DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 2018/20

Uranium potential in Greenland

Reporting on the 8th Greenland mineral resource assessment workshop, November 2016

Kristine Thrane, Nynke Keulen & Per Kalvig

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

GEUS

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Contents

Executive summary

In November 2016, a workshop on the 'Assessment of the uranium potential in Greenland' was arranged jointly by the Geological Survey of Denmark and Greenland (GEUS) and the Ministry of Mineral Resources (MMR), Government of Greenland with the purpose of: 1) presenting and discussing known uranium occurrences in Greenland and 2) estimating the probability for the existence of undiscovered and hidden uranium deposits. The workshop was carried out in the framework of the Global Mineral Resource Assessment Project, and Greenlandic – undiscovered - uranium resources were estimated down to a depth of one km. Three uranium deposit types were chosen for the assessment: intrusive, sandstone hosted and unconformity related. A total of thirty five permissive tracts were assessed. The main conclusion of the workshop was that intrusive and unconformity-related deposits have the highest probability of having formed uranium deposits in Greenland and that South Greenland hosts the best potential for hidden deposits.

Introduction

Quantitative information on mineral resources availability and distribution is required by decision makers from governmental agencies and from the private mining sector. For this reason, the United States Geological Survey (USGS) in 2002 launched the 'Global Mineral Resource Assessment Project' (GMRAP), aimed primarily at identifying the main areas in the world with potential for undiscovered mineral resources, down to a depth of one kilometre.

The GMRAP makes use of available compiled information about geology, geochemistry, geophysics, and previous exploration results in the context of modern quantitative grade/tonnage statistical models. The GMRAP is being conducted on a regional-multinational basis for selected deposit models and commodities, and on a global scale, coordinated by the USGS, by compiling information from the regional assessments.

The Ministry of Mineral Resources in Greenland (MMR) and the Geological Survey of Denmark and Greenland (GEUS) participate in GMRAP. As a result, workshops were held for the assessment of the sediment-hosted copper, rare-earth elements, sediment-hosted zinc, magmatic nickel, tungsten, gold and Ti-V potential in Greenland, in 2009-2015 respectively. Within the same framework, GEUS and MMR organised a workshop held in Copenhagen 23-25 November 2016, to assess the potential for undiscovered uranium deposits in Greenland.

The aim of the workshop is to provide the uranium exploration industry with data which, hopefully, can constitute a useful tool for the selection of areas for their mineral exploration in Greenland.

On a global scale uranium is almost entirely used for generating electricity. As of January, 2015, a total of 437 commercial nuclear reactors were connected to the grid worldwide, generating 377 GWe and requiring *c*. 56,600 tonnes of uranium annually. At the same time, 70 new reactors were under construction in 15 countries. The world nuclear power capacity in 2035 is projected to grow to 418 GWe in the low demand case and 683 GWe in the high demand case. Accordingly, world annual reactor-related uranium requirements are projected to rise to between 66,995 and 104,740 tonnes of uranium by 2035 (OECD/NEA-IAEA 2016).

Uranium supply has so far been adequate to meet the demand for decades with no supply shortages. Sufficient proven uranium resources also exist to support continued use of nuclear power including the maximum projected growth case in the foreseeable future. However, new mining projects have to be initiated in a timely manner to make up for mines that will be shut down due to resource exhaustion and to satisfy the expected increasing demand. The demand for uranium has been predicted to rise for several years as nuclear power is projected to grow considerably with a large number of new nuclear reactors in the pipeline. This reflects an increased demand for electricity combined with more focus on clean air and zero CO_2 emission production. The East Asia region is projected to experience the largest increase in nuclear power plants, a movement that is already underway. However, the projections for the global demand for uranium are subject to great uncertainty, especially following the Fukushima Daiichi accident and the decisions of several countries to phase out nuclear power. As such, the projections for demand for uranium in the European Union vary from a minor increase to a large decrease by 2035 (OECD/NEA-IAEA 2016).

Denmark, including Greenland, joined the European Economic Community in 1973 when uranium exploration was encouraged in member states to secure the community's uranium resources. The government institutions, Geological Survey of Greenland (GGU) and Risø National Laboratory, conducted exploration in Greenland until 1984, when the Danish government decided to exclude nuclear power from its energy supply policy. An administrative ban was later introduced on uranium exploration in Greenland. In 2013, the Greenland government lifted the ban, which created a renewed interest in assessing Greenland's uranium resources.

Methods

A modified version of the standardised 'Global Mineral Resource Assessment Project' (GMRAP) procedures defined by the US Geological Survey (USGS) was applied at the workshop. The modification was required due to the absence of a grade and tonnage model for the three types of uranium deposits. Instead, predetermined regions (tracts) favourable for the formation of the selected uranium deposit types were presented and discussed. Subsequently, the members of the assessment panel made their individual estimates (bids) for the number of undiscovered deposits likely to occur within a tract, under the best circumstances and to a depth of 1 km below the surface. A consensus bid was compiled based on discussion among the panel-members.

Mineral deposit models assessed

The three types of uranium deposit model that were assessed were:

- Intrusive type deposit model
- Sandstone type deposit model
- Proterozoic unconformity type deposit model

While only these three deposit types were assessed during the workshop, a variety of additional uranium deposit types in Greenland has been described in the literature (Nielsen 1980, Keulen et al., 2014).

Tract delineation

Tracts, assumed to carry the potential of hosting non-discovered uranium deposits of the selected models were defined and delineated by an internal GEUS assessment group prior to the workshop. The selected tracts covered areas with geological settings found to be permissive to host these uranium deposits.

The assessment was carried out to a depth of 1 km beneath the present day surface for all tracts. All tracts were defined in a GIS environment and digitally accessible data relevant for the assessment was compiled, and were made available to all workshop participants.

In the course of the workshop, some of the tracts proposed by the GEUS assessment group, were modified according to the consensus view of the assessment panel team, and in some cases, additional tracts were added.

Assessment panel

At the workshop, the estimation of the number of undiscovered deposits within each tract was done by an assessment panel that included twelve geologists from the USGS, IAEA, University de Lorraine, AREVA, GEUS, MMR, and private exploration and consulting companies, collectively covering expertise in uranium deposits and Greenland geology. The following individuals were part of the assessment panel:

- Agnete Steenfelt (GEUS)
- Ashlyn Armour-Brown (Private consultant)
- Bo M. Stensgaard (GEUS)
- Diogo Rosa (GEUS)
- Henrik Stendal (MMR)
- John Pedersen (Private consultant)
- John Robbins (AREVA)
- Jonas Petersen (MMR)
- Julie Hollis (MMR)
- Julien Mercardier (University de Lorraine)
- Kristine Thrane (GEUS)
- Mark Mihalasky (USGS)
- Martin Fairclough (IAEA)
- Nynke Keulen (GEUS)
- Per Kalvig (GEUS)
- Remy Chemillac (AREVA)

Key literature

Key literature on the deposit models covered by this assessment and on the assessment procedure, as well as the initial tract proposals, was forwarded to the team members prior to the workshop. The bibliography is available in Appendix A. Several of the tracts described in this paper were previously described by Keulen et al. (2014). In these cases, the text from Keulen et al. (2014) has been reused in this paper either in the original form or modified if new information or re-assessments have been made.

Workshop presentations

At the workshop, presentations on the assessment procedure, deposit models and regional geology were given by selected speakers. This constituted an opportunity to review the important facts, before providing individual estimates. The presentations of this review are listed in Appendix B and included as PDF files on the CD-ROM accompanying this report.

Process at the Workshop

The first day of the workshop was used to present and discuss the uranium deposit types subject to assessment. This was done to ensure that the assessment panel had a common understanding of the premises for the evaluation procedures and to identify key criteria. Subsequently, the assessment panel assessed the deposit models one at a time. Each assessment was started with presentations on the tract distribution, their regional geological frameworks that were relevant for the tracts, and the known uranium occurrences and exploration history.

Following the pertinent presentations and discussions of the information/data available, the tract outline was discussed and the outline was then, based on a decision of the assessment panel, either kept or changed.

Each of the panel members were subsequently requested to provide independent estimates on the number of undiscovered deposits at 90%, 50%, 10%, 5% and 1% probability levels in the various 'tracts', *under the best possible circumstances*, down to one km below surface. Subsequent to the discussions, the panel members were invited to adjust their estimate if deemed relevant, and a consensus bid was negotiated for each tract.

Assessment of Uranium deposits

Deposit models for uranium

The IAEA classification of the deposit models is followed, however each deposit model is described in further detail in key publications which were also presented during the workshop. The following publications are used:

- Bruneton, P., Cyney, M, Dahlkamp, F. & Zaluski, G. (in press): IAEA geological classification of uranium deposits.
- IAEA-TECDOC-1629, 2009: World Distribution of Uranium Deposits (UDEPO) with Uranium Deposit Classification. IAEA, Vienna, 2009.
- OECD/NEA-IAEA, Uranium 2014: Resources, Production and Demand (Red Book). A Joint Report by the OECD Nuclear Energy Agency and the International Atomic Energy Agency. OECD Paris, 2014.

The evaluated deposit types are described below according to the modified geological classification of uranium deposits approved by IAEA in 2013 (Bruneton et al. in press) and UDEPO:

Intrusive type deposit model

Deposits included in this type are hosted in intrusive rocks of many different petrochemical compositions. Two main subtypes are recognised: 1) intrusive anatectic deposits associated with partial melting processes and contained in granite-pegmatite and 2) intrusive plutonic deposits related to magmatic differentiation processes and subdivided into three classes: quartz monzonite, peralkaline complexes and carbonatite.

Uranium deposits in intrusive rocks consist of disseminated primary, non-refractory uranium minerals dominantly uraninite, uranothorianite and/or uranothorite. These deposits are generally low-grade (20–500 ppm), but may contain substantial resources tonnages (more than 100 kt U). These deposits comprise only 4% of the current global production.

Sub-type 1. Intrusive anatectic pegmatite-alaskite
Disseminated uranium occurs in medium- to very coarse-grained alaskite bodies (leucocratic, quartz and alkali feldspar-rich granites) that are discordant to concordant with surrounding folded and highly metamorphosed and migmatized sedimentary rocks. The alaskite bodies range in size from small lenses and tabular dykes to large stocks and domes several hundred metres across. No alteration is associated with the uranium mineralisation. The main example is Rössing, in Namibia. Other examples include Goanikontes, Ida Dome, Valencia/Trekkopje and SJ Claims (Namibia) and Johan Beetz (Canada).

The pegmatite-related deposits are characterised by uraninite and other uranium-thorium minerals and occur in unzoned granitic and syenitic pegmatitic dykes (siliceous and mafic tendency with aegirine and augite) in sedimentary and igneous rocks, metamorphosed to the amphibolite facies. The main example is Bancroft area in Canada. Deformation and metasomatism commonly follow metamorphism. Hematite is a characteristic alteration product. Pegmatite deposits may average up to 0.08% U, but resources are generally low (a few t U to a few hundred t U).

Sub-type 2. Intrusive plutonic deposits
A. Quartz monzonite: very low-grade uranium disseminations occur in highly differentiated granitic to (cupriferous) quartz-monzonitic (copper porphyries) complexes. Because of their very low U content, uranium is recovered only as a by-product of copper heap leaching. The main examples are Bingham Canyon in USA and Chuquicamata in Chile.
B. Peralkaline complexes: low-grade uranium disseminations occur in peralkaline syenitic domes or stocks. Uranium phases are commonly of a more refractory nature. The main examples are Kvanefjeld in Greenland and Pocos de Caldas in Brazil. In addition Greenland also hosts the Motzfeld intrusion.
C. Carbonatite: disseminated uranothorianite occurs in cupriferous carbonatite complexes. Up until 2002, uranium was recovered as a by-product from copper production. The main examples are Palabora in South Africa and Catalao in Brazil.

Sandstone type deposit model

Sandstone-hosted uranium deposits occur in medium- to coarse-grained sandstones deposited in continental fluvial or marginal marine sedimentary environments. Volcanic ash may represent a major uranium source within the sandstone in some regions (Niger; Lodève, France; Wyoming, USA). Uranium is precipitated by reduction processes caused by a variety of possible reducing agents within the sandstone. These include carbonaceous material (mainly detrital plant debris), sulphides (pyrite), ferro-magnesian minerals (chlorite), bacterial activity, migrated fluids derived from underlying hydrocarbon reservoirs. Sandstone deposits are commonly low-to-medium grade. However, they make up more than 50% of the worlds uranium production. The largest producer is Kazakhstan, which has numerous sandstone deposits (e.g. Kanzhugan, Moinkum, Budenovskoye) all mined by the *in-situ* acid-leaching method. Sandstone deposits can be divided into five main sub-types with frequent transitional types between them:

Sub-type 1. Basal channel deposits consist of wide channels filled with thick, permeable alluvial-fluvial sediments. The uranium is predominantly associated with detrital plant debris, forming ore bodies that display, in a plan view, an elongated lens or ribbon-like configuration and, in a section-view, a lenticular or, more rarely, a roll-shape. Individual deposits may range from several hundred to 20 000 t of uranium, at grades ranging from 0.01% to 3%. Examples are the deposits of Dalmatovskoye (Transural Region) and Khiagdinskoye (Vitim District) in the Russian Federation and Beverley (Australia).

Sub-type 2. Tabular deposits consist of uranium matrix impregnations that form irregularly shaped lenticular masses within reduced sediments. The mineralised zones are largely oriented parallel to the depositional trend. Individual deposits may contain several hundred to 150 000 tonnes of uranium, at average grades ranging from 0.05% to 0.5%. Examples of deposits include Hamr-Stráz (Czech Republic), Akouta, Arlit, and Imouraren (Niger) and those of the Colorado Plateau (USA).

Sub-type 3. Roll-front deposits: the mineralised zones are convex in shape, oriented down the hydrologic gradient. They display diffuse boundaries with reduced sandstone on the down-gradient side and sharp contacts with oxidized sandstone on the up-gradient side. The mineralised zones are elongated and sinuous along strike and perpendicular to the direction of deposition and groundwater flow. Resources range from a few hundred tonnes to several thousand tonnes of uranium, at grades averaging 0.05% to 0.25%. Examples are Budenovskoye, Tortkuduk, Moynkum, Inkai and Mynkuduk (Kazakhstan) and Crow Butte and Smith Ranch (USA).

Sub-type 4. Tectonic-lithologic deposits are discordant to strata. They occur in permeable fault zones and adjacent sandstone beds in reduced environments created by hydrocarbons and/or detrital organic matter. Uranium is precipitated in fracture or fault zones related to tectonic extension. Individual deposits contain a few hundred tonnes up to 5 000 tonnes of uranium at average grades ranging from 0.1-0.5%. Examples include the deposits of the Lodève District (France) and of the Franceville Basin (Gabon).

Sub-type 5. Mafic dykes/sills in Proterozoic sandstones: mineralisation is associated with mafic dykes and sills that are concordant with or crosscut Proterozoic sandstone formations. Deposits may be subvertically oriented along the dyke's margins (Matoush, Otish Basin, Canada), or hosted within the dykes, or stratabound within the sandstones along lithological contacts with mafic sills (Red Tree, Westmoreland District, Australia). Deposits are small to medium (300-10 000 t) with low to medium grades (0.05-0.40%).

Unconformity type deposit model

Unconformity-related deposits are associated with and occur immediately below, above, or spanning an unconformable contact that separates Archaean to Palaeoproterozoic crystalline basement from overlying, red-bed clastic sediments of Proterozoic age. In most cases, the basement rocks immediately below the unconformity are strongly hematised and clay altered, possibly a result of paleo-weathering and/or diagenetic/hydrothermal alteration. Deposits consist of pods, veins and semi-massive replacements consisting mainly of pitchblende. Strong quartz dissolution is generally associated with them. The unconformity deposits are commonly very high grade. They are preferentially located in two major districts, the Athabasca Basin (Canada) and the Pine Creek Orogen (Australia), supplying *c*. 20% of the global uranium market. The unconformity deposits include three sub-types of variable importance:

Sub-type 1. Unconformity-contact deposits which all occur in the Athabasca Basin (Canada).

Sub-type 2. Basement-hosted deposits such as Kintyre, Jabiluka and Ranger (Australia), Millennium and Eagle Point in the Athabasca Basin and Kiggavik and Andrew Lake in the Thelon Basin (Canada).
Sub-type 3. Stratiform structure-controlled deposits (Chitrial and Lambapur, Cuddapah Basin, India).

Tract distribution

The internal GEUS assessment group identified 36 tracks based on the geological environment and uranium anomalies. Some tracks consists of several polygons in the GIS system and some tracks cover several geological periods. During the workshop it was decided not to assess some of the tracks, mainly due to too high metamorphic grade, while it was decided to split up other tracks into smaller once, mainly due to tracts covering two sedimentary units deposited over a long geological history with largely varying paleoclimate. Eventually, a total of 35 tracts (Figure 1) were assessed at the workshop, 11 for intrusive deposits, 16 for sandstone deposits and eight for unconformity-related deposits.
All the assessed tracts are described in this paper. Several of them were described previously by Keulen et al. (2014). In these cases, the text from Keulen et al. (2014) has been reused in this paper either in the original form or modified if new information or re-assessments have been made.

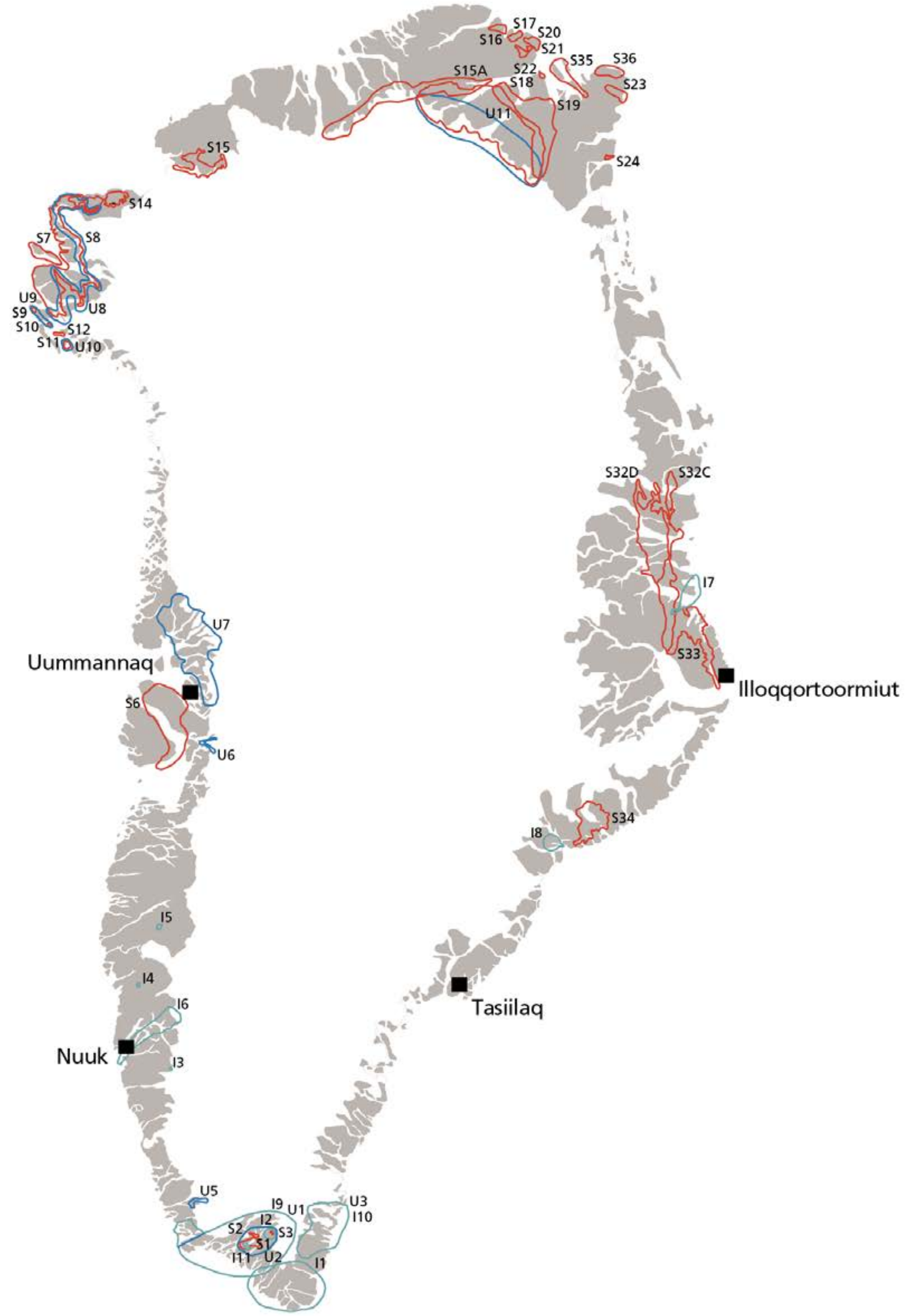

Figure 1. *Overview of the 35 tracts assessed at the workshop. The light blue lines are tracts for intrusive deposits, the dark blue lines for unconformity deposits and the red lines for sandstone deposits.*

Historic background

Uranium exploration in Greenland was initiated by the Danish Atomic Energy Commission (AEK) headed by Danish physicist and Nobel Prize winner Niels Bohr. The aim at the time was to develop nuclear power in Denmark, based on uranium sources from Greenland. The AEK was established in January 1955 where the planning of the atomic research facility at Risø was initiated, but already before the funding for the test facility was in place AEK started to plan uranium exploration in Greenland. The Greenland Geological Survey (GGU) was approached for advice to identify the most advantageous place to explore for uranium. The Survey suggested to focus on the area around the Ilímaussaq alkaline intrusion in South Greenland. This area was chosen because the intrusion was known to host a wide range of rare minerals. One of these minerals is the uranium-bearing steenstrupine, which was discovered by K.J.V. Steenstrup in the Ilímaussaq igneous complex, South Greenland in 1876 and described by Lorenzen in the 1881.

In 1955 and 1956 geological mapping and systematic uranium exploration was carried out by a consortium consisting of the Geological Survey of Greenland (GGU), the Danish Atomic Energy Commission, and Kryolitselskabet Øresund A/S. The exploration campaign used Geiger counter instruments in the regional reconnaissance surveys. In 1956 a high radioactive zone was identified at Kvanefjeld.

The following years, several drilling campaigns were carried out by the Danish Atomic Energy Commission‘s research establishment and later on by Risø National Laboratory (Risø; see Kalvig 1983). Furthermore, beneficiation studies were undertaken by Risø in the early 1980’s.

During the period from 1970-84, exploration for uranium and beneficiation studies were undertaken by GGU and Risø National Laboratory on behalf of the Danish government. The work included radiometric surveys, geochemical prospecting, and geological mapping (Steenfelt et al. 1977; Nielsen 1980). Airborne surveys were undertaken in central East Greenland (1971-74; Nielsen & Løvborg 1976), West Greenland (1975-76; Secher 1976), and South Greenland (1979-82; Armour-Brown et al. 1982a, 1983a, 1983b), and a number of uranium anomalies were identified as a result of these efforts. Pre-feasibility studies for the Kvanefjeld Uranium Project were published by Risø in 1983.

Nordisk Mineselskab A/S undertook uranium exploration in central East Greenland working on the basis of an exploration licence granted for the work around the Mestersvig Lead Mine 1952-1984. The licence was later replaced by six exclusive mineral exploration licences targeting base- and special metals, and one oil exploration licence on Jameson Land lasting until the liquidation of the company in 1991.

In the period 1978-1982, the South Greenland Regional Uranium Exploration Project (‘Syduran’), a reconnaissance exploration programme to outline the uranium potential in South Greenland, was executed under the auspices of GGU (Armour-Brown et al. 1982a). Syduran defined a number of mineralisations within the region. See Sørensen (2001) for further details on the exploration history. Afterwards, the South Greenland Exploration Programme (Sydex) aimed at a more detailed evaluation of the uranium showing in Illorsuit (1984-1986). Sydex was carried out by GGU and Risø, financed by the Danish Ministry of Energy (Armour-Brown 1986).

In 1985 the Danish Parliament changed the energy policy strategy excluding the option of power generated by Danish nuclear power plants, to a strategy based on conventional fossil fuel based energy. As a consequence, it was decided not to continue the investigations of the uranium potential at Kvanefjeld and not to undertake further uranium exploration in Greenland. A no-uranium-exploration, administrative practice was introduced in Greenland excluding any exploration and exploitation on uranium-bearing rock. Over time, this administrative practice was named the “zero-tolerance” policy (for further detail on this practice see Vestergaard and Thomasen, 2015).

On 24 October 2013, the Greenland parliament, Inatsisartut, lifted this decades-long moratorium on mining radioactive elements, which has opened the way for potential future exploration of uranium (OECD/NEA-IAEA, 2016).

In January 2016, Denmark and Greenland signed an agreement concerning the special foreign-, defence- and security policy issues related to the possible future mining and export of uranium in Greenland. While Denmark is responsible for non-proliferation matters in the Kingdom of Denmark, especially safeguards, security and dual-use exports, the agreement establish a framework for a shared approach to ensure compliance with the Kingdom of Denmark’s international non-proliferation obligations. The agreement underlines the joint Danish and Greenlandic commitment to observe the highest international standards comparing with other uranium supplier states.

The agreement also served as a basis for the new Danish legislation for Greenland on safeguards and export controls, including export of nuclear material from Greenland, being subject to nuclear cooperation agreements to provide assurances that exports are properly protected and used for peaceful purposes (OECD/NEA-IAEA, in press).

