DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 2013/49

Greenland 3D-Geology Legend

Pierpaolo Guarnieri & Morten Bjerager

GEOLOGICAL SURVEY OF DENMARK AND GREENLAND
DANISH MINISTRY OF CLIMATE, ENERGY AND BUILDING

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Summary

This report describes the different legends that can be used in order to construct an accurate, multi-scalar geo-spatial model covering Greenland: GL3D. The geological complexity, the time span covered by the outcropping rocks together with the presence of the Greenland Ice Sheet that covers almost 80% of the largest island of the Earth with more than 400 000 Km2 of ice free area, put many challenges in the development of a 3D-Geological modelling.

This report will briefly introduce the geology of Greenland and off-shore, together with four levels of geological details available with particular emphasis on the development of a pilot study using the geological map 1:100 000 scale covering part of East Greenland in the Jameson Land area. Available digital maps of Greenland are in the scales of 1: 5 000 000, 1:2 500 000, 1:500 000 and partly 1: 100 000

1. Greenland Geology (after Henriksen et al. 2009)

1.1 Introduction

The geological development of Greenland spans a period of 4 Ga, from the earliest Archaean to the Quaternary. Greenland is the largest island in the world with a total area of 2 166 000 km, but only c. 410 000 km are exposed bedrock, the remaining part being covered by an inland ice cap reaching over 3 km in thickness. The adjacent offshore shelf areas underlain by continental crust have an area of c. 825 000 km.
Greenland is dominated by crystalline rocks of the Precambrian shield, formed during a succession of Archaean and early Proterozoic orogenic events which stabilised as a part of the Laurentian shield about 1600 Ma ago. The shield area can be divided into three distinct basement provinces: (1) Archaean rocks (3100–2600 Ma old, with local older units), almost unaffected by Proterozoic or later orogenic activity; (2) Archaean terranes reworked during the early Proterozoic around 1850 Ma ago; and (3) terranes mainly composed of juvenile early Proterozoic rocks (2000–1750 Ma old).

Subsequent geological developments mainly took place along the margins of the shield. During the later Proterozoic and throughout the Phanerozoic major sedimentary basins formed, notably in North and North-East Greenland, and in places accumulated sedimentary successions which reached 10–15 km in thickness. Palaeozoic orogenic belts, the Ellesmerian fold belt of North Greenland, and the East Greenland Caledonides, affected parts of these successions; the latter also incorporates reworked Precambrian crystalline basement complexes.
Upper Palaeozoic and Mesozoic sedimentary basins developed along the continent–ocean margins in North, East and West Greenland and are now preserved both onshore and offshore. Their development was closely related to continental break-up with formation of rift basins. Initial rifting in East Greenland in latest Devonian to earliest Carboniferous time and succeeding phases culminated with the opening of the North Atlantic in the late Paleocene. Sea-floor spreading was accompanied by extrusion of Tertiary plateau basalts in both central West and central East Greenland.
During the Quaternary Greenland was almost completely covered by ice sheets, and the present Inland Ice is a relic of the Pleistocene ice ages. Vast amounts of glacially eroded detritus were deposited on the coastal shelves offshore Greenland.

1.2 Greenland Precambrian shield:

1.2.1 Crystalline rocks older than 1600 Ma

About half of the ice-free area of Greenland consists of Archaean and early Proterozoic crystalline basement rocks, mainly orthogneisses with some enclaves of supracrustal rocks. They belong to three distinct types of basement province: (1) Archaean rocks (3100–2600 Ma old, with local older units), almost unaffected by Proterozoic or later orogenic activity; (2) Archaean terranes reworked during the early Proterozoic around 1850 Ma ago; (3)

terranes mainly composed of juvenile early Proterozoic rocks (2000–1750 Ma old). Terranes of categories (2) and (3) often contain high grade early Proterozoic.

Nearly all unreworked Archaean gneisses occur within the Archaean craton of southern Greenland. They are cut by swarms of basic dykes, most of which belong to a c. 2000–2200 Ma suite; the dykes are undeformed and non-metamorphosed and the gneisses of the Archaean craton cut by the dykes cannot have been significantly affected by early Proterozoic orogenic activity around 1850 Ma ago.

Reworked Archaean gneisses are prominent in the Nagssugtoqidian and Rinkian mobile belts that occur north of the Archaean craton in West Greenland, and in the Ammassalik mobile belt of East Greenland. Juvenile early Proterozoic gneisses and granitoid rocks (1900–1750 Ma) make up most of the Ketilidian mobile belt of South Greenland, and they a lso form a large proportion of the crystalline basement within the Caledonian fold belt of North-East Greenland; they are also present in the Inglefield mobile belt in North-West Greenland.

1.2.2 Proterzoic units developed after formation of the Precambrian shield

The Greenland Precambrian shield is mainly composed of crystalline gneisses and plutonic rocks older than 1600 Ma. Younger rock units, nearly all middle Proterozoic to Phanerozoic in age, are in part related to the formation of sedimentary basins and fold belts along the margins of the stable shield. Two major Palaeozoic fold belts – the Ellesmerian fold belt of Ellesmere Island (Canada) and North Greenland and the Caledonian fold belt of East Greenland – developed along the north and east margins of the shield respectively.

Independence Fjord Group, North Greenland

The earliest recorded major depositional basin developed on the Greenland shield is represented by the Independence Fjord Group [31] which is found over large areas of eastern North Greenland and North East Greenland between north-eastern Peary Land (83 o N) and westernmost Dronning Louise Land (77ºN). The group is more than 2 km thick, with its base only exposed in western Dronning Louise Land. Strongly deformed units are found within the Caledonian fold belt in Kronprins Christian Land and areas to the south. Radiometric dating indicated a middle Proterozoic age (about 1380 Ma) for the deposition, but more recent SHRIMP U-Pb dates from intercalated volcanics in equivalent sandstones occurring within the Caledonian fold belt suggest that some of the sandstones were deposited before 1740 Ma ago. The new data post-date compilation of the map, where a middle Proterozoic age is indicated for the Independence Fjord Group.
The succession has primarily been studied in the type area around Independence Fjord in North Greenland, where deposition took place in an intracratonic sag basin. The Independence Fjord Group is dominated by alluvial clastic deposits, mainly sandstones that form three 300–900 m thick, laterally correlatable units. These are separated by two laterally extensive, much thinner (4–90 m) silt-dominated units that represent deposition in ephemeral lakes.

Zig-Zag Dal Basalt Formation, North Greenland

This middle Proterozoic formation [30] of up to 1350 m of well-preserved tholeiitic flood basalts is among the oldest well-preserved basalt sequences known; the main outcrops are south of Independence Fjord in eastern North Greenland. The Zig-Zag Dal Basalt Formation comformably overlies the Independence Fjord Group and is itself disconformably overlain by the Hagen Fjord Group. South of Independence Fjord the basalt sequence outcrops over an area of 10 000 km 2 , but the local occurrence of similar basalts in eastern Peary Land indicates that the formation once covered a very large part of North Greenland.

Gardar Province, South Greenland

The Mesoproterozoic Gardar Province is characterised by faulting, deposition of sediments and volcanic rocks, and alkaline igneous activity. An approximately 3400 m thick succession of sandstones and lavas described as the Eriksfjord Formation accumulated within an ENE–WSW trending continental rift, preserved at about 61 o N. Within and outside the rift major central intrusions and numerous dykes were emplaced.

The Gardar intrusive complexes range in age from c. 1300 to c. 1120 Ma and have been divided into three age groups. These comprise central ring intrusions, complexes with several individual intrusive centres and giant dykes. Petrologically the intrusive complexes are dominated by differentiated salic rocks including syenites, nepheline syenites, quartz syenites, and granites; mildly alkaline gabbros and syenogabbros are subordinate but are dominant in the giant dykes. The intrusions were emplaced in the middle part of the Gardar rift as well as in the areas both to the north and south. Major swarms of basic dykes of Gardar age occur throughout South and South-West Greenland.

Mesoproterozoic orogenic units in the Caledonian fold belt

A Mesoproterozoic 'Grenvillian- event has been recorded in the crystalline rocks of the Caledonian fold belt between Scoresby Sund (70ºN) and Grandjean Fjord (76ºN). A thick sequence of middle Proterozoic metasediments, the Krummedal supracrustal sequence, rests on early Proterozoic and Archaean basement gneisses. During a tectonometamorphic event around 950 Ma ago the supracrustal rocks and the underlying basement rocks were apparently reworked to form a migmatite and paragneiss complex containing granite and augen granite intrusions. Zircon and Rb-Sr whole rock studies indicated some of the granites were c. 1000 Ma old, and SHRIMP studies on zircons from a major granite body (74º 19´N) yielding an age of c. 930 Ma have recently confirmed the Grenvillian age.

Meso – Neoproterozoic sedimentary basin in North-West Greenland

Thule Supergroup

The Thule Basin in North-West Greenland is one of several middle–late Proterozoic depocentres fringing the northern margin of the Canadian–Greenland shield. The basin fill consists of undeformed sediments and basaltic rocks assigned to the Thule Supergroup. The rocks are widely exposed in the region between Inglefield Land (79ºN) and Thule Air Base/Pituffik (76ºN) in Greenland and also crop out in the coastal regions of Ellesmere Island in Canada. The lower part of the basin-fill shows many similarities with the Independence Fjord Group and overlying volcanic rocks.

Neoproterozoic sedimentary basins in North, North-East and East Greenland

Hagen Fjord Group, North Greenland

Deposits of a late Proterozoic basin laid down between 800 and 590 Ma ago occur extensively in eastern North Greenland, where they crop out over an area of 10 000 km 2 west of Danmark Fjord. These deposits, assigned to the Hagen Fjord Group, overlie sandstones of the lower Proterozoic Independence Fjord Group and basalts of middle Proterozoic Zig-Zag Dal Basalt Formation. The easternmost occurrences of the succession are found in Caledonian thrust sheets with substantial westward displacement in Kronprins Christian Land, indicating that the basin originally had a wider eastwards extent.

The Hagen Fjord Group is an up to 1000 m thick succession of siliciclastic and carbonate sediments deposited on a shallow water shelf.

Eleonore Bay Supergroup, East and North-East Greenland

The Eleonore Bay Supergroup comprises an up to 16 km succession of shallow water sediments which accumulated in a major sedimentary basin extending between latitudes 71º40´ and 76º00´ N in East and North-East Greenland. Exposures occur within the present Caledonian fold belt, and in general are moderately deformed and weakly to moderately metamorphosed. The contact with the underlying basement is structural, variously described as an extensional detachment preceded or post-dated by thrusting. Sedimentation is constrained to the interval between c. 950 Ma and 610 Ma on the basis of Grenvillian ages on underlying basement rocks and the Varangian age of the overlying Tillite Group. Acritarchs from the three youngest groups of the Eleonore Bay Supergroup indicate a Sturtian age.

1.2.3 The Palaeozoic development

The Franklinian Basin of North Greenland

The Palaeozoic Franklinian Basin extends from the Canadian Arctic Islands across North Greenland to Kronprins Christian Land in eastern North Greenland, an E–W distance of 2000 km; only part of the Canadian segment of the basin is represented on the map. The preserved part of the succession shows that deposition in this E–W trending basin began in the latest Precambrian or earliest Cambrian and continued until at least earliest Devonian in Greenland and later Devonian to earliest Carboniferous in Canada; sedimentation was brought to a close by the mid- to late Palaeozoic Ellesmerian orogeny.

Throughout the Lower Palaeozoic, the basin in Greenland can be divided into a southern shelf and slope area and a northern deep water trough. The shelf succession is dominated by carbonates and reaches 3 km in thickness, whereas the trough deposits are dominated by siliciclastic rocks and have a total thickness of c. 8 km. The shelf–trough boundary was probably controlled by deep-seated faults, and with time the trough expanded southwards to new fault lines, with final foundering of the shelf areas in the Silurian.

Ellesmerian orogeny in North Greenland and Ellesmere Island

The Palaeozoic Ellesmerian orogeny, which brought sedimentation in the Franklinian Basin to a close, involved compression of the Lower Palaeozoic trough succession against the carbonate shelf to the south following collision with an unknown continent to the north. The resulting Ellesmerian fold belts of both North Greenland and northern Ellesmere Island are characterised by E–W to NE–SW trending chains of folds, broadly parallel to the main facies boundaries within the Franklinian Basin. In the North Greenland fold belt deformation is most intense in the north where three phases of folding are recognised and metamorphic grade reaches low amphibolite facies. Deformation decreases southwards, and the southern part of the fold belt is a thin-skinned fold and thrust zone that coincides with the region which was transitional between the platform and trough for much of the Cambrian.

Cambro–Ordovician sediments in the Caledonian fold belt in East Greenland
Cambrian–Ordovician rocks make up an approximately 4000 m thick sequence within the East Greenland Caledonian fold belt between latitudes 71º40' and 74º30'N. The sediments laid down in this Lower Palaeozoic basin are disturbed by large scale folding and faulting, but are non-metamorphic. Limestones and dolomites dominate the succession which spans the period from the earliest Cambrian to the Late Ordovician

Caledonian orogeny in East and North-East Greenland
The Caledonian fold belts on both sides of the North Atlantic developed as a consequence of collision between the continents of Laurentia to the west and Baltica to the east following closure of the proto-Atlantic ocean (Iapetus). The East Greenland Caledonian fold belt is well exposed between 70º and 81º30´N as a 1300 km long and up to 300 km wide coast-parallel belt. Large regions of the fold belt are characterised by reworked Precambrian basement rocks [74, 70, 52], overlain by middle and upper Proterozoic [46–43] and lower Palaeozoic [40] sediments. The deep-seated infrastructural levels are characterised by superimposed fold phases of several different ages, whereas the high level suprastructural levels exhibit relatively simple open folds of Caledonian age. Large scale west-directed nappes and thrust sheets interleave different levels of the Caledonian fold belt against each other and the margin of the Greenland shield. Extensional structures characterise some of the late tectonic phases. The southern and central parts of the fold belt in East Greenland mainly expose deep-seated infracrustal basement, whereas in the northernmost part of the fold belt in Kronprins Christian Land high level thin-skinned structures are preserved.
Devonian continental sediments in East Greenland
Following the Caledonian orogeny a period of extensional faulting led to the initiation of a Devonian sedimentary basin in central East Greenland. The Devonian sediments unconformably overlie Ordovician and older rocks, and are preserved in north–south trending graben-like structures.
The basin fill is of Middle and Late Devonian age [39] and consists of more than 8 km of continental siliciclastic sediments with some volcanic intervals. Four lithostratigraphic groups have been established, each corresponding to a tectonostratigraphic stage.

1.2.4 Mesozoic-Tertiary deposits

Carboniferous–Tertiary deposits of the Wandel Sea Basin, central and eastern North Greenland
The Wandel Sea Basin deposits were laid down along the northern and north-eastern margin of the Greenland shield. Three main phases of basin formation are recognised, commencing with a widespread Carboniferous to Triassic event of block faulting and regional subsidence. Later, during the Late Jurassic and Cretaceous, more localised basin for-

mation took place during two separate events in a strike-slip zone formed at the plate boundary between Greenland and Svalbard.

