A new 'Geological map of Greenland'

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The first general overview of the geology of Greenland to be presented in the form of a map was the 'Tectonic/geological map of Greenland' published by the Geological Survey of Greenland (GGU) in 1970 at a scale of 1:2 500 000. This wall map proved very popular, and stocks were exhausted in 1990. A new 'Geological map of Greenland' at the same scale (Escher & Pulvertaft, 1995) has now been prepared; this presents a wealth of new information, including a representation of the geology of offshore areas.

Onshore geology

In the 25 years since the publication of the 'Tectonic/geological map of Greenland', geological knowledge of Greenland has increased greatly. Forty-five of the 50 geological map sheets in GGU's 1:100 000 series have been published since 1970, as well as 10 of the 14 sheets at 1:500 000 covering the ice-free area of Greenland.

Since 1970 major Survey projects have focused in particular on geological investigation of the least accessible and least known regions of Greenland, in particular North-West, North, North-East and South-East Greenland. Geological maps published as a result of these projects include a number of sheets in both the 1:100 000 and the 1:500 000 series; one more sheet in the 1:500 000 series is complete in draft form, and field work is almost complete on one further sheet. This geological information, as well as data from larger scale published maps and unpublished field maps, has been incorporated in the entirely revised new 'Geological map of Greenland' (Fig. 1).

The geological units represented in Greenland range from early Archaean crystalline rocks to unconsolidated Quaternary sediments. Archaean and Early Proterozoic rock units, older than *c.* 1600 Ma, dominate the stable Precambrian shield, and are distinguished on the new map according to their lithology and age; the extent of regional tectono-metamorphic provinces is also depicted. Younger rock units, Middle Proterozoic to Phanerozoic in age, are in part related to formation of sedimentary basins and fold belts along the margins of the stable shield. The principal subdivisions depicted on the map illustrate the general depositional environment, age and extent of the main sedimentary and volcanic basins, with a geographical distinction between those represented in West, North and East Greenland. Middle Proterozoic and younger infracrustal gneisses and plutonic rocks are distinguished by lithology, and age of orogenic formation and emplacement.

Deformation trends in orogenic belts are shown by coloured overprints and structural symbols. The principal Precambrian orogenic events distinguished are late Archaean (2800–3000 Ma) and early Proterozoic (1850–2000 Ma); Phanerozoic orogenic events include the Caledonian of East Greenland (400–450 Ma) and the Ellesmerian of North Greenland (360–400 Ma).

Offshore geology

Interpretation of the geology of offshore areas around Greenland is based mainly on seismic surveys supplemented by aeromagnetic and gravity data, and in the case of offshore West Greenland the five exploration wells drilled in the 1970s. Geophysical surveys have been carried out partly in connection with commercial oil exploration activities, and partly as exploration and scientific research projects sponsored by the Mineral Resource Administration for Greenland, the former Ministry of Energy, the European Union and foreign research institutions. Interpretation of data acquired in the often ice-filled waters offshore North-West and North-East Greenland as part of the commercially sponsored KANUMAS project, with Nunaoil A/S as operator, has been included in the new map, with revisions added up to summer 1994. Geophysical coverage of the offshore areas of Greenland ranges from excellent to fair for the scale of the map, except for areas offshore northern Greenland where there are no seismic data.

Distinction is made between areas underlain by continental crust and areas underlain by oceanic crust; a transition zone is also recognised. Areas with oceanic crust are further subdivided into time slices of 15 Ma shown by different colours; the oldest units correspond to the initiation of sea floor spreading off South-West Greenland (Paleocene) and off South-East Greenland (Eocene). Linear magnetic anomaly patterns are shown, together with spreading axes and transform faults.