Regional data

Steenfelt (2014) compiled all geochemical and radiometric data for uranium in Greenland stored at GEUS. This includes geochemical data from stream sediment fine fraction, stream sediment heavy mineral concentrate, stream water and rock samples. The radiometric data is from airborne gamma-spectrometry and ground scintillometry. The overall results are presented below and in Figures 2-7. The maps give a clear indication of areas with high uranium values. For details on sampling and analytic methods and calibration see Steenfelt (2014).

Geochemical data

Stream sediments

The data set is based on ca. 12,000 systematically sampled, treated and analysed stream sediment samples, and has a coverage corresponding to 75% of the ice-free Greenland (Figure 2). Although stream sediment is the preferred sample medium, soil or lake shore sediment has been sampled as substitute in (rare) low-relief areas where proper streams are absent. In very steep topography typically along glaciers, samples of scree have been collected as substitute for stream sediment. Substitute samples were treated in the same way as stream sediment with analysis of the fine fraction.

Heavy mineral concentrates

Heavy mineral concentrates of stream sediment samples have been used for exploration for gold, tungsten or other heavy minerals, and has also been useful for uranium. Figure 3 is based on ca. 7,500 heavy mineral concentrates that were analysed for uranium, by GEUS, Nordisk Mineselskab A7S and Nuna Minerals A/S.

Stream water

Owing to the mobility of U^{6+}, surface and ground water have found application already in the early days of geochemical uranium exploration. More than 8,000 samples have been collected by GEUS in East, South and West Greenland (Figure 4).

Rock samples

During the uranium exploration campaigns from 1972 to 1986 whole rock samples were routinely analysed for uranium. Afterwards uranium has been analysed in many rock samples collected for mapping and mineral exploration purposes as uranium is one element of many standard multi-element analytical packages. Figure 5 shows the result of ca. 9,000 rock samples collected by GEUS and Nordisk Mineselskab A/S.

Radiometric data

Airborne gamma ray spectrometric surveys

Contour-flying was applied in the surveys at regional scale performed over large areas of East, West and South Greenland (Figure 6). The surveys were performed using fixed-wing aircrafts in East and West Greenland and helicopter in South Greenland.

Ground measurements

Total gamma-radiation was routinely measured by scintillometer at stream sediment sampling sites for the Geochemical Mapping Programme of West and South Greenland (Figure 7).

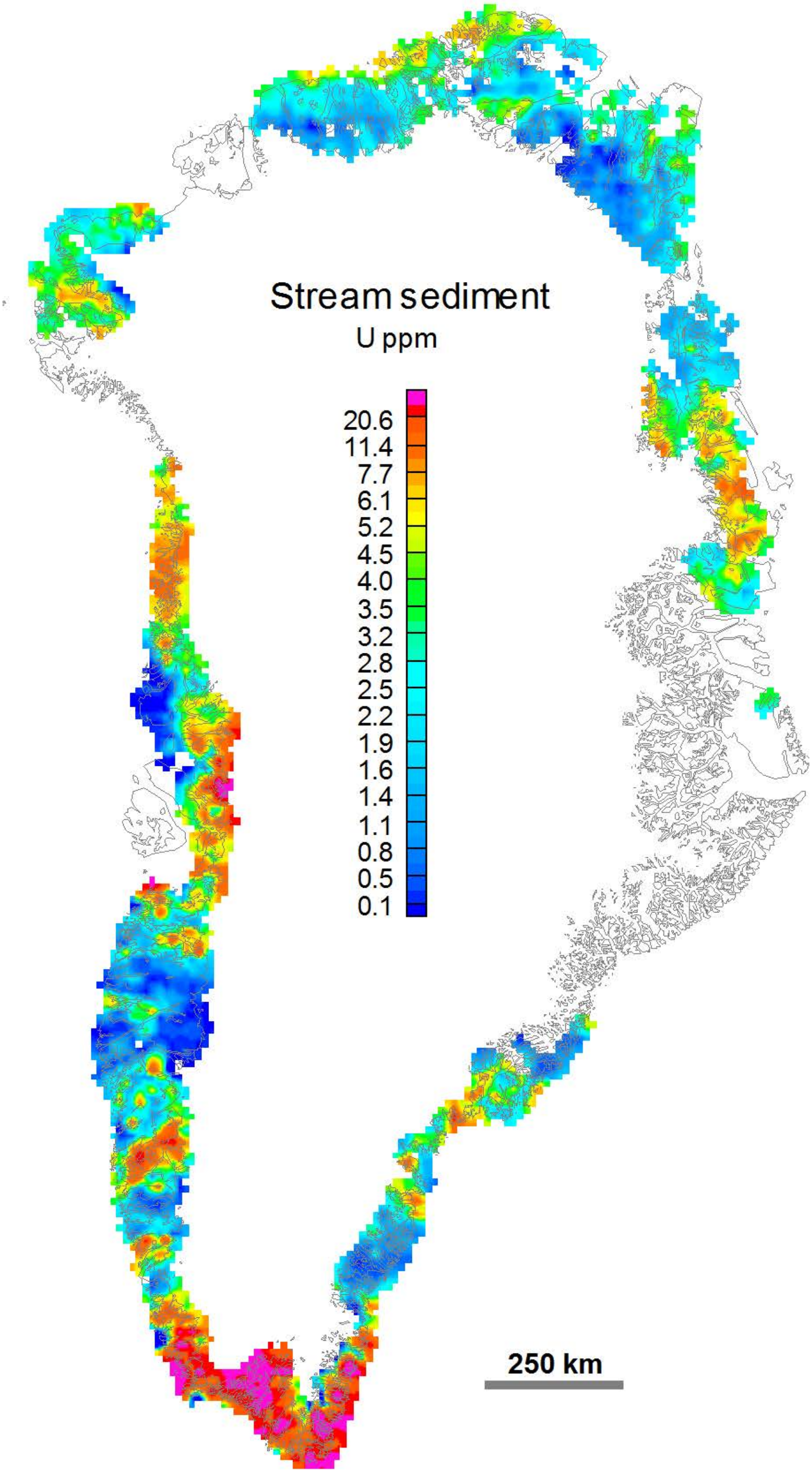

Figure 2. *Colour contoured grid of U concentrations of the <0.1 mm grain size fraction of stream sediment collected for geochemical mapping and analysed by instrumental neutron activation method (Steenfelt 2014).*

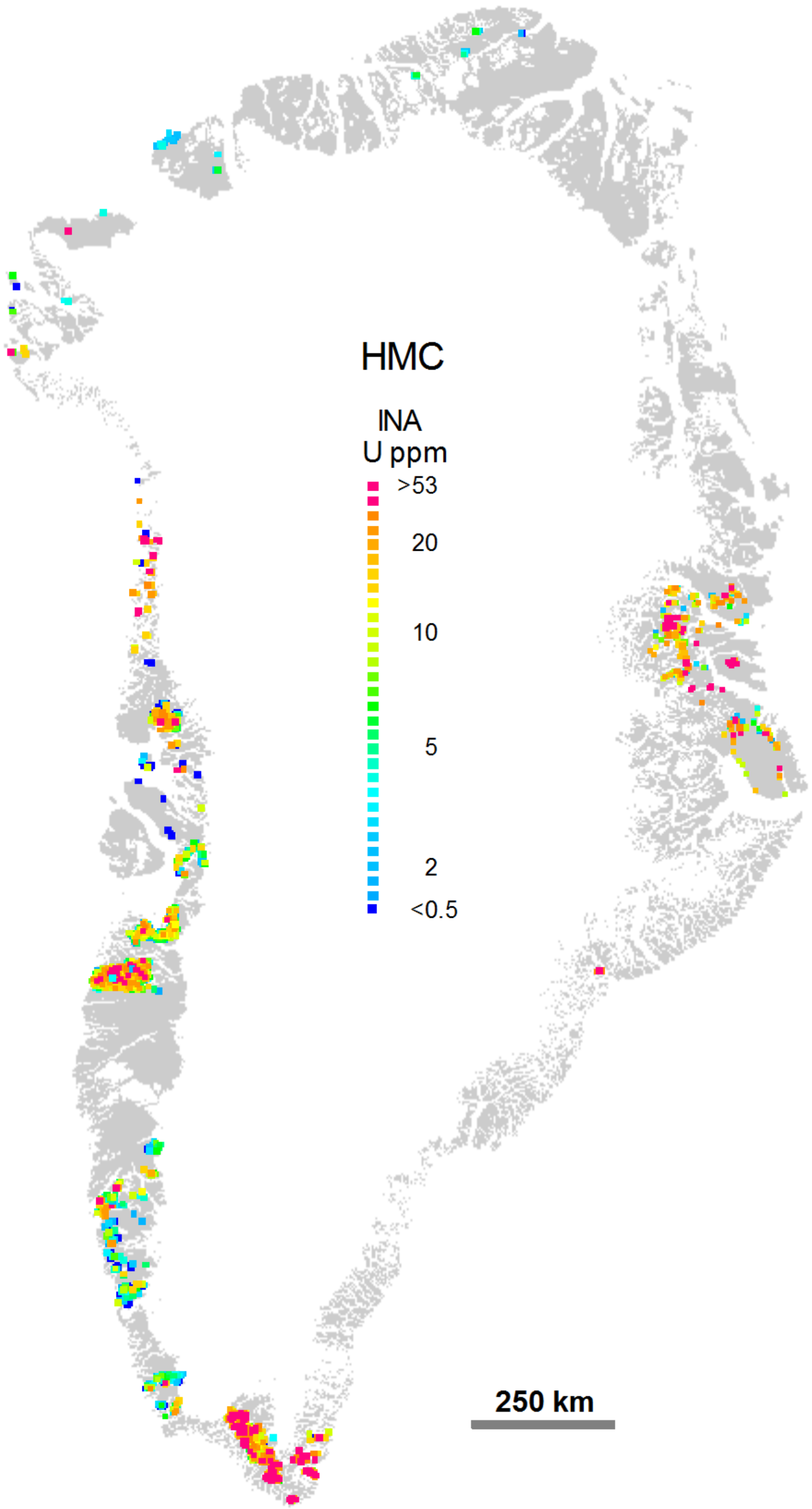

Figure 3. *Colour-scaled symbol plot of U concentrations of heavy mineral concentrates of stream sediment collected by GEUS and companies and analysed by instrumental neutron activation method (INA) (Steenfelt 2014).*

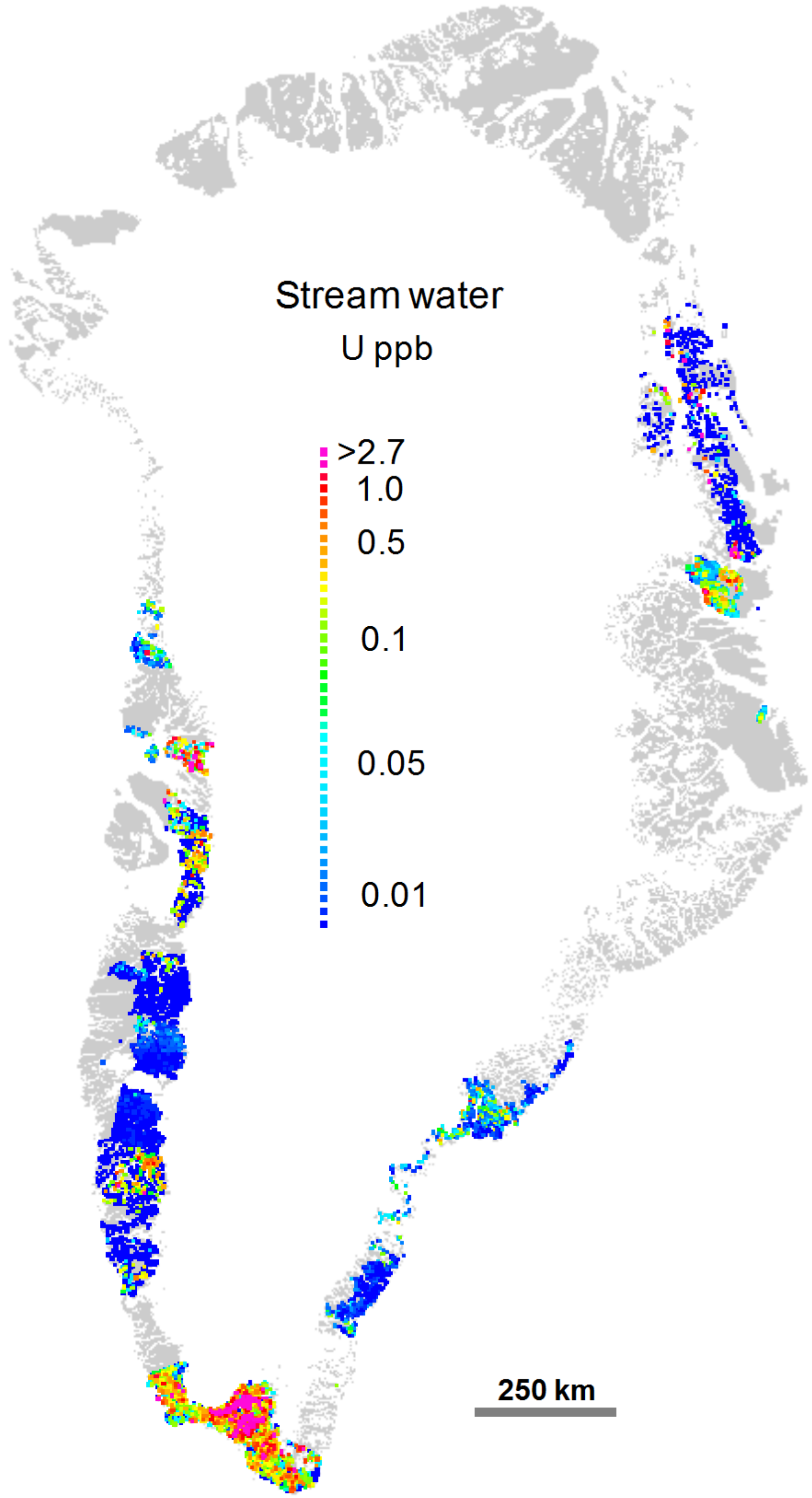

Figure 4. *Colour-scaled symbol plot of U concentrations of stream water analysed by various methods. The values shown are adjusted to compensate for bias between the methods and batches (Steenfelt 2014).*

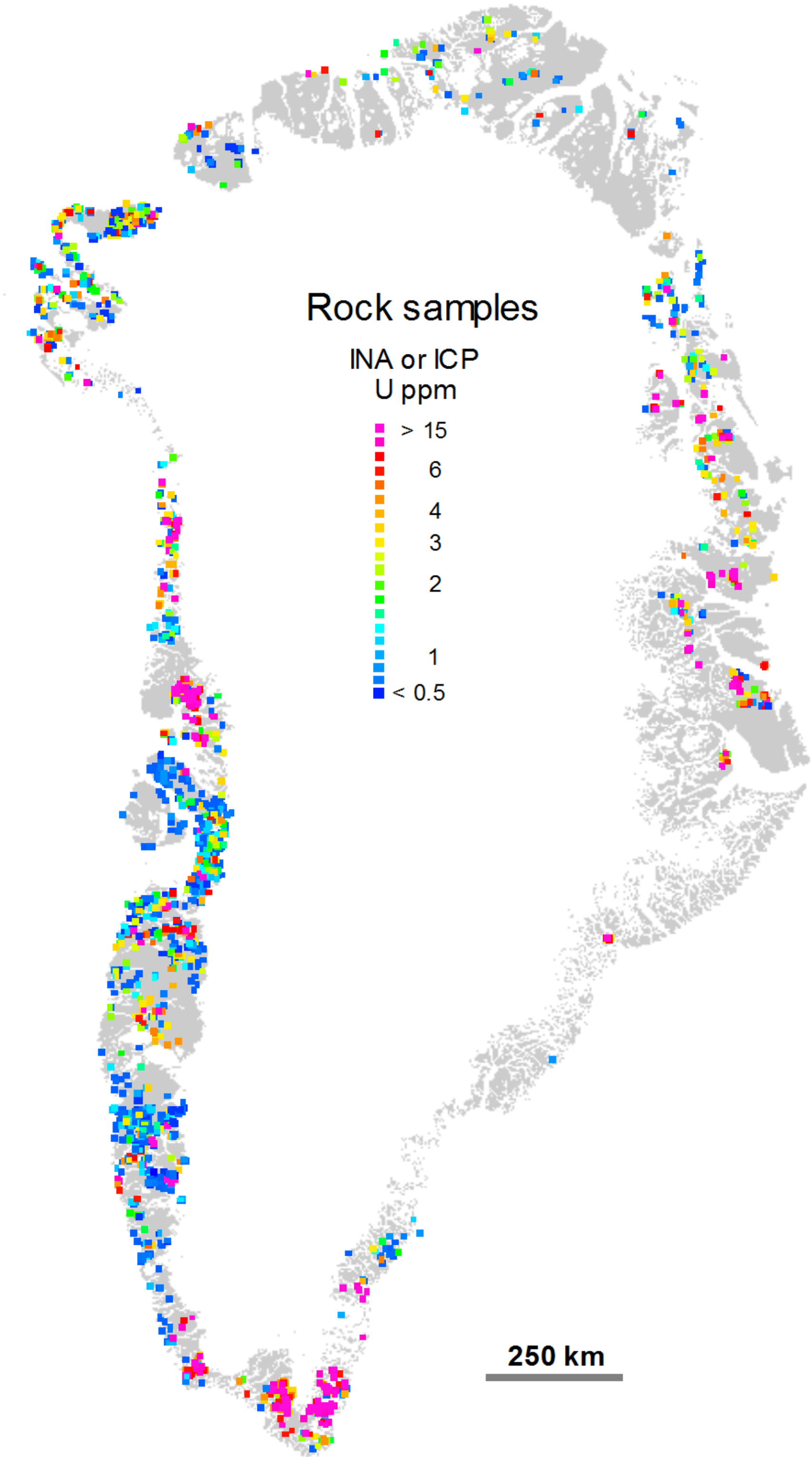

Figure 5. *Colour-scaled symbol plot of U concentrations of rock samples collected for mineral exploration and geological research and analysed by instrumental neutron activation (INA) or inductively coupled plasma spectrometry (ICP) (Steenfelt 2014).*

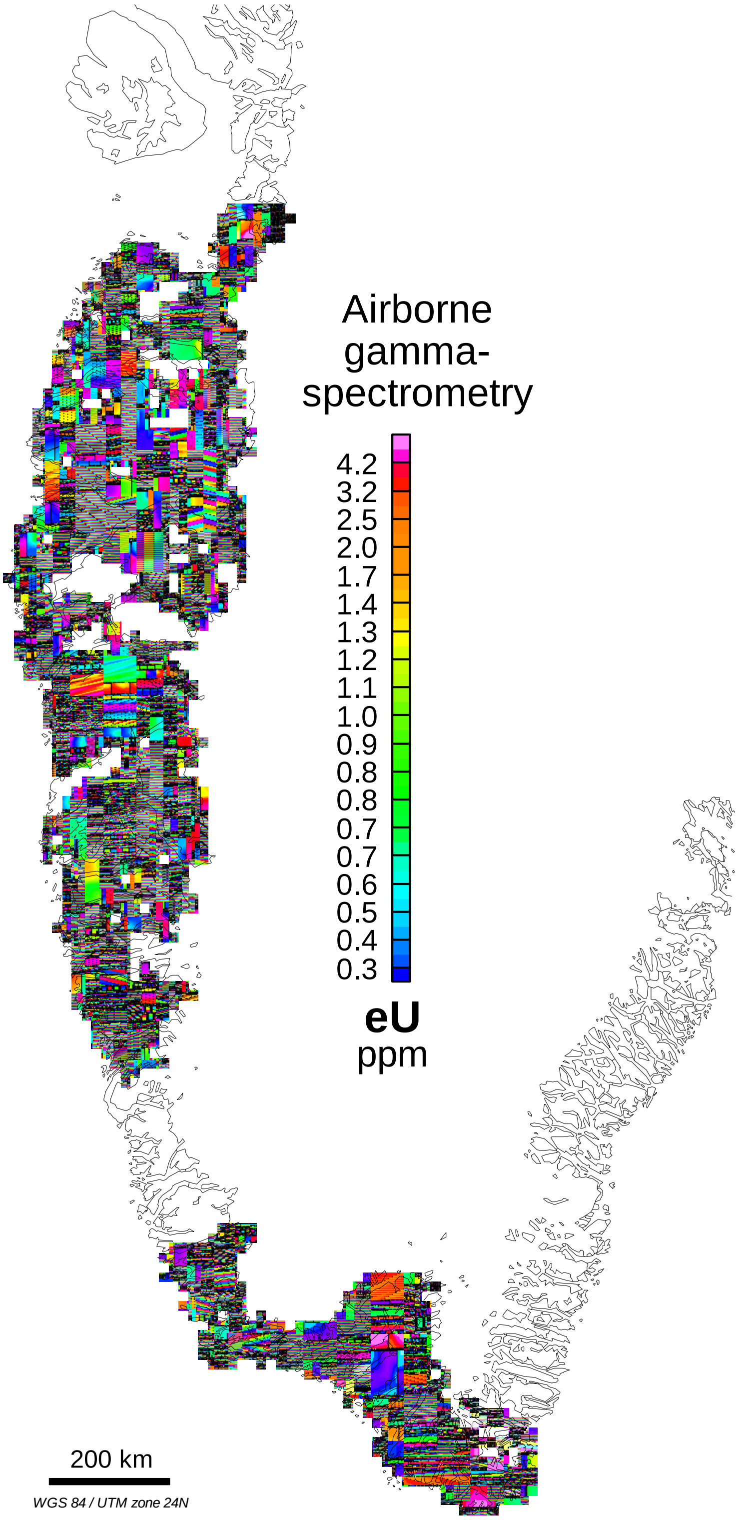

Figure 6. *Colour contoured grid of equivalent (eU) ground concentration of U determined by airborne gamma ray spectrometry (Steenfelt 2014).*

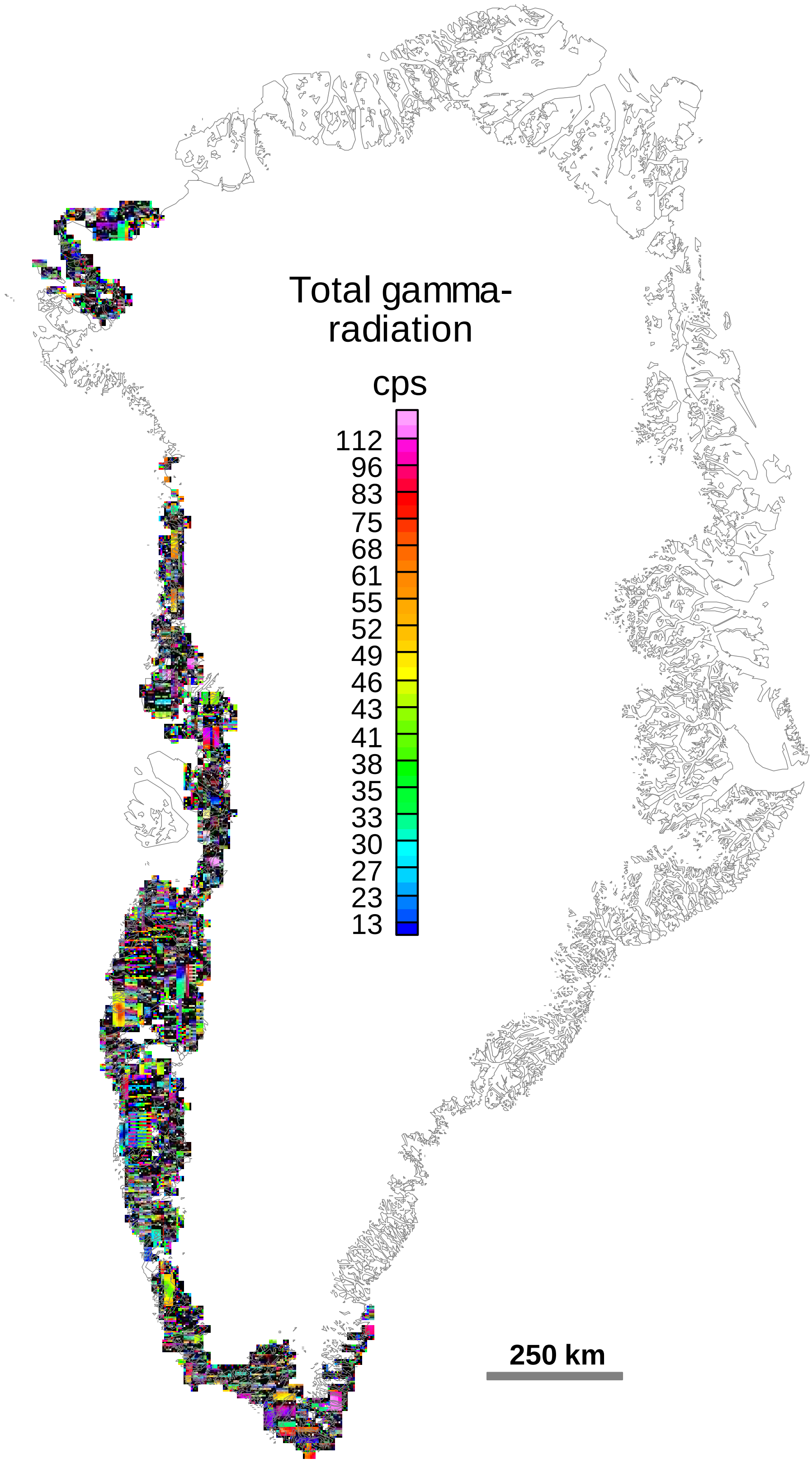

Figure 7. *Colour contoured grid of total gamma radiation measured by scintillometer in counts per second (cps) at sampling sites for stream sediment geochemical mapping (Steenfelt 2014).*

Uranium exploration and resources

No uranium has ever been produced in Greenland. However, since 2007, Greenland Minerals and Energy Ltd (GME) has conducted REE (U-Zn) exploration activities in the Kvanefjeld area, South Greenland, including drilling of 57,710 m of core; the business concept encompasses uranium and zinc by-products in addition to the main products of REE. Uranium will be recovered from leach solutions using industry standard solvent extraction to produce approximately 500 tonnes of U_3O_8 per year. The Kvanefjeld Feasibility Study, as well as the environment and social impact assessments (EIA and SIA), were carried out in 2014-2015 and were submitted together with the exploitation licence application in December, 2015.
The application is currently being evaluated by the Greenland Government. However, the Greenland Government requested further environmental tests and investigations which is still pending.