Late Palaeozoic and Mesozoic rift basins in East Greenland

A series of Carboniferous–Mesozoic sedimentary basins formed in East Greeland following initial post-Caledonian Devonian deposition. The basins formed as N–S trending coast-parallel depocentres which reflect prolonged subsidence. Important phases of block faulting and rifting took place during the Early and Late Carboniferous, Late Permian, Late Jurassic and Cretaceous, presaging the opening of the North Atlantic in the Late Paleocene. There is a marked difference in post-Carboniferous structural style and depositional history between the basins south and north of Kong Oscar Fjord (c. 72ºN). The Jameson Land Basin to the south developed as a Late Permian – Mesozoic sag basin, while the region to the north was characterised by continued block faulting and rifting.

The Jameson Land Basin contains a stratigraphically complete succession of Upper Permian to earliest Cretaceous sediments. Sediment infill was derived from both the east and west during most of the basin history.

Cretaceous–Tertiary sediments

In central West Greenland Cretaceous–Tertiary sediments [8] outcrop in the Disko–Svartenhuk Halvø region (69–72ºN) of West Greenland, where they are overlain by Lower Tertiary basalts. The sediments were laid down in the Nuussuaq Basin. Although now bounded to the east by an extensional fault system, the sediments may originally have extended both east and south of their present area of outcrop. Recently acquired seismic data indicate that the maximum thickness of sediments in the basin exceeds 8 km, but the age and character of the deepest sediments are not known.

Tertiary volcanics, intrusions and post-basaltic sediments

The early Tertiary lava regions of both West and East Greenland represent major eruption sites at the edges of the continent, from which lavas spilled over Mesozoic sedimentary basins and lapped onto the Precambrian basement of the continental interior. The volcanic products were formed during the initial phase of continental break-up and initiation of sea-floor spreading in the early Tertiary.

Tertiary basalts, central West Greenland

In central West Greenland Tertiary volcanics crop out between latitudes c. 69º and 73ºN. They are noted for the presence of native iron-bearing basalts and the large volumes of high-temperature picrites and olivine basalts. The composite thickness of the sequence varies between 4 and 10 km, with the smallest thickness on Disko and a maximum on Ubekendt Ejland/Illorsuit (71ºN).

Eruption of the basalts began in a submarine environment, and the earliest basalts, which occur to the west, consist of hyaloclastite breccias. When the growing volcanic pile became emergent, thin subaerial pahoehoe lava flows started to form. They flowed eastwards into a deep marine embayment where they became transformed into hyaloclastite breccias which prograded eastwards in large-scale Gilbert-type deltas with foresets up to 700 m high.

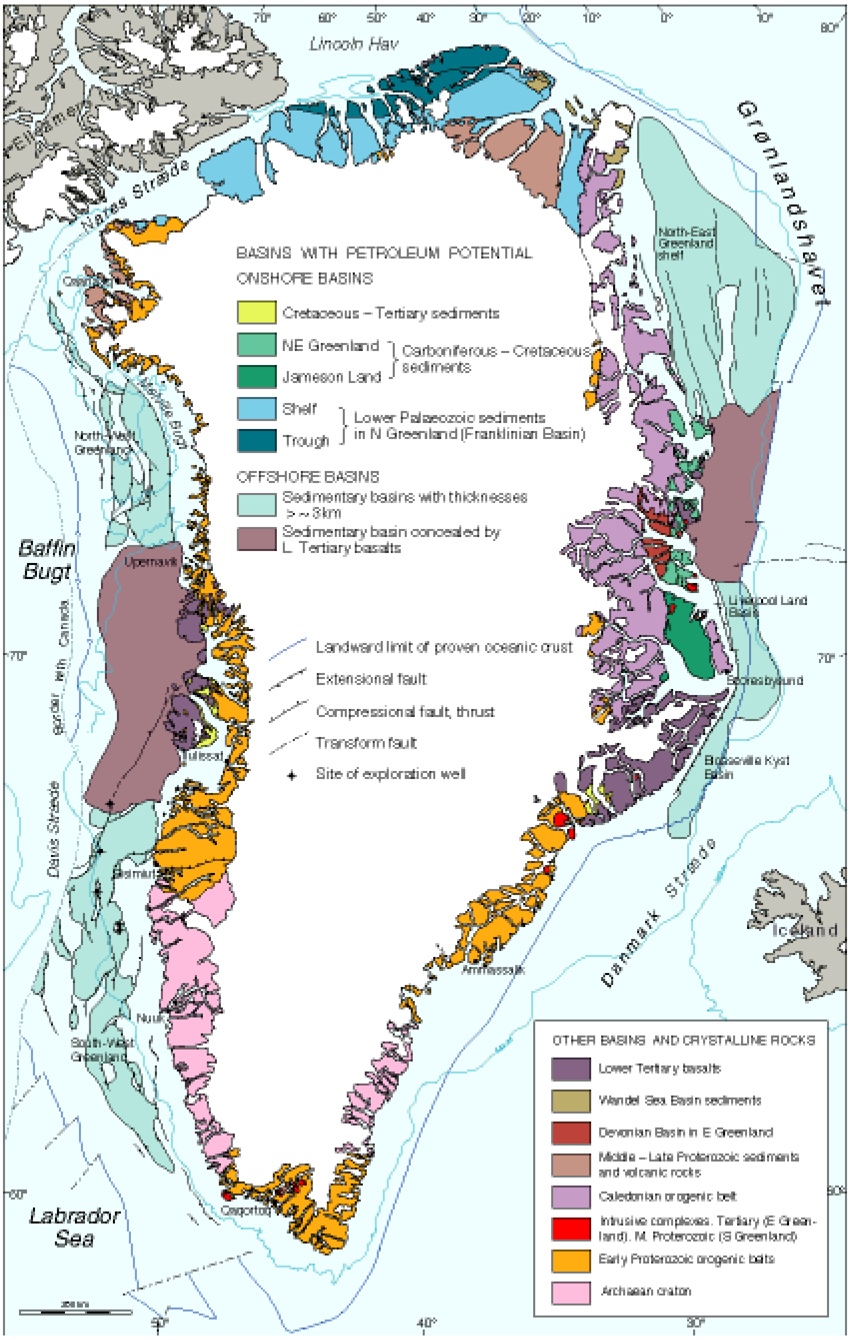
Tertiary basalts, East Greenland

In East Greenland early Tertiary volcanic rocks crop out in East Greenland between latitudes 68º and c. 75ºN. South of Scoresby Sund/Kangertittivaq (c. 70ºN) plateau basalts cover an extensive region of c. 65 000 km 2, resting on Mesozoic–Tertiary sediments in the east and south, and on Caledonian and Precambrian gneisses in the west. North of Scoresby Sund lower Tertiary basic sills and dykes are widespread in the Mesozoic sediments, and a further sequence of plateau basalts is found between latitudes 73º and 75º N. The earliest Tertiary volcanics are a c. 1.8–2.5 km thick succession of tholeiitic basalts with subordinate picrite [49], which occurs in the southernmost part of the volcanic province between 68º and 68º30'N. The basalts are aphyric or olivine-pyroxene-phyric, and the succession consists of intercalated subaerial flows, hyaloclastites, tuffs and sediments.

The main part of the region 68º–70ºN is made up of a thick succession of tholeiitic plateau basalts which form 5–50 m thick subaerial flows of plagioclase-phyric to aphyric basalt. The succession is at least 5.5 km thick in the central Blosseville Kyst area and thins inland and to the north to 2–3 km.

2. Offshore Geology (after Henriksen et al. 2003)

Interpretation of the offshore geology around Greenland is based mainly on seismic surveys, supplemented by aeromagnetic and gravimetric data and, in the case of southern West Greenland, by data from five exploration wells drilled in 1976–77. Offshore South-East Greenland six holes have recently been drilled (three are shown on the map) in connection with the Ocean Drilling Project.



2.1 The continental margin off East and North Greenland

The continental margin off East Greenland between 60 o and 76 o N can in general terms be described as a volcanic rifted margin. The position of the continent–ocean transition was drawn on the basis of aeromagnetic data supplemented by characteristic features in the NAD reflection seismic data. The absolute seawards (eastern) limit of continental crust cannot overlap areas where linear magnetic anomalies characteristic of oceanic crust can be identified.

The zone off East Greenland shown on the map as underlain by transitional crust [b] was drawn in a rather arbitrary manner, at least with regards to its width. This zone is thought to consist of continental crust with increasing numbers of dykes and other intrusions as oceanic crust is approached.

The north-east margin of continental Greenland, north of 78 o N, has a very different character. It is shown as a former intracontinental transform plate boundary. According to current interpretations of the history of the opening of the Greenland – Norwegian Sea and Arctic Ocean a substantial dextral lateral displacement of Svalbard relative to North-East Greenland took place in the time interval corresponding to magnetochrons 24R–13 (earliest Eocene – earliest Oligocene), prior to the opening of the Fram Strait between Greenland and Svalbard.

2.2 The continental margin off West Greenland

The continental margin off West Greenland is complex and the interpretation is a subject of discussions. The transition zone between typical oceanic and normal continental crust is certainly much wider off southern West Greenland than it is thought to be anywhere off East and South-East Greenland. The seawards limit of normal continental crust off southern West Greenland lies well to the south-west of the continental slope, at water depths of more than 1500 m. This interpretation of the distribution of crustal types is supported by the structural pattern seen in the seismic lines. Both the normal continental crust and the zone of transitional crust show large tilted fault blocks overlain by syn- and post-rift sediments. The oldest sediments are most likely of Early Cretaceous age.

The crust under Davis Stræde (Davis Strait) is estimated to be 22 km thick, which is intermediate between the thickness of normal oceanic and continental crust.

The crust is therefore interpreted by the Survey as being formed of thinned continental crust, in accordance with the interpretation of the distribution of crustal types farther south.

The nature of the crust underlying Baffin Bugt is not obvious. There are no distinct sea-floor spreading magnetic anomalies in this region.

2.3 Offshore sedimentary basins

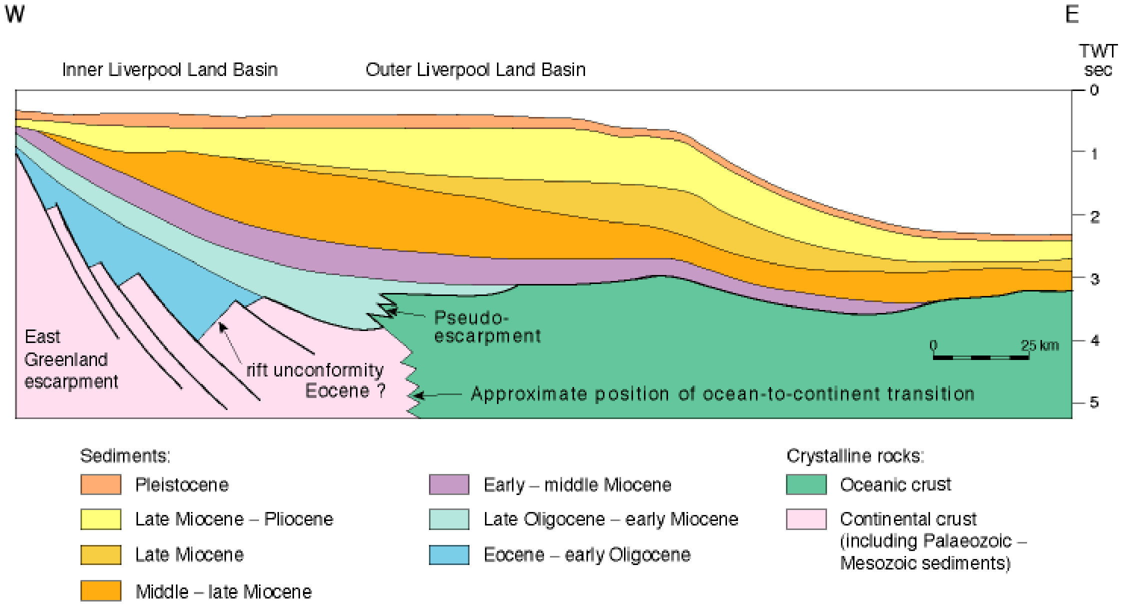
Reflection seismic surveys have shown that large sedimentary basins occur offshore East Greenland between latitudes 67 o –72 o N and 75 o –77 o N, and offshore West Greenland between 63 o –68 o N and 73 o –77 o N. In the intervening areas off both East and West Greenland there are extensive Lower Tertiary basalts below which there are expected to be thick sedimentary successions, but these cannot be resolved in the seismic data.

2.4 North-East Greenland shelf (72°–80°N)

The existence of thick sedimentary successions on the North-East Greenland shelf was first suggested on the basis of interpretation of aeromagnetic data. Judging from the known geology of the Barents Sea, the Norwegian shelf and onshore North-East Greenland, the age of these sediments is likely to be Devonian to Recent, with unconformities in the middle Permian and in the Cretaceous.
On the shelf between latitudes 72 o 15' and 75 o 30'N extensive volcanic rocks of presumed Early Tertiary age have been interpreted from the aeromagnetic and seismic data. In the near-shore area these are exposed at the seabed; eastwards they become increasingly deeply buried under younger sediments. It is considered almost certain that the pre-Tertiary sediments interpreted to the north and south of this area continue beneath the volcanic rocks.

2.5 Liverpool Land Basin, East Greenland (70°–72°N

A very thick succession of sediments can be recognised in the seismic data offshore Liverpool Land. The sediments are particularly thick within the part of the area underlain by continental crust, where the base of the sediments cannot be identified on the existing data. The upper part of the sedimentary succession is a virtually complete Tertiary succession up to 6 km thick; this formed a large prograding wedge that spread out across both continental and oceanic crust from the mouth of present-day Scoresby Sund. In the part of the area underlain by continental crust the Tertiary succession lies with angular unconformity on block-faulted and tilted sediments of pre-Tertiary (Late Palaeozoic – Mesozoic) age, while where the Tertiary sediments have prograded into the area underlain by oceanic crust, the subsurface consists of subaerial lavas seen as seaward-dipping reflectors in the seismic data.



E-W cross-section across the transition from continental crust to oceanic crust and the overlying Liverpool Land Basin at c.71 o N, East Greenland. Vertical exaggeration x 3.8.

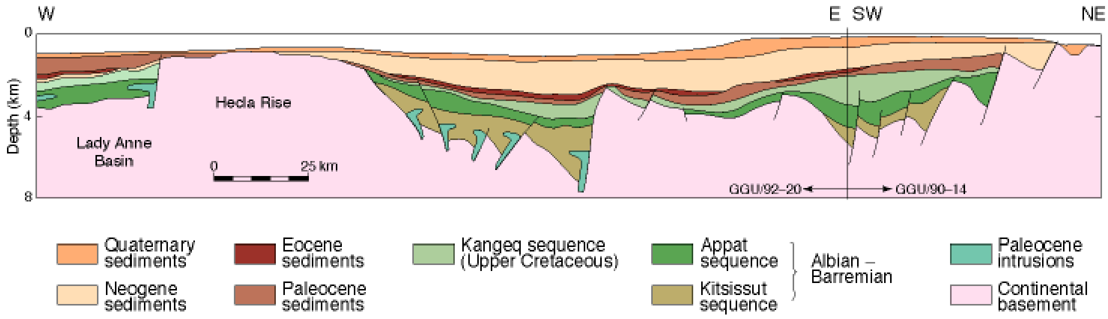
2.6 Blosseville Kyst Basin, East Greenland (67°–70°N)

More than 4 km of post-middle Eocene sediments occupy an elongate, coast-parallel sedimentary basin off the Blosseville Kyst. The sediments lie entirely on a subsurface of Lower Tertiary basalts. In the area underlain by continental crust there are almost certainly Mesozoic and Paleocene sediments beneath the basalts, as there are onshore and farther to the south. However, it is not possible to interpret the geology underlying the basalts on the basis of existing seismic data.

2.7 Southern West Greenland (60°–68°N)

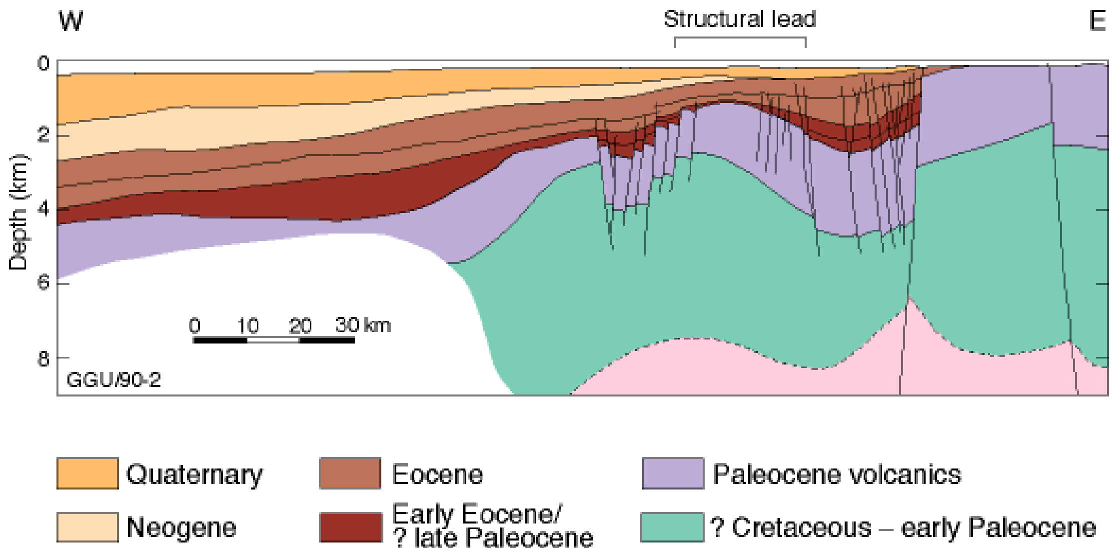
The earliest sediments offshore southern West Greenland are pre- and syn-rift sequences up to 3 km or more in thickness, the Kitsissut and Appat sequences; by analogy with the better known Labrador Shelf, these are believed to be Early Cretaceous (Barremian–Albian) in age.

These successions are overlain by a widespread Upper Cretaceous mudstone sequence, the Kangeq sequence, the upper part of which was penetrat in the Ikermiut–1 well (c. 67 0 N). A major hiatus spanning the interval Campanian – early Paleocene probably reflects the same episode(s) of faulting, uplift and erosion as are recorded in the succession in the Nuussuaq Basin. Following these disturbances fan sands intercalated with mudstones were deposited. Deposition of mudstones continued into the early Eocene, but from the middle Eocene sedimentation was dominated by coarser clastic sediments deposited in simple prograding sequences.



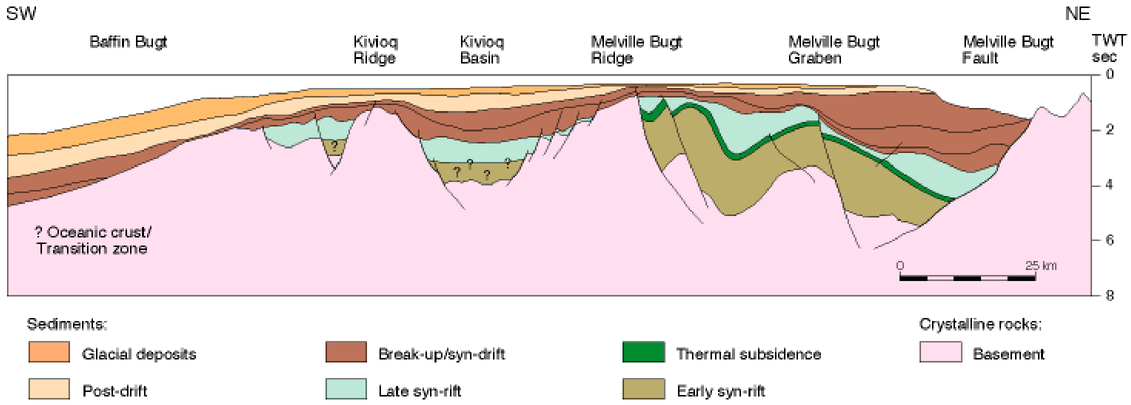
2.8 Central West Greenland (68°–73°N)

The Lower Tertiary basalts exposed onshore in the Disko – Nuussuaq – Svartenhuk Halvø area continue offshore where they have been mapped from seismic and magnetic data over the entire area between latitudes 68 o and 73 o N. In the eastern part of this area the basalts are exposed at the seabed and have been sampled by dredging, but to the west they become increasingly buried under a cover of Eocene and younger sediments. Below the basalts underlaying sediments may be as much as 5 km in thickness.



2.9 North-West Greenland (73°–78°N)

North of 73 o N the new seismic data acquired as part of the KANUMAS project have confirmed the existence of a very deep graben or half-graben in the west and south-west part of Melville Bugt. This had earlier been outlined from aeromagnetic and gravity data acquired in the late 1960s and early 1970s. The new data have also revealed several other graben and half-graben structures extending to the northern limit of the survey at 76 o 30'N. In the Melville Bugt graben the thickness of sediments exceeds 13 km.



3. Available GIS Geo-database of Greenland

The available digital maps and geo-database covering the entire Greenland have three levels of details: 1:5 000 000 scale, 1:2 500 000 scale and 1:500 000 scale. Moreover, part of Greenland is covered with more detail and, in particular, the East Greenland margin where the Scoresby Sund sheet n. 14 at 1:500 000 scale is in part completed at 1:100 000 scale. All these maps are in GIS format with attribute tables descriptive of the legend, with information levels including designation of Age, Group and Formation. The proposal for constructing GL3D is to consider four levels of detail and the corresponding legends to be used.

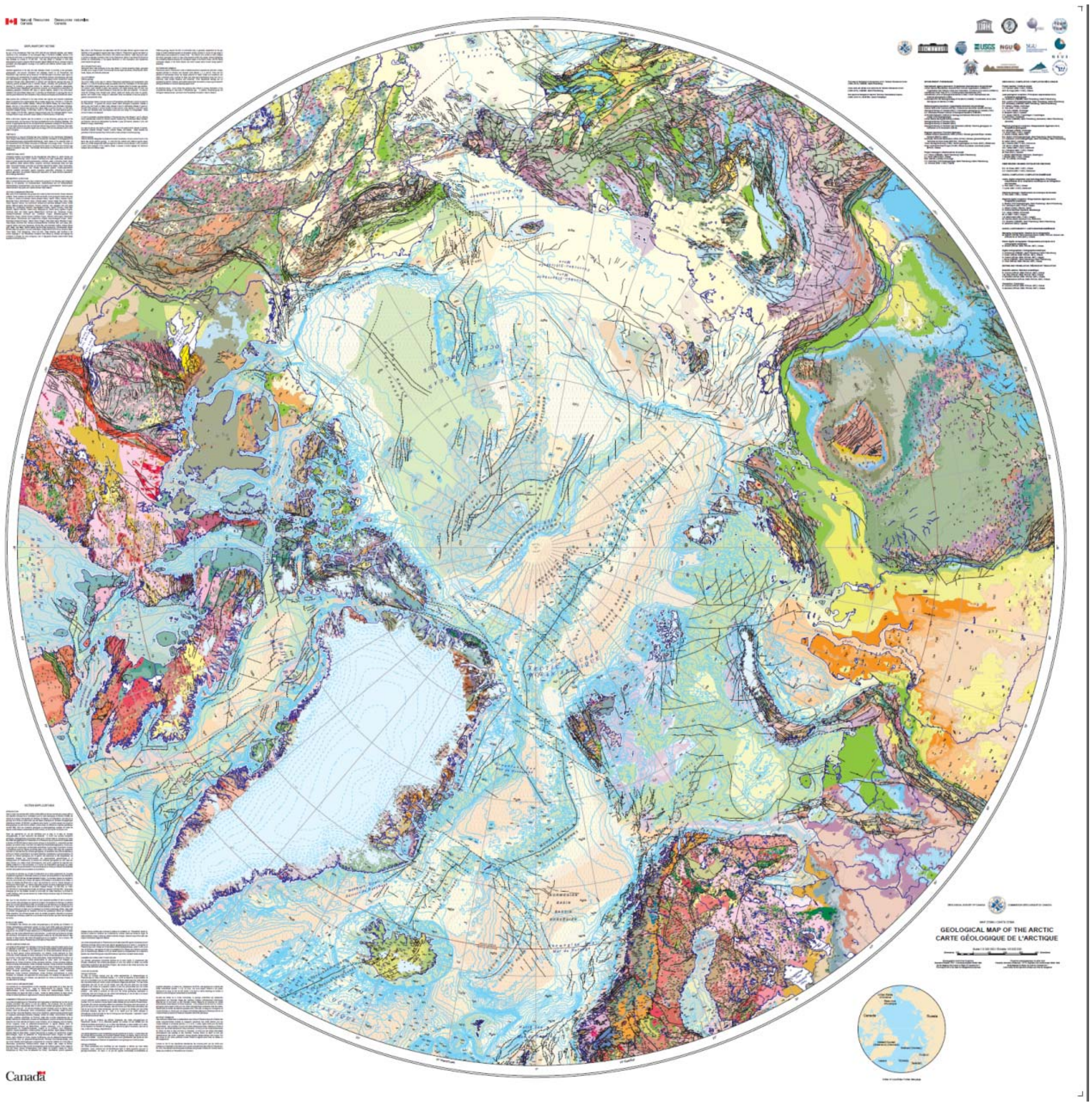
3.1 Geological Map of the Arctic 1:5 000 000 scale (After Harrison et al. 2011)

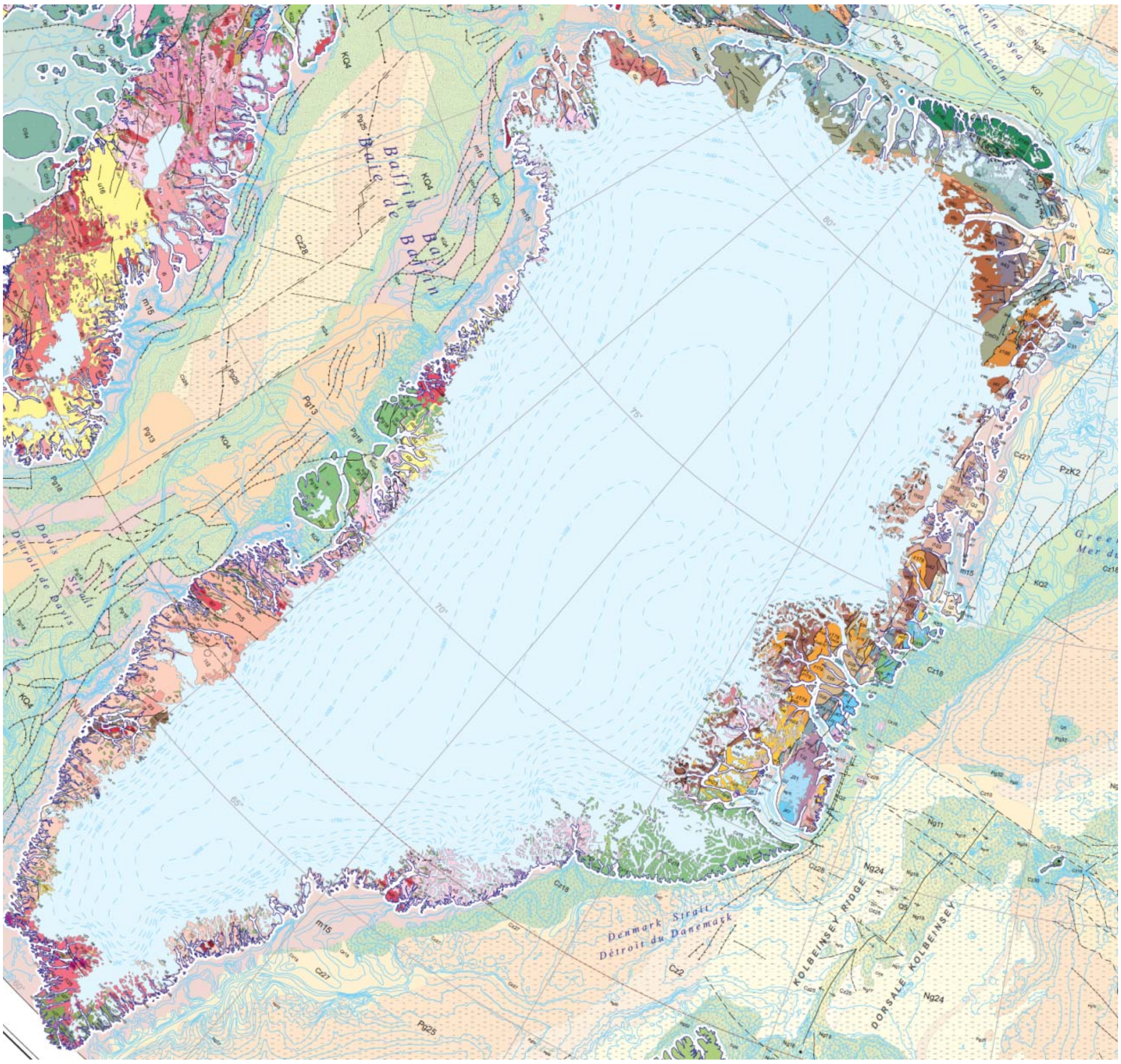
3.1.1 Introduction

As part of the International Polar Year (IPY) 2007–08 and 2008–09 activities, and related objectives of the Commission for the Geological Map of the World (CGMW), nations of the circumpolar Arctic have co-operated to produce a new bedrock geology map and related digital map database at a scale of 1:5 000 000.

Identified applications of the map and map database include: 1) providing a new geological, physiographic, and tectonic compilation and database context for all Precambrian and Phanerozoic map units that can be shown at 1:5 000 000 scale in the Arctic polar region.

Data sources that contributed to the map include new regional and national compilations simplified from original spatial data at scales ranging from 1:50 000 to 1:5 000 000. New compilation work includes Sweden, onshore and offshore Russia, the United States in Alaska, and two of the northern territories of Canada (Nunavut and Northwest Territories). Existing published material was derived from digital maps of northern Europe (1:4 000 000), Greenland (Kalaallit Nunaat, 1:2 500 000), Yukon (1:1 000 000), and other selected parts of Arctic Canada (1:5 000 000). Captured analog sources cover the northwest Atlantic Ocean, northeast Pacific Ocean, and Arctic Ocean offshore of North America (1:5 000 000).


