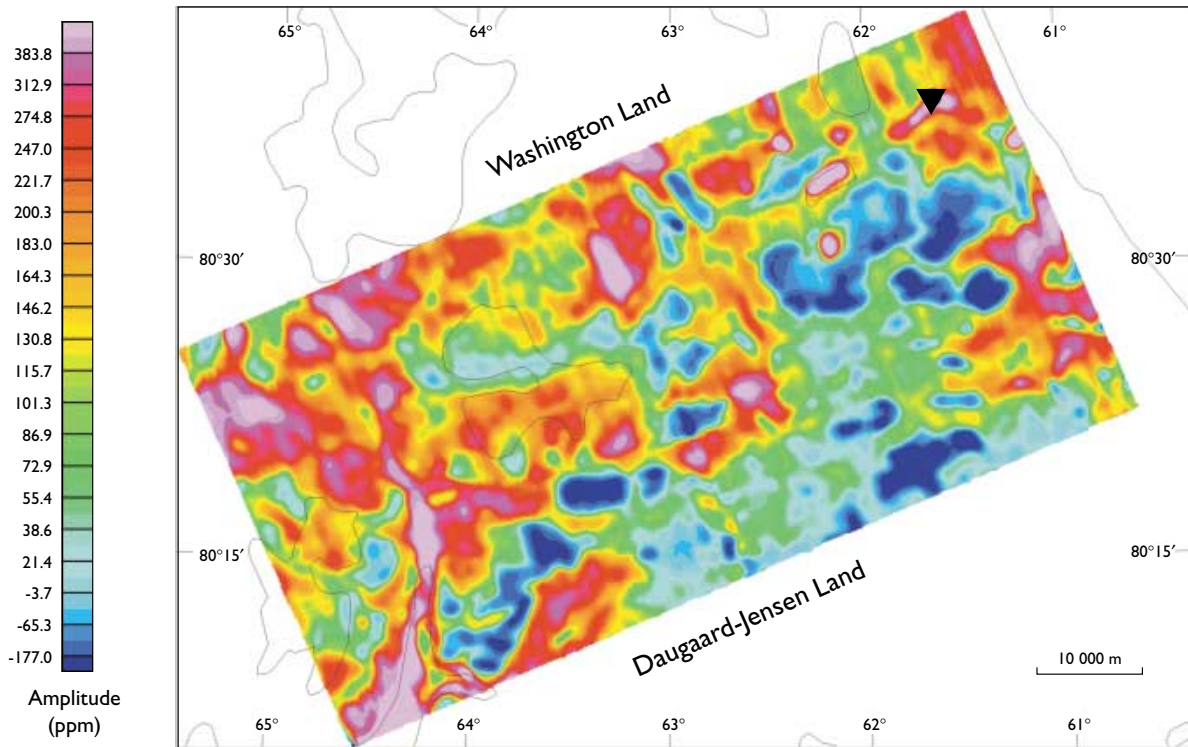


Fig. 3. Amplitude in ppm with respect to max. signal strength of the vertical component for the GEOTEM system channel 10 in Washington Land and Dagaard-Jensen Land, western North Greenland. The location of the Zn-Pb-Ag mineralisation is indicated by a black, inverted triangle. For location see Fig. 1.

and those parts dominated by amphibolite facies rocks are reflected clearly in the wavelength of the anomalies. The rocks in granulite facies are characterised by anomalies of short wavelength with high amplitudes whereas the amphibolite facies rocks cause more gentle variations of the magnetic field.

As part of project Aeromag 1998, a detailed survey was flown in the Disko Bugt area covering an arch-shaped magnetic feature with a radius of about 10 km. This had been revealed from the Aeromag 1997 data. The greater part of the survey area was over water of Disko Bugt and only the south-west portion was over the island of Disko which rises to more than 800 m above sea level. Line spacing for this survey was 250 m with a total of 1755 line km flown. The survey altitude was 120 m above ground or sea level.

### AEM Greenland 1998

Project AEM Greenland 1998 included surveys of an area of 3200 km<sup>2</sup> in Washington Land and Dagaard-Jensen

Land, western North Greenland, 1650 km<sup>2</sup> in J.C. Christensen Land, eastern North Greenland and 485 kilometres of reconnaissance lines in eastern Peary Land, central North Greenland (Fig. 1). The project was carried out as a combined transient electromagnetic (GEOTEM) and magnetic survey, and was flown by Geotrex-Digheem Ltd., Canada. Nominal flight height was 120 m over the terrain with total field magnetic sensor and electromagnetic sensor at heights above ground of 75 m and 70 m, respectively. The base frequency for the GEOTEM system was 90 Hz. The survey was flown using two geophysically equipped Casa aircraft during the period from 29 May to 24 June, 1998.