Uranium occurrences

Uranium exploration in Greenland has identified large low-grade uranium deposits hosted by alkaline igneous complexes as well as a number of high-grade uraninite occurrences hosted in fractures and pegmatites. Known uranium occurrences are all situated in areas outlined as uranium-enriched by reconnaissance scale airborne gamma-spectrometric and drainage geochemical surveys.
The location of significant uranium occurrences discovered during exploration between 1955 and 1985 are shown in Figure 8-10. In addition, a large number of showings with samples yielding above 100 ppm U are known. The majority of the occurrences are related to the depositional environments evaluated in this report and will therefore be introduced in the following.

Identified conventional resources (reasonably assured and inferred resources)

The Mesoproterozoic Ilímaussaq alkaline complex of South Greenland hosts the REE-U-Zn-F deposit referred to as Kvanefjeld. Greenland Minerals & Energy (GME), the licence holder of the Kvanefjeld area, exploring for rare earth elements, considers uranium as a by-product in a potential open-pit mine. The uranium is hosted mainly by steenstrupine and is a large-tonnage, low-grade uranium-enriched intrusive deposit. Kvanefjeld is the only uranium deposit in Greenland with JORC-code compliant uranium resources, hosting a JORC compliant measured deposits of 143 Mio. tonnes, grading 304 ppm U_3O_8. (cut-off grade 150 ppm U_3O_8), and around Kvanefjeld the total resource (measured, indicated and inferred) is estimated to 673 Mio tonnes U_3O_8. Additional inferred mineral resources of 242 Mt/ 304 ppm U_3O_8 and 95 Mt/300 ppm U_3O_8 are known from the Zone Sørensen and Zone 3 respectively.

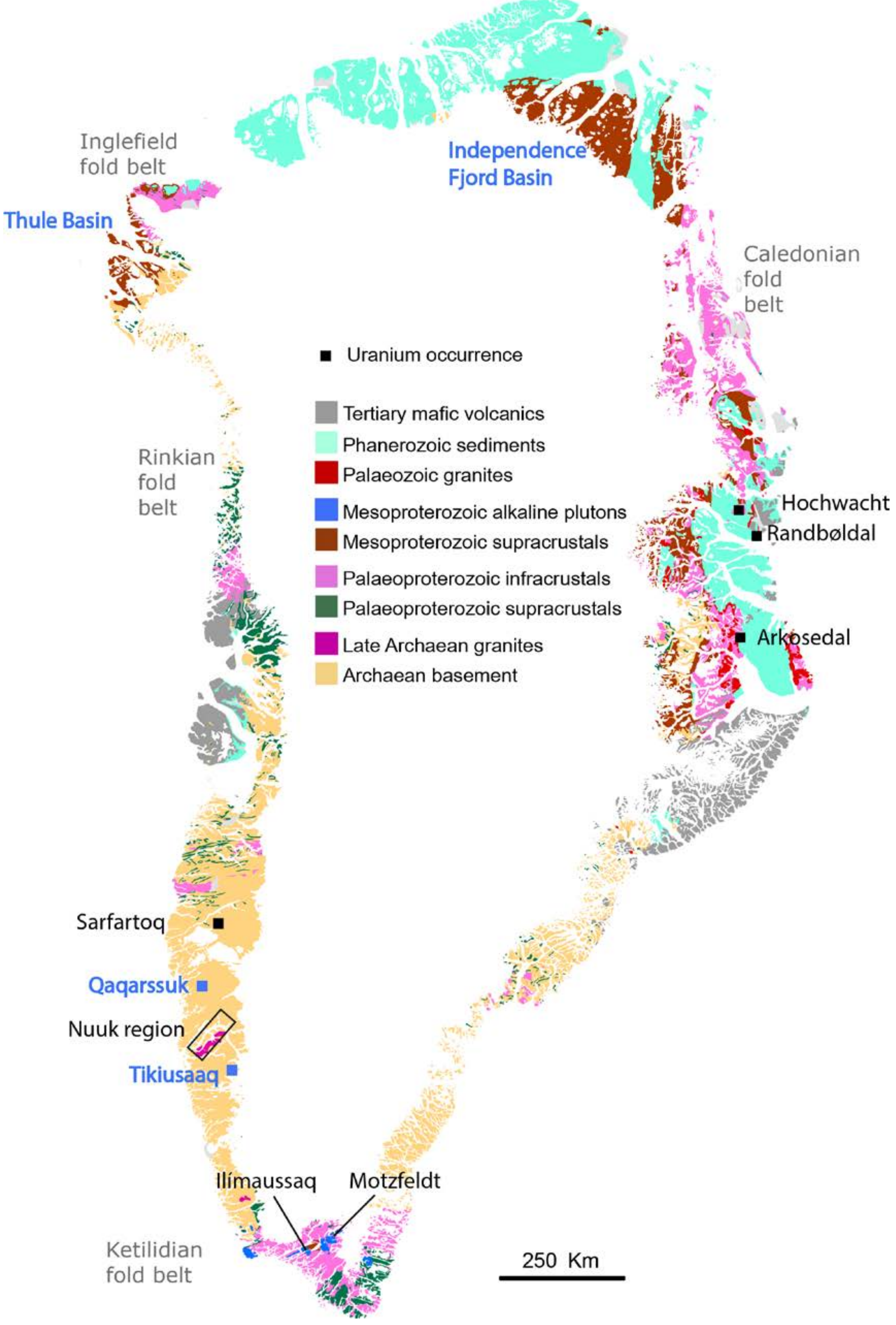

Figure 8. *Main lithostratigraphic units in Greenland with location of known uranium occurrences (see Table 1). Black squares for localities with uranium concentrations above 0.5% in rock samples. Blue text for lithological units with uranium potential. For South Greenland see Figure 9. Source: Steenfelt (2014).*

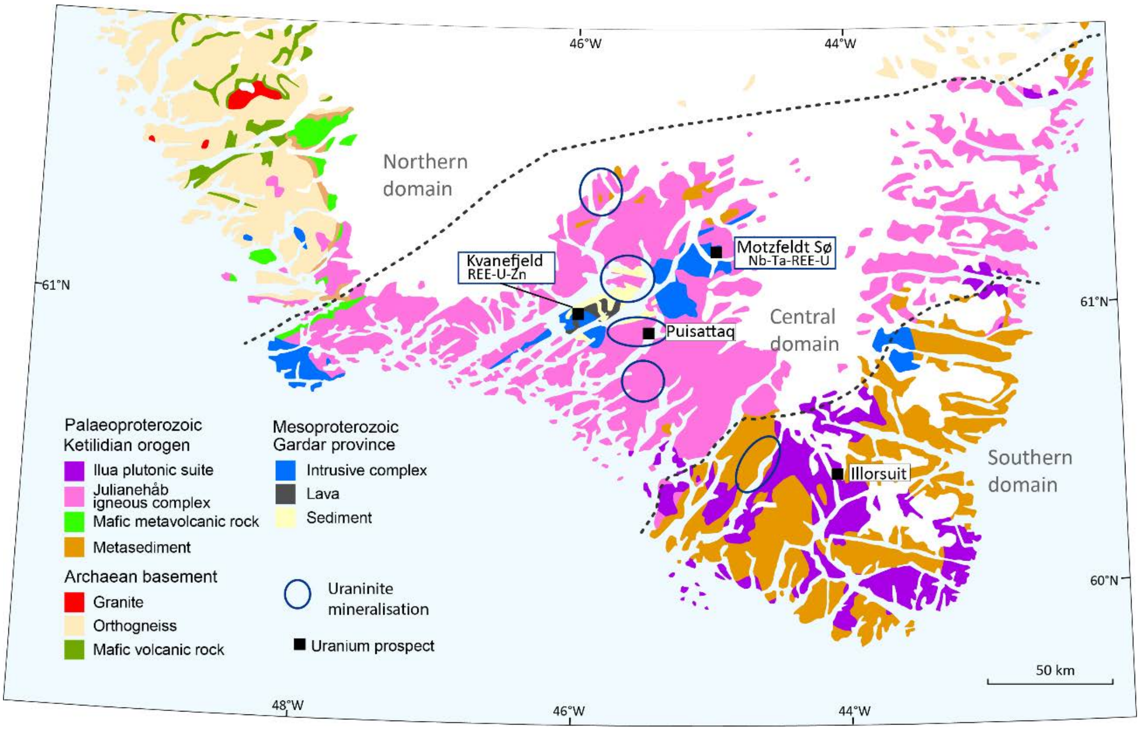

Figure 9. *Main lithostratigraphic units within South Greenland together with known uranium occurrences. Uranium mineralisations are documented by rock samples (see Fig. 10); prospects have been investigated in detail. Based on Steenfelt et al. (2016).*

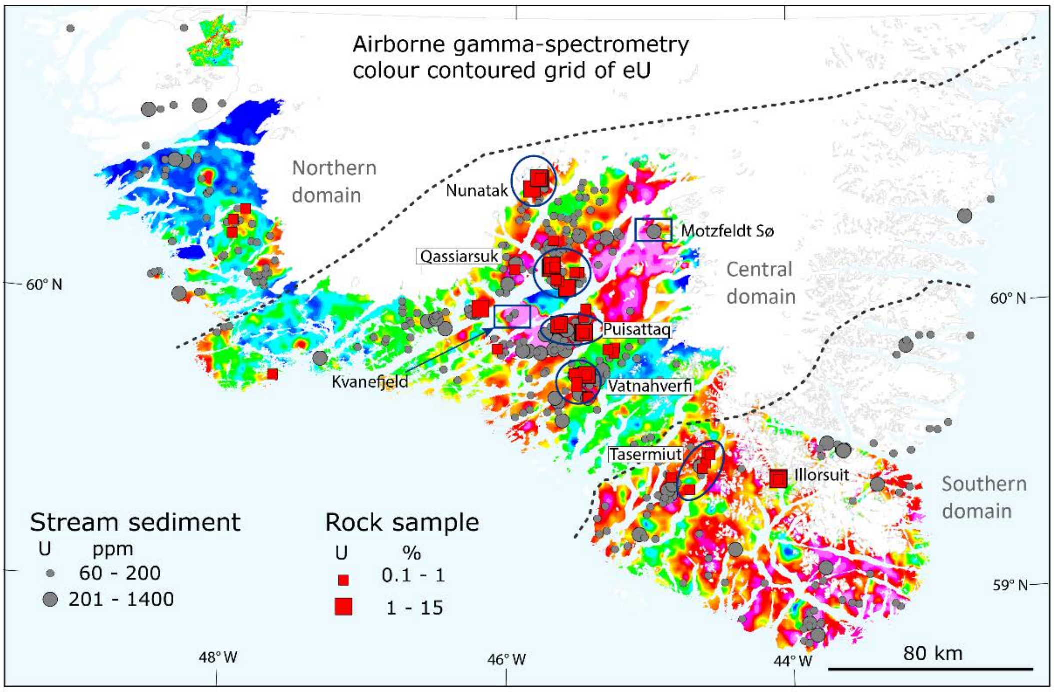

Figure 10. *Summary of results of uranium exploration 1979–1984 in South Greenland. Elevated to high uranium contents of stream sediment and rock samples displayed on top of gridded data for equivalent uranium (eU) recorded during helicopter-borne gamma-spectrometry. From the workshop presentation by A. Steenfelt in the uranium workshop.*

Assessment of intrusive deposits

Tract distribution

The tracts were based on evaluation of the geology using the 1:500 000 scale geological map. These units were extracted as georeferenced polygons.
Eleven tracts for intrusive deposits were assessed at the workshop.

Table 1. *Overview of the individual tracts that were assessed for metasomatic type deposits at the workshop.*

Polygon name	Tract name	Tract size (km^2)	Description	Comments	Metamorphic grade	Setting
I1	Southern Domain	5,401	Mesoproterozoic pegmatite and anatectic veins in metasediment, South Greenland	uraninite	none	Ketilidian Orogen
I2	Motzfeldt	282	Mesoproterozoic Motzfeldt peralkaline intrusion, South Greenland	pyrochlore	none	Gardar alkaline igneous province
I3	Tikiusaaq	50	Jurassic Tikiusaaq carbonatite, SW Greenland	pyrochlore	none	Archaean craton
I4	Qaqarssuk	15	Jurassic Qaqarssuk carbonatite, SW Greenland	pyrochlore	none	Archaean craton
I5	Sarfartoq	200	Neoproterozoic Sarfartoq carbonatite, SW Greenland	pyrochlore	none	Archaean craton
I6	Nuuk region	1,482	Archaean Nuuk pegmatites, SW Greenland	uraninite, U-Th minerals	medium	Neoarchaean suture zone
I7	Werner Bj., Kap Simpson, Kap Parry	712	Palaeogene alkali intrusion (Werner Bj., Kap Simpson, Kap Parry), East Greenland		none	North Atlantic margin
I8	Kangerdlugssuaq	182	Palaeogene alkali intrusion (Kangerdlugssuaq), East Greenland			
I9	Central Domain, SVG	8,815	Undiscovered Mesoproterozoic peralkaline intrusions in the Central Domain, South-West Greenland		none	Gardar alkaline igneous province
I10	Central Domain, SEG	1,274	Undiscovered Mesoproterozoic peralkaline intrusions in the Central Domain, South-East Greenland		none	Gardar alkaline igneous province

I11	Ilímaussaq	78	Mesoproterozoic Ilímaussaq peralkaline intrusion, South Greenland	Steenstru-pine	none	Gardar alkaline igneous province

Individual tracts assessed during the workshop

Tract I1 – Southern Domain, South Greenland

The Southern Domain of the Ketilidian orogeny, South Greenland, covers large volumes of supracrustal rocks that are moderately to strongly folded, thrusted and partially melted (Figure 11). The supracrustal sequences are dominated by paragneiss and schists of metasedimentary origin, but also include occurrences of amphibolite and other rocks of metavolcanic origin. The metamorphic grade varies across the domain; granulite and upper amphibolite facies metamorphic rocks in the southernmost and structurally lower part, and greenschist and lower amphibolite facies rocks in the uppermost parts (Steenfelt et al. 2016).

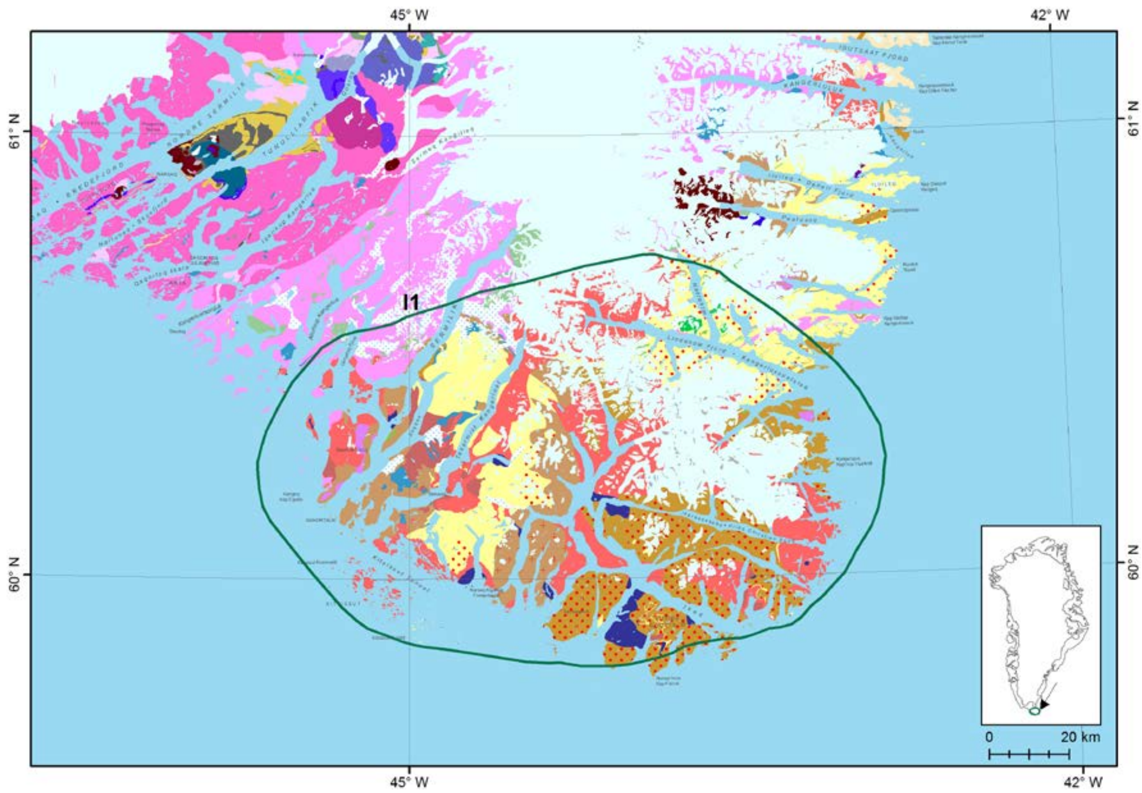

Figure 11. *Tract I1, Southern Domain, South Greenland.*

At a few places, strata of the upper part of the sedimentary succession rest upon granitoids of the early Julianehåb igneous complex. A granite clast in a conglomerate with an age of c. 1815 Ma provides a maximum age for this part. Isotopic data for the youngest detrital zircons from the uppermost supracrustal sequences suggest they were deposited in the interval c. 1794 to 1762 Ma (Garde et al. 2002). The area is dominated by Mesoproterozoic pegmatitic and anatectic veins crosscutting the metasedimentary rocks. Accessory uraninite is found in the pegmatites and anatectic veins (Steenfelt et al. 2007).

The Southern Domain hosts two closed mines, the Nalunaq gold mine and the Amitsoq graphite mine, and prospects for gold, uranium and graphite (Schjøth et al. 2000).

Mineral showings comprise localities with Au >1 ppm, sulphides mineralisation with high concentrations of Cu and Zn hosted by mafic metavolcanic rocks, orthomagmatic Fe–Ti–V mineralisation hosted by the Stendalen gabbro as well as uranium occurrences with U > 0.2%. Stream sediment data show that the entire Southern Domain is enriched in As and that Sb- and Cs-enriched areas are spatially associated with occurrences of meta-arkose at low metamorphic grade. The data also shows enriched areas of U, Cu and Zn. The stream sediment samples with high Cu and Zn contents carry material from small occurrences of sulphide mineralised mafic metavolcanic rocks (Steenfelt et al. 2016).

Table 2. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract I1, Southern Domain, South Greenland.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km²)	Deposit density (N_{total}/km²)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	2	3	4	6	1.84	1.51	83	0	1.84	5,401	0.00034

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	1	2	2	4
Individual 2	0	0	1	2	3
Individual 3	1	1	3	5	7
Individual 4	1	2	4	6	10
Individual 5	0	1	2	3	5
Individual 6	0	0	1	2	4
Individual 7	0	1	3	4	5
Individual 8	0	1	5	6	7
Individual 9	0	1	3	4	8
Individual 10	1	2	3	3	5
Individual 11	0	3	4	6	8
Individual 12	1	3	5	5	5
Individual 13	0	1	1	2	5
Individual 14	0	1	2	3	4
Individual 15	1	3	6	10	15
Individual 16	0	2	4	6	8
Consensus	**0**	**2**	**3**	**4**	**6**

Investigations of the strongest of many aeroradiometric uranium anomalies recorded in these environments led to the identification of uraninite mineralisation within rafts of metasediment enclosed by granitoids at Illorsuit. The mineralisation is described as stratiform and the original mineralisation is interpreted as syn-sedimentary/syn-volcanic, although locally mineralisation is now situated in folds and veins, due to tectonic and metamorphic processes. The highest grade uranium mineralisation is about 50 m long and up to 5 m wide with grades up to 7 % U. It is estimated that the Illorsuit prospect contains 17,000 tonnes of uranium ore with a grade of 0.31 % U.

The anatectic melting of metasediments in the Southern domain created pegmatites and migmatitic veins that host scattered, small uraninite occurrences that were investigated cursorily at Tasermiut. It is still not fully understood where the uranium is coming from, but there is clearly a large amount of uranium in the system. This tract received a high ranking (Table 2) due to all the uranium anomalies and mineralisations found in the area, in combination with the tectonic setting.

Tract I2 – Motzfeldt

The Mesoproterozoic Motzfeldt Centre within the Igaliko alkaline intrusive complex, is part of the Gardar Province. It is made up of multiple intrusions of syenite and nepheline syenite. It is emplaced as two main igneous episodes into the Proterozoic Julianehåb batholith and the unconformably overlying Gardar supracrustal rocks (Figure 12). It contains an extensive U-Nb-Ta-Zr-REE mineralisation that was discovered by the reconnaissance surveys of the Syduran project (Armour-Brown et al. 1982b).

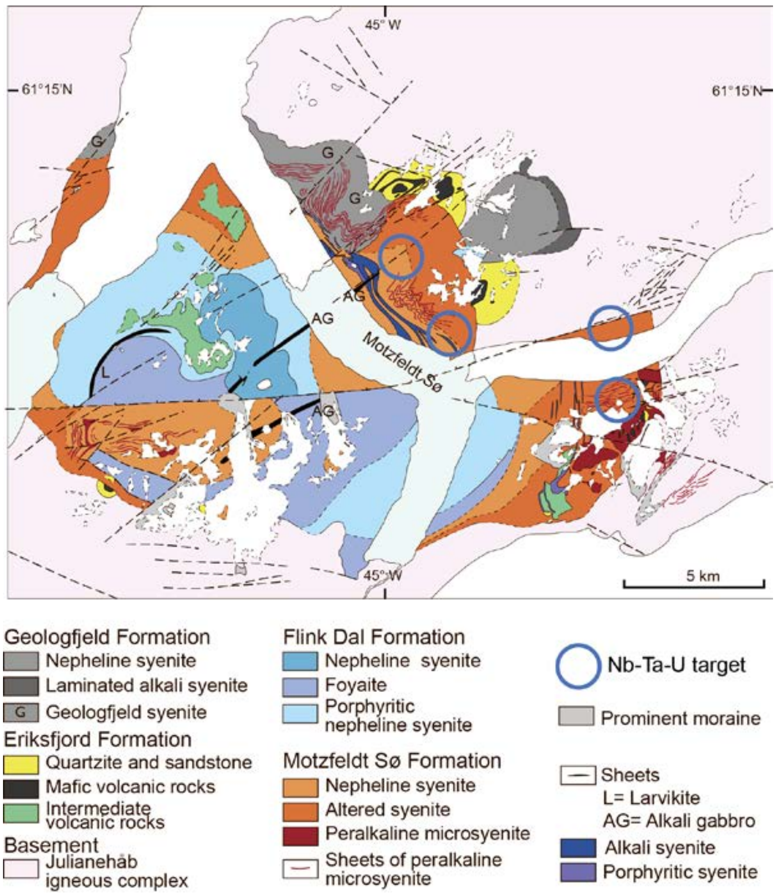

Figure 12. *Geological map of the Motzfeldt Complex with the location of investigated pyrochlore mineralisastion. Based on Thomassen et al. (1989) and Steenfelt et al. (2016).*

The coarser syenitic rocks are intruded by sills or sheets of microsyenite in the north and northeast part of the Motzfeldt Centre. At least two sets of faults cut the intrusion; the older generation of faults strikes SW-NE and those of the younger generation strike E-W. Uranium is hosted in pyrochlore, which is concentrated in a 200-300 m wide zone along the outer margin of the intrusion. The mineral is hosted in both peralkaline microsyenite and altered syenite (Thomassen 1988). The micro-syenite contains 100-500 ppm U and up to 1% Th. Metasomatic processes enriched uranium in zones to concentrations larger than 500 ppm, which extend over several 100 metres. The width of most zones lies in the range several m-100 m, but few are wider than 100 m. The altered rocks are also enriched in Zr, Nb, Ta, REE and Th. Pyrochlore contains 3-9% UO_2 and 0-0.25% ThO_2, with a typical Th/U ratio of 0.5-1.5 (Tukiainen 1986).