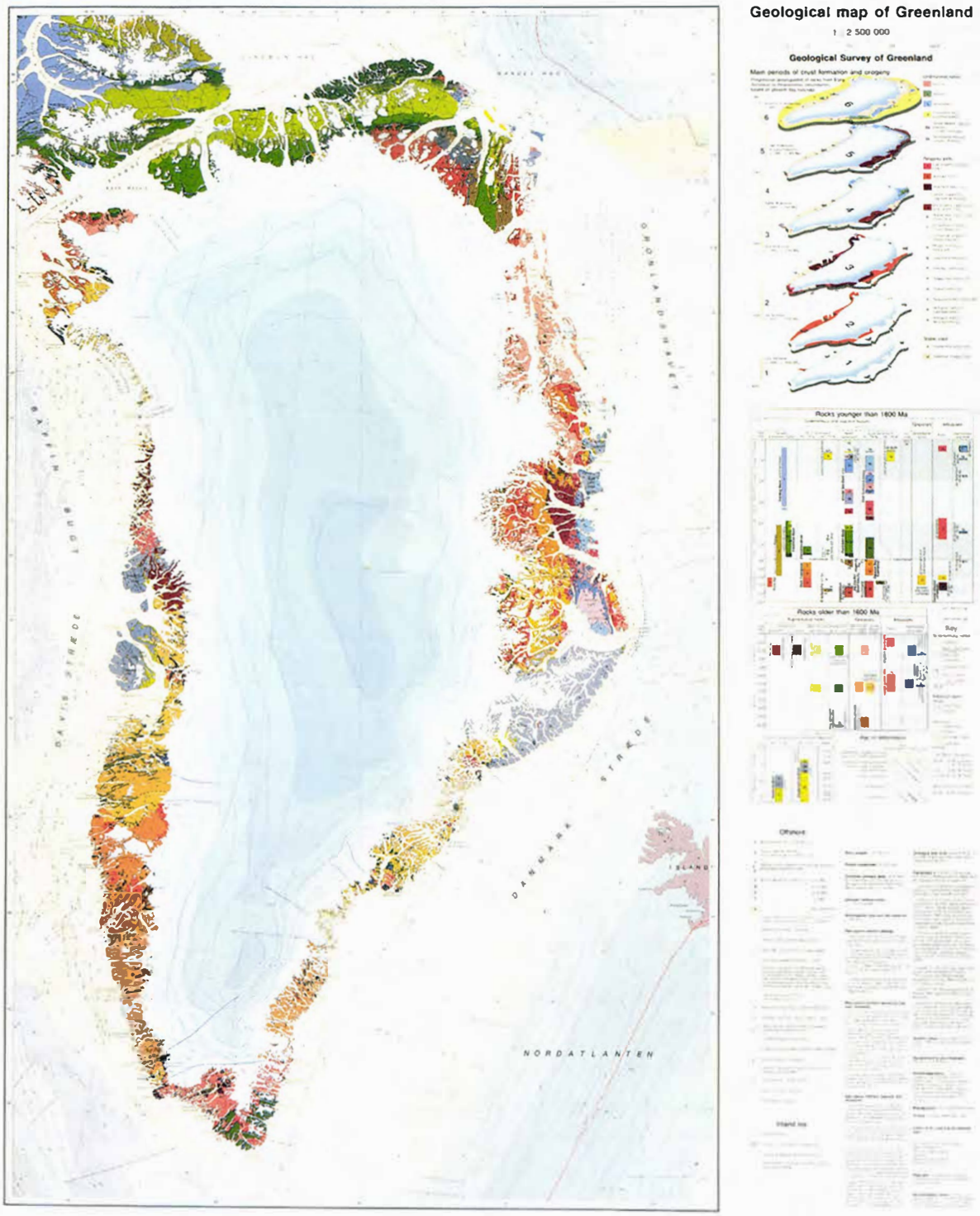

Fig. 1. The new 'Geological map of Greenland'. Publication scale is 1:2 500 000; the printed map sheet measures 96 × 120 cm.

Isopachs showing the thickness of overlying sediments are superimposed on the representation of crust type. Sediments are believed to be mainly Upper Palaeozoic to Tertiary in age offshore northern East Greenland, and Mesozoic–Tertiary off West Greenland. Offshore areas of Tertiary volcanic and intrusive rocks are also shown, together with a variety of tectonic features.

Inland Ice

More than 80% of Greenland is covered by the Inland Ice, local ice caps or local glaciers. The Inland Ice, the major ice sheet covering central Greenland, is more than 3 km thick at its highest point, and thins gradually towards the margins. Airborne radar surveys during the past decade have established the altitudes of the upper and lower surfaces of the Inland Ice, and thus the thickness of the ice sheet. All three parameters are represented by contours on the new map.

Topographic base

The topographic base for the new 1:2 500 000 map has been constructed as a UTM projection in zone 24 with WGS 84 datum; the central meridian is 39°W.

The topography has been drawn on the basis of fixed points established throughout Greenland by Kort- og Matrikelstyrelsen (KMS) (National Survey and Cadastre – formerly the Geodetic Institute). Photogrammetric constructions by KMS and GGU have been combined and coordinated to produce the first geometrically correct and complete topographical projection of all of Greenland. All previous maps have suffered from insufficient ground control, especially in North Greenland where errors in the location of topographic features of up to 25 km occur on earlier maps.

A new topographical map of Greenland at a scale of 1:2 500 000 was published by KMS in 1994 (KMS, 1994). The new 'Geological Map of Greenland' at the same scale uses an identical topographic base map with the same projection; the only significant topographical difference is the omission of contour lines for the land areas to allow representation of geological detail.

Crustal evolution of Greenland

The legend to the new geological map incorporates a cartoon illustration of the crustal evolution of Greenland based on the present day outcrop. Six stages of evolution are shown from the Early Archaean to the Tertiary. Each of the time slices shows the distribution of stable older crust, younger orogenic belts and sedimentary and volcanic rocks.

Publication format and design intentions

The main purpose of the new 'Geological map of Greenland' is to provide an up-to-date overview of the geology of Greenland, onshore and offshore, in the form of a wall map. Geological subdivisions and colours have been selected to allow distinction of regional geological provinces on a scale which can be appreciated when used as a wall map. Closer inspection of the map reveals more detailed information about the type and age of the major rock units and basic structural information, and offshore an explanation of magnetic anomaly patterns and sediment thicknesses.

The 'Geological map of Greenland' will be published in three formats:

- A wall map 96 cm by 120 cm in size, unfolded.
- A folded map sheet.
- An atlas, made up of 12 folded segments cut from the map sheet, including the legend.

Work is in progress on a descriptive text, to accompany the folded map and atlas formats.

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