A Zn-Pb-Ag mineral occurrence discovered in 1997 (Jensen & Schönwandt 1998) led to the selection of Washington Land and Dagaard-Jensen Land in western North Greenland as one of the target areas for the AEM Greenland 1998 project (Fig. 1). The mineralisation is within exposed Lower Palaeozoic carbonate deposits. The surveyed area is indicated in Fig. 1 as AEM Greenland 1998(1). The survey was flown out of Alert in Canada using a line separation of 400 m. A smaller area cover-

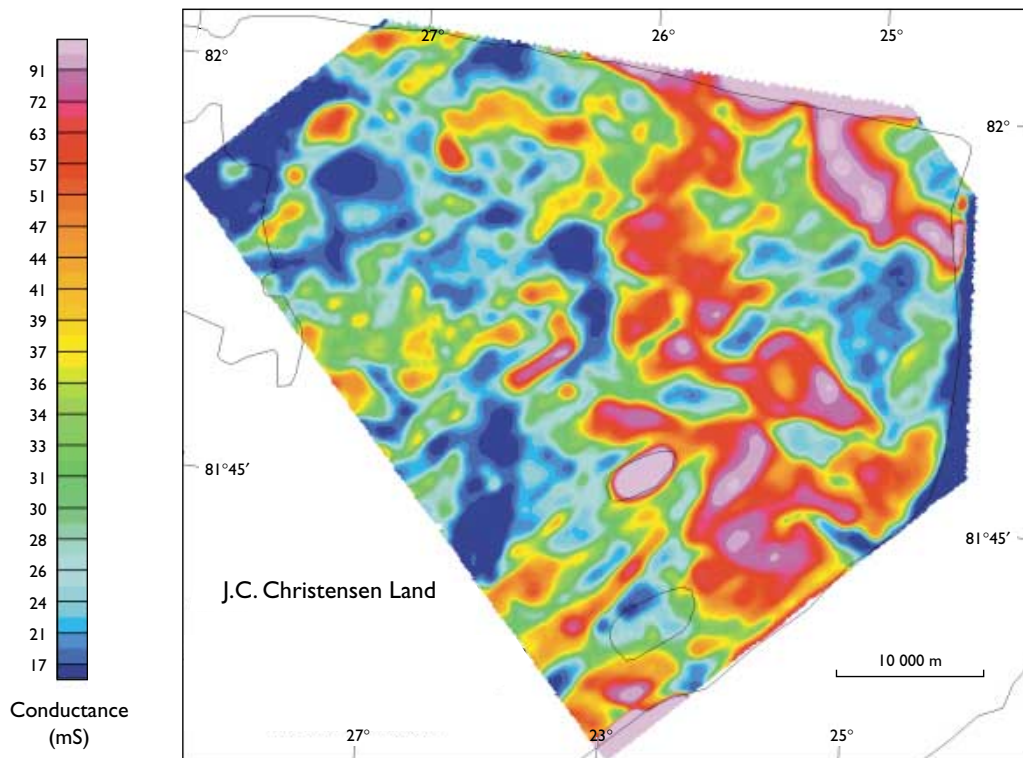


Fig. 4. Estimated apparent conductance from the survey in J.C. Christensen Land, eastern North Greenland. For location see Fig. 1.

ing the mineral occurrence was flown with lines at a different orientation separated by 200 m and at lower altitude. Tie-lines with a separation of 4000 m were flown in the direction orthogonal to the ordinary survey lines. A total of 9321 line km were flown. The base station used for correction of magnetic diurnal variations was placed in Alert, Ellesmere Island, Canada (Fig. 1). Further details of the survey operation and equipment can be found in a report by Geotrex-Dighem Ltd. (1998a), which is supplied with purchase of the digital data package. The maps produced from the survey are of six types: total magnetic field and associated vertical derivative, amplitudes of the vertical component for GEOTEM channel 10, apparent conductance, GEOTEM anomalies with flight lines and a separate topographic sheet. The maps are available at scales 1:250 000 and 1:50 000 for the entire survey area, and at scale 1:20 000 from the detailed survey covering the mineral occurrence. An example of the data shows the amplitude of the vertical components for off-time channel 10 of the GEOTEM system (Fig. 3) for the entire survey area and the position of the mineral occurrence. A detailed description of the measured data

can be found in Rasmussen (1999a). Several targets for a follow-up search for mineralisation showings can be identified from the new data.