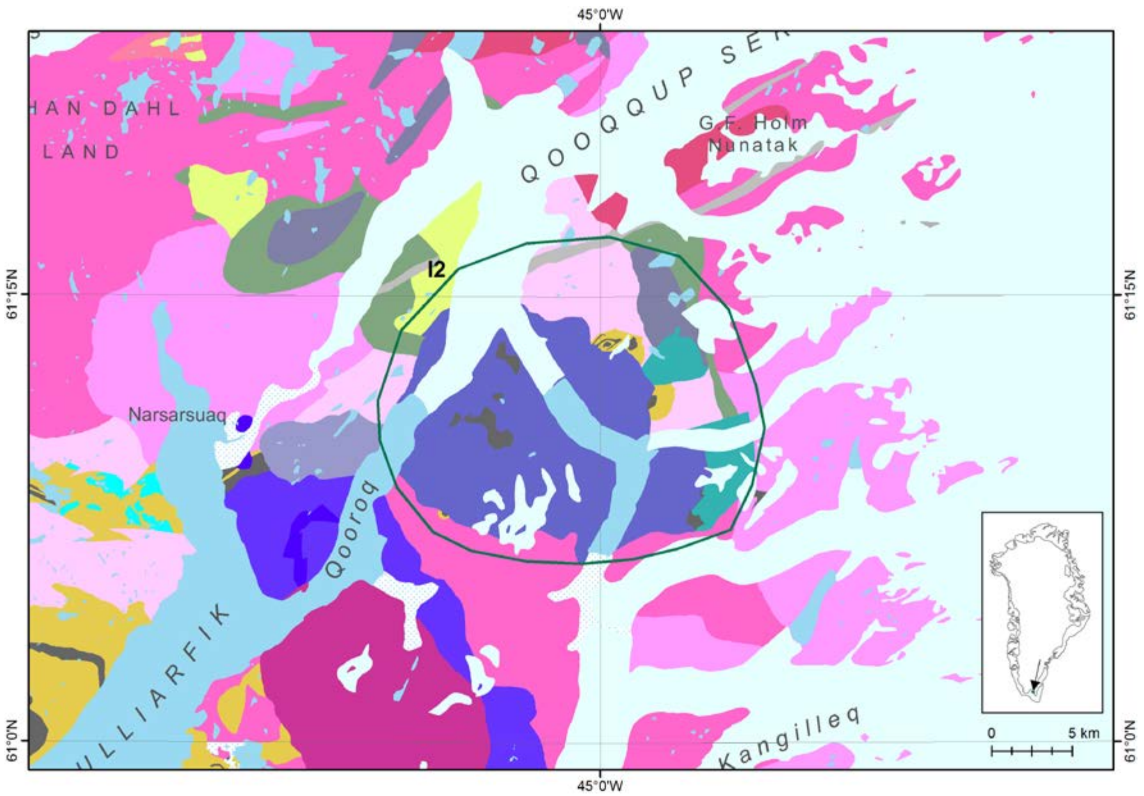

Figure 13. *Tract I2, Motzfeldt, South Greenland.*

The tract (Figure 13, Table 3) is estimated to have a high potential to host an additional deposit. Several mineralisations have already been identified and several areas have yet not been explored, partly due to difficult accessability.

Table 3. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract I2, Motzfeldt.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
1	2	3	4	5	2.04	1.15	57	0	2.04	282	0.0072

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	1	2	2
Individual 2	1	2	3	4	5
Individual 3	3	3	6	6	10
Individual 4	1	2	3	3	3
Individual 5	1	1	3	4	5
Individual 6	3	3	5	7	10
Individual 7	0	0	1	2	2
Individual 8	0	1	2	3	4
Individual 9	1	2	4	6	8
Individual 10	0	2	2	3	4
Individual 11	3	5	6	7	8
Individual 12	1	2	2	2	2
Individual 13	2	2	3	3	3
Individual 14	0	2	3	4	6
Individual 15	1	1	2	3	4
Individual 16	0	0	1	2	3
Consensus	**1**	**2**	**3**	**4**	**5**

Tract I3 – Tikiussaq

The Late Jurassic Tikiusaaq carbonatite complex was discovered in 2005 by GEUS (Steenfelt et al. 2006) and further studied during 2006 and 2007. The Tikiusaaq complex is intruding into Archaean basement and comprises massive carbonatite sheets, carbonatite veins and ultramafic lamprophyre dykes (Figure 14). The exposed carbonatite sheets cover ca. 2 by 3 km, but the alteration zone surrounding the carbonatite complex veining is extensive. Remote sensing data suggest that a massive carbonatite is hidden below the glacial terraces. The carbonatite contains accumulations of apatite and multi-element mineralisation with Ba, REE, U and Li. Just as elevated values of Nb, Ta, Mg and Be have been recorded. Uranium values up to 169 ppm have been recorded in the carbonatite, while surface samples have yielded up to 243 ppm U (Steenfelt et al. 2007). The intrusion reflects one single event. No later event took place to remobilize and concentrate the uranium, it is a small area with low grades therefor this tract was rated very low.

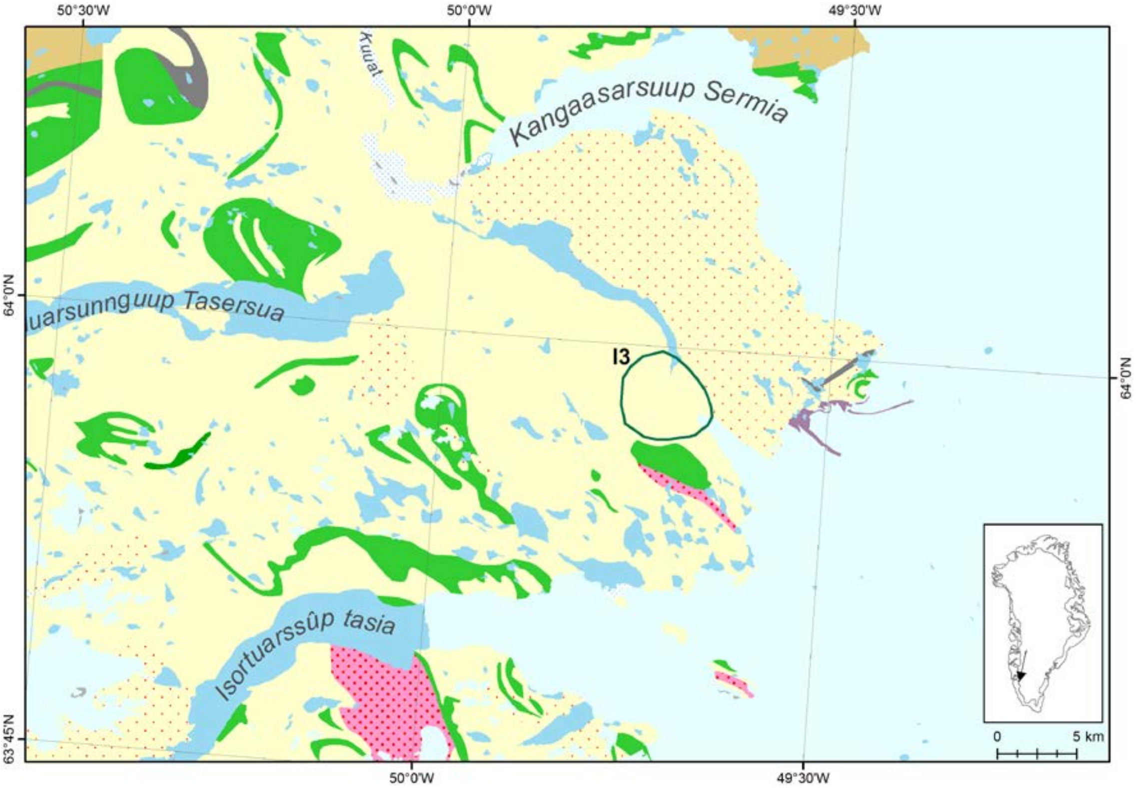

Figure 14. *Tract I3, Tikiussaq, SW Greenland.*

Table 4. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract I3, Tikiussaq.*

Consensus undiscovered deposit estimates					**Summary statistics**					**Tract Area (km^2)**	**Deposit density (N_{total}/km^2)**
N90	**N50**	**N10**	**N05**	**N01**	**N_{und}**	**s**	**Cv%**	**N_{known}**	**N_{total}**		
0	1	1	2	3	0.81	0.73	90	0	0.81	50	0.016

Estimator	**Estimated number of undiscovered deposits**				
	N90	**N50**	**N10**	**N05**	**N01**
Individual 1	0	0	0	0	0
Individual 2	0	0	0	0	0
Individual 3	0	0	0	0	0
Individual 4	0	0	0	2	3
Individual 5	0	0	0	0	0
Individual 6	0	0	0	0	0
Individual 7	0	0	0	0	0
Individual 8	0	0	0	0	1
Individual 9	0	0	0	0	1
Individual 10	0	0	1	1	1
Individual 11	0	0	0	0	1
Individual 12	0	0	0	1	1
Individual 13	0	2	3	3	6
Individual 14	0	0	0	0	1
Individual 15	0	0	0	0	0
Individual 16	0	0	0	0	2
Consensus	**0**	**0**	**0**	**0**	**2**

Tract I4 – Qaqerssuk (Qeqertaasaq)

The Qaqarssuk carbonatite complex, east of Maniitsoq, was found in 1965 by Kryolitselskabet Øresund A/S (Figure 15). The carbonatite intruded into the Archaean basement as dykes and veins over several generations during the Jurassic (165.7 ± 1.9 Ma) (Larsen et al. 1983; Secher et al. 2009). It covers an area of ca. 15 km^2 of which 15% consists of largely concentric steeply outward-dipping ring-dykes. During the years after the finding, the complex was mapped, radiometric and magnetic surveys were carried out and 248 drill holes were made (Gothenborg & Pedersen 1975).

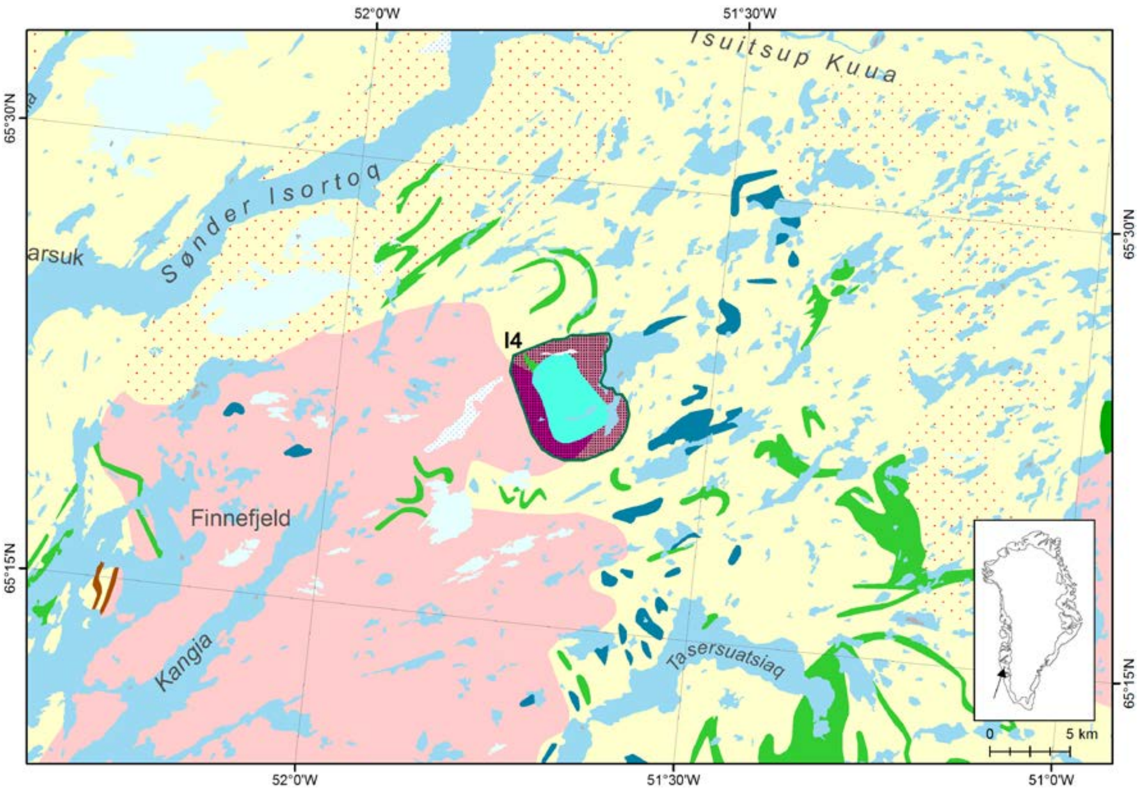

Figure 15. *Tract I4, Qaqerssuk, SW Greenland.*

The complex is composed of different types of carbonatites, the most common being sövite, silico-sövite and dolomite carbonatite (rauhaugite). The outermost carbonatite ring-dyke in the complex is the fine-grained dolomite carbonatite, rich in deformed and corroded fenite inclusions. Radioactive, narrow ferrocarbonatite dykes (beforsite) and vents, rich in altered basement fragments, are found in the highly altered basement, often located in shear zones with a higher radioactivity. The ring-dykes are cut by coarse-grained late stage sövite and REE carbonatite veins. Pyrochlore occurs in these late stage sövite veins, which are locally enriched in U, Th, Ta, Ba and REE. Pyrochlore enriched in U and uranopyrochlore also occur in the fenite zone (Knudsen 1991). The average values in the sövitic carbonatite are 1 ppm U, but close to the southern margin values up to 180 ppm U occur. The tract covers a rather small area with low grades therefor this tract was rated very low.

The Qaqarssuk carbonatite complex prospect has recently been renamed to Qeqertaasaq by Nuna Minerals.

Table 5. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract I4, Qaqerssuk.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	1	1	2	3	0.81	0.73	90	0	0.81	10	0.081

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	0	0	0
Individual 2	0	0	0	1	1
Individual 3	0	0	0	0	0
Individual 4	0	0	0	4	6
Individual 5	0	0	0	0	0
Individual 6	0	0	0	0	0
Individual 7	0	0	0	1	1
Individual 8	0	0	0	0	1
Individual 9	0	0	0	0	1
Individual 10	0	0	1	1	1
Individual 11	0	0	0	1	1
Individual 12	0	0	0	1	1
Individual 13	1	3	4	4	5
Individual 14	0	0	0	0	1
Individual 15	0	0	0	1	3
Individual 16	0	0	0	1	3
Consensus	**0**	**0**	**0**	**1**	**3**

Tract I5 – Sarfartoq

The Sarfartoq carbonatite complex was found by airborne radiometric surveys carried out in 1975-76 by the Geological Survey of Greenland. The carbonatite was emplaced at 560 ± 13 Ma in a zone of weakness in the Precambrian shield (Larsen et al. 1983; Secher et al. 2009). It comprises a core area of carbonatite and Na-fenite (15 km^2), mantled by a large marginal zone of hydrothermally altered gneisses (K-fenite) with carbonatite dykes (beforsite). The carbonatite rocks of the core occur as concentric sheets dominated by rauhaugite and sövite occurs only occasionally in schlieren. Pyrochlore occurs both sporadically in the core with an average of 15 ppm U and peak values up to 400 ppm and as disseminated accumulation within the marginal zone, average of 10 ppm U and peak values at 140 ppm U. Pyrochlore veining and brecciation are also found as 1-5 m wide monomineralic veining, yielding up to 10,000 ppm U.

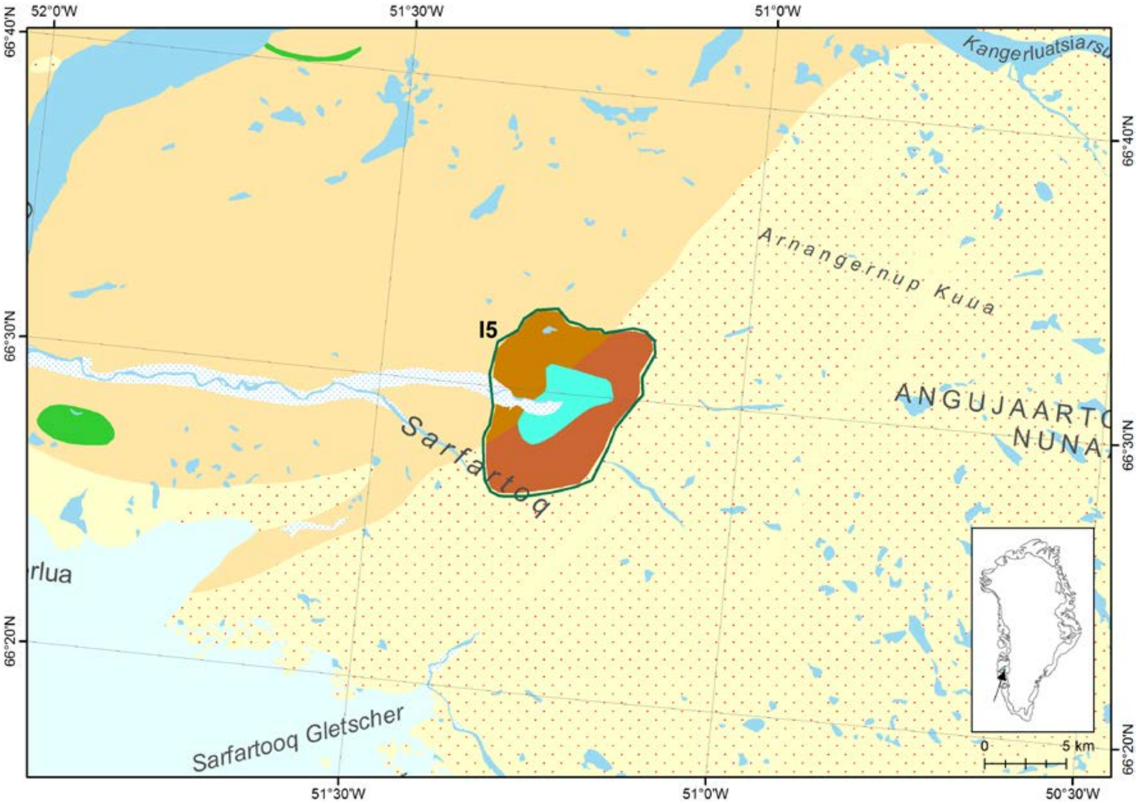

Figure 16. *Tract I5, Sarfartoq, SW Greenland.*

Uranium values up to 1% in the veins of the marginal zone are consistently explained by high modal content of pyrochlore and accordingly with Nb content reaching 40 vol% (Secher & Larsen 1980). The pyrochlore mineralisation has been dated separately and is thought to represent an initial burst of the magmatism around 600 Ma. REE are observed in anomalous concentrations in carbonate as well as in phosphate minerals gathered in so-called radioactive shear zones that are accompanied with thorium as the predominant fissile element. At the end of the carbonatite activity, hydrothermal activity apparently reached the surface, and hot circulating water locally dissolved the carbonatite (Secher 1986). This hydrothermal activity is thought to have caused the mobilisation of uranium, and concentrated it.

Exploration activities conducted by Hecla Mining Company in 1989 were focused on the pyrochlore occurrence located within veining. A total of 13 drill holes (568 cored metres) carried out into the subsurface extension of a N70ºE-trending mineralised zone. Pyrochlore mineralisation occurs as massive replacement, thin veins and disseminations within the veined zone. Results of the drilling programme based on assayed core intervals show a relatively wide and continuous low-grade (1-10% Nb_2O_5) envelope enclosing discontinuous pockets and lenses of high-grade (>10%)) pyrochlore material. The mineralisation pinches-out laterally along both ends of the zone and becomes thin and discontinuous at depth. The estimated tonnage at a cut-off grade of 10% Nb_2O_5 was estimated to 25,000 – 30,000 tonnes.

The resources estimate of the pyrochlore project has later been recalculated by new owners (New Millennium Resources Ltd.), resulting in an indicated resource of 350,000 tonnes at a cut-off grade at 2.5 % Nb_2O_5.

Hudson Resources Inc. currently has the licence of the area and are investigating the REE, Nb, and Ta potential. They have discovered a REE mineral resource in more separate radioactive shear zones within the marginal areas, where thorium is enriched. Hudson Resources drilled over 30,000 m on several zones of that target.

Table 6. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract I5, Sarfartoq.*

Consensus undiscovered deposit estimates					**Summary statistics**					**Tract Area (km^2)**	**Deposit density (N_{total}/km^2)**
N90	**N50**	**N10**	**N05**	**N01**	**N_{und}**	**s**	**Cv%**	**N_{known}**	**N_{total}**		
0	1	1	2	3	0.81	0.73	90	0	0.81	200	0.0040

Estimator	**Estimated number of undiscovered deposits**				
	N90	**N50**	**N10**	**N05**	**N01**
Individual 1	1	1	1	1	1
Individual 2	0	1	1	1	1
Individual 3	1	3	3	3	5
Individual 4	0	0	1	2	4
Individual 5	0	0	1	1	1
Individual 6	0	1	2	3	4
Individual 7	0	0	0	1	1
Individual 8	0	0	1	2	2
Individual 9	0	0	1	1	1
Individual 10	0	1	1	2	3
Individual 11	0	0	1	2	2
Individual 12	0	0	0	2	3
Individual 13	1	2	4	4	5
Individual 14	0	0	1	2	2
Individual 15	0	0	1	3	3
Individual 16	0	0	0	1	3
Consensus	**0**	**0**	**1**	**2**	**3**

Tract I6 – Nuuk region

The Nuuk region, southern West Greenland, is composed of Palaeoarchaean to Neoarchaean basement rocks. The area has a relatively high level of background radiation, compared to other areas in Greenland (Steenfelt 2001). The enrichment recorded in the U channel of the airborne gamma spectrometry is associated with numerous Neoarchaean pegmatites intruding the supracrustal belts. Allanite, uraninite and euxenite are common in biotite-rich part of leucopegmatites. The sizes of the pegmatites vary, but many are 2 to 10 m wide and can be followed for hundreds of metres. The radioactive minerals usually appear as fine-grained material. However, allanite also occurs as course crystals of up to 5 cm in length. U content in the pegmatites generally ranges from 10-70 ppm, but uraninite-rich samples have reached 6000 ppm U (Secher 1980).

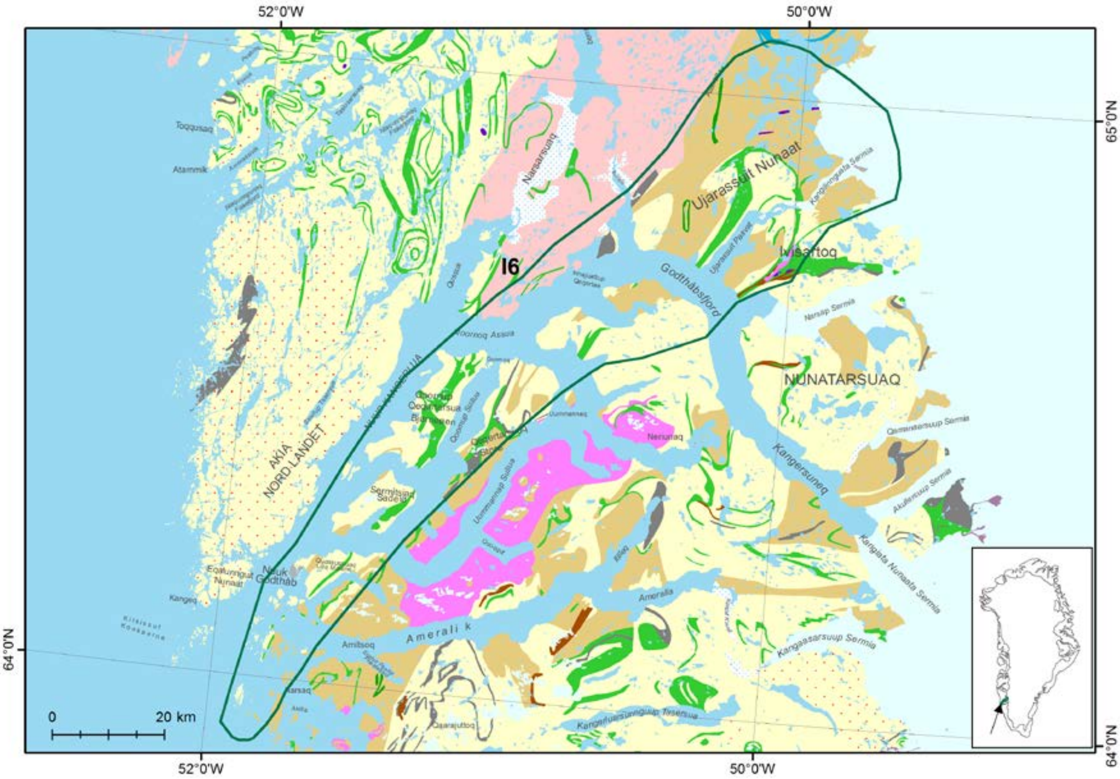

Figure 17. *Tract I6, Nuuk region, SW Greenland.*

The radioactive pegmatites occur mainly along the Ivinnguit fault zone, e.g. on Storø and Sermitsiaq and this has defined the tract (Figure 17). The emplacement of the pegmatites on Storø occurred during crustal-scale thrusting in the Storø shear zone around 2630 Ma (Hollis et al. 2006). Mineralisation with uraninite forming up to 2 mm crystals has been encountered in amphibolite's on Storø. A rock sample returned 8000 ppm U in uraninite (Steenfelt pers. comm. 2013).

The tract is rated to have a relative good potential as it is a large area with significant proportion of prospective rocks and relatively high levels of anomalies and mineralisations.

Table 7. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract I6, Nuuk region.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	1	1	2	3	0.81	0.73	90	0	0.81	1,482	0.00054

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	1	1	2	2	2
Individual 2	0	0	0	4	4
Individual 3	0	0	0	0	1
Individual 4	0	0	3	15	20
Individual 5	0	0	0	1	2
Individual 6	0	0	0	1	2
Individual 7	0	0	0	1	2
Individual 8	0	0	0	0	1
Individual 9	0	0	1	1	2
Individual 10	0	0	0	0	0
Individual 11	0	0	2	3	4
Individual 12	0	1	3	3	3
Individual 13	2	3	4	4	5
Individual 14	0	0	1	1	2
Individual 15	0	1	2	2	3
Individual 16	0	0	1	3	5
Consensus	**0**	**1**	**1**	**2**	**3**

Tract I7 – Werner Bjerge, Kap Simpson and Kap Parry, East Greenland

A series of gabbroic (tholeiitic) to alkaline basic to salic intrusive complexes with intermediate syenitic-granitic to nepheline syenite composition intrusions outcrops in central East Greenland around Kong Oscar Fjord and make up this tract (Figure 18).

