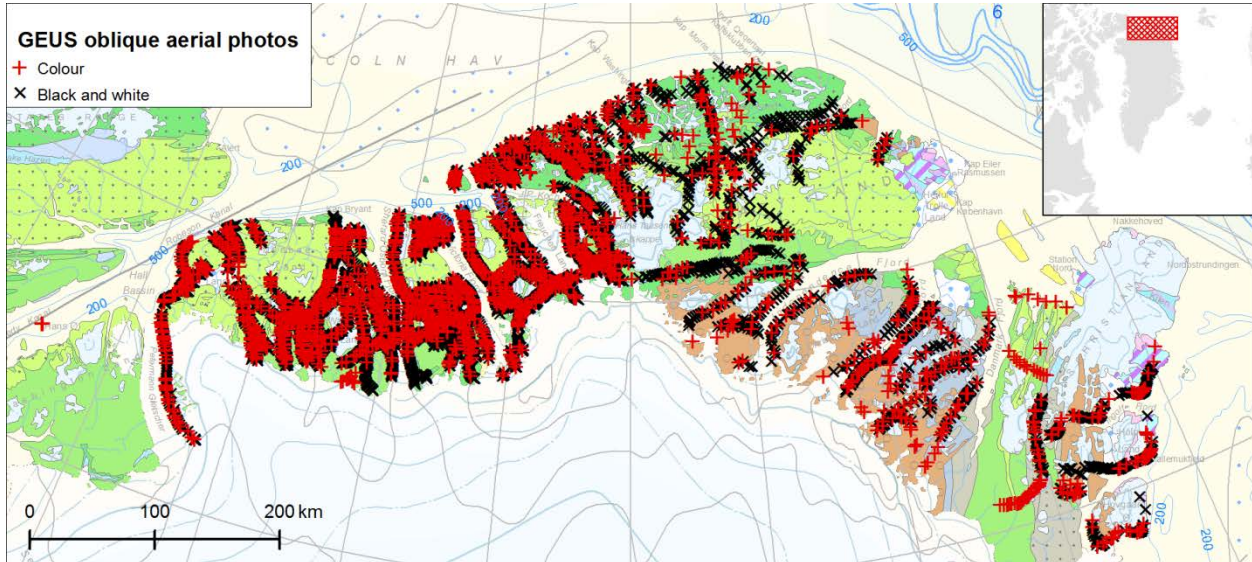


North Greenland collection of oblique aerial photographs - (Twin Otter photos)

The Geological Survey of Greenland (now part of the Geological Survey of Denmark and Greenland: GEUS) carried out a systematic 1 : 500 000 geological mapping program in North Greenland with fieldwork between 1978 and 1985 (Henriksen & Higgins 1991). One of many activities was a systematic programme of oblique aerial photography of the steep walls of fjords and valleys. This web-site makes available more than 6400 of these photographs. Using a map interface the user gain access to the individual images, their geological coding and the geological map.

A primary aim of the mapping project was to establish a geological framework which would facilitate the exploitation of mineral resources and hydrocarbons. The results of the investigations are documented in a large number of reports, international published papers and topographical and geological maps (Peel & Sønderholm, 1991; Henriksen, 1992 and Henriksen et al., 2009).



Coverage of low altitude oblique aerial photographs taken during the geological mapping of North Greenland between 1978 and 1985 (base map: reduced from Geological map of Greenland, 1:2 500 000, GGU, 1995).

Geology

The geology of North Greenland encompasses a succession of Proterozoic sedimentary rocks, deposited on a Precambrian crystalline shield, that in the north are deformed and metamorphosed. The oldest sediments are continental sandstones of the Palaeo-Mesoproterozoic *Independence Fjord Group*. These are overlain with an unconformity by the *Midsommersø dolerites/Zig-Zag Dal volcanic rocks* (c. 1380 Ma), which again are overlain by a Neoproterozoic passive margin succession of sedimentary rocks (*Hagen Fjord Group*).

Most of North Greenland is dominated by sedimentary rocks of the Early Palaeozoic (Lower Cambrian to earliest Devonian) *Franklinian Basin*. The basin developed with a 4 km thick carbonate-dominated platform succession in the south and an 8 km thick trough succession in the north comprising sandstones, shales and turbiditic sedimentary rocks. The trough succession is affected in its northern part by the east-west trending upper Palaeozoic Ellesmerian *fold belt*.

The latest geological development in North Greenland encompasses a late Palaeozoic to Cenozoic evolution characterised by tectonic regimes related to the opening of the North Atlantic. It includes deposits assigned to the *Wandel Sea Basin* exposed in eastern North Greenland. This succession includes Carboniferous to Triassic sandstones and limestones, and Jurassic to early Palaeogene sandstones and mudstones. Along the northern fringe of North Greenland a 5 km thick succession of uppermost Cretaceous to Paleocene volcanic rocks (Kap Washington Group) is preserved. The pre-Paleocene Wandel Sea Basin deposits were subjected to compressional deformation ("Kronprins Christian Land orogeny" in the east and Eureka tectonism in the north).

Field work

The field work in the uninhabited region of North Greenland was carried out as a series of summer expeditions with participation of between 15 and 23 geologists in each of the five seasons of the project (Henriksen & Higgins, 1991). Access to the area was by air and during the work the geologists were supported by small helicopters and a fixed wing Twin Otter aircraft. Tent base camps were established each year as operational centres for the expedition, and the geological field work was primarily carried out by geologists working in two-man parties and living in small tent camps.

Oblique low altitude aerial photographs

An extensive program of low altitude black and white and colour photography was undertaken to supplement the field observations of geological teams. The photographic flights generally followed fjords and valleys, and the photographs were taken from a Twin Otter aircraft flying at low altitudes. The aim was to document geological profiles and sections through as much of the several kilometres thick successions as possible.