The survey in J.C. Christensen Land, eastern North Greenland, was flown out of Station Nord (Fig. 1), and comprises 4492 line km of data. The surveyed area is indicated in Fig. 1 as AEM Greenland 1998(2). Survey parameters and map products are similar to those of the survey in Washington Land and Dagaard-Jensen Land. A comprehensive summary is found in the processing report by Geotrex-Dighem Ltd. (1998b). A description of the data and discussion of the results can be found in Rasmussen (1999b). Copper-sulphide mineralisations constitute the main target for this survey. The geology of J.C. Christensen Land is dominated by undeformed Mesoproterozoic sandstones and mafic volcanic rocks, overlain to the north-east by Neoproterozoic and Lower Palaeozoic sedimentary successions. An example of the acquired data (Fig. 4) shows the calculated apparent conductance.

A large number of conductivity anomalies were revealed by a reconnaissance flight in eastern Peary

Land, central North Greenland indicated in Fig. 1 as AEM Greenland 1998(3). This part of the survey was flown with a nominal height of 120 m, but the severe topography caused some problems flying at a low altitude. The magnetic data indicate the presence of an igneous structure not previously recognised. The data from the reconnaissance flight are presented in the reports covering the survey in J.C. Christensen Land (Geoterrex-Dighem Ltd. 1998b; Rasmussen 1999b).

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## References

- Geoterrex-Dighem Ltd. 1998a: Logistics and processing report Project AEM Greenland 1994–1998. Airborne GEOTEM / magnetic survey over Washington Land / Daugaard-Jensen Land in western North Greenland, 25 pp., 14 app. + data vol. Unpublished report, Geoterrex-Dighem Ltd, Ottawa, Canada (in archives of Geological Survey of Denmark and Greenland, Copenhagen, Denmark).
- Geoterrex-Dighem Ltd. 1998b: Logistics and processing report Project AEM Greenland 1994–1998. Airborne GEOTEM / magnetic survey over J.C. Christensen Land in central North Greenland, 19 pp., 14 app. + data vol. Unpublished report, Geoterrex-Dighem Ltd, Ottawa, Canada (in archives of Geological Survey of Denmark and Greenland, Copenhagen, Denmark).
- Jensen, S.M. & Schönwandt, H.K. 1998: A new carbonate-hosted Zn-Pb-Ag occurrence in Washington Land, western North Greenland. Danmarks og Grønlands Geologiske Undersøgelse Rapport **1998/3**, 31 pp.
- Rasmussen, T.M. 1999a: Airborne electromagnetic and magnetic survey in Washington Land and Daugaard-Jensen Land, western North Greenland. Danmarks og Grønlands Geologiske Undersøgelse Rapport **1999/10**, 19 pp.
- Rasmussen, T.M. 1999b: Airborne electromagnetic and magnetic survey of north-eastern J.C. Christensen Land, eastern North Greenland. Danmarks og Grønlands Geologiske Undersøgelse Rapport **1999/11**, 17 pp.
- Sander Geophysics Ltd. 1998: Project report, High resolution aeromagnetic survey, Aeromag '98 – Nuuk, Greenland, 29 pp., 9 app. + data vol. Unpublished report, Geoterrex-Dighem Ltd, Ottawa, Canada (in archives of Geological Survey of Denmark and Greenland, Copenhagen, Denmark).
- Stemp, R.W. 1996: Airborne electromagnetic and magnetic survey of the Maniitsoq–Nuuk area, southern West Greenland. Results from project AEM Greenland 1995. Geological Survey of Denmark and Greenland Report **1996/11**, 34 pp.
- Stemp, R.W. & Thorning, L. 1995: A new airborne electromagnetic and magnetic survey of Inglefield Land, North-West Greenland: Project AEM Greenland 1994–1998. Rapport Grønlands Geologiske Undersøgelse **165**, 64–68.
- Thorning, L. & Stemp, R.W. 1998: Airborne geophysical surveys in central West Greenland and central East Greenland in 1997. Geology of Greenland Survey Bulletin **180**, 63–66.

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