The Werner Bjerge complex is a series of alkaline dyke-swarms, which were formed 25.7 Ma ago and is described as tholeiitic and similar to the Kangerdlugssuaq complex (see below). In the same area over- and under-saturated syenites and alkali granites (including the Malmbjerg molybdenum deposit) are found. A few smaller bodies outcrop immediately to the north between Mestersvig and Antartic Havn (Nielsen 1987).

Eastern Traill Ø shows alkali granites and syenites of the Kap Simpson complex (*c.* 38 Ma). Here the roof of the complex is exposed together with large sediment blocks and ring-dykes. Sills and dykes extend into the Mesozoic sediments next to the complex. Immediately north, also on Traill Ø the Kap Parry syenite complex (*c.* 40 Ma) is located, which exists of three volcanic centres including acid volcanic breccias, quartz syenites and alkali granites (Nielsen 1987).

The intrusions are emplaced in an extensional regime and an enhanced radioactivity has been measured in these alkaline complexes (Steenfelt, personal comment 2014; Nielsen & Steenfelt 1977).

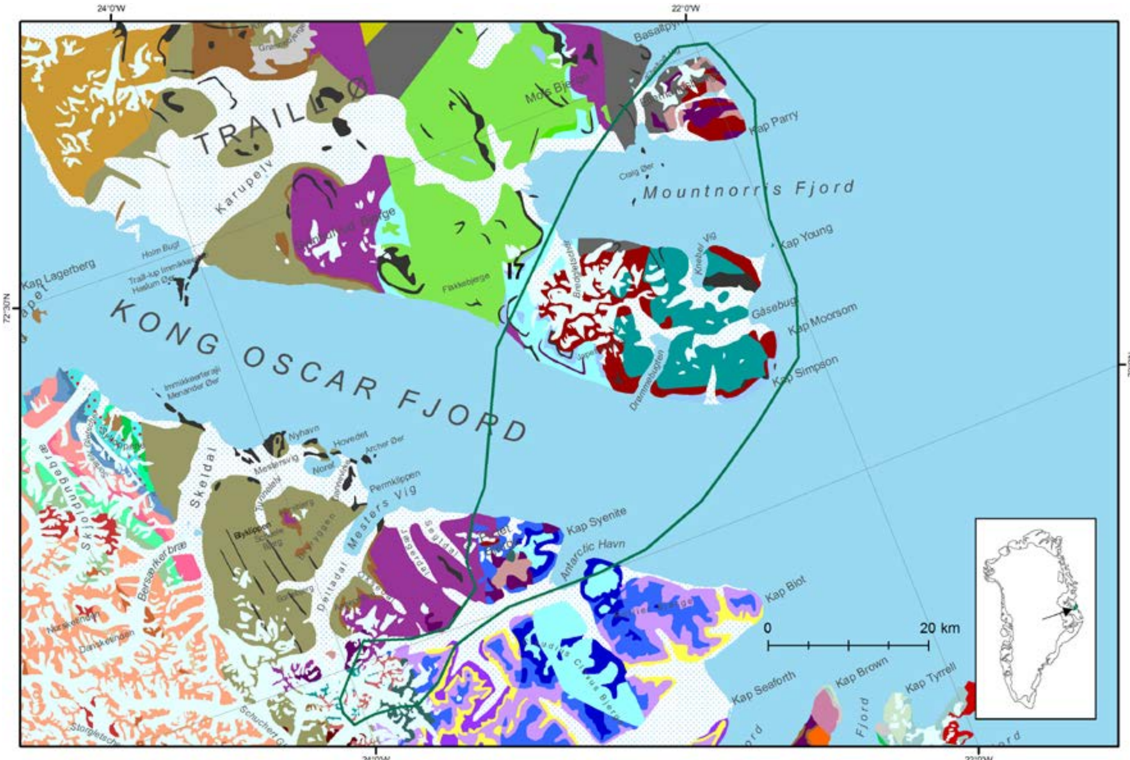

Figure 18. *Tract I7, Werner Bjerge, Kap Simpson and Kap Perry, East Greenland.*

Table 8. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract I7, Werner Bjerge, Kap Simpson and Kap Parry.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	**N50**	**N10**	**N05**	**N01**	**N_{und}**	**s**	**Cv%**	**N_{known}**	**N_{total}**		
0	0	0	1	2	0.11	0.44	419	0	0.11	712	0.00015

Estimator	Estimated number of undiscovered deposits				
	N90	**N50**	**N10**	**N05**	**N01**
Individual 1	0	0	0	1	2
Individual 2	0	0	0	0	0
Individual 3	0	0	0	0	0
Individual 4	0	0	0	0	4
Individual 5	0	0	0	1	3
Individual 6	0	0	0	1	2
Individual 7	0	0	0	0	0
Individual 8	0	0	0	0	1
Individual 9	0	0	0	1	2
Individual 10	0	0	2	3	4
Individual 11	0	0	0	0	1
Individual 12	0	0	0	0	1
Individual 13	0	0	1	1	1
Individual 14	0	1	2	3	5
Individual 15	0	0	1	2	4
Individual 16	0	0	0	0	0
Consensus	**0**	**0**	**0**	**1**	**2**

Tract I8 – Kangerdlugssuaq intrusion

The largest intrusion related to the opening of the Atlantic is the Paleogene alkaline Kangerdlugssuaq intrusion. This intrusion consists of quartz syenites, syenites, pulaskites and foyaites. The different rock types are exposed in rings. The pluton has vertical walls and was emplaced by cauldron subsidence in an extensional basin. Rb-Sr isochrones indicate a crystallization age of 50 Ma (Pankhurst et al. 1976).
Elevated values of uranium have been observed in a stream sediment sample and a rock sample.

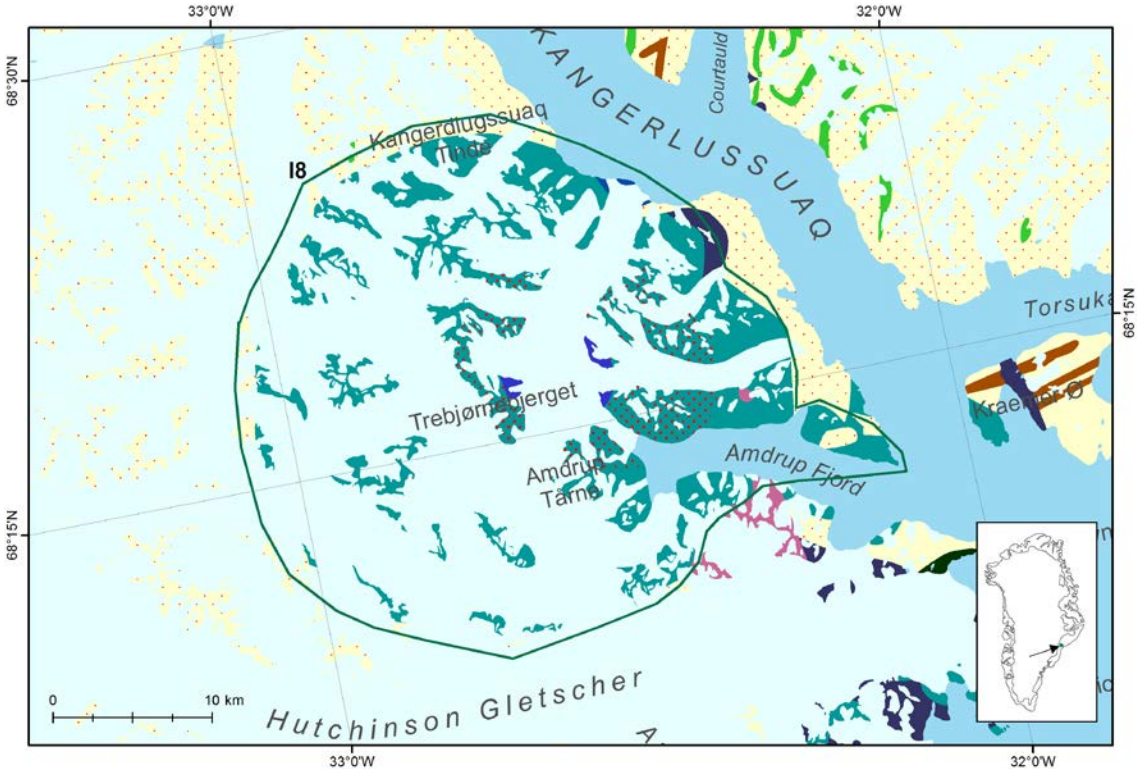

Figure 19. *Tract I8, Kangerdlugssuaq intrusion, East Greenland.*

Table 9. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract I8, Kangerdlugssuaq intrusion.*

Consensus undiscovered deposit estimates					**Summary statistics**					**Tract Area (km^2)**	**Deposit density (N_{total}/km^2)**
N90	**N50**	**N10**	**N05**	**N01**	**N_{und}**	**s**	**Cv%**	**N_{known}**	**N_{total}**		
0	0	0	0	1	0.03	0.24	813	0	0.03	182	0.00016

Estimator	**Estimated number of undiscovered deposits**				
	N90	**N50**	**N10**	**N05**	**N01**
Individual 1	0	0	0	0	1
Individual 2	0	0	0	0	0
Individual 3	0	0	0	0	0
Individual 4	0	0	0	0	2
Individual 5	0	0	0	1	1
Individual 6	0	0	0	0	1
Individual 7	0	0	0	0	0
Individual 8	0	0	0	0	1
Individual 9	0	0	0	1	1
Individual 10	0	0	0	0	1
Individual 11	0	0	0	0	1
Individual 12	0	0	0	1	1
Individual 13	0	0	1	1	1
Individual 14	0	0	1	2	4
Individual 15	0	0	0	0	2
Individual 16	0	0	0	0	0
Consensus	**0**	**0**	**0**	**0**	**1**

Tract I9 – Central Domain SWG (excluding Motzfeldt and Ilímaussaq intrusions)

The Central Domain of the Ketilidian orogen of South Greenland, covers the majority of the igneous components related to the orogeny together with few enclaves of supracrustal rocks. The Central Domain has been divided into a western part tract I9 (Figure 20) and an eastern part I10 (Figure 21). This tracts do not include the Motzfeldt and Ilímaussaq intrusions, as they are covered in separate tracks (I2 and I11).

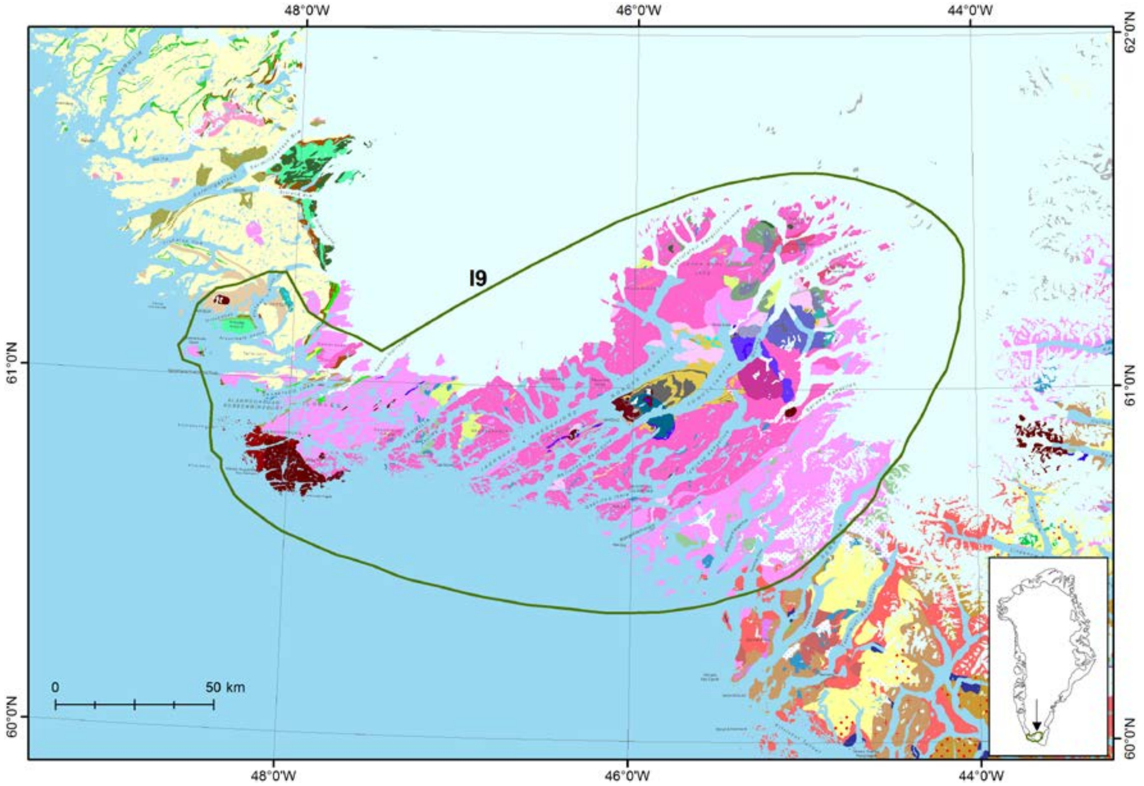

Figure 20. *Tract I9, Central Domain SWG (Motzfeldt and Ilímaussaq intrusions not included), South Greenland.*

The Central Domain is dominated by the Julianehåb igneous complex, which can be divided into an early and a late stage. The early part of the Julianehåb igneous complex is situated along the margins of the Domain, it consists of variably deformed and foliated granitoids, mainly granodiorite, with subordinate diorite and gabbro (Steenfelt 2016). U-Pb isotope data show that most protolith ages range from c. 1850 to 1835 Ma (Garde et al. 2002). The rocks are calc-alkaline and interpreted to have formed from juvenile Proterozoic magmas (Kalsbeek & Taylor 1985). Their trace element signatures are compatible with their formation in a volcanic arc (Garde et al. 2002). The late part of the Julianehåb igneous complex is undeformed to weakly deformed and occupy the central part of the Domain. This part of the complex is dominated by granodiorites to monzonites and syenites, some coarse-grained, many porphyritic, but it also includes monzogranites, aplitic granites and members of the appinite suite (Allaart 1973, 1983; Kalsbeek et al. 1990). A U-Pb age from the late part of the Julianehåb igneous complex yield an age of 1796 Ma ± 3 Ma (Garde 2002).

Large parts of the late Julianehåb igneous complex are strongly faulted and fractured, which is reflected by a high frequency of topographic and aeromagnetic lineaments. The important faults are ESE–WNW to EW striking with sinistral displacement, and they occur at regular intervals of 10–18 km (Allaart 1973, 1983).
The faulted part of the Central Domain was clearly outlined by an abundance of stream sediment and stream water uranium anomalies, and over 200 occurrences with more than 100 ppm U or Th were discovered during ground follow-up (Armour-Brown et al. 1983b).
Uranium occurrences are commonly small lenses, but they occur along fractures traceable for up to 10 km. Comprehensive descriptions are found in Armour-Brown et al. (1984), Nyegaard and Armour-Brown (1986) and reviews are provided by Nyegaard (1985), Nyegaard et al. (1986).
The radioactive occurrences comprise four types: 1) pitchblende associated with faults, fractures and related joints; 2) brannerite, also associated with fractures and disseminated in altered granite along them. This type occurs particularly in the southern part of the Julianehåb igneous complex; 3) thorium dominated veins in fenitised granite. These veins are found in ENE–WSW striking tension fractures and show a strong sodium metasomatism; and 4) allanite in pegmatites in the late Julianehåb igneous complex.
Uranium vein mineralisation is typically accompanied by alteration, such as desilicification, introduction of iron oxides and calcite, decomposition of plagioclase and its replacement by albite (Armour-Brown et al. 1982b; Nyegaard et al. 1986). Pitchblende or brannerite may be accompanied by secondary uranium minerals, galena, pyrite, and chalcopyrite, while gangue minerals commonly include calcite, quartz and fluorite. Isotopic data indicate an age of ca. 1180 Ma for pitchblende (Nyegaard & Armour-Brown 1986). The association of pitchblende with alkaline hydrothermal wall rock alteration together with its Mesoproterozoic age point to a hydrothermal genesis related to magmatic and tectonic events during rifting and alkaline magmatism (Armour-Brown et al. 1982b).

The Central Domain contains widespread known uranium mineralisation, the largest are described below (text from Steenfelt et al. 2016).

Nunatak (Nordre Sermilik) uranium occurrences:
North and northwest of Narsarssuaq, the Julianehåb igneous complex contains several enclaves of fine-grained and porphyritic quartz-feldspar-rich metamorphic rocks interpreted to be of volcanic origin (Allaart 1983). Both aeroradiometric and stream sediment data from the Syduran project showed that the area around Nordre Sermilik is generally enriched in uranium (Armour-Brown et al. 1983a; Schjøth et al. 2000). During ground follow-up of one of the radiometric anomalies, two kinds of uranium mineralisation, stratabound and vein-hosted, were discovered at Nunatak north of the head of Nordre Sermilik (Nyegaard and Armour-Brown 1986). Nunatak is underlain by granodioritic rocks of the late Julianehåb igneous complex (Allaart 1983), which contain sub-horizontal rafts (up to 50 m thick and 500 m long) of leucocratic quartzo-feldspathic paragneiss. Many rafts have 10–40 times higher background radioactivity than the surrounding granodiorite owing to uranium and thorium mineralisation. The richest stratabound mineralisation occurs within a 0.5 to 1 m thick raft comprising white, granular, medium-grained paragneiss and a reddish aplitic gneiss. Uraninite and secondary U-minerals are concentrated in two small zones along poorly developed gneissic banding and of up to 1.3% U and 1131 ppm Th were recorded in the zones. U–Pb isotopic data for paragneiss-hosted uraninite indicate an age of c. 1780 Ma, which is contemporaneous with

intrusion of the late Julianehåb igneous complex (Nyegaard & Armour-Brown 1986). Although the mineralisation is sub-economic, the occurrence provides evidence that uranium was enriched in volcano–sedimentary environments in the roof of the late igneous complex (Armour-Brown & Wallin 1985).
Vein-hosted pitchblende mineralisation is located in late fractures in the granodiorite. Pb isotope data for this kind of mineralisation indicate a Mesoproterozoic age. It was suggested that it belongs to the widespread vein-type U mineralisation hosted in fractures elsewhere in the late Julianehåb igneous complex. Two samples of vein material with uranium pitchblende returned 1.1 and 1.6% U, respectively. However, uranium vein-type does not exist any longer in the IAEA classification. Instead several of these veins has to belong to the intrusive-type.

Pitchblende vein occurrences, the Puisattaq prospect and Vatnahverfi showings:
The densest population of pitchblende veins occurs at Puisattaq situated in the eastern end of an E–W-trending, sinistral, strike-slip fault zone stretching across the peninsula between Igaliko fjord and Erik's fjord. Investigations included outcrop mapping, scintillometric surveying, geophysical profiling and trenching (Armour-Brown et al. 1984). Four pitchblende veins were located 100–200 m above sea level in the northern part of the 150–200 m wide fault zone. The veins are not exposed, and were found by tracing radioactive boulders back to their source. Two of the veins are parallel to the EW fault zone with a dip close to vertical; one vein is 'en echelon' with two shorter veins. The other two veins strike NE–SW, which is the orientation of the tension fractures in the fault zone. The veins are up to 11 m long and 5 cm wide. Vein samples contain from 0.75% to 6.3% U and very little Th. The dolerite or granite wall rock is altered and brecciated. One occurrence is a few metres long joint filling located in a 5 m wide red felsic dyke that has a number of additional radioactive fractures for 50 m along its strike. Pitchblende occurs as botryoidal masses often displaying cataclastic texture indicating some fault movement after its deposition. It is associated with specular hematite and minor pyrite and chalcopyrite. The pyrite is cataclastic and partly altered to limonite and may be replaced by hematite. Veinlets of pitchblende are noticed to cut specular hematite and to form pseudomorphs after pyrite. The frequency of faults and fractures in the Central Domain appears to increase towards the Sârdloq shear zone in the Vatnahverfi area (Berrangé 1966). Veinlets or irregular bodies with pitchblende or more commonly brannerite have been observed in many of the faults together with fluorite, calcite and hematite (Armour-Brown et al. 1984). Individual occurrences are rarely more than one metre long. Samples from the richest locality returned up to 3.6 wt.% U.

This track covers a very large area with large uranium anomalies and numerous uranium showings in veins and pegmatites. There are also two large intrusions with elevated uranium values, the Ilímaussaq and Motzfeldt intrusions within the Central Domain, even if they are not part of this tract. It is therefore know that there is large amounts of uranium in the system, and there might still be undiscovered uranium-rich intrusions within the tract, especially considering that the assessment includes a depth of 1 km.

Table 10. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract I9, Central Domain SWG.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	2	2	4	5	1.58	1.21	76	0	1.58	8,815	0.00018

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	1	1	2
Individual 2	0	0	0	0	0
Individual 3	0	2	2	6	8
Individual 4	2	4	6	8	10
Individual 5	0	0	1	2	3
Individual 6	0	0	1	2	3
Individual 7	0	0	0	2	2
Individual 8	0	0	1	2	3
Individual 9	0	0	1	1	3
Individual 10	0	1	2	3	4
Individual 11	1	2	3	4	5
Individual 12	3	5	8	8	8
Individual 13	2	3	3	3	4
Individual 14	0	1	2	4	6
Individual 15	1	2	4	7	10
Individual 16	0	1	2	4	6
Consensus	**0**	**2**	**2**	**4**	**5**

Tract I10 – Central Domain SEG

The Central Domain of the Ketilidian orogen of South Greenland, covers the majority of the igneous components related to the orogeny together with few enclaves of supracrustal rocks. The Central Domain has been divided into a western part tract I9 and an eastern part I10. See the description of the Central Domain under tract I9. The area of Tract I10 (Figure 21) is much less explored than I9, and there is much less exposure, hence our knowledge is smaller and no uranium occurrences or showing are found yet.

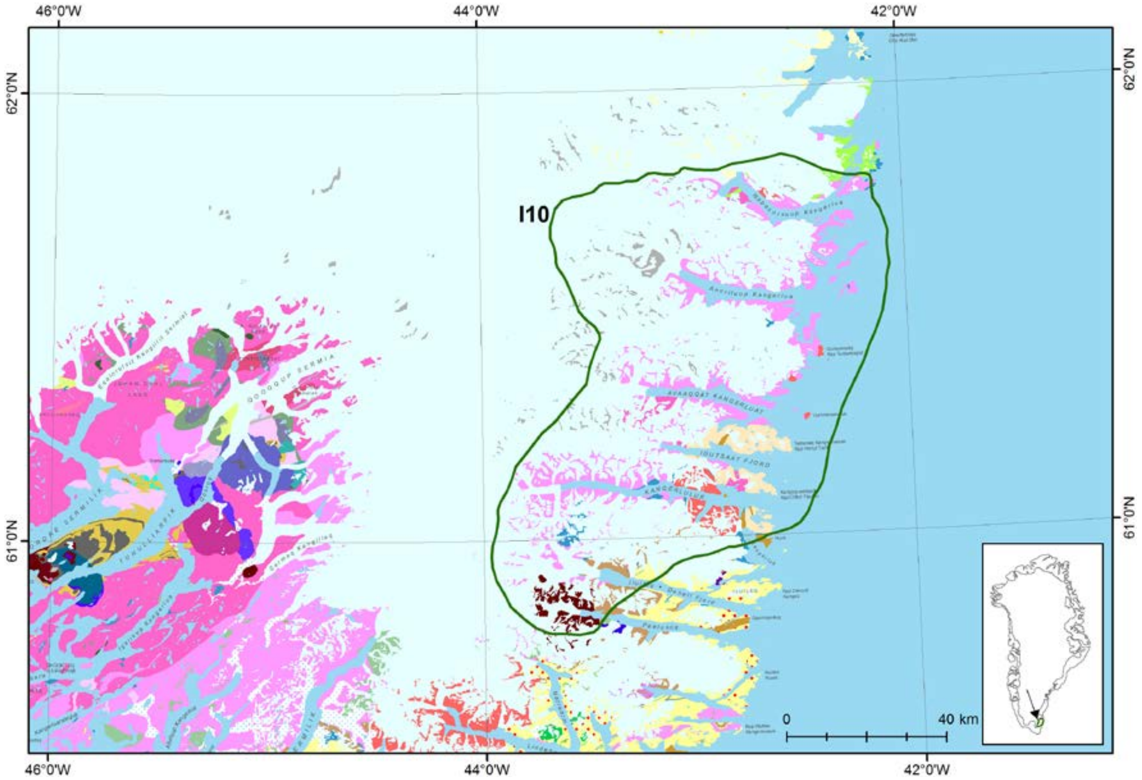

Figure 21. *Tract I10, Central Domain SEG, South Greenland.*

Table 11. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract I10, Central Domain SEG.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	1	1	2	3	0.81	0.73	90	0	0.81	1,274	0.00063

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	0	0	1
Individual 2	0	0	2	3	4
Individual 3	0	0	1	1	3
Individual 4	0	1	2	4	6
Individual 5	0	0	1	2	3
Individual 6	0	0	0	0	1
Individual 7	0	0	0	2	2
Individual 8	0	0	0	1	2
Individual 9	0	0	1	1	4
Individual 10	0	1	1	2	2
Individual 11	0	1	2	3	4
Individual 12	1	3	5	5	5
Individual 13	1	2	3	4	4
Individual 14	0	1	1	2	3
Individual 15	0	1	2	6	7
Individual 16	0	0	2	4	6
Consensus	**0**	**0**	**2**	**3**	**4**

Tract I11 – Ilímaussaq

The Mesoproterozoic Ilímaussaq alkaline complex of South Greenland hosts the only developed uranium deposit in Greenland, referred to as Kvanefjeld.

Ilímaussaq is part of the Gardar complex and intruded into the Palaeoproterozoic Julianehåb Igneous Complex and the unconformably overlying Mesoproterozoic Eriksfjord formation comprising sandstone and basalt. The intrusion is developed by several different pulses of magma. The main intrusion is made up by a floor, and roof and an intermediate sequence (Figure 23). The floor series consist of cumulates, solidifying upwards in rhythmically layered agpaitic nepheline syenites (kakortokite). The floor sequence passes gradually upwards into the intermediate series of agpaitic rocks called lujavrite. The roof series crystallized downwards from the intrusion roof in the order pulaskite, foyaite, and the agpaitic rocks such as sodalite foyaite and naujaite. The intermediate sequence of different types of lujavrite are sandwiched between roof and floor series. The lujavrite represent the most evolved rocks in the Ilímaussaq intrusion (Sørensen 2001).

The Kvanefjeld mineralisation is hosted by lujavrite, which has an average U concentration of 300 ppm and approximately 3 times the amount of thorium. The dominant carrier of uranium, Y and REE is the mineral steenstrupine, a sodium-cerium-silico-phosphate.

The Kvanefjeld uranium deposit is unique in Greenland and has been described in great detail. Geological mapping and radiometric acquisition have been carried out from 1956 to 1985, and 12,455 metres of core were drilled and a 1 km long adit was constructed.

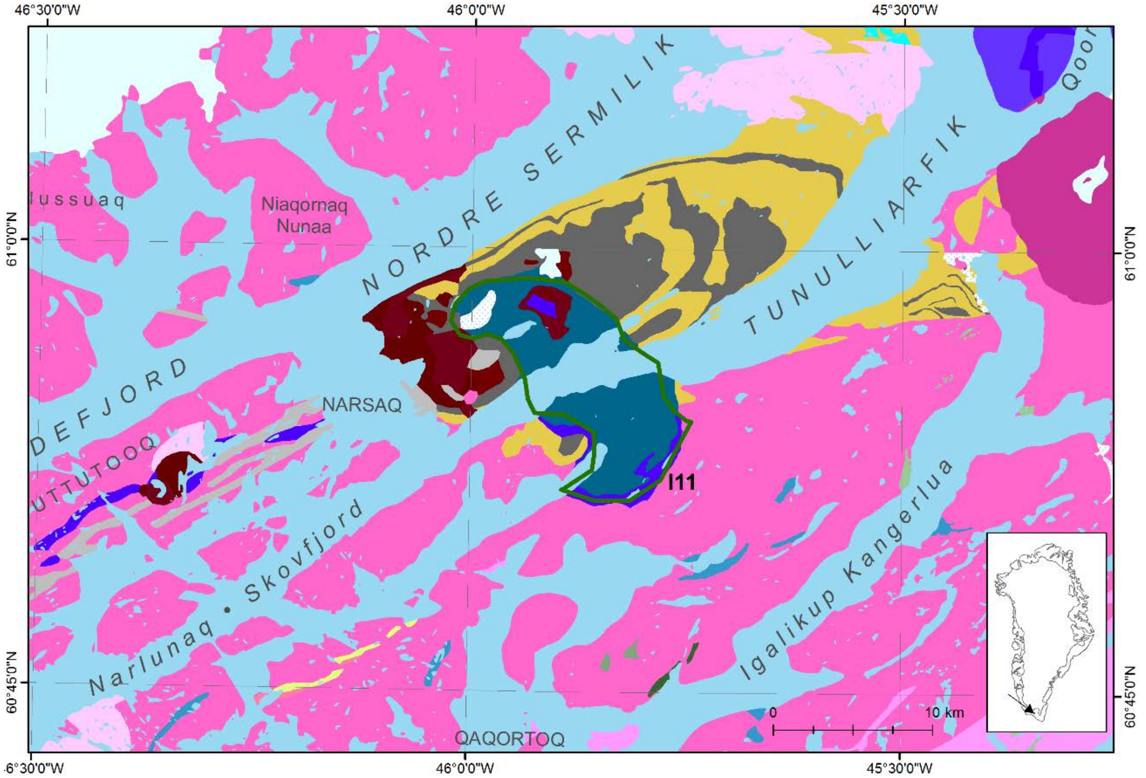

Figure 22. *Tract I11, Ilímaussaq, South Greenland.*

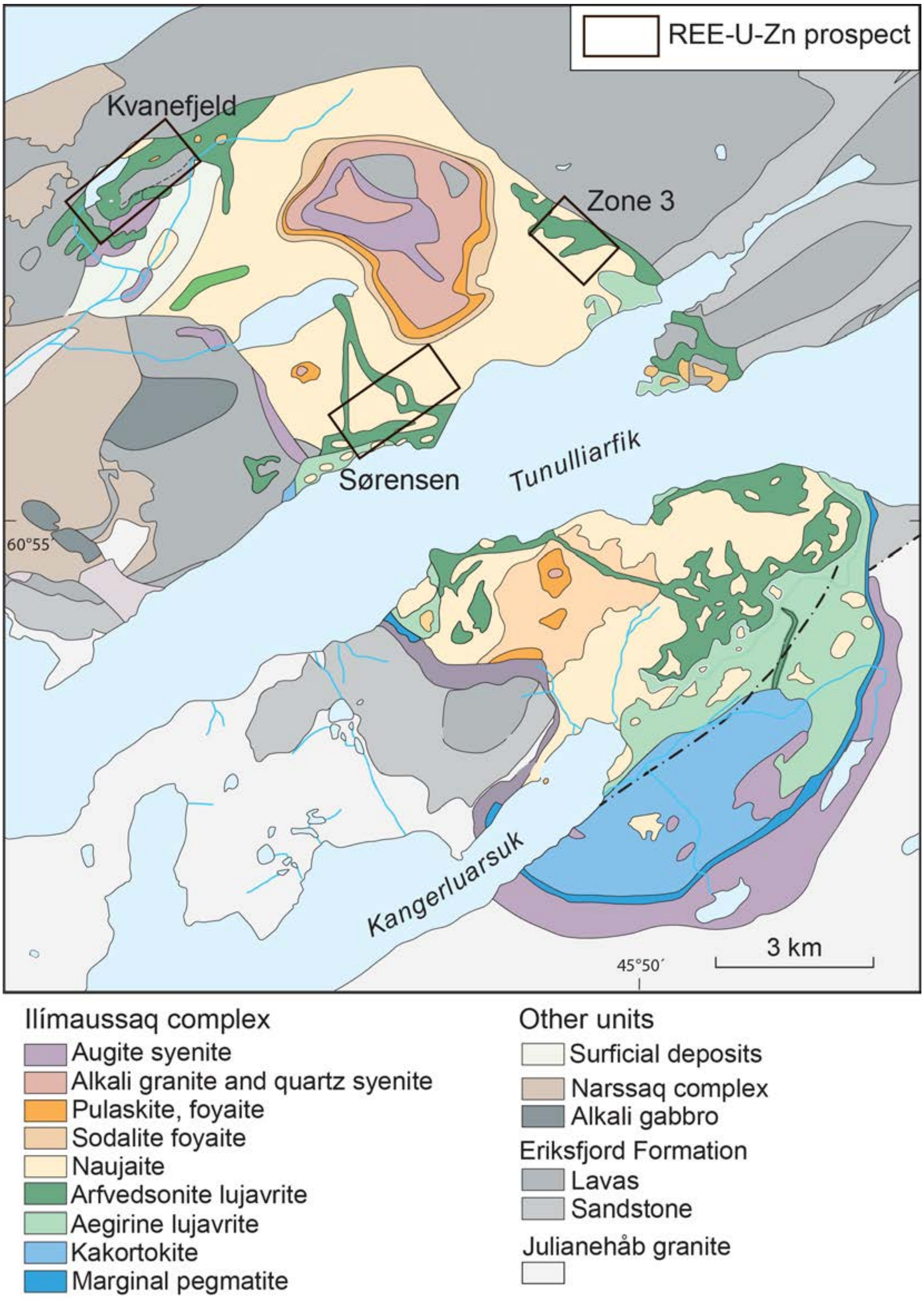

Figure 23. *Geological map of the Mesoproterozoic Ilimaussaq intrusive complex with location of prospective areas of REE-U-Zn-F mineralisation assessed by Greenland Minerals and Energy Ltd. Modified from Steenfelt et al. (2016).*

Since 2007, Greenland Minerals and Energy Ltd. have conducted exploration activities in the Kvanefjeld area with the main product being REE while uranium and zinc is planned to be mined as by-products. GME drilled an additional 57,710 meters of core. The total identified conventional mineral resource inventory for Kvanefjeld is 102,820 tonnes U. Additional inferred mineral resources of 338 Mt ore exist in the Zone Sørensen and Zone 3, related to the Kvanefjeld, equivalent to 125,143 tonnes U. This is a significant resource already identified which is likely to be much larger as the lujavrite layer extents between the identified zones. It was therefore rated as having a high potential for additional undiscovered deposits.
Further detail on Kvanefjeld can be found in the section on "Historic background" and "Uranium exploration and resources".

Table 12. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract I11, Ilímaussaq.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	**N50**	**N10**	**N05**	**N01**	**N_{und}**	**s**	**Cv%**	**N_{known}**	**N_{total}**		
2	3	4	5	7	3.00	1.33	44	3	6.00	78	0.077

Estimator	Estimated number of undiscovered deposits				
	N90	**N50**	**N10**	**N05**	**N01**
Individual 1	5	6	7	8	10
Individual 2	3	4	4	4	4
Individual 3	4	4	8	8	12
Individual 4	3	5	6	8	10
Individual 5	2	3	4	4	6
Individual 6	5	5	7	8	10
Individual 7	0	2	3	4	5
Individual 8	1	2	3	4	6
Individual 9	3	3	5	8	10
Individual 10	2	3	4	4	5
Individual 11	3	4	5	6	7
Individual 12	2	2	4	4	4
Individual 13	2	2	2	3	3
Individual 14	1	2	4	6	8
Individual 15	1	1	2	4	4
Individual 16	0	1	3	4	5
Consensus	**2**	**3**	**4**	**5**	**7**

Assessment of sandstone deposits

Tract distribution

The tracts were based on evaluation of the geology using the 1:500 000 scale geological map. These units were extracted as georeferenced polygons.
Twenty different tract for sandstone deposits were identified prior to the workshop, however four of them were representing metamorphosed sandstones and were therefor not evaluated during the workshop. These are marked by yellow in Table 13.

Table 13. *Overview of the individual tracts that were assessed for sandstone type deposits at the workshop. The tracts in yellow were discussed but not assessed.*

Polygon name	Tract name	Tract size (km^2)	Description	Comments	Metamorphic grade	Setting
S1 S2 S3	Eriksfjord Basin	167	Mesoproterozoic sandstones of the Eriksfjord Formation, South Greenland	Fluvial, limnic, aeolian	none	Intracratonic
S4	Danell Fj Basin	792	Palaeoproterozoic Danell Fj-Tasermiut metaarkose within the Ketilidian Orogen, South Greenland	Sedimentary-volcanic	low-medium	Intermontane basin
S5	Anap Nuna Group	101	Palaeoproterozoic silt- and sandstone, NE Disko Bay, West Greenland	very thin ss units	low-medium	Shelf to marine basinal
S6	Nuussuaq Basin	289	Cretaceous-Neogene Nuussuaq Group, West Greenland	Lacustrine, fluvial, marine	none	Shelf to marine basinal
S7 S8 S9 S10 S11 S12	Thule Basin	2,398	Mesoproterozoic Thule Supergroup, NW Greenland	Low U in surrounding basement	none	Intracratonic basin
S13 S14 S15 S15A	Franklinian shelf	2,574	Lower to Middle Cambrian sandstones of the Franklinian Basin, North Greenland	Shelf deposits potential oil reservoirs	None	Shelf
S16 S17 S18	Independence Fj Group	7,987	Paleo-Mesoproterozoic Independence Fjord Group, North Greenland	Alluvial sandstones overlain by lacustrine silt	None	Intracratonic siliciclastic dominated sag

S19	Hagen Group	1,790	Neoproterozoic Hagen Fjord Group, North Greenland		None	Shelf Sequence
S20	Dunken & Parish bj. Formation	505	Upper Carboniferous to Middle Triassic sandstones, North Greenland	Wandel Sea Basin Various basins formed in response to rifting	None	Shelf, shallow
S21	Ladegårds åen Fm	131	Jurassic sandstone, North Greenland			Shelf, shallow
S22	Kap Rigsdagen	29	Upper Jurassic to lower Cretaceous sediments, North Greenland			Marine
S23	Kilen	117				Marine
S24	Sortebakker Formation	39	Early Carboniferous sequence, North Greenland			Fluvial, terrestrial, siliciclastic
S25 S26 S27 S28 S29 S30	Deformed Independence Fj Group	1,292	Paleo-Mesoproterozoic Independence Fjord Group, North Greenland	Parautochonous to allochthonous in Caledonian Orogen	low-medium	Intracratonic siliciclastic dominated sag sequence,
S31	Dronning Louise Land	214	Paleo-Mesoproterozoic Trekant series sandstones, Dronning Louise Land, East Greenland	Correlated with Independence Fj Gp, underlain by basement	low-medium	Intracratonic basin
S32D	Devonian East Greenland Basin	3,225	Devonian sandstone units of the East Greenland Basin		None	Rift basin formation at cont. margin
S32C	Carboniferous East Greenland Basin	1,620	Carboniferous sandstone units of the East Greenland Basin		None	Rift basin formation at cont. margin
S33	Jameson Land	2,838	Sandstone units of Jameson Land, East Greenland		None	Variable continental, lacustrine and shelf
S34	Kangerdlugssuaq Group	486	Mesozoic to Paleogene Kangerdlugssuaq Group and Kap Gustav Holm Formation, East Greenland		None	
S35	Princess Islands	534	Prinsesse Margrethe, Prinsesse Thyra og Prinsesse Dagmar Ø	Wandel Sea Basin Various basins formed in response to rifting	None	
S36	Nakkehoved	74	Upper Cretaceous		None	

Individual tracts assessed during the workshop

Tract S1-S3 – Eriksfjord Basin, South Greenland

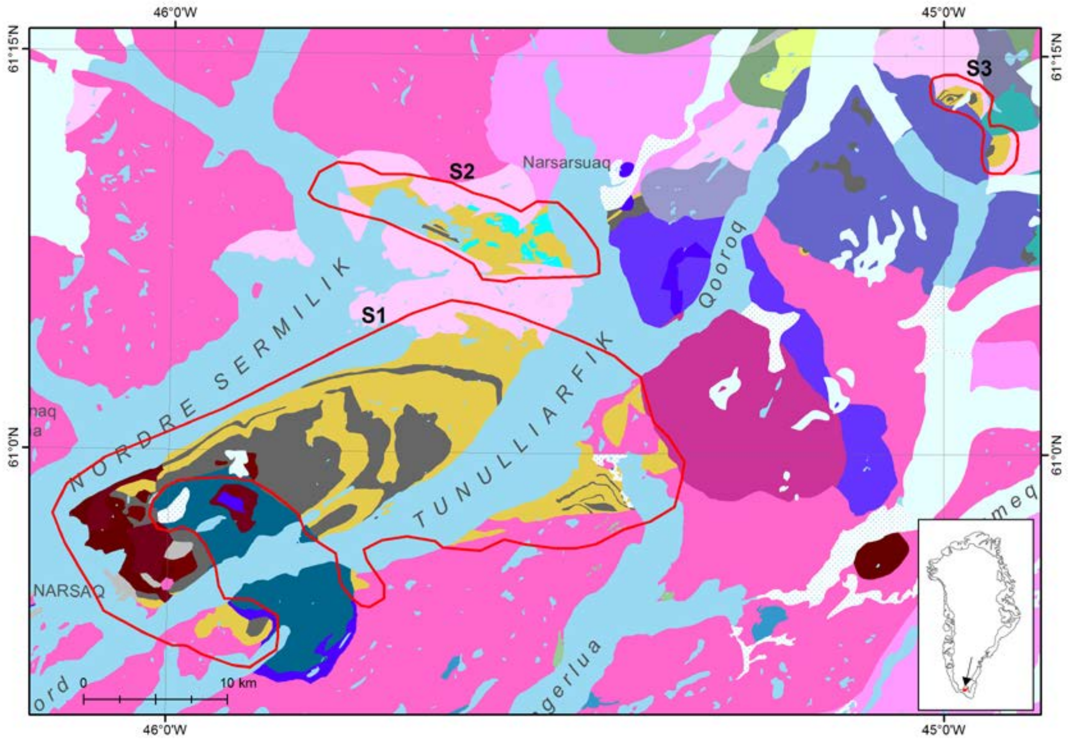

Figure 24. *Tract S1-S3, Eriksfjord Basin, South Greenland.*

Remnants of the Mesoproterozoic Eriksfjord Formation sandstones are preserved in an ENE trending fault-bounded basin formed *at* c.1350-1260 Ma during a phase of rifting and denudation. The sediments were derived from the Julianehåb batholith (c. 1850-1790 Ma), which was uplifted during the Ketilidian orogeny (c. 1880-1720 Ma). The sandstones have been deposited under a high rate of tectonic activity and under constant subsidence of the area (Tirsgaard & Øxnevad 1998). The sandstones stretch over an area of c. 100 km between the Inland Ice and the island Tuttutooq. The formation consists of interfingering basaltic and trachytic lavas and sandstones, and is deposited on a floor of granites of the Julianehåb batholith (Allaart 1983; Henriksen et al. 2009). Interlayered in the sandstones are thin conglomerate layers with quartzite, quartz or hematite coated sandstone pebbles. The preserved section of the Eriksfjord Formation consists of six members with a total cumulative thickness of 3085 m, more than half of these are sedimentary rocks. The base of the sandstone, the Mâjût member, is formed by a conglomerate and arkose, which pass upwards into bedded red sandstone with cross-bedding and ripple marks. Boulders at the base of the unit consist of almost disintegrated granite and are up to 2 metres in diametre. Laterally and upward the amount of arkose increases. The Mussartût member consists of interbedded sills and red sandstone with conglomerate layers. Near the top of this member a red sandy tuff is found within the conglomerate. On top of this member the Naujarssuit Sandstone Member of soft red sandstone with occasional ripple marks was found. The major part of this member consists of white quartzite. The Ulukasik Volcanic Member only contains sporadic intercalated sandstone. The Nunasarnaq Sandstone Member consists of wind-blown sand with relicts of dunes. The Ilímaussaq Volcanic Member is made up entirely of extrusives (Tirsgaard & Øxnevad 1998). Near Narsarssuaq the Eriksfjord Formation is only 500 m thick and consists mainly of extrusive basalts with carbonatitic pyroclastics in the upper part. Many sandstone and mudstone bed show reduction spots (Fig. 25). The area shows an elevated uranium concentration, however there are no obvious trap, and therefore this tract does not score very high.

Figure 25. *The sandstone and mudstone beds of Eriksfjord Formation shows reduction spots. Their timing and extent is unknown. Photograph by Thomas Kokfelt.*

Table 14. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract S1-S3, Eriksfjord Basin.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	0	0	1	2	0.11	0.44	419	0	0.11	167	0.00063

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	0	0	0
Individual 2	0	0	0	0	0
Individual 3	0	0	0	2	4
Individual 4	0	0	1	2	4
Individual 5	0	0	1	2	4
Individual 6	0	0	0	1	2
Individual 7	0	0	0	2	2
Individual 8	0	0	0	1	2
Individual 9	0	0	1	1	2
Individual 10	0	0	0	0	1
Individual 11	0	0	1	1	1
Individual 12	0	0	0	0	1
Individual 13	0	0	0	0	0
Individual 14	0	0	0	1	3
Individual 15	0	0	1	2	3
Individual 16	0	0	1	2	4
Consensus	**0**	**0**	**0**	**1**	**2**

Tract S6 – Nuussuaq Basin, West Greenland

The Nuussuaq Group sedimentary rocks crop out between Svartenhuk Halvø and Disko where they were deposited in the Cretaceous to Paleogene Nuussuaq Basin (Dam et al. 2009). The oldest rocks are of Albian age and consist of syn-rift sediments, overlain by fluvio-deltaic sediments and coeval deep marine sedimentary rocks. Tectonic activity in the Early Campanian caused block faulting and uplift, and incision of the earlier sediments by subaerial and submarine canyons that were filled with conglomerates, turbiditic and fluvial sands and mudstones of Maastrichtian to Danian age. During the Selandian, marine mudstones overlie the earlier mentioned formations and locally volcanoclastic sandstones and tuffs record the onset of the later volcanic activity in the area. The youngest sediments are fluvial sediments deposited in lakes in a coarsening upward sequence. The cumulative thickness of the sediments is c. 500 m. The sediments are derived from the Precambrian basement; the lowermost units (Kome Formation and Upernavik Næs Formation) lie directly on the weathered basement and contain a sparse amount of coal (Dam et al. 2009).

The Cretaceous-Paleogene Nuussuaq Group sandstones was estimated to have a low potential to host uranium, despite the presence of coal and investigations for oil in the area prove and that reducing conditions prevailed. However, it is mostly rated low due to lack of data in the area.

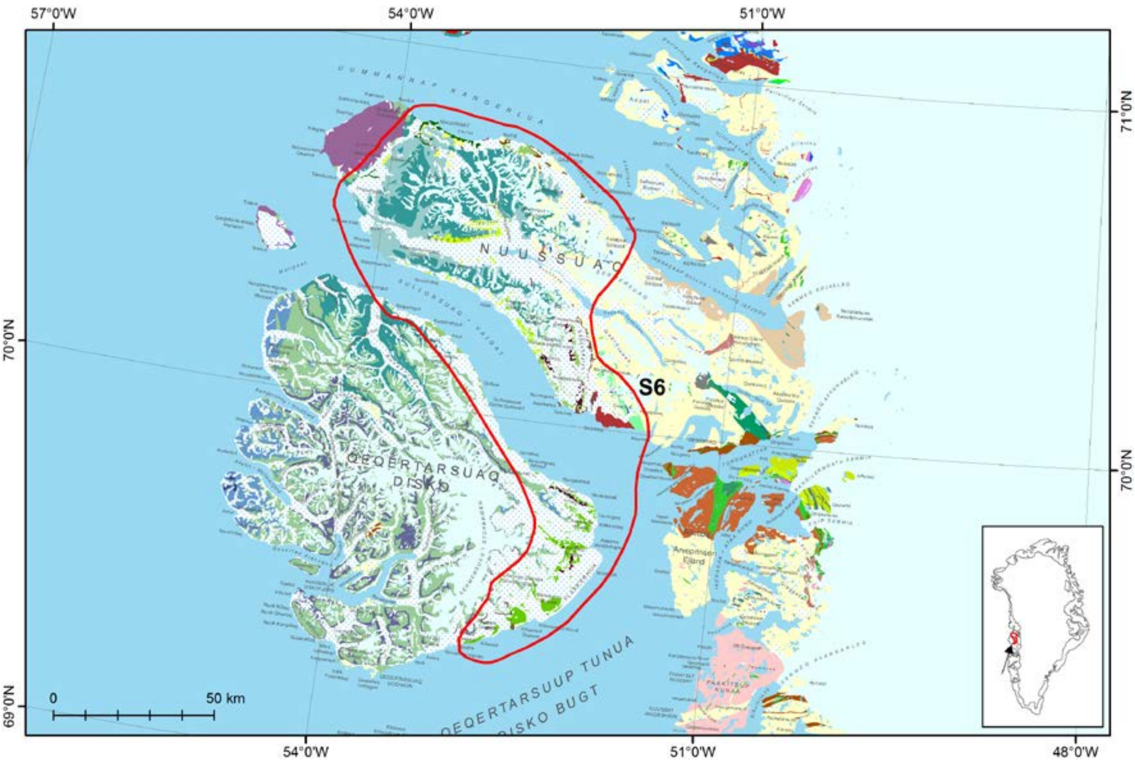

Figure 26. *Tract S6, Nuussuaq Basin, West Greenland.*

Table 15. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract S6, Nuussuaq Basin.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	0	1	2	4	0.44	0.94	217	0	0.44	289	0.0015

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	1	2	3
Individual 2	0	1	2	3	4
Individual 3	0	1	1	3	4
Individual 4	0	0	1	2	4
Individual 5	0	0	0	0	1
Individual 6	0	0	0	1	1
Individual 7	0	0	2	4	6
Individual 8	0	0	1	2	3
Individual 9	0	1	2	3	5
Individual 10	0	1	3	4	5
Individual 11	0	0	1	2	3
Individual 12	0	0	1	2	3
Individual 13	0	0	0	1	3
Individual 14	0	0	1	2	4
Individual 15	0	0	2	3	4
Individual 16	0	0	2	3	6
Consensus	**0**	**0**	**1**	**2**	**4**

Tract S7-S12 – Thule Basin, North Greenland

The Thule Supergroup consists of an unmetamorphosed sedimentary-volcanic succession that is at least 6 km thick and was deposited at middle Mesoproterozoic-late Neoproterozoic times. The Thule Basin is an intracratonic fracture basin characterised by block faulting and basin sagging formed during an extensional tectonic regime. The sediments are deposited in a series of half-grabens on top of the gneisses and granites of the Precambrian basement and the Palaeoproterozoic Prudhoe Land supracrustal complex. Alteration of the crystalline rocks, intense reddish-brown banding and strong reduction patterns have been recorded particularly in basal strata close to the Precambrian shield, both in the central basin (e.g. Northumberland Ø) and in basin margins (e.g. Wolstenholme Ø), suggesting that the unconformity acted as a passageway for the reducing solutions (Dawes 2006). Important groups within the Thule Supergroup include the Smith Sound, Nares Strait, Baffin Bay and Dundas groups; these are summarised below.

The Smith Sound Group outcrops in the northern part of the Thule Supergroup in Inglefield Land. It was deposited simultaneously with the Nares Strait Group and Baffin Bay Group, but forms a much more condensed section. It consists of shallow marine sandstones and multi-coloured shales with stromatolitic carbonates. The group is rich in quartz arenites and quartz-pebble conglomerate. The Cape Camperdown Formation, which is the lowermost formation of the Smith Sound Group is subarkosic at the base of the formation (Dawes 1997).

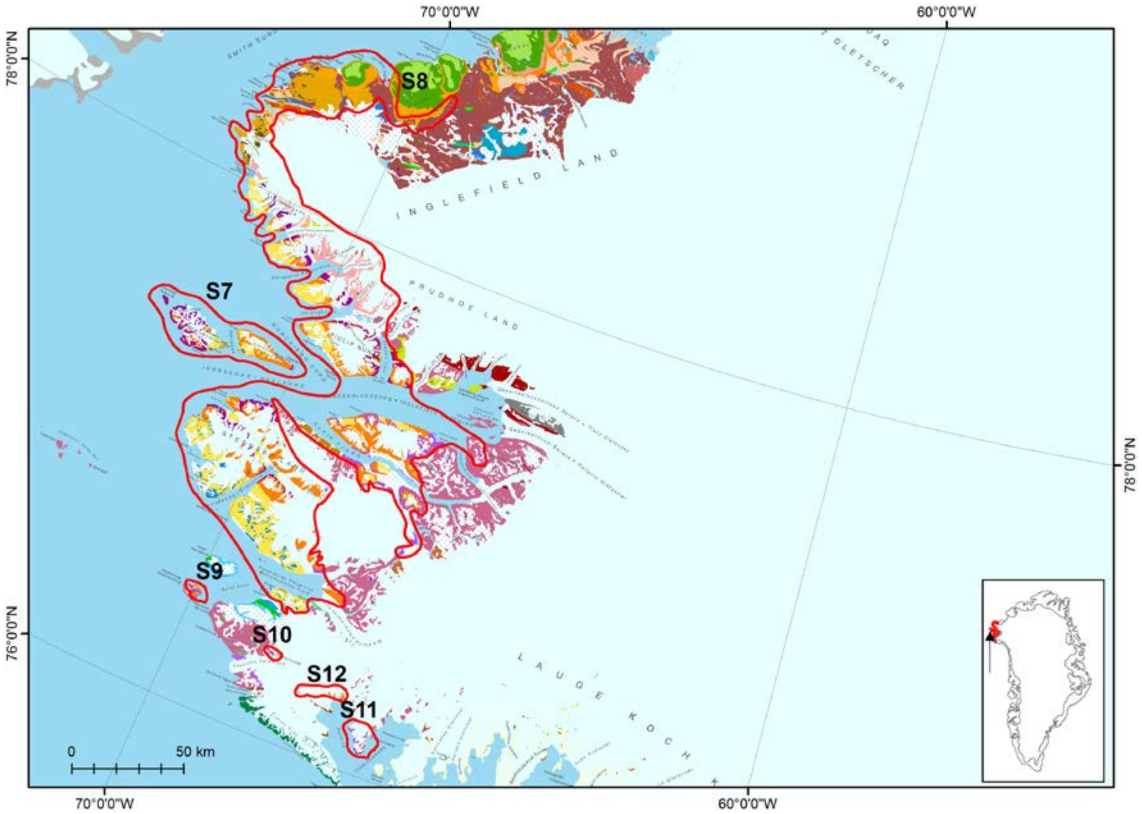

Figure 27. *Tract S7-S12, Thule Basin, North Greenland.*

The Nares Strait Group forms the oldest strata of the Thule Supergroup. The sediments are at least 1268 Ma old and consist of sandstone, basic sills, volcanic/redbed sequence of tholeiitic lavas, agglomerates, tuffaceous strata, and stromatolitic carbonates (Dawes 2006). The sediments are of alluvial plain and littoral environments. The Northumberland Formation overlies the Precambrian shield in the central basin and contains up to 10% feldspar (Dawes 1997).

The lowermost formation in the Baffin Bay Group in the Kap York area, the Wolstenholme Formation, mainly consists of the ferruginous sandstone, conglomerate, minor siltstone and shales that were deposited as fluvial deposits settled in an oxidizing environment.

The Dundas Group contains sandstones, siltstones, shales with evaporitic beds, cherts and limestones. The Steensby Land Formation is dominated by black shales with carbonate bands and stromatolitic reefs and the development of pyrite. The depositional area is deltaic to off-shore. The Narssârssuk Group is similar in composition to the Dundas Group, but usually richer in carbonate rocks (Dawes 2006).

The Thule Supergroup sediments at the base of the succession have a high potential to contain uranium-bearing sandstones.

Figure 28. *Severe bleaching of ferruginous sandstone showing relict redbeds. Arrows point to late generation of reduction spots c. 10 m above the Precambrian basement. From Dawes 2006.*

Table 16. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract T7-T12, Thule Basin.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km²)	Deposit density (N_{total}/km²)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	0	0	1	4	0.17	0.69	416	0	0.17	2,398	0.000069

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	0	1	1
Individual 2	0	0	2	4	6
Individual 3	0	0	0	2	4
Individual 4	0	0	0	0	5
Individual 5	0	0	0	1	2
Individual 6	0	0	0	2	3
Individual 7	0	0	0	0	1
Individual 8	0	0	0	1	2
Individual 9	0	0	0	0	1
Individual 10	0	0	0	0	0
Individual 11	0	0	0	2	4
Individual 12	0	0	0	0	0
Individual 13	0	0	0	0	0
Individual 14	0	2	3	5	10
Individual 15	0	1	5	10	15
Individual 16	0	0	0	0	0
Consensus	**0**	**0**	**0**	**1**	**4**

Tract S13-S15A – Franklinian shelf, North Greenland.

This tract is part of the Paleozoic Franklinian Basin in North Greenland, and it extends for more than 600 km from east to west, from Peary Land to Inglefield Land.

The Franklinian Basin was deposited along a passive continental margin during the Cambrian until the Devonian. 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 (Higgins et al. 1991).

This tract only covers the oldest shelf deposits, the Lower to Middle Cambrian, and consist of a mixture of carbonates and siliciclastic sediments. In Inglefield Land the deposits are made up by the Dallas Bugt, Cap Leiper and Cape Ingersoll Formations (S13 & S14). In Washington Land it is Kastrup Elv Formation and Humboldt Formation (S15) and in central North Greenland the deposits are made up by the Portland Formation and the Buen Formation (15A). The total thickness reaches 1-2 km in Inglefield Land and by Victoria Fjord in North Greenland the sediments rest on crystalline basement (Dawes 2004, Henriksen 1992).

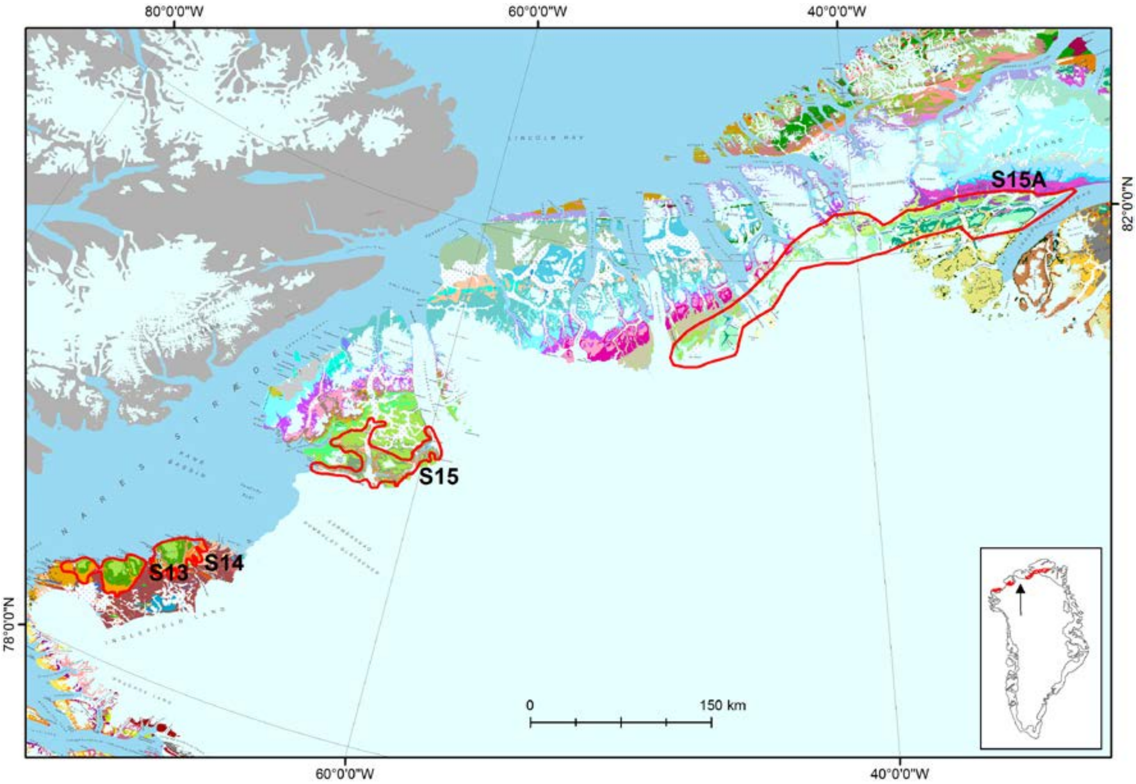

Figure 29. *Tract S13-S15A, Franklinian shelf, North Greenland.*

Table 17. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract S13-S15A, Franklinian shelf.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	0	0	2	3	0.18	0.64	353	0	0.18	2,574	0.000070

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	0	0	1
Individual 2	0	0	1	3	5
Individual 3	0	0	0	2	4
Individual 4	0	0	0	0	5
Individual 5	0	0	0	1	2
Individual 6	0	0	0	2	4
Individual 7	0	0	0	0	2
Individual 8	0	0	0	1	2
Individual 9	0	0	0	2	5
Individual 10	0	0	0	2	3
Individual 11	0	0	0	0	2
Individual 12	0	1	2	2	2
Individual 13	0	0	0	0	1
Individual 14	0	0	0	0	1
Individual 15	0	1	4	5	10
Individual 16	0	0	0	0	1
Consensus	**0**	**0**	**0**	**2**	**3**

Tract S16-S18 – Independence Fjord Group, North Greenland

Independence Fjord Group is the oldest sedimentary basin phase in North Greenland. It is a cratonic, middle Proterozoic sequence of mainly alluvial sandstones, at least 2 km thick. It has been recognised over an area of 80 by 300 km and a much larger extension of the basin has been indicated. In the easternmost part, the Independence Fjord Group is deformed and metamorphosed during the Caledonian orogeny, therefore this part is not included in the tract. The base of the group is not exposed but is inferred to lie unconformably upon crystalline basement. The bulk of the group is made up by medium to coarse-grained sandstones. The sandstones are quartzitic to arkosic, and parts have a high amount of feldspars. The sandstone members show diagenitically defined colour variations in red intensity. The sandstone beds are separated thin silt-dominated units that is suggested to represent epithermal lakes (Collinson 1980; Sønderholm & Jepsen 1991). The development of extensive lacustrine conditions suggest that sedimentation was controlled by basin-wide changes in subsidence rate (Collinson 1983). Radiometric dating by Larsen and Graff-Petersen (1980) indicated a middle Proterozoic age (about 1380 Ma) for the diagenesis, but more recent SHRIMP U-Pb dates from intercalated volcanics in similar sandstones suggest that they were deposited before 1740 Ma ago (Kalsbeek et al. 1999).

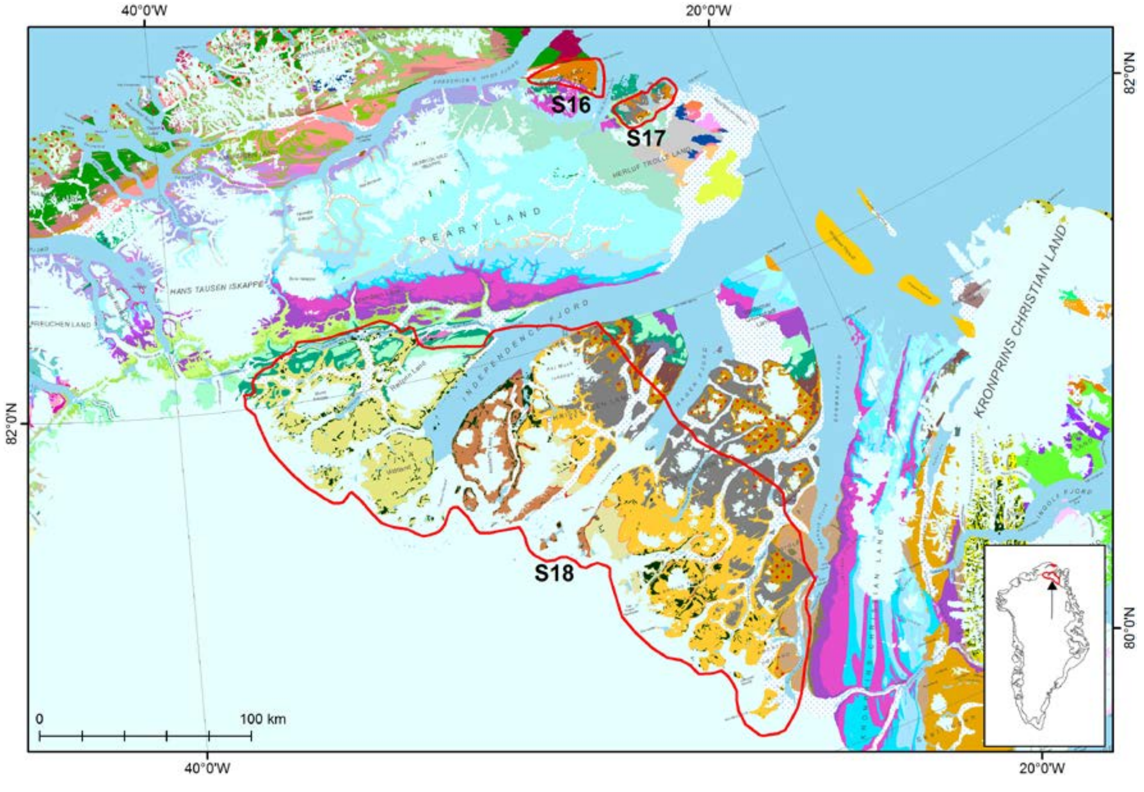

Figure 30. *Tract S16-S18, Independence Fjord Group, North Greenland.*

The Independence Group has a low potential to host uranium-bearing sandstones based on their setting in an intracratonic basin and the age of the sediments (which are too old). No information about the presence of reducing agents is found. The feldspar-bearing composition of the rocks and the presence of red beds are positive indicators but not enough to convince the panel. There is no evidence of elevated uranium in this area, however, only very limited work has been done here, and therefore limited information is available

Table 18. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract S16-S18, Independence Fjord Group.*

Consensus undiscovered deposit estimates					**Summary statistics**					**Tract Area (km^2)**	**Deposit density (N_{total}/km^2)**
N90	**N50**	**N10**	**N05**	**N01**	**N_{und}**	**s**	**Cv%**	**N_{known}**	**N_{total}**		
0	0	0	0	1	0.03	0.24	813	0	0.03	7,987	0.000004

Estimator	**Estimated number of undiscovered deposits**				
	N90	**N50**	**N10**	**N05**	**N01**
Individual 1	0	0	0	1	2
Individual 2	0	0	1	2	3
Individual 3	0	0	0	0	1
Individual 4	0	0	0	0	2
Individual 5	0	0	0	0	1
Individual 6	0	0	0	0	1
Individual 7	0	0	0	0	0
Individual 8	0	0	0	1	2
Individual 9	0	0	0	0	1
Individual 10	0	0	0	0	0
Individual 11	0	0	0	0	0
Individual 12	0	0	0	0	1
Individual 13	0	0	0	0	0
Individual 14	0	0	0	0	2
Individual 15	0	0	0	0	2
Individual 16	0	0	0	0	0
Consensus	**0**	**0**	**0**	**0**	**1**

Tract S19 – Hagen Group, North Greenland

The Hagen Fjord Group is a series of Neoproterozoic shallow marine basin deposits that were deposited between 800-590 Ma. The group has a maximum total thickness of 1000-1100 m. The lower part mainly comprises sandstones which are overlain by sandstone-siltstone association. The upper part is characterised by limestones and dolomites with abundant stromatolites. The lowermost Jyske Ås Formation consists of basal red shallow marine sandstones, followed by cross-bedded tidal sandstones. Deposition occurred in a half-graben. The two overlying formations consist mainly of fine- to medium grained sandstone and siltstones with intercalated dolostone and are interpreted as post-rifting sediments (Clemmensen & Jepsen 1992; Sønderholm et al. 2008).

The potential for the Hagen Fjord Group is hard to estimate, owing to a lack of information on the presence of feldspar minerals, reducing agents and porosity of the sandstones. Evaporites could be present, but have not been found.

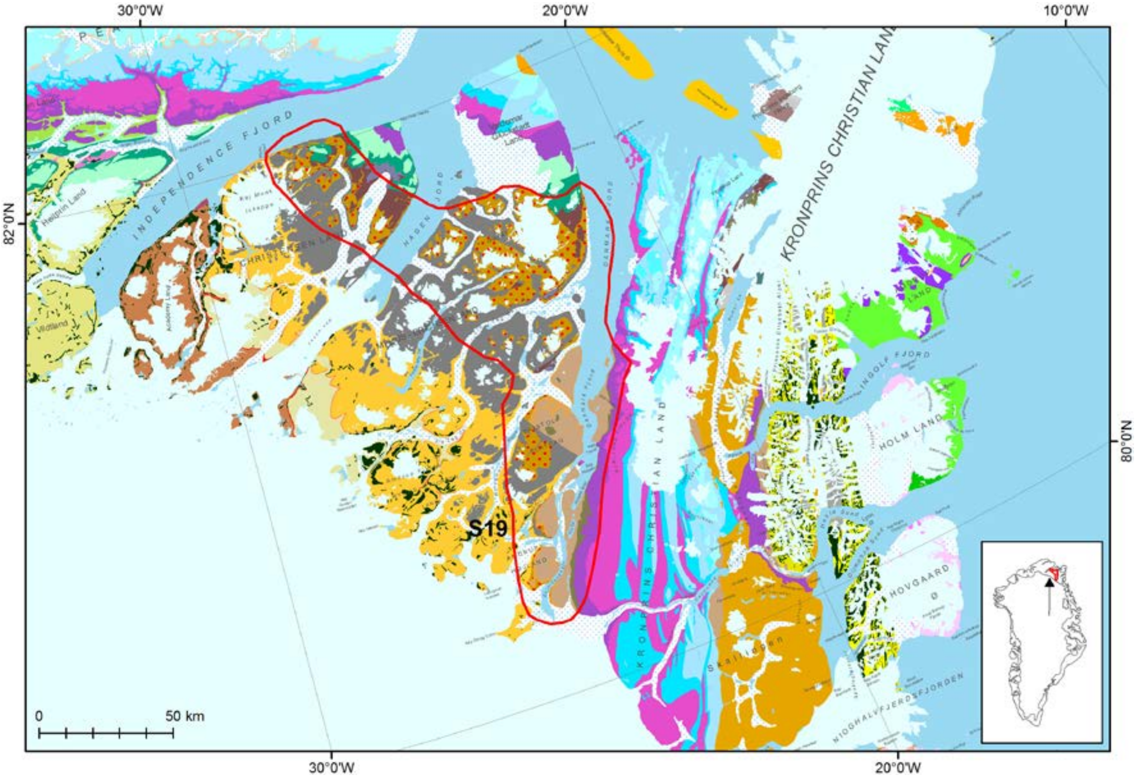

Figure 31. *Tract S19, Hagen Group, North Greenland.*

Table 19. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract S19, Hagen Group.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km²)	Deposit density (N_{total}/km²)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	0	0	1	3	0.14	0.56	417	0	0.14	1,790	0.000075

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	0	1	1
Individual 2	0	0	0	1	2
Individual 3	0	2	2	4	6
Individual 4	0	0	0	1	4
Individual 5	0	0	0	0	1
Individual 6	0	0	0	0	2
Individual 7	0	0	0	0	5
Individual 8	0	0	0	0	2
Individual 9	0	0	0	0	1
Individual 10	0	0	1	3	5
Individual 11	0	0	0	1	3
Individual 12	0	0	0	1	1
Individual 13	0	0	0	1	1
Individual 14	0	0	0	0	2
Individual 15	0	0	0	2	4
Individual 16	0	0	0	1	5
Consensus	**0**	**0**	**0**	**1**	**3**

Tract S20-S24 and S35 – Wandel Sea Basin

Prior to the workshop the Wandel Sea Basin had been defined as one tract, but during the workshop it was decided to break it up in 6 different tracts as they represents different time and geology. S35 – the Princess Islands had not originally been considered and was added during the workshop, hence the number is out of sequence. The individual tracts are described below.

The Wandel Sea Basin was formed from the Carboniferous to Triassic and again in the Late Jurassic to Eocene along the northern and north-eastern margin of the Greenland shield. The Carboniferous and Triassic sediments were deposited during a wide-spread block faulting and half-graben formation. The sediments consist of fluvial deposits with medium to coarse grained sandstones inter-bedded with shale and minor coal layers (Lower Carboniferous). Afterwards, regional uplift took place followed by deposition of c. 1100 m of shallow marine sediments in the Late Carboniferous and Early Permian (Stemmerik & Håkansson 1989). This succession is rich in carbonates but also contains Carboniferous sandstones and shales.

During the Late Jurassic and Early Cretaceous small isolated sub-basins were formed and filled with shelf sandstones and shales. The sedimentation-rate increased during the Late Cretaceous where deltaic to full marine siliciclastica were deposited (Stemmerik et al. 2000; Henriksen et al. 2009). The earliest Paleocene deposits are extrusive volcanic rocks and volcanogenic sediments of peralkaline affinity, which are preserved below a major thrust zone.

In some of the Carboniferous and Eocene units coal layers were found, which hints at a period with reducing conditions during or after deposition.

Tract S20 – Dunken and Parish Bjerge Formations, North Greenland.

The Dunken and Parish Bjerge Formations are situated in Eastern Herluf Trolle Land in North Greenland. The formations are the Triassic part of the Wandel Sea Basin, and consists of 900 meters of clastic sandstone, shales and conglomerates (Håkansson 1979). The sediments were deposited in a shelf environment and represents both shallow water and terrestrial deposits. The tract includes all of Herlufsholm Strand as it is very likely that the Triassic sediments are continuing out here, but just not exposed. This tract got a low rating because it is a marine setting and there is no source for uranium.

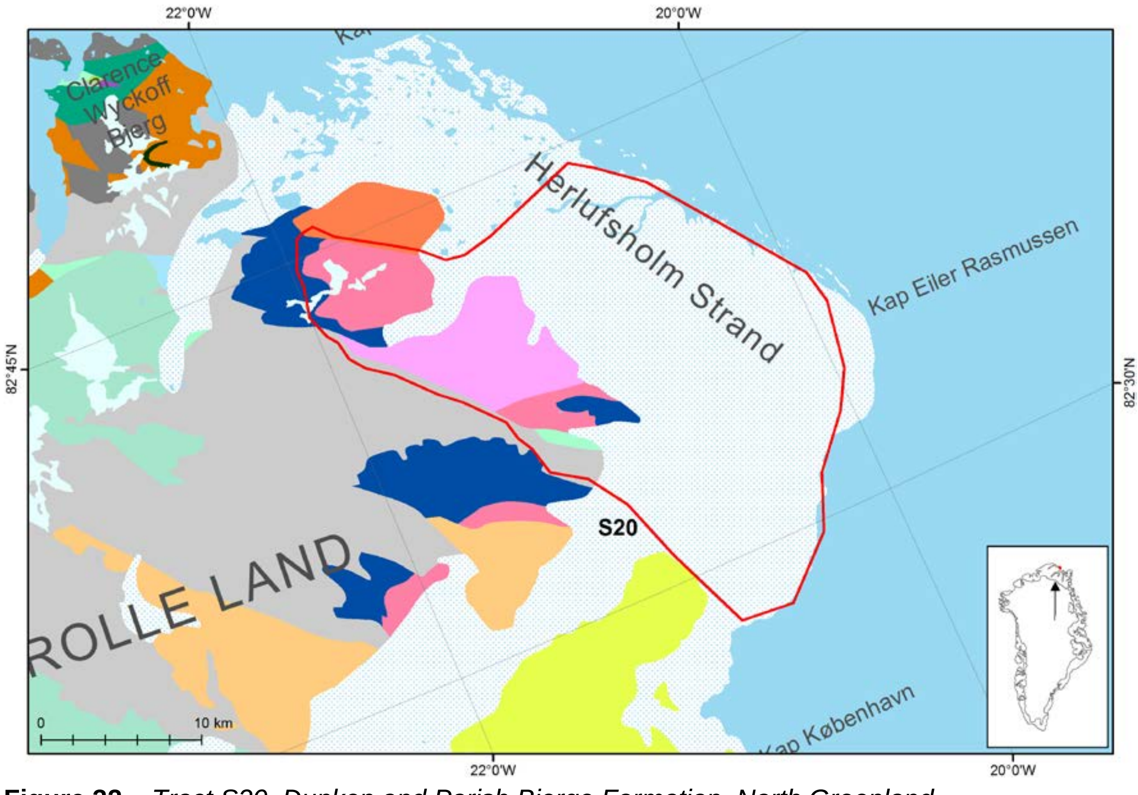

Figure 32. *Tract S20, Dunken and Parish Bjerge Formation, North Greenland.*

Table 20. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract S20, Dunken and Parish Bjerge Formation.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	0	0	1	1	0.08	0.32	423	0	0.08	505	0.00015

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	0	0	1
Individual 2	0	0	0	1	2
Individual 3	0	0	1	1	3
Individual 4	0	0	0	0	1
Individual 5	0	0	0	0	1
Individual 6	0	0	0	0	3
Individual 7	0	0	0	2	1
Individual 8	0	0	0	0	1
Individual 9	0	0	0	1	1
Individual 10	0	0	0	0	1
Individual 11	0	0	0	1	1
Individual 12	0	0	0	2	2
Individual 13	0	0	0	0	0
Individual 14	0	0	0	0	2
Individual 15	0	0	0	1	2
Individual 16	0	0	0	0	0
Consensus	**0**	**0**	**0**	**1**	**1**

Tract S21 – Ladegårdsåen Formation, North Greenland.

The Ladegårdsåen Formation is exposed in central Herluf Trolle Land in the eastern North Greenland (Dawes & Soper 1973). The Formation makes up the period from Upper Jurassic to Lower Cretaceous of the Wandel Sea Basin. It comprises more than 200 m of flat-lying, poorly exposed sands and sandstones distributed along the southern margin of Kim Fjelde. The formation rests on an erosional surface exposing a variety of rocks ranging from Silurian turbidites to Triassic sandstones and shales. Two main areas of outcrop have been delimited. These display somewhat different lithological sequences. Locally, the lowest beds of the formation consist of shallow pockets of a highly fossiliferous conglomerate with abundant belemnites. These rapidly give way to a unit comprising weakly cemented, fine-grained sands or sandy shales. Calcareous concretions are abundant and, in restricted horizons, they contain dense faunas dominated by pelecypods and scattered ammonites, in addition to widespread carbonised wood. The middle part of the formation is composed of prominent fine- to coarse-grained sandstones which are generally poorly sorted and, in their lower part, often vividly coloured in shades of red, brown and orange. The sandstones are composed mainly of planar cross-bedded sets a metre or more in thickness, typically with a southerly foreset dip. Calcite cementation is widespread in this unit, commonly destroying completely the initial porosity. The upper unit is very poorly exposed. It is generally developed as soft, fine-grained sands, but occasional coarser beds occur. Comminuted carbonaceous material is widespread and commonly concentrated in heterolithic intervals in otherwise homogeneous sand. The only macrofossils found are fragments of iron-impregnated wood (Håkansson 1979). The faunal distribution and the lithological development suggest that the deposits of the Ladegårdsåen Formation represent a gradual transition from marine to limnic conditions.
There is no source for uranium.

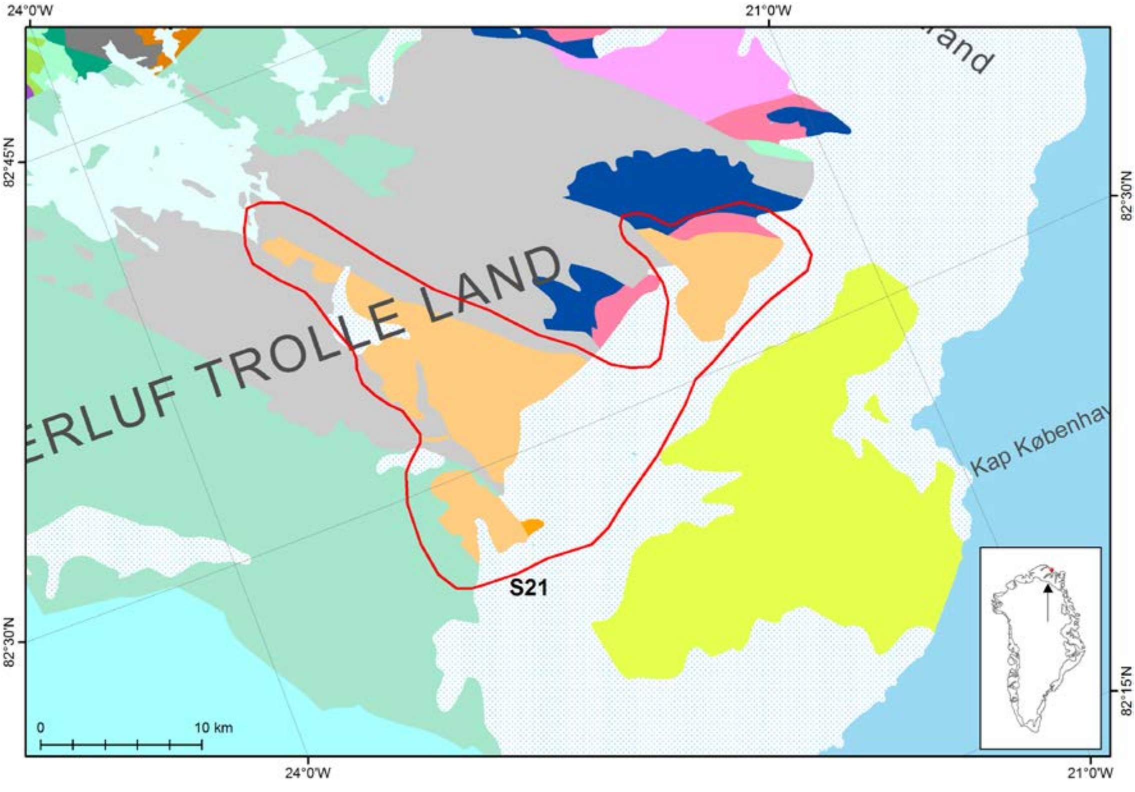

Figure 33. *Tract S21, Ladegårdsåen Formation, North Greenland.*

Table 21. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract S21, Ladegårdsåen Formation.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	0	0	1	2	0.11	0.44	419	0	0.11	131	0.00080

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	1	1	2
Individual 2	0	0	0	1	2
Individual 3	0	0	0	1	3
Individual 4	0	0	0	1	2
Individual 5	0	0	0	1	2
Individual 6	0	0	0	0	1
Individual 7	0	0	0	1	1
Individual 8	0	0	0	0	2
Individual 9	0	0	0	1	2
Individual 10	0	0	3	5	6
Individual 11	0	0	0	1	1
Individual 12	0	0	0	2	2
Individual 13	0	0	0	1	1
Individual 14	0	0	1	1	2
Individual 15	0	0	0	1	2
Individual 16	0	0	0	1	3
Consensus	**0**	**0**	**0**	**1**	**2**

Tract S22 – Kap Rigsdagen, North Greenland.

Kap Rigsdagen beds are the lower Cretaceous part of the Wandel Sea Basin. It consist of an isolated sequence of marginally marine to lagoonal clastic deposits of more 85 meters thickness (Håkansson et al. 1991).

Low ratings due to the very small size and a marine setting.

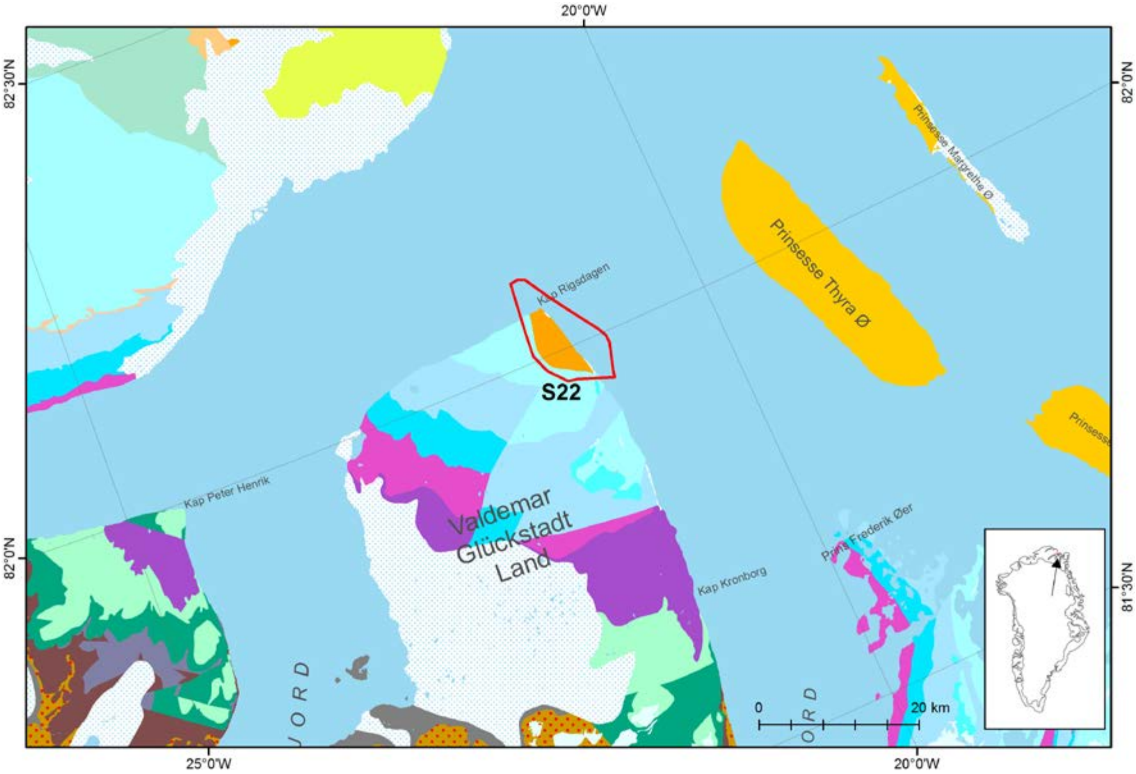

Figure 34. *Tract S22, Kap Rigsdagen, North Greenland.*

Table 22. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract S22, Kap Rigsdagen.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	0	0	0	1	0.03	0.24	813	0	0.03	29	0.0010

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	0	0	0
Individual 2	0	0	0	1	2
Individual 3	0	0	0	0	0
Individual 4	0	0	0	0	0
Individual 5	0	0	0	0	1
Individual 6	0	0	0	0	2
Individual 7	0	0	0	0	1
Individual 8	0	0	0	0	0
Individual 9	0	0	0	1	1
Individual 10	0	0	0	0	1
Individual 11	0	0	0	0	0
Individual 12	0	0	0	1	2
Individual 13	0	0	0	0	0
Individual 14	0	0	0	0	1
Individual 15	0	0	0	0	0
Individual 16	0	0	0	0	0
Consensus	**0**	**0**	**0**	**0**	**1**

Tract S23 – Kilen, North Greenland.

Kilen comprises more than 3000 m of Carboniferous to Cretaceous mainly marine clastic mudstone and sandstone. The sediments are part of the Wandel Sea Basin and represent the marine equivalent of the Dunken, Parish Bjerg and Ladegårdsåen Formations (Tract S20 and S21). The basin has a complex structural history of several events of folding, faulting and partly thermal alteration (Håkansson et al. 1993). A new revised and simplified lithostratigraphy of has just been accepted for publication (Hovikoski et al. 2018).
No source for uranium.

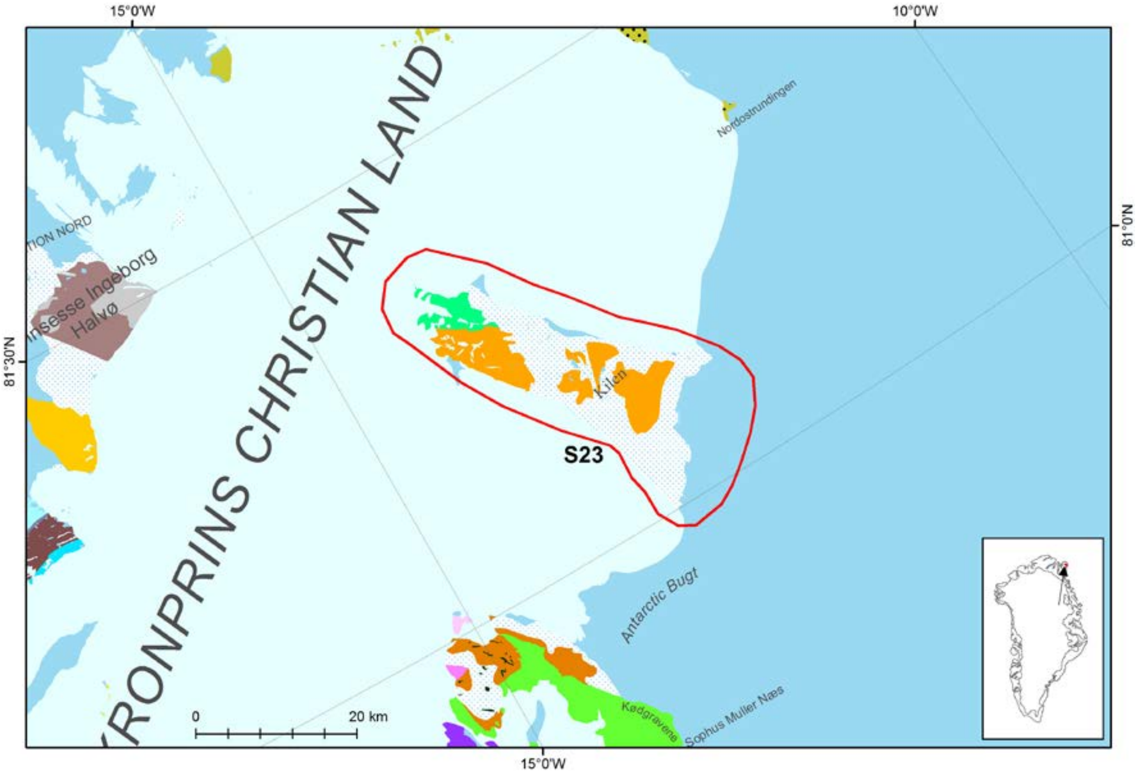

Figure 35. *Tract S23, Kilen, North Greenland.*

Table 23. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract S23, Kilen.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	**N50**	**N10**	**N05**	**N01**	N_{und}	**s**	**Cv%**	N_{known}	N_{total}		
0	0	0	1	2	0.11	0.44	419	0	0.11	117	0.00090

Estimator	Estimated number of undiscovered deposits				
	N90	**N50**	**N10**	**N05**	**N01**
Individual 1	0	0	0	0	0
Individual 2	0	0	0	0	0
Individual 3	0	0	0	1	2
Individual 4	0	0	0	0	1
Individual 5	0	0	0	0	1
Individual 6	0	0	0	0	2
Individual 7	0	0	0	0	0
Individual 8	0	0	0	0	1
Individual 9	0	0	0	1	2
Individual 10	0	1	3	3	5
Individual 11	0	0	0	0	0
Individual 12	0	0	0	1	1
Individual 13	0	0	0	0	0
Individual 14	0	0	0	0	1
Individual 15	0	0	0	1	4
Individual 16	0	0	0	0	0
Consensus	**0**	**0**	**0**	**1**	**2**

Tract S24 – Sortebakker Formation, North Greenland

The Sortebakker Formation form the bottom of the Wandel Sea Basin. It comprises a succession of non-marine, mainly fluviatile sediments exposed along the south coast of Holm Land in eastern North Greenland. The formation is Early Carboniferous of age and estimated to be *c*. 1000 m thick, resting directly on Caledonian-affected basement (Dalhoff et al. 2000). The formation is dominated by stacked fining-upward cycles of fluvial sandstones and shales with some lacustrine shale deposits towards the top. Individual cycles can be traced laterally for at least 1–2 km, the limiting factor in most cases being the amount of exposure. The formation is divided by a low-angle disconformity into a lower unit of shale-dominated cycles and an upper unit of sandstone-dominated cycles. The succession consists of six lithofacies associations. Five of these characterise different parts of a meandering river system; the sixth represents a lacustrine system. Details of the sedimentology are given in Dalhoff & Stemmerik (2000).
The terrestrial setting and the abundant presence of coal makes this one of the higher rated tract than the other Wandel Sea Basin sandstone tracts.
It has a good setting for a uranium deposit but is very small, hence the poor rating.

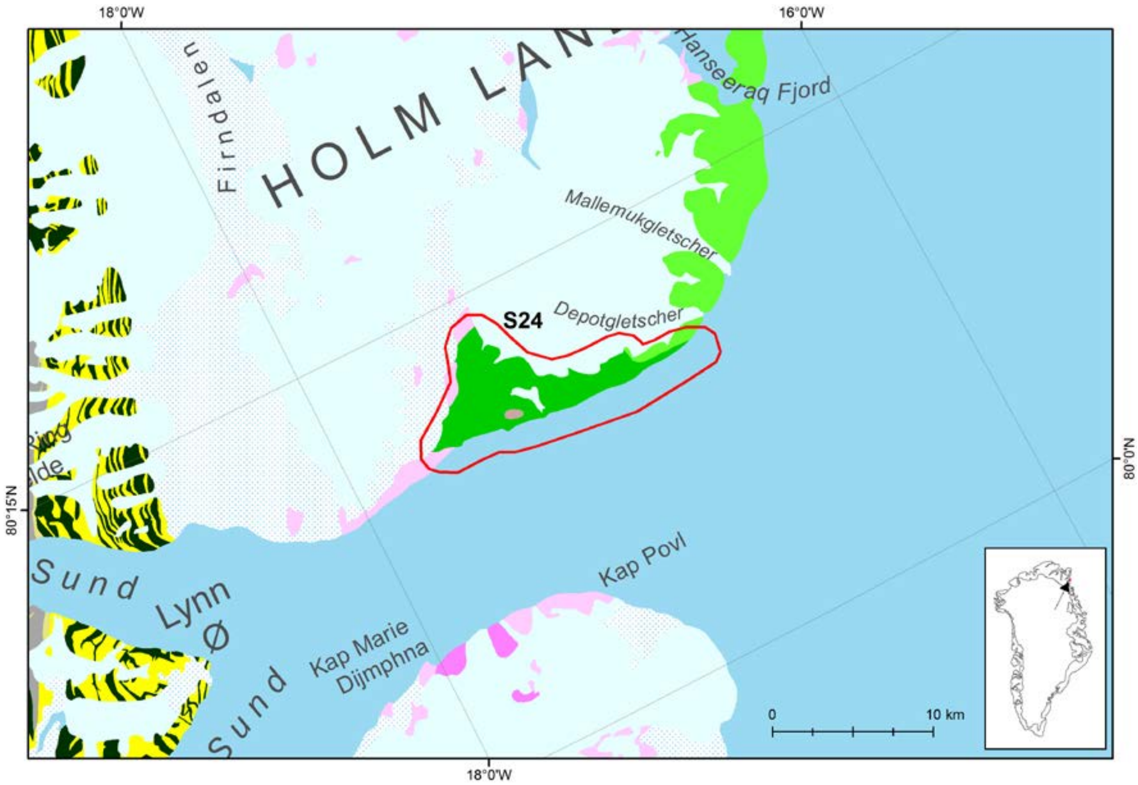

Figure 36. *Tract S24, Sortebakker Formation, North Greenland.*

Table 24. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract S24, Sortebakker Formation.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	0	1	1	2	0.33	0.62	189	0	0.33	39	0.0085

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	0	1	2
Individual 2	0	0	2	3	5
Individual 3	0	0	1	2	3
Individual 4	0	0	0	0	2
Individual 5	0	0	0	1	1
Individual 6	0	0	0	0	2
Individual 7	0	0	0	0	0
Individual 8	0	0	0	0	0
Individual 9	0	0	0	1	1
Individual 10	0	0	1	1	2
Individual 11	0	0	1	2	3
Individual 12	0	0	0	0	1
Individual 13	0	0	1	1	2
Individual 14	0	0	0	0	2
Individual 15	0	0	2	3	4
Individual 16	0	0	1	2	5
Consensus	**0**	**0**	**1**	**1**	**2**

Tract S32D – Devonian East Greenland Basin

The Caledonian orogeny in East Greenland was followed by rifting and drifting phases associated with the opening of the Northern Atlantic. As a consequence several large basins were formed between Devonian and Paleocene times. The Devonian and Carboniferous sedimentary basins are intramontane basins formed as a result of orogenic extensional collapse, and are filled with continental derived siliciclastic sediments with basic and felsic volcanic intervals. The sediments are rich in gravelly red sandstones, conglomerates and siltstone and result from deposition in braided rivers, alluvial fans, and flood plains grading into more aeolian, fluvial, lacustrine and flood plain dominated settings. Sediments were derived from the Caledonian orogen and lie unconformably on top of those. The clasts in the conglomerates and sandstones consist of limestone, granites, gneiss, and sandstone (Olsen & Larsen 1993; Larsen et al. 2008; Henriksen et al. 2009). Locally Devonian granites and rhyolites have intruded the sediment. Elevated uranium concentrations have been identified in joints and faults as well as in the granites and rhyolites (Harpøth 1986; Thomassen & Nielsen 1982) and could act as a source for at potential deposit. This tract could have a good source for uranium but there is no obvious trap, which resulted in a poor rating.

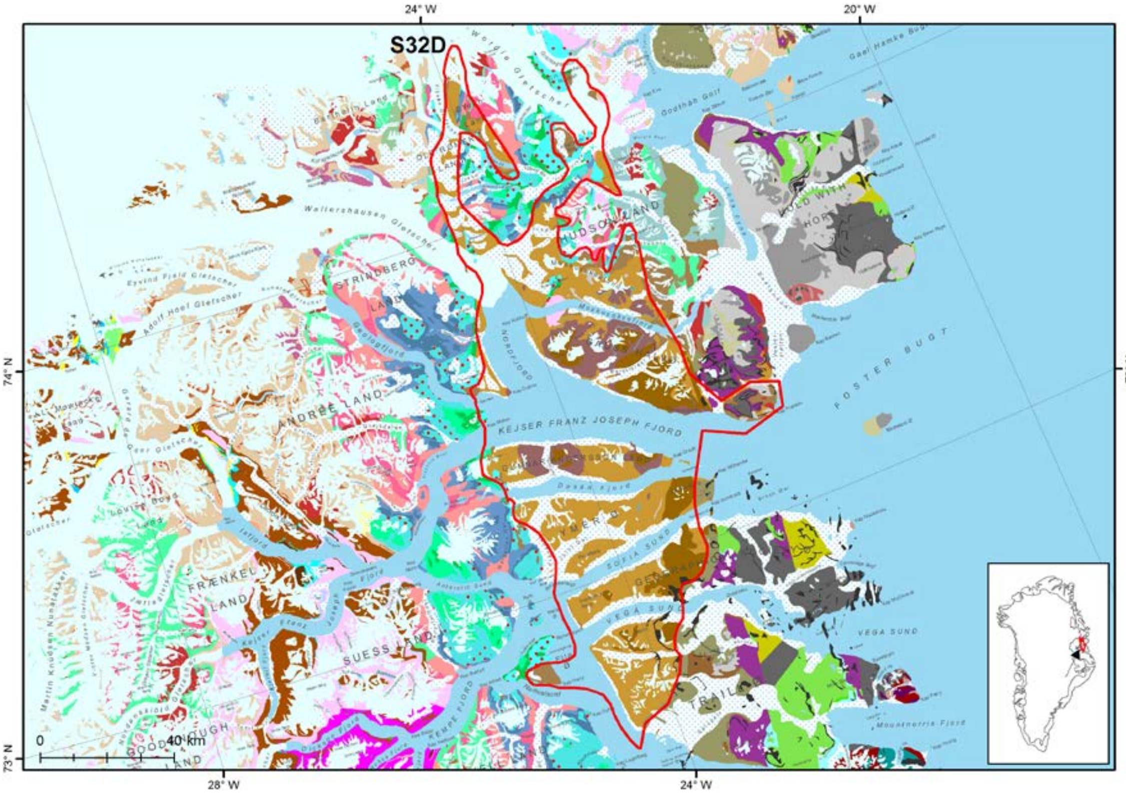

Figure 37. *Tract S32D, Devonian East Greenland Basin.*

Table 25. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract S32D, Devonian East Greenland Basin.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	0	2	2	3	0.63	1.00	159	0	0.63	3,225	0.00020

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	1	2	2	3
Individual 2	0	0	0	1	2
Individual 3	0	0	1	2	4
Individual 4	0	0	2	3	5
Individual 5	0	1	2	4	6
Individual 6	0	0	1	2	4
Individual 7	0	0	2	4	6
Individual 8	0	1	3	4	6
Individual 9	0	1	1	3	5
Individual 10	0	0	0	2	2
Individual 11	0	0	0	0	2
Individual 12	0	0	0	1	2
Individual 13	0	0	0	1	1
Individual 14	0	0	0	1	2
Individual 15	1	1	4	5	6
Individual 16	0	0	1	2	3
Consensus	**0**	**0**	**2**	**2**	**3**

Tract S32C – Carboniferous East Greenland Basin

See the section above on Devonian East Greenland Basin. In the Carboniferous, a series of north-south trending sedimentary basins developed reflecting prolonged subsidence. Block-faulting and rifting took place in several episodes. This could act as a trap for uranium, but there is uncertainly of a source and the porosity is also questionable.