GEOLOGICAL MAP OF THE ARCTIC
CARTE GÉOLOGIQUE DE L'ARCTIQUE
Canada



3.1.2 Time scale

Standardization of map-unit attributes has been facilitated by the International Stratigraphic Chart (August 2009 version) published by the International Commission on Stratigraphy (ICS) (http://www.stratigraphy.org/upload/ISChart2009.pdf), which draws on the absolute scale for the Precambrian and the relative time scale for Ediacaran and younger rocks. The map and GIS database feature 135 divisions of geological time based on maximum and minimum age ranges of compilation map units. This includes 105 divisions in the Phanerozoic and 30 in the Precambrian.

3.1.3 Compositional units

Lithological variation is expressed by 28 compositional units, which include one supracrustal (sedimentary and/or volcanic: undivided) and eight sedimentary associations based on gross depositional setting (sedimentary: undivided, clastic: continental, clastic: deltaic and nearshore, clastic: shallow marine, evaporite, carbonate, sedimentary: slope and deep water, marine sedimentary: undivided); six extrusive associations (alkalic, felsic, intermediate, mafic, ultramafic, undivided); nine intrusive associations (granitic, tonalitic-granodioritic, gabbroic, peridotitic, anorthositic, syenitic, kimberlitic, carbonatitic, undivided); an undivided igneous association; an undivided metamorphic association; an impact structure association; and a mélange association.

3.1.4 Metamorphic conditions

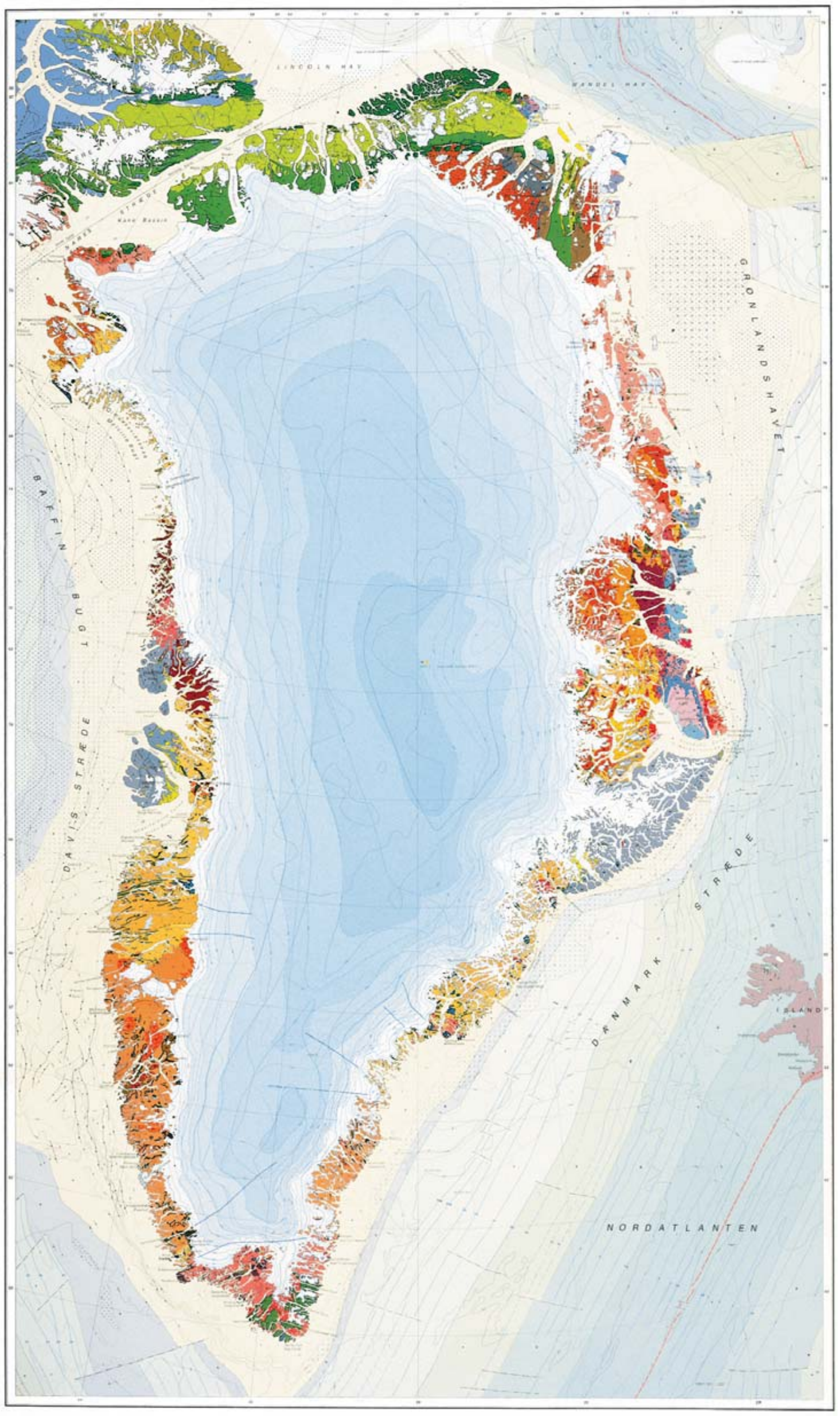
Data on metamorphism have also been collected and: not specified, not metamorphosed, metamorphosed and not metamorphosed, metamorphosed, metamorphosed: very low and low grade, metamorphosed: medium grade, metamorphosed: high grade, and metamorphosed: high pressure.

3.1.5 Tectonic domains and regions

Map units in the Precambrian are grouped and coded by their host tectonic domain wherever possible. These domains include: the Archean craton (North Atlantic Craton); magmatic arcs and suites (Gardar Province); orogens, fold-thrust belts, and folded regions (Caledonian Orogen, Ellesmere-Inglefield belt, Ellesmerian Orogen, Ketilidian Orogen); post-orogenic basins and cover sequences (Eleonore Bay Supergroup, Independence Fjord Group).
Map units in the Phanerozoic are associated with 58 informally defined regions. Phanerozoic regions are based on major physiographic features of the Arctic, both onshore and offshore.

3.2 Geological Map of Greenland 1:2 500 000 scale (after Henriksen et al 2009)

Two different legend concepts have been used – one for the onshore ice-free areas and one for the offshore regions.
In the legend for the ice-free land areas a distinction has been made between rocks older and younger than 1600 Ma. In the older group, which mainly comprises crystalline rocks of the stable Precambrian Greenland shield, the rock units are distinguished according to their lithology and age; the extent of regional tectono-metamorphic provinces is also depicted. Developments younger than 1600 Ma are shown in relation to the formation of sedimentary basins and orogenic belts along the margins of the stable shield. The principal subdivision depicted on the map illustrates the general depositional environment, age and extent of the main sedimentary and volcanic basins and, in the Franklinian Basin in North Greenland, the overall depositional setting. Younger crystalline gneisses and plutonic rocks are distinguished by lithology, and age of orogenic formation and emplacement. A schematic chronological representation of the geological units shown on the map is included in the map legend.



The legend concept for the offshore areas is based on geological interpretation of the available geophysical 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 based on magnetic anomaly patterns. Magnetic anomaly lines with chron-numbers are shown, together with spreading axes and transform faults. Major sedimentary basins are indicated by isopachs showing the sediment thickness superimposed on a representation of crustal type. Volcanic rocks exposed on the seabed (mostly Tertiary in age) are also shown. Geological units indicated by key numbers in brackets ( ) in the following text refer to numbers in the map legend.

The legend is subdivided into 86 units onshore and essentially four offshore units which are listed in the following table. About 11 regional geological profiles onshore and offshore are presented in the map description of the 1: 2 500 000 map. The legends to the geological profiles do not match up with the legend to the map. Additional eight geological profiles can be included from the East Greenland Caledonian margin (1:1000 000 map in Henriksen, 2003).
Note: there are probably more subregional profiles in different publications that can be included.

3.2.1 Legend explanation

Geological units
Onshore: indicated by numbers **[1]–[86]** in the map legend.
Offshore: indicated by letters **[a]–[g]** and six ornamentations in the map legend.
Referred page numbers from Henriksen et al. 2009.

Onshore
[1] Sverdrup Basin (undifferentiated). Unit occurs only on Ellesmere Island, Canada.
[2] Pearya – mainly exotic terrane. Unit occurs only in northernmost Ellesmere Island, Canada (p. 49).
[3]–[5] Middle Mesoproterozoic to early Neoproterozoic Thule Supergroup (p. 40), North-West Greenland. Age shown on map legend must be revised according to more recent acritarch studies.
[3] Carbonate and siliciclastic sediments: Narssârssuk Group, North-West Greenland (p. 40).
[4] Shales and siltstones: Dundas Group, North-West Greenland.
[5] Sandstones and shales: Smith Sound, Nares Strait and Baffin Bay Groups, North-West Greenland (p. 40).
[6] Palaeogene tholeiitic lavas, central West Greenland (p. 60).
[7] Palaeogene picritic lavas, central West Greenland (p. 60).
[8] Cretaceous–Paleocene sediments: Nuussuaq Group, central West Greenland (p. 57).
[9] Ordovician limestone in fault block in Archaean gneiss. 'Fossilik' locality (Stouge & Peel 1979), southern West Greenland (65°25´N) (pp. 71, 75).
[10] Phanerozoic limestones in fault block within reworked Archaean gneiss (Peel & Secher 1979), southern West Greenland (66°32´N).
[11] Basaltic lavas: Eriksfjord Formation, Mesoproterozoic, Gardar Province, South Greenland (p. 38).
[12] Continental sandstones and conglomerates: Eriksfjord Formation, Mesoproterozoic, Gardar Province, South Greenland (p. 38).
[13] Pliocene–Pleistocene sand-silt deposits: Kap København Formation, central North Greenland (p. 62).
[14] Paleocene–Eocene fluviatile and marine sandstones: Thyra Ø Formation, Wandel Sea Basin, eastern North Greenland (pp. 54, 55).
[15] Upper Cretaceous sandstones and shales: Herlufsholm Strand Formation and correlatives, Wandel Sea Basin, central and eastern
North Greenland (p. 54).
[16] Lower Paleocene basic volcanics and volcanogenic sediments: Kap Washington Group, Wandel Sea Basin, central North Greenland (p. 54).
[17] Upper Jurassic – Lower Cretaceous sandstones and shales: Ladegårdsåen Formation and correlatives, Wandel Sea Basin, central and eastern North Greenland (p. 54).
[18] Upper Permian – Middle Triassic shales and sandstones: Trolle Land Group, Wandel Sea Basin, central and eastern North Greenland (p. 54).
[19] Upper Carboniferous – Lower Permian carbonates: Mallemuk Mountain Group, Wandel Sea Basin, central and eastern North Greenland (p. 54).
[20] Lower Carboniferous sandstones and siltstones: Sortebakker Formation, Wandel Sea Basin, eastern North Greenland (p. 54).
[21] Silurian carbonates deposited on shelf and slope areas: Washington Land Group, Franklinian Basin, North Greenland (pp. 46, 47).
[22] Silurian sandstones and siltstones deposited in deep-water turbiditic trough: Peary Land Group, Franklinian Basin, North Greenland and Ellesmere Island (pp. 46, 47).
[23] Lower Cambrian – Lower Silurian carbonates from shelf and slope areas: Brønlund Fjord, Tavsen Iskappe, Ryder Gletscher and Morris Bugt Groups, Franklinian Basin, North and North-West Greenland and Ellesmere Island (pp. 45, 46).

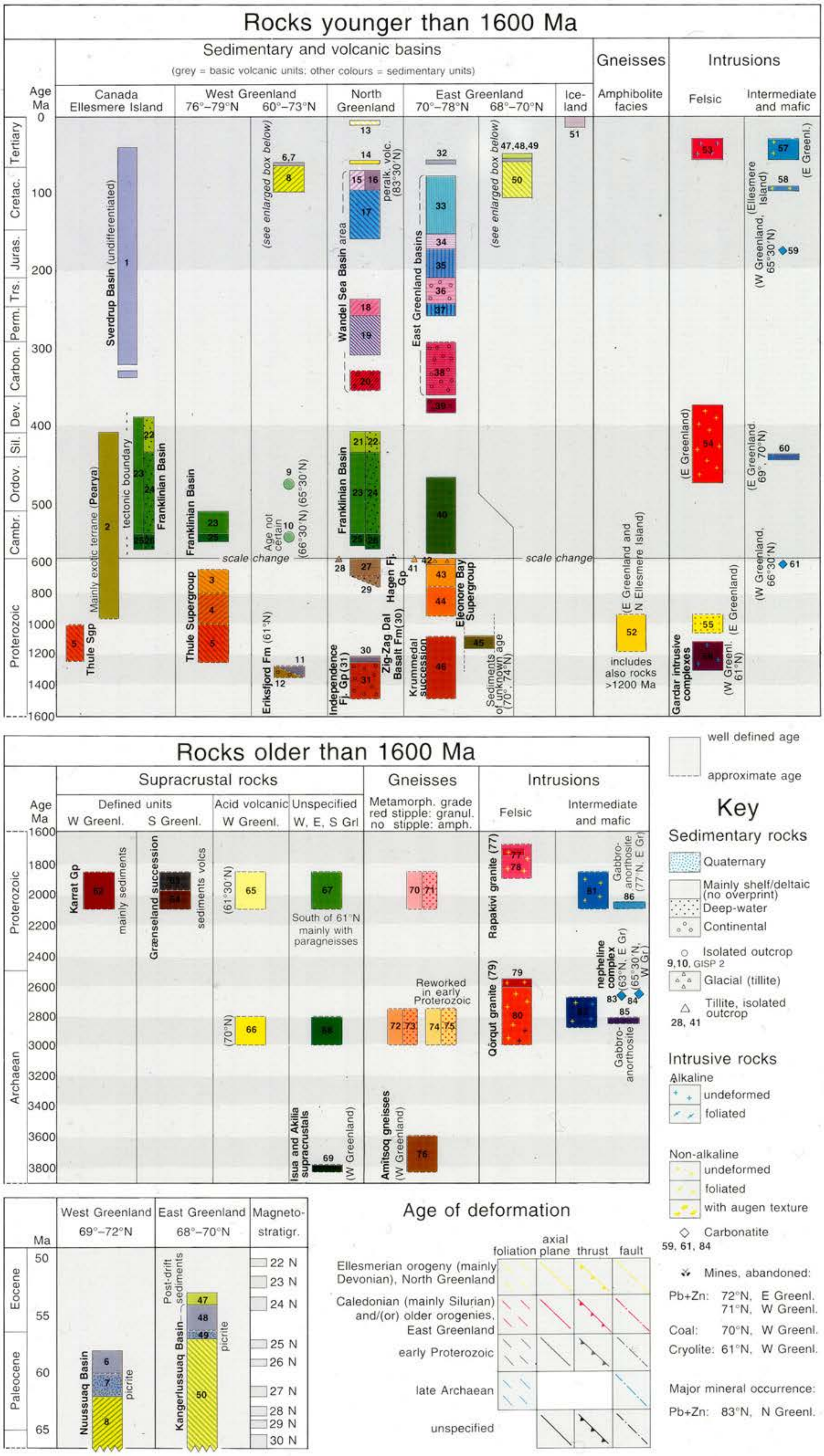
[24] Upper part of Lower Cambrian – Lower Silurian mudstones and shales: starved slope and trough deposits, Vølvedal and Amundsen Land Groups, Franklinian Basin, North Greenland and Ellesmere Island (pp. 46, 82).
[25] Lower Cambrian carbonates and siliciclastic sediments; shallow water deposits: Portfjeld and Buen Formations, Franklinian Basin, North and North-West Greenland and Ellesmere Island (pp. 46).
[26] Upper Neoproterozoic – Lower Cambrian calcareous mudstones and sandy turbidites: Skagen, Paradisfjeld and Polkorridoren Groups, deep-water trough deposits in the Franklinian Basin in North Greenland and on Ellesmere Island (pp. 45, 46).
[27] Neoproterozoic siliciclastic and carbonate sediments: Hagen Fjord Group, North Greenland (p. 41).
[28] Upper Neoproterozoic (Marinoan ~ uppermost Cryogenian) diamictites and sandstones: Morænesø Formation, central North Greenland (pp. 41, 43).
[29] Neoproterozoic sandstones in Caledonian nappe units: Rivieradal Group, in part older than the Hagen Fjord Group, eastern North Greenland (p. 41).
[30] Mesoproterozoic tholeiitic basalts (1380 Ma): Zig-Zag Dal Basalt Formation, central and eastern North Greenland west of Danmark Fjord (pp. 33, 35). Basalts in Kronprins Christian Land, east of Danmark Fjord, indicated on the map as Zig-Zag Dal Basalt Formation, are 1740 Ma old, i.e. much older.
[31] Palaeo- to Mesoproterozoic sandstones: Independence Fjord Group, central and eastern North Greenland. Shown as Meso - proterozoic on the map legend, but new age dating shows that parts are around 1740 Ma (pp. 33, 35).
[32] Palaeogene (Paleocene–Eocene) plateau basalts: North-East Greenland (p. 61).
[33] Upper Jurassic and Lower Cretaceous shallow marine sandstones: Raukelv, Hesteelv, Lindemans Bugt and Palnatokes Bjerg
Formations and Aptian–Albian sediments, central East and North-East Greenland (pp. 56, 57). A revised stratigraphy has been proposed by Surlyk (2003).
[34] Middle–Upper Jurassic marine sandstones and shales: Vardekløft, Olympen, Hareelv and Bernberg Formations, central East and North-East Greenland (pp. 56, 57). A revised stratigraphy has been proposed by Surlyk (2003).
[35] Upper Triassic – Lower Jurassic lacustrine sandstones and shales: Kap Stewart and Neill Klinter Groups, central East Greenland (p. 56). A revised stratigraphy has been proposed by Surlyk (2003).
[36] Lower–Upper Triassic alluvial sandstones and lacustrine dolomites and shales: Pingo Dal, Gipsdalen and Fleming Fjord Formations, central East Greenland (pp. 56, 57).
[37] Upper Permian – Lower Triassic shallow marine carbonates, sandstones and shales: Foldvik Creek Group and Wordie Creek Formation, central East Greenland (pp. 56, 57).
[38] Carboniferous – Lower Permian fluvial sandstones and shales, central East and North-East Greenland (pp. 53, 55).
[39] Middle–Upper Devonian continental siliciclastic sedimentary rocks: Vilddal, Kap Kolthoff, Kap Graah and Celsius Bjerg Groups, North-East and central East Greenland (pp. 52, 53).
[40] Cambro-Ordovician dominantly limestones and dolomites in the East Greenland Caledonian fold belt: Kløftelv, Bastion, Ella Ø, Hyolithus Creek, Dolomite Point, Antiklinalbugt, Cape Weber, Narwhale Sound and Heim Bjerge Formations, North- East Greenland (p. 50).
[41] Tillites of supposed Marinoan (uppermost Cryogenian) age in isolated occurrences, central East Greenland (p. 43).
[42] Diamictites, sandstones, shales and dolostones in succession of Marinoan – Ediacaran age: Tillite Group in East Greenland Caledonian fold belt, North-East Greenland (pp. 42, 43).
[43] Succession of siliciclastic, calcareous and dolomitic sediments of Neoproterozoic (Cryogenian) age: upper Eleonore Bay Supergroup including Lyell Land, Ymer Ø and Andrée Land Groups, East Greenland Caledonian fold belt, North-East Greenland (pp. 42, 43).
[44] Succession of sandstones and siltstones of Neoproterozoic (Tonian–Cryogenian) age: lower Eleonore Bay Supergroup –
the Nathorst Land Group, East Greenland Caledonian fold belt, North-East Greenland (pp. 42, 43).
[45] Palaeoproterozoic to early Palaeozoic. Mixed basement gneisses, metasedimentary rocks, greenstones, tillites and sedimentary
rocks. Exposed in tectonic windows in the East Greenland Caledonian fold belt, North-East Greenland (pp. 31, 43).
[46] Late Mesoproterozoic to early Neoproterozoic metasedimentary rocks in the East Greenland Caledonian fold belt: Krummedal
supracrustal sequence and correlative Smallefjord sequence, North-East Greenland (pp. 38, 39).
[47] Eocene siliciclastic sedimentary rocks overlying Lower Palaeogene basalts, central and southern East Greenland (p. 62).
[48] Eocene tholeiitic plateau basalts in central and southern East Greenland (p. 61).
[49] Paleocene tholeiitic basalts with picritic intervals, southern East Greenland (p. 61).
[50] Lower Cretaceous – Upper Paleocene sandstones and shales. Pre-basaltic succession in Kangerlussuaq Basin, southern East Greenland (p. 60).
[51] Neogene and Quaternary volcanic rocks in Iceland, predominantly basalt lavas.
[52]Migmatites and gneisses of Palaeoproterozoic to early Neoproterozoic and Caledonian origin in the East Greenland Caledonian fold belt, central East and North-East Greenland (pp. 39, 50) and Ellesmere Island, Canada (p. 49).
[53] Palaeogene felsic intrusions in East Greenland (p. 62).
[54] Late- to post-kinematic granitic *s.l.* intrusions in the East Greenland Caledonian fold belt, central East and North-East Greenland (pp. 39, 51).

[55] Neoproterozoic augen granite intrusions, deformed during the Caledonian orogeny, central East and North-East Greenland (pp. 38, 39).
[56] Mesoproterozoic intrusive complexes, mainly syenites: Gardar Province, South Greenland (pp. 38, 82).
[57] Palaeogene mafic to intermediate intrusive complexes in East Greenland (p. 62).
[58] Upper Cretaceous gabbroic intrusion. Pearya terrane, Ellesmere Island, Canada.
[59] Middle Jurassic carbonatite complex: Qaqarssuk, southern West Greenland (pp. 44, 82).
[60] Silurian pyroxenitic intrusions in Archaean granulite gneisses: Batbjerg complex, southern East Greenland (p. 51).
[61] Late Neoproterozoic carbonatite complex in Archaean gneisses: Sarfartoq, southern West Greenland (pp. 44, 82).
[62] Palaeoproterozoic metasedimentary rocks (marbles and siliciclastic rocks) in the Rinkian fold belt: Karrat Group comprising the Mârmorilik, Qeqertarssuaq and Nûkavsak Formations,central West Greenland (pp. 25, 26, 81).
[63] Palaeoproterozoic basic metavolcanic rocks: Sortis Group in the northern border zone of the Ketilidian orogen, South-West Greenland (pp. 28, 29).
[64] Palaeoproterozoic metasedimentary rocks: Vallen Group in the northern border zone of the Ketilidian orogen, South-West Greenland (pp. 28, 29).
[65] Palaeoproterozoic acid metavolcanic rocks in the Ketilidian orogen, South Greenland (p. 30).
[66] Archaean acid metavolcanic rocks north-east of Disko Bugt in the Rinkian fold belt, central West Greenland (p. 26).
[67] Palaeoproterozoic, high-grade supracrustal units (paragneisses, marbles, quartzites and basic metavolcanic rocks) in Palaeoproterozoic orogenic belts (pp. 23, 24, 28, 30, 32).
[68] Meso- and Neoarchaean supracrustal rocks (amphibolites and gneissic metasediments) in the Archaean craton, West Greenland and South-East Greenland (pp. 19, 23, 26).
[69] Eoarchaean supracrustal rocks (Isua and Akilia assemblages) in the Archaean craton, southern West Greenland (pp. 17, 18, 80).
[70] Palaeoproterozoic amphibolite facies gneisses (generally orthogneisses) dominantly of juvenile Proterozoic origin. Ketilidian orogen, South and South-East Greenland (pp. 28, 29) and basement in northern part of Caledonian fold belt in North-East Greenland (pp. 31, 32, 38, 50).
[71] Palaeoproterozoic gneisses in granulite facies: Inglefield Land orogenic belt, North-West Greenland and Ellesmere Island, Canada (p. 28); Nagssugtoqidian orogen, South-East Greenland (p. 25) and Caledonian fold belt in North-East Greenland (p. 32).
[72] Meso- and Neoarchaean orthogneisses in amphibolite facies. Archaean craton, southern West Greenland and South-East Greenland (pp. 19, 20).
73]Meso- and Neoarchaean orthogneisses in granulite facies. Archaean craton, southern West Greenland and South-East Greenland (pp. 19, 20).
[74] Reworked amphibolite facies Archaean gneisses in Palaeo - proterozoic orogens in West and South-East Greenland (pp. 22, 25–27) and in the basement of the southern part of the East Greenland Caledonian fold belt, central East Greenland (pp. 31, 32, 50).
[75] Reworked Archaean granulite facies gneisses in Palaeoproterozoic orogens in central and southern West Greenland (pp. 22, 24) and in South-East Greenland (p. 24).
[76] Eoarchaean gneisses in the core of the Archaean craton in southern West Greenland: 'Amîtsoq gneiss' (p. 18).
[77] Palaeoproterozoic rapakivi 'granites' in the Ketilidian orogen, South Greenland (pp. 28, 30, 38).
[78] Palaeoproterozoic granites: the Julianehåb batholith in the Ketilidian orogen, South Greenland (pp. 28, 29); the Prøven Igneous Complex in the Rinkian fold belt (pp. 26, 27) and some granites in the Nagssugtoqidian orogen of southern West and South- East Greenland (pp. 24, 25) and within the basement of the Caledonian fold belt in East Greenland (p. 31).
[79] Neoarchaean post-tectonic granite complex: Qôrqut granite, southern West Greenland (p. 21).
[80]Meso- to Neoarchaean granitic to tonalitic plutonic rocks; early–late kinematic intrusions: Taserssuaq tonalite, Ilivertalik augen granite, southern West Greenland (pp. 20, 21, 24). In South-East Greenland syenitic and granitic rocks (p. 21), and an intrusive complex in central West Greenland (p. 26).
[81] Palaeoproterozoic intermediate plutonic rocks in the Nagssugtoqidian orogen: Arfersiorfik quartz diorite at 68°N, West Greenland (p. 22, 24); Ammassalik intrusive complex and similar rocks in SE Greenland (p. 24, 25). Other occurrences in the Ketilidian orogen in South Greenland (p. 29) and in the Caledonian fold belt in North-East Greenland (p. 32). **[82]** Meso- and Neoarchaean post-tectonic intermediate and mafic intrusions in South-East and West Greenland (pp. 21, 26) and North-West Greenland (p. 27).
[83] Neoarchaean alkaline intrusive complex: Skjoldungen alkaline province, South-East Greenland (p. 21).
[84]Mesorchaean carbonatite sheet: Tupertalik, southern West Greenland (pp. 21, 44).
[85]Mesoarchaean anorthositic rocks in the Archaean craton: Fiskenæsset complex and correlatives, southern West Greenland (pp. 19, 80); also in central West Greenland (p. 26), in South- East Greenland (p. 24) and in the Thule region (*c*. 77°30´N) North-West Greenland (p. 27).
[86] Palaeoproterozoic gabbro-anorthosite, East Greenland Caledonian fold belt, North-East Greenland (76°N) (Stecher & Henriksen 1994).

Offshore
[a] Areas underlain by continental crust with or without cover of sedimentary rocks and Tertiary volcanic rocks (p. 66).

[b] Transition zone between continental and oceanic crust. In many areas thought to consist of continental crust with increasing intensity of dykes and intrusions as oceanic crust is approached (p. 66). Off South-West Greenland transition zone is extremely thin continental crust flanked to the south-west by a zone of serpentinised mantle peridotite.
[c]–[f] Areas underlain by oceanic crust, divided according to age at 15 million year intervals. Oldest oceanic crust [**f**] was formed more than 45 million years ago. Divisions based on sea-floor spreading magnetic anomalies (p. 66).
[g] Oceanic crust of unspecified age (pp. 66, 70).

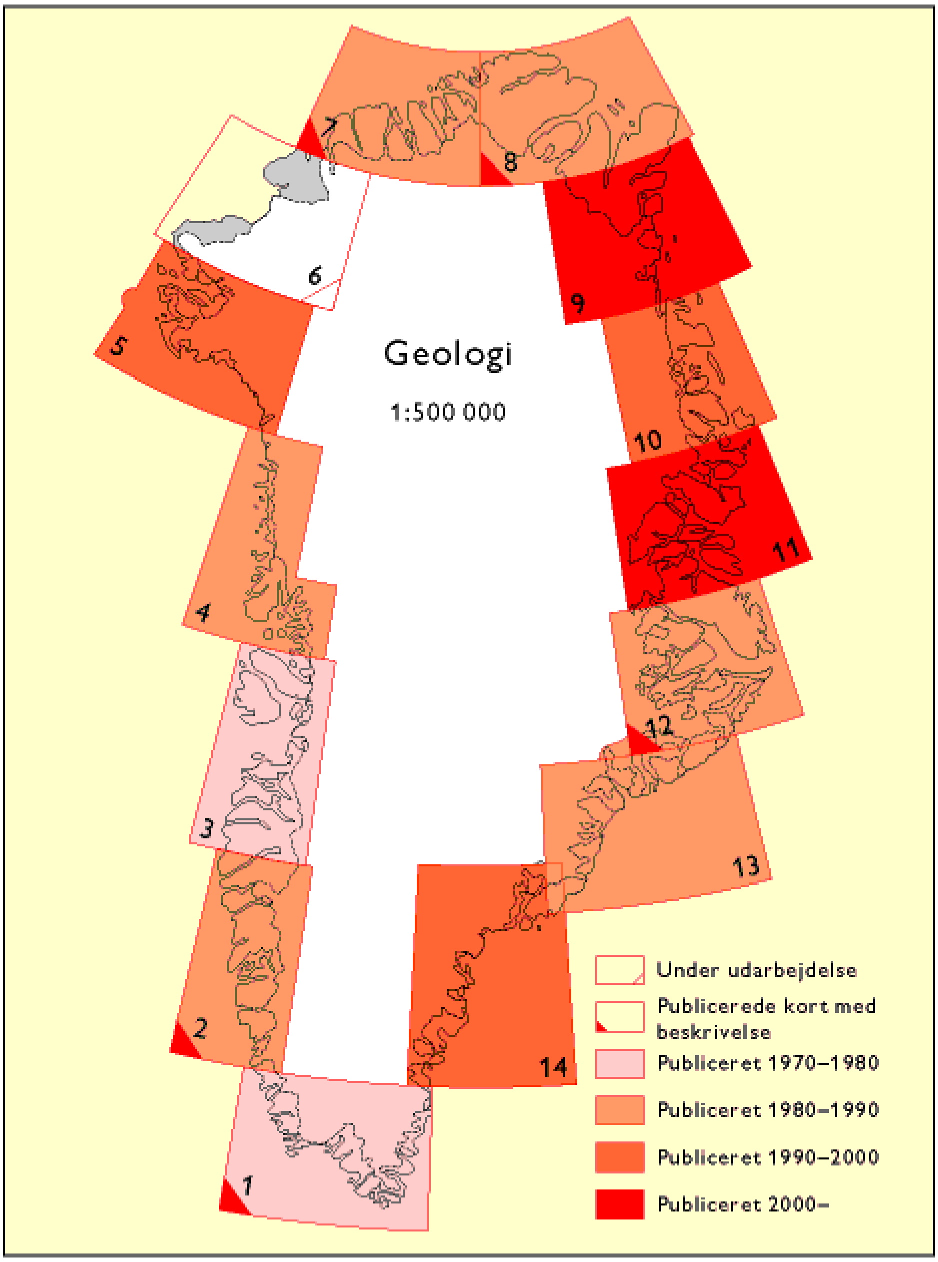
Ornamentations
Palaeogene volcanic rocks at seabed or concealed, latter only shown in areas underlain by continental crust: North-East Greenland 72–75°N (p. 74); West and North-West Greenland 68–73°N (p. 76).
Buried volcano with high relief, central East Greenland, 69°N.
Intrusions in sedimentary and volcanic rocks, East Greenland (71–73°N). Probably of Palaeogene age (p. 74).
Areas with widespread salt deposits of supposed Late Palaeozoic age, North-East Greenland shelf 76°30´–79°30´N (p. 73).
Sedimentary basins with thicknesses over 4 km (pp. 73–77). Most sediments are of Late Palaeozoic – Cenozoic age.
Little known basins with thick sedimentary successions (pp. 73, 74, 76, 77



Rocks younger than 1600 Ma
Sedimentary and volcanic basins
(grey = basic volcanic units; other colours = sedimentary units)
Gneisses
Intrusions
Age Ma
Canada Ellesmere Island
West Greenland 76°–79°N 60°–73°N
North Greenland
East Greenland 70°–78°N 68°–70°N
Ice-land
Amphibolite facies
Felsic
Intermediate and mafic
Tertiary
Cretac.
Juras.
Trs.
Perm.
Carbon.
Dev.
Sil.
Ordov.
Cambr.
Proterozoic
Sverdrup Basin (undifferentiated)
Mainly exotic terrane (Pearya)
tectonic boundary
Franklinian Basin
Thule Sgp
Thule Supergroup
(see enlarged box below)
Age not certain
Eriksfjord Fm (61°N)
Wandel Sea Basin area
peralk. volc. (83°30'N)
Independence Fj. Gp (31)
Zig-Zag Dal Basalt Fm (30)
Hagen Fj. Gp
East Greenland basins
Krummedal succession
Eleonore Bay Supergroup
Sediments of unknown age (70°–74°N)
scale change
(E Greenland and N Ellesmere Island)
includes also rocks >1200 Ma
Gardar intrusive complexes
(E Greenland)
(W Greenl. 61°N)
(W Greenland, Ellesmere Island)
(E Greenl.)
(W Greenland, 65°30'N)
(E Greenland, 69°, 70°N)
(W Greenland, 66°30'N)
Rocks older than 1600 Ma
Supracrustal rocks
Defined units W Greenl. S Greenl.
Acid volcanic W Greenl.
Unspecified W, E, S Grl
Metamorph. grade red stipple: granul. no stipple: amph.
Archaean
Karrat Gp
mainly sediments
Grænseland succession
sediments volcs
(61°30'N)
(70°N)
South of 61°N mainly with paragneisses
Isua and Akilia supracrustals
(W Greenland)
Amitsoq gneisses (W Greenland)
Reworked in early Proterozoic
Rapakivi granite (77)
Qôrqut granite (79)
Gabbro-anorthosite (77°N, E Gr)
nepheline complex (63°N, E Gr)
(65°30'N, W Gr)
Gabbro-anorthosite
well defined age
approximate age
Key
Sedimentary rocks
Quaternary
Mainly shelf/deltaic (no overprint)
Deep-water
Continental
Isolated outcrop
9,10, GISP 2
Glacial (tillite)
Tillite, isolated outcrop
28, 41
Intrusive rocks
Alkaline
undeformed
foliated
Non-alkaline
undeformed
foliated
with augen texture
Carbonatite
59, 61, 84
Mines, abandoned:
Pb+Zn: 72°N, E Greenl. 71°N, W Greenl.
Coal: 70°N, W Greenl.
Cryolite: 61°N, W Greenl.
Major mineral occurrence:
Pb+Zn: 83°N, N Greenl.
West Greenland 69°–72°N
East Greenland 68°–70°N
Magneto-stratigr.
Eocene
Paleocene
Nuussuaq Basin
picrite
Kangerlussuaq Basin
Post-drift sediments
Age of deformation
foliation
axial plane
thrust
fault
Ellesmerian orogeny (mainly Devonian), North Greenland
Caledonian (mainly Silurian) and/(or) older orogenies, East Greenland
early Proterozoic
late Archaean
unspecified

3.3 Regional Geological maps 1:500 000 scale (after Kokfelt et al. 2013)

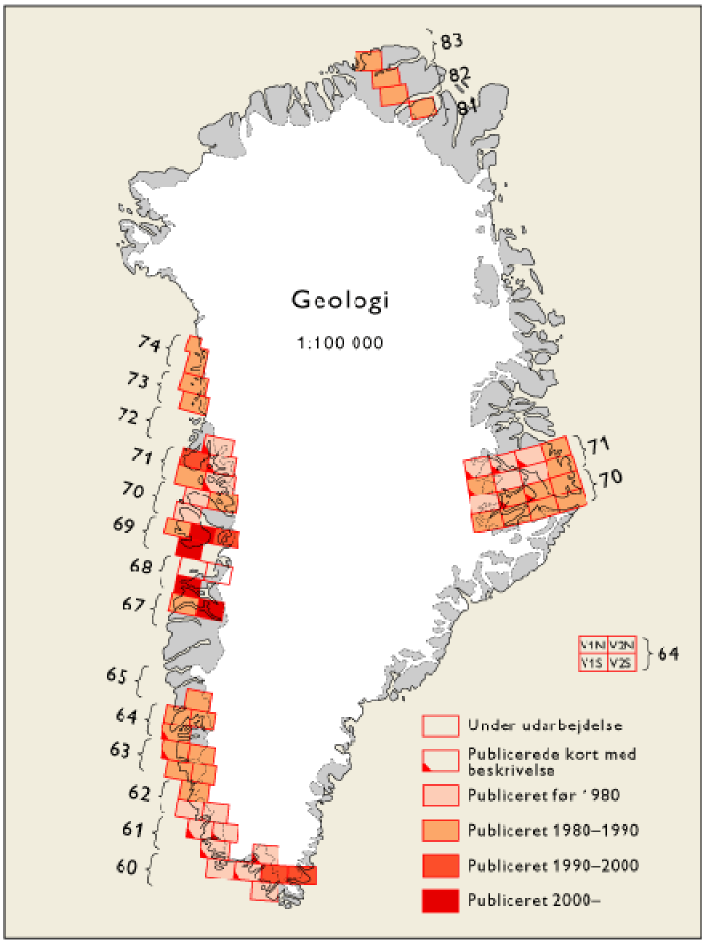
This 14 map series of the ice-free land areas of Greenland shows the distribution of rock types, orogenic belts, and lithostratigraphical and chronostratigraphical relationships. Thirteen sheets are published, with one sheet (No 6) in an advanced state of compilation. The legend has about 450 units, where many units are on Formation level. Only local geological profiles, correlation panels of sedimentary logs or idealized stratigraphical shemes exists in this level and they are published in numerous varies geological papers. They are not geo referenced.



Geological map of Greenland - 1 : 500 000 - Polygon Legend

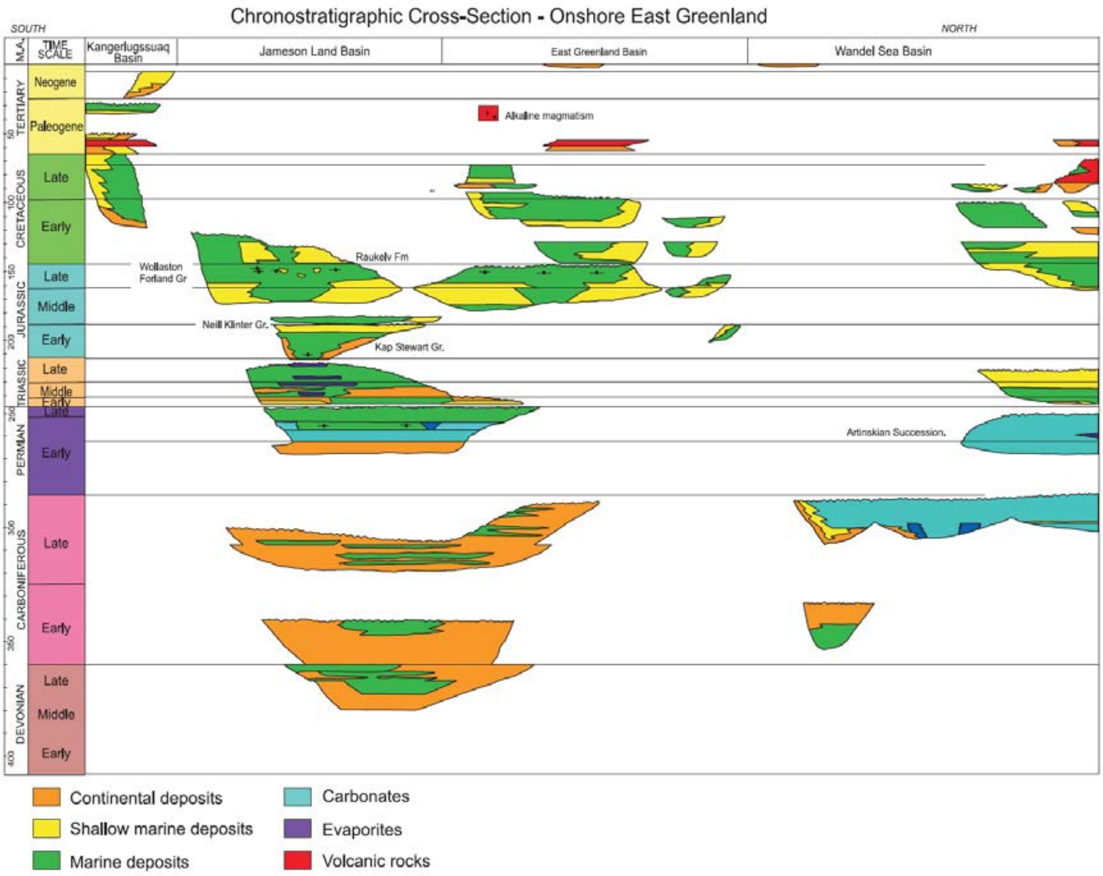
4. Detailed Geological maps 1:100 000 scale

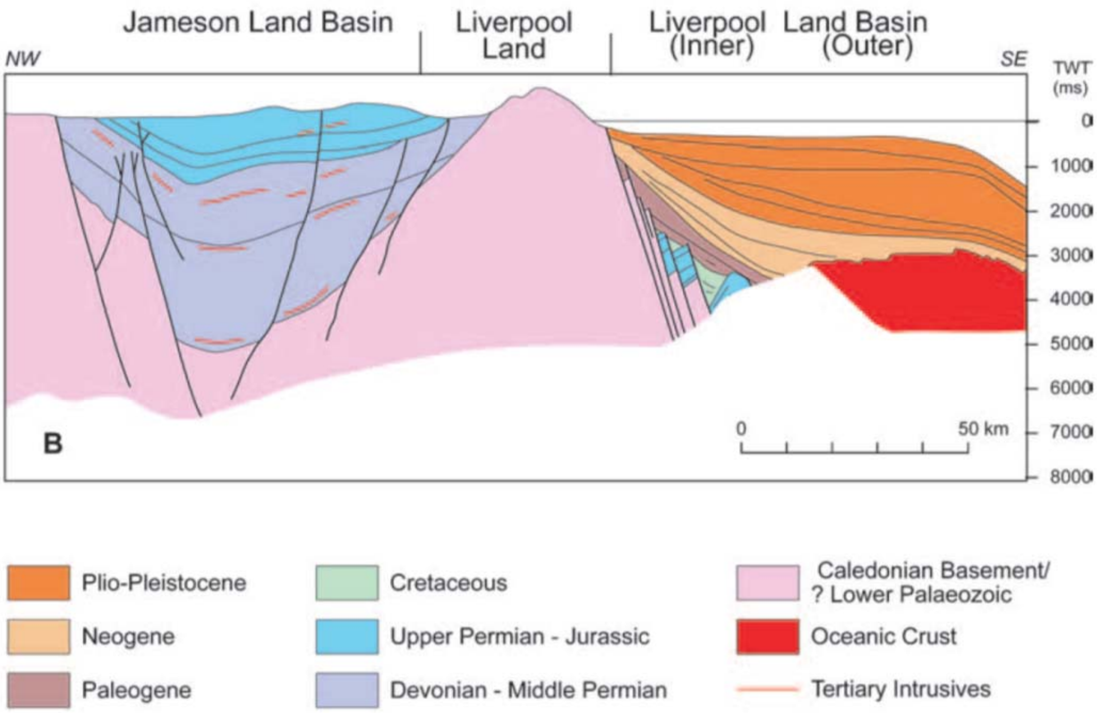
The 1:100 000 map sheets are the most detailed standard map sheets available, and depict both rock types and Quaternary deposits. A total of 56 sheets have been published, mainly covering areas in western Greenland. A block of 16 sheets covers the Scoresby Sund region of East Greenland, and there are four sheets in North Greenland.



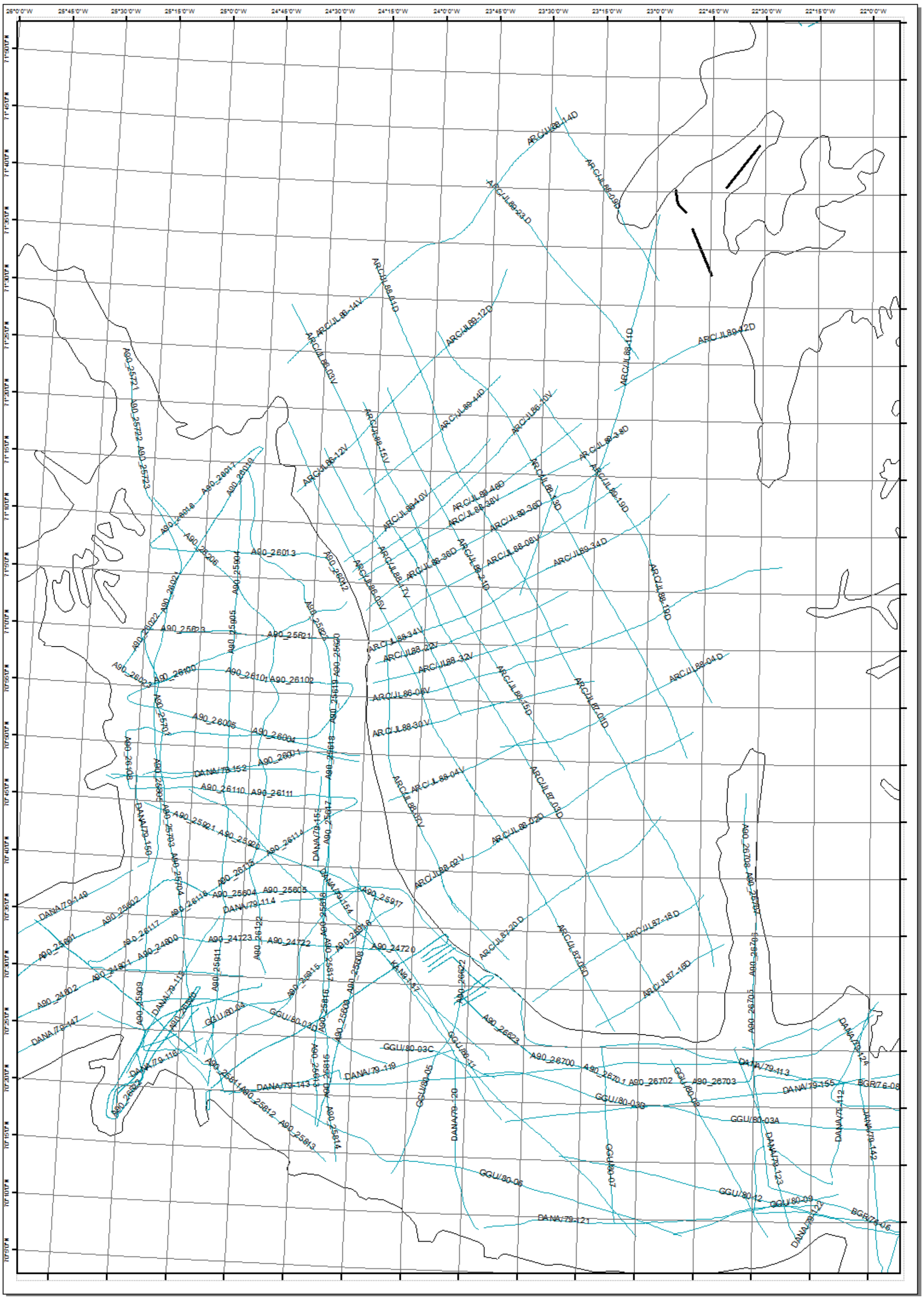
4.1 The Jameson Land Basin (East Greenland)

The Jameson Land Basin, which extends over an area of about 10 000 km2, has been investigated by a 1798 km seismic survey carried out by Atlantic Richfield Company (ARCO) in 1985–89, and is therefore relatively better known than the basins to the north. The structural history of the basin is also different in that rifting began in the Devonian and ended in the mid-Permian; Late Permian – Mesozoic deposition in the basin was governed by thermal subsidence. In addition to the source rock intervals known to the north (Christiansen et al. 1992), an important lowermost Jurassic lacustrine type I–II source rock (highly oil-prone – oil-prone) occurs in Jameson Land (Dam & Christiansen 1990). Potential reservoirs are Upper Carboniferous (and possibly older) fluvial sandstones, Upper Permian carbonates, and Lower Jurassic deltaic sandstones. Apart from an Upper Carboniferous tilted fault block play, play types are stratigraphic. The main risk factor in the Jameson Land Basin is a consequence of a Tertiary uplift of 2 km or more (Mathiesen et al. 1995).





The Jameson Land Basin and the 1:100 000 scale Geological map can represent a pilot area to which start developing a 3D-model. The Map is well detailed, the stratigraphy is well known and the area is covered by several seismic lines. Moreover, the basin is considered an analogue of the Norwegian offshore and future development of 3D-modeling of this basin can be interesting for Oil industry.



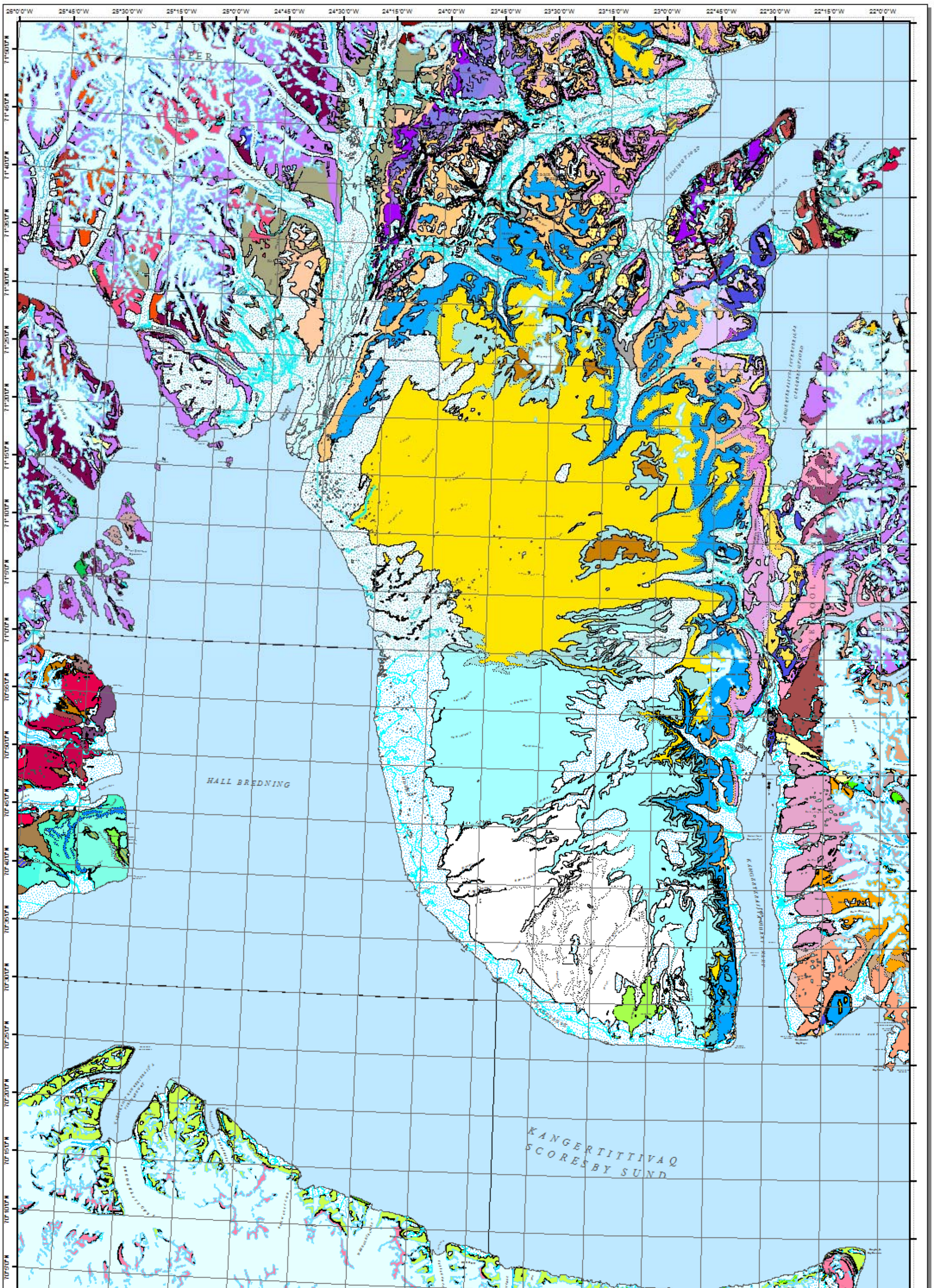
Seismic lines coverig the Jameson Land Area

A	H	I	J	K	L	M	N	O	P	Q
LABEL	**HIERARCHY-100**	**PERIOD-100**	**DESCRIPT 250**	**PERIOD 250**	**LABEL-250**	**LABEL-500**	**GM_LABEL**	**GML_UC**	**LABEL-250**	**LABEL-500**
alfa		Tertiary	Basic complex	Palaeogene	gc	delta1	gc	GC	gc	delta1
ALV		Quaternary	Undifferentiated Quaternary	Quaternary	Qundif	?	Qundif	QUNDIF	Qundif	?
Ba	Paleozoic	Paleozoic	Clastic deposits	Devonian	Vi	Vi	Vi	VI	Vi	Vi
beta		Tertiary			?	?			?	?
betaG		Tertiary	Plateau basalt, lower sequence	Palaeogene	beta1	BETA1	beta1	BETA1	beta1	BETA1
betaG`										
betaHf		Tertiary	Plateau basalt, lower sequence	Palaeogene	beta1	BETA1	beta1	BETA1	beta1	BETA1
betaMa		Tertiary	Plateau basalt, lower sequence	Palaeogene	beta1	BETA1	beta1	BETA1	beta1	BETA1
betaMi		Tertiary	Plateau basalt, lower sequence	Palaeogene	beta1	BETA1	beta1	BETA1	beta1	BETA1
betaR		Tertiary	Plateau basalt, upper sequence	Palaeogene	beta2	BETA2	beta2	BETA2	beta2	BETA2
betaS		Tertiary	Plateau basalt, upper sequence	Palaeogene	beta2	BETA2	beta2	BETA2	beta2	BETA2
Ch		Middle-Upper Jurassic	Charcot Bugt Formation	Jurassic	Ch	C	Ch	CH	Ch	C
Ch	Charcot Bugt Fm.	Mesozoic Eastern Milne Land	Charcot Bugt Formation	Jurassic	Ch	C	Ch	CH	Ch	C
DELTA		Tertiary			?	?			?	?
delta`										
DELTA1		Tertiary	Basic complex	Palaeogene	gc	delta1	gc	GC	gc	delta1
delt1`										
DELTA5		Tertiary			?	delta			?	delta
epsilon		Tertiary	Alkali syenite and alkali granite	Palaeogene	sigma	sigma	sigma	SIGMA	sigma	sigma
FC	Paleozoic	Paleozoic	Foldvik Creek Group	Permian	FC	Fk	FC	FC	FC	Fk
FC`										
FF		Mesozoic	Fleming Fjord Formation	Triassic	FF	F	FF	FF	FF	F
FF1	Flemming Fjord Fm.	Mesozoic	Fleming Fjord Formation	Triassic	FF	F	FF	FF	FF	F
FF1`										
FF2	Flemming Fjord Fm.	Mesozoic	Fleming Fjord Formation	Triassic	FF	F	FF	FF	FF	F
FF3	Flemming Fjord Fm.	Mesozoic	Fleming Fjord Formation	Triassic	FF	F	FF	FF	FF	F
FF3`										
G		Mesozoic	Gipsdalen Formation	Triassic	G	G	G	G	G	G
G1	Gipsdalen Fm.	Mesozoic	Gipsdalen Formation	Triassic	G	G	G	G	G	G
G2	Gipsdalen Fm.	Mesozoic	Gipsdalen Formation	Triassic	G	G	G	G	G	G
gamma		Tertiary			?	?			?	?
ggi	Paleozoic	Paleozoic	Granite	Devonian	g7	ggi	g7	G7	g7	ggi
H		Mesozoic	Hesteelv member	Lower Cretaceous	H	H	Ha	HA	H	H
Ha		Mesozoic	Hareelv Formation	Jurassic	Ha	Ha	Ha	HA	Ha	Ha
Ha		Mesozoic Jameson Land	Hareelv Formation	Jurassic	Ha	Ha	Ha	HA	Ha	Ha
Hz		Mesozoic Eastern Milne Land	Hartz Fjeld Formation	Jurassic-Cretaceous	Hz	Hz	Hz	HZ	Hz	Hz
HzKL4`										
ib/s		Tertiary			?	?			?	?
ICE		Quaternary	Ice and perennial snow	Quaternary	ICE	?	ICE	ICE	ICE	?
JTls_FF`										
KB		Tertiary	Kap Brewster Formation and Kap Dalton G	Neogene - Palaeogene	BD	D	BD	BD	BD	D
KD		Tertiary	Kap Brewster Formation and Kap Dalton G	Neogene - Palaeogene	BD	D	BD	BD	BD	D
KL	Kap Leslie Fm.	Mesozoic Eastern Milne Land	Kap Leslie Formation	Jurassic	KL	KL	KL	KL	KL	KL
KL1	Kap Leslie Fm.	Mesozoic Eastern Milne Land	Kap Leslie Formation	Jurassic	KL	KL	KL	KL	KL	KL1
KL2	Kap Leslie Fm.	Mesozoic Eastern Milne Land	Kap Leslie Formation	Jurassic	KL	KL	KL	KL	KL	KL2
KL3	Kap Leslie Fm.	Mesozoic Eastern Milne Land	Kap Leslie Formation	Jurassic	KL	KL	KL	KL	KL	KL3
KL4	Kap Leslie Fm.	Mesozoic Eastern Milne Land	Kap Leslie Formation	Jurassic	KL	KL	KL	KL	KL	KL4
KL4Mi`										
KS		Mesozoic	Kap Stewart Group	Triassic-Jurassic	KS	K	KS	KS	KS	K
KS`										
Ksdel`										
N		Mesozoic	Neill Klinter Group	Jurassic	N	N	N	N	N	N
N`										
O		Mesozoic	Olympen Formation	Jurassic	O	O	O	O	O	O
omega		Tertiary	Basic dykes, sills and stocks	Palaeogene	d2	delta	d2	D2	d2	delta
P		Mesozoic	Pingo Dal Formation	Triassic	P	P	P	P	P	P
P1	Pingodal Fm.	Mesozoic	Pingo Dal Formation	Triassic	P	P	P	P	P	P
P1`										
P2	Pingodal Fm.	Mesozoic	Pingo Dal Formation	Triassic	P	P	P	P	P	P
P3	Pingodal Fm.	Mesozoic	Pingo Dal Formation	Triassic	P	P	P	P	P	P
P4	Pingodal Fm.	Mesozoic	Pingo Dal Formation	Triassic	P	P	P	P	P	P
Pl		Tertiary	Plateau basalt, upper sequence	Palaeogene	beta2	BETA2	beta2	BETA2	beta2	BETA2
PSI		Tertiary	Nepheline syenite	Palaeogene	psi	psi	psi	PSI	psi	psi
Pz	Paleozoic	Paleozoic	Clastic deposits	Devonian	Pz	Pz	Pz	PZ	Pz	Pz
Q	Paleozoic	Paleozoic	Clastic deposits	Devonian	Q	Q	Q	Q	Q	Q
Q1		Quaternary	Undifferentiated Quaternary	Quaternary	Qundif	?	Qundif	QUNDIF	Qundif	?
Q10		Quaternary	Undifferentiated Quaternary	Quaternary	Qundif	?	Qundif	QUNDIF	Qundif	?
Q11		Quaternary	Undifferentiated Quaternary	Quaternary	Qundif	?	Qundif	QUNDIF	Qundif	?
Q13		Quaternary	Undifferentiated Quaternary	Quaternary	Qundif	?	Qundif	QUNDIF	Qundif	?
Q14		Quaternary	Undifferentiated Quaternary	Quaternary	Qundif	?	Qundif	QUNDIF	Qundif	?
Q15		Quaternary	Undifferentiated Quaternary	Quaternary	Qundif	?	Qundif	QUNDIF	Qundif	?
Q2		Quaternary	Undifferentiated Quaternary	Quaternary	Qundif	?	Qundif	QUNDIF	Qundif	?
Q5		Quaternary	Undifferentiated Quaternary	Quaternary	Qundif	?	Qundif	QUNDIF	Qundif	?
Q6		Quaternary	Undifferentiated Quaternary	Quaternary	Qundif	?	Qundif	QUNDIF	Qundif	?
Q7		Quaternary	Undifferentiated Quaternary	Quaternary	Qundif	?	Qundif	QUNDIF	Qundif	?
Q8		Quaternary	Undifferentiated Quaternary	Quaternary	Qundif	?	Qundif	QUNDIF	Qundif	?
Qundif		Quaternary	Undifferentiated Quaternary	Quaternary	Qundif	?	Qundif	QUNDIF	Qundif	?
R1	Raukelv Fm.	Mesozoic Jameson Land			Rv	R			Rv	R
R2	Raukelv Fm.	Mesozoic Jameson Land			Rv	R			Rv	R
rh	Paleozoic	Paleozoic	Rhyolitic lavas	Devonian	rh	rh	rh	RH	rh	rh
rhf										
RO1	Paleozoic	Paleozoic	R°de Ì Conglomerate	Permian	RO	C-P	RO	RO	RO	C-P
RO2	Paleozoic	Paleozoic	R°de Ì Conglomerate	Permian	RO	C-P	RO	RO	RO	C-P
RO3	Paleozoic	Paleozoic	R°de Ì Conglomerate	Permian	RO	C-P	RO	RO	RO	C-P
RO4	Paleozoic	Paleozoic	R°de Ì Conglomerate	Permian	RO	C-P	RO	RO	RO	C-P
Rv1	Raukelv Fm.	Mesozoic			Rv	R			Rv	R
RV2	Raukelv Fm.	Mesozoic			Rv	R			Rv	R
RV3	Raukelv Fm.	Mesozoic			Rv	R			Rv	R
SH	Paleozoic	Paleozoic	Clastic deposits	Devonian	Vi	Vi	Vi	VI	Vi	Vi
SIGMA		Tertiary	Alkali syenite and alkali granite	Palaeogene	sigma	sigma	sigma	SIGMA	sigma	sigma
tau		Tertiary	Central volcanic complex	Palaeogene	voc	tau	voc	VOC	voc	tau
TOG	Paleozoic	Paleozoic	Traill Ì Group	Carboniferous	TOG	C-P	TOG	TOG	TOG	C-P
UCm		Mesozoic			Ucm	Cm			Ucm	Cm
Vi	Paleozoic	Paleozoic	Clastic deposits	Devonian	Vi	Vi	Vi	VI	Vi	Vi
Vi1										
Vi2										
Vi3										
VK1	Vardekløft Fm.	Mesozoic			Vk	V			Vk	V
VK2	Vardekløft Fm.	Mesozoic			Vk	V			Vk	V
VK3	Vardekløft Fm.	Mesozoic			Vk	V			Vk	V
Vo	Paleozoic	Paleozoic	Rhyolitic lavas	Devonian	rh	rh	rh	RH	rh	rh
WC		Mesozoic	Wordie Creek Formation	Triassic	WC	W	WC	WC	WC	W
WH	Paleozoic	Paleozoic	Clastic deposits	Devonian	Vi	Vi	Vi	VI	Vi	Vi

Database for Sedimentary sequences

B41 fx intermediate dykes

1	LABEL	DESCRIPTION	MEMBER	LITHOLOGICAL UNIT	AREA SPECIFIC TYPES	LITHOLOGICAL TYPES	ROCK GROUPS	REGION	LITHOTECTONIC UNIT
2	CK	Sandstones, shales, dolomites and limestones				Kong Oscar Fjord Group			FRANZ JOSEPH ALLOCHTHON
3	TG	Diamictites				Tillite Group			FRANZ JOSEPH ALLOCHTHON
4	EBS						Eleonore Bay Supergroup		FRANZ JOSEPH ALLOCHTHON
5	AG2	Limestones and dolomites	beds 18–19			Andrée Land Group	Eleonore Bay Supergroup		FRANZ JOSEPH ALLOCHTHON
6	AG1	Limestones and dolomites	beds 14–17			Andrée Land Group	Eleonore Bay Supergroup		FRANZ JOSEPH ALLOCHTHON
7	YG2	Shales, dolomites, limestones	beds 11–13	Rytterknægten, Skildvagten, Elisabeth Bjerg Fm		Ymer Ø Group	Eleonore Bay Supergroup		FRANZ JOSEPH ALLOCHTHON
8	YG1	Shales, dolomites, limestones	beds 7–10	Kap Petersen, Antarctic Sund, Tågefjeld Fm		Ymer Ø Group	Eleonore Bay Supergroup		FRANZ JOSEPH ALLOCHTHON
9	LG	Shales, sandstones, quartzites				Lyell Land Group			FRANZ JOSEPH ALLOCHTHON
10	NG	Black shales with quartzites				Nathorst Land Group			FRANZ JOSEPH ALLOCHTHON
11	gi7a	Granite		Hurry Inlet granite		Post-kinematic	Orogenic intrusive rocks	Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
12	gi7	Granite		Kap Jones and non specified		Post-kinematic	Orogenic intrusive rocks	Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
13	sgi7	hornblende syenite		hornblende syenite		Post-kinematic	Orogenic intrusive rocks	Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
14	tgi7	quartz-monzodiorite				Post-kinematic	Orogenic intrusive rocks	Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
15	mgi7	quartz-monzodiorite		Carlsberg Fjord and Sandbach Halve quartz-monzonites		Post-kinematic	Orogenic intrusive rocks	Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
16	ag7	hornblende granodiorite		hornblende granodiorite		Post-kinematic	Orogenic intrusive rocks	Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
17	di7	diorite-granodiorite (intermediate)		diorite-granodiorite (intermediate)		Post-kinematic	Orogenic intrusive rocks	Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
18	gn7b	Gneiss (undiff., orthogneiss?)		Gneiss (undiff., orthogneiss?)	South Liverpool Land gneiss sequence	Migmatitic rocks and gneisses	Proterozoic gneisses (s.l.) and schists	Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
19	gn7c	Gneiss (paragneiss)		Gneiss (paragneiss)	South Liverpool Land gneiss sequence	Migmatitic rocks and gneisses	Proterozoic gneisses (s.l.) and schists	Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
20	agn7a	granodioritic gneiss		granodioritic gneiss	South Liverpool Land gneiss sequence	Migmatitic rocks and gneisses	Proterozoic gneisses (s.l.) and schists	Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
21	bgn7a	basic gneiss (schistose)		basic gneiss	South Liverpool Land gneiss sequence	Migmatitic rocks and gneisses	Proterozoic gneisses (s.l.) and schists	Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
22	gn7a	Gneiss		Gneiss	Kap Greg gneiss	Migmatitic rocks and gneisses	Proterozoic gneisses (s.l.) and schists	Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
23	gnm7	Migmatitic gneiss		Migmatitic gneiss		Migmatitic rocks and gneisses	Proterozoic gneisses (s.l.) and schists	Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
24	c7c	marble and calc silicates		marble and calc silicates	North Liverpool Land sequence	Supracrustal units and paragneisses		Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
25	q7c	quartzite and siliceous gneiss		quartzite and siliceous gneiss	North Liverpool Land sequence	Supracrustal units and paragneisses		Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
26	mgn7c	schistose gneiss (pelitic and semipelitic)		schistose gneiss (pelitic and semipelitic)	North Liverpool Land sequence	Supracrustal units and paragneisses		Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
27	bgn7c	basic gneiss (schistose)		basic gneiss (schistose)	North Liverpool Land sequence	Supracrustal units and paragneisses		Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
28	qgn7d	siliceous gneiss		siliceous gneiss	Central Liverpool Land sequence	Supracrustal units and paragneisses		Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
29	q7d	quartzite		quartzite	Central Liverpool Land sequence	Supracrustal units and paragneisses		Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
30	c7d	marble and calc silicates		marble and calc silicates	Central Liverpool Land sequence	Supracrustal units and paragneisses		Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
31	a7d	amphibolite		amphibolite	Central Liverpool Land sequence	Supracrustal units and paragneisses		Outer coastal region, Liverpool Land	HAGAR BJERG THRUST SHEET
32	gi5	granite, intrusive, Oxford Gletscher		granite, intrusive, Oxford Gletscher	Migmatite zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
33	g5	granite		granite	Migmatite zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
34	sgi5	syenite		syenite	Migmatite zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
35	tgi5	quartz-monzodiorite, quartz-diorite		quartz-monzodiorite, quartz-diorite	Migmatite zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
36	mg5	monzonite		monzonite	Migmatite zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
37	agi5	granodiorite–quartz-monzonite		granodiorite–quartz-monzonite	Migmatite zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
38	di5	diotite-granodiorite, intermediate rocks		diotite-granodiorite, intermediate rocks	Migmatite zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
39	ag5	granodiorite		granodiorite	Migmatite zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
40	peg	pegmatite		pegmatite	Migmatite zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
41	di6	intermediate dykes		intermediate dykes	East Milne Land zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
42	ggi6	granite (leucogranite) 444 Ma		granite (leucogranite)	East Milne Land zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
43	gi6	granite (pink) 432 Ma		granite (pink)	East Milne Land zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
44	mg6	quatrz monzonite		quatrz monzonite	East Milne Land zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
45	mgi6	quartz-monzonite, mafic. 432 Ma		quartz-monzonite, mafic	East Milne Land zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
46	agi6	granodiorite 466 Ma		granodiorite	East Milne Land zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
47	sgi6	quartz syenite		quartz syenite	East Milne Land zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
48	ub6	ultramafic rocks		ultramafic rocks	East Milne Land zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
49	q6	quartzite		quartzite	East Milne Land zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
50	tgi6	granodiorite		granodiorite	East Milne Land zone		Orogenic intrusive rocks	Central fjord region	HAGAR BJERG THRUST SHEET
51	gm5	granitic migmatite, in migmatite zone		granitic migmatite, in migmatite zone		Migmatitic rocks and gneisses	Proterozoic gneisses (s.l.) and schists	Central fjord region	HAGAR BJERG THRUST SHEET
52	gm6	granitic migmatite, (EMLZ)		granitic migmatite, (EMLZ)		Migmatitic rocks and gneisses	Proterozoic gneisses (s.l.) and schists	Central fjord region	HAGAR BJERG THRUST SHEET
53	gnm5	gneissic migmatite, in migmatite zone		gneissic migmatite, in migmatite zone		Migmatitic rocks and gneisses	Proterozoic gneisses (s.l.) and schists	Central fjord region	HAGAR BJERG THRUST SHEET
54	gnm6	gneissic migmatite, (EMLZ)		gneissic migmatite, (EMLZ)		Migmatitic rocks and gneisses	Proterozoic gneisses (s.l.) and schists	Central fjord region	HAGAR BJERG THRUST SHEET
55	gn5a	gneiss, unspecified		gneiss, unspecified		Migmatitic rocks and gneisses	Proterozoic gneisses (s.l.) and schists	Central fjord region	HAGAR BJERG THRUST SHEET
56	gn5b	gneiss, in migmatite zone		gneiss, in migmatite zone		Migmatitic rocks and gneisses	Proterozoic gneisses (s.l.) and schists	Central fjord region	HAGAR BJERG THRUST SHEET
57	gn4	gneiss (? Archean origin)		gneiss (? Archean origin)		Migmatitic rocks and gneisses	Proterozoic gneisses (s.l.) and schists	Central fjord region	HAGAR BJERG THRUST SHEET
58	aug5	augen granites		augen granites		Plutonic rocks	Proterozoic gneisses (s.l.) and schists	Central fjord region	HAGAR BJERG THRUST SHEET
59	ms3	Mica schist		Mica schist		Krummedal supracrustal sequence	Supracrustal units and paragneisses	Central fjord region	HAGAR BJERG THRUST SHEET
60	msq3	Mica schist with frequent quartzite units		Mica schist with frequent quartzite units		Krummedal supracrustal sequence	Supracrustal units and paragneisses	Central fjord region	HAGAR BJERG THRUST SHEET
61	msq6	Mica schist interbanded with quartzite (EMLZ)		Mica schist interbanded with quartzite (EMLZ)		Krummedal supracrustal sequence	Supracrustal units and paragneisses	Central fjord region	HAGAR BJERG THRUST SHEET
62	q3	quartzite		quartzite		Krummedal supracrustal sequence	Supracrustal units and paragneisses	Central fjord region	HAGAR BJERG THRUST SHEET
63	qms3	quartzite with frequent micaschist		quartzite with frequent micaschist		Krummedal supracrustal sequence	Supracrustal units and paragneisses	Central fjord region	HAGAR BJERG THRUST SHEET
64	c3	marble		marble		Krummedal supracrustal sequence	Supracrustal units and paragneisses	Central fjord region	HAGAR BJERG THRUST SHEET
65	c6	marble (EMLZ)		marble (EMLZ)		Krummedal supracrustal sequence	Supracrustal units and paragneisses	Central fjord region	HAGAR BJERG THRUST SHEET
66	a3	amphibolite		amphibolite		Krummedal supracrustal sequence	Supracrustal units and paragneisses	Central fjord region	HAGAR BJERG THRUST SHEET
67	q5	quartzite, band in migmatites		quartzite, band in migmatites		Supracrustal rocks in the migmatite zone	Supracrustal units and paragneisses	Central fjord region	HAGAR BJERG THRUST SHEET
68	c5	marble, band in migmatites		marble, band in migmatites		Supracrustal rocks in the migmatite zone	Supracrustal units and paragneisses	Central fjord region	HAGAR BJERG THRUST SHEET
69	a5	amphibolite (in migmatites)		amphibolite (in migmatites)		Supracrustal rocks in the migmatite zone	Supracrustal units and paragneisses	Central fjord region	HAGAR BJERG THRUST SHEET
70	mgn3	gneissic schists		gneissic schists		Gneisses and migmatitic rocks	Supracrustal units and paragneisses	Central fjord region	HAGAR BJERG THRUST SHEET
71	mgn5	gneissic schists, migmatised		gneissic schists, migmatised		Gneisses and migmatitic rocks	Supracrustal units and paragneisses	Central fjord region	HAGAR BJERG THRUST SHEET
72	mgn5a	gneissic schists, unspecified (origin ?)		gneissic schists, unspecified (origin ?)		Gneisses and migmatitic rocks	Supracrustal units and paragneisses	Central fjord region	HAGAR BJERG THRUST SHEET
73	qgn3	siliceous gneiss		siliceous gneiss		Gneisses and migmatitic rocks	Supracrustal units and paragneisses	Central fjord region	HAGAR BJERG THRUST SHEET
74	qgn5	siliceous gneiss, migmatised (origin ?)		siliceous gneiss, migmatised (origin ?)		Gneisses and migmatitic rocks	Supracrustal units and paragneisses	Central fjord region	HAGAR BJERG THRUST SHEET
75	uba	ultrabasic rocks, plugs ?		ultrabasic rocks, plugs ?			Plutonic rocks	Central fjord region	HAGAR BJERG THRUST SHEET
76	ub3	ultrabasic rocks		ultrabasic rocks			Plutonic rocks	Central fjord region	HAGAR BJERG THRUST SHEET
77	ub5	ultramafic rocks (in migmatites)		ultramafic rocks (in migmatites)			Plutonic rocks	Central fjord region	HAGAR BJERG THRUST SHEET



The Geological Map 1:100 000 scale of the Jameson Land Basin

Legend of the 1:100 000 scale Geological map

5. References

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