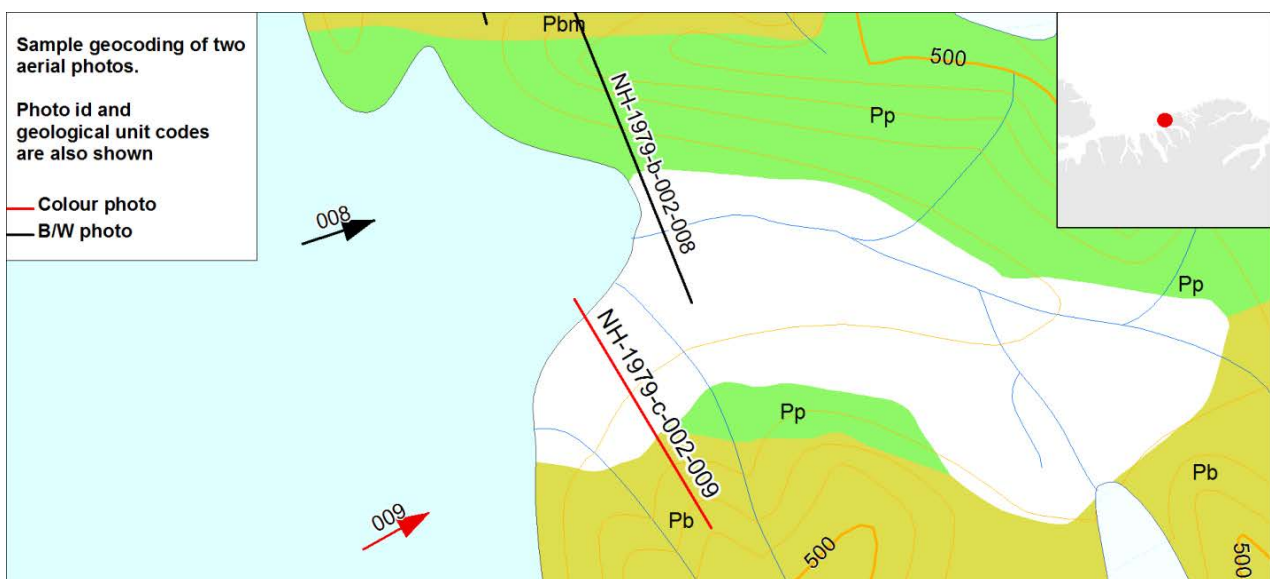


Icelandic Twin Otter aircraft used for aerial photo flights. Photo N. Henriksen 1978.

The planned photographic flights were undertaken at altitudes between c. 900 and 1700 metres, depending on the terrain. Two photographers used different cameras, one with black and white film and one with colour. The 4455 black and white photographs generally have a sideways overlap. The total number of 1976 colour photographs were intended as a supplement to the black and white photographs, and do not have sideways overlap. The B/W photographs in 1978 were taken with a Linhoff camera, format 60 x 70 mm, while in later years (1979, 1980, 1984, and 1985) a Mamiya 645 camera, format 46 x 60 mm, was used. All colour photographs were taken using standard colour slide films (format 24 x 36 mm).

Digitising

All photographs have been scanned and georeferenced. The black and white photographs were scanned using an Epson Perfection V 750 Pro scanner while the colour photographs were scanned using a Nikon SF-200 Scanner. Both film types were scanned as tiff-files at 2400 dpi resolution. Each photograph is approximately georeferenced (in a 2D GIS environment) by a line indicating the optical axis of the image and a line showing the central scene. This is done visually using the flight line maps and GEUS digital geological and topographical maps at scale 1:250 000 of the area.



Example of how the localisation of two oblique aerial photographs, one in black and white and one in colour, are depicted on the digitised geological map, with colours and symbols showing the geological mapping units. The arrows indicate the direction of the view, while the bars indicate the position and approximate width of the area shown. The image numbers are indicated above the bars.

At the web-site the position is represented by the centre point of scene-line used in the map above. The image-file linked to, is a compressed jpg-version of the original tiff-scan.

Geological coding

Most of the photos have also been assigned one or more codes indicating the geological units in the photograph. The codes used are those of the background map which is also published as Geological maps of North and North-East Greenland 1 : 250 000, GEUS 2007. The two photos shown in the map above are coded in this way. Photo no NH-1979-c-002-009 is coded 'Pb' (Polkorridoren Group, semipellitic sediments) while NH-1979-b-002-008 is coded 'Pp' (Polkorridoren Group, psammitic sediments).

References

Henriksen, N. 1992: Geological map of Greenland, 1:500 000, Nyeboe Land, Sheet 7, Peary Land, Sheet 8. Descriptive text, 40 pp., 2 maps. Copenhagen: Geological Survey of Greenland.

Henriksen, N. & Higgins, A.K. 1991. The North Greenland Project *in* Peel, J.S. and Søndersholm, M. (eds.) 1991: Sedimentary basins of North Greenland. Bulletin Grønlands Geologiske Undersøgelse, 160, p. 9–24.

Henriksen, N., Higgins, A.K., Kalsbeek, F. and Pulvertaft, C.T.R., 2009: Greenland from Archean to Quaternary. Descriptive text to the 1995 Geological map of Greenland 1:2 500 000. 2nd edition. Geological Survey of Denmark and Greenland Bulletin 18, 126 pp. 1 map.

Peel, J.S. and Søndersholm, M. (eds.) 1991: Sedimentary basins of North Greenland. Bulletin Grønlands Geologiske Undersøgelse, 160, 164 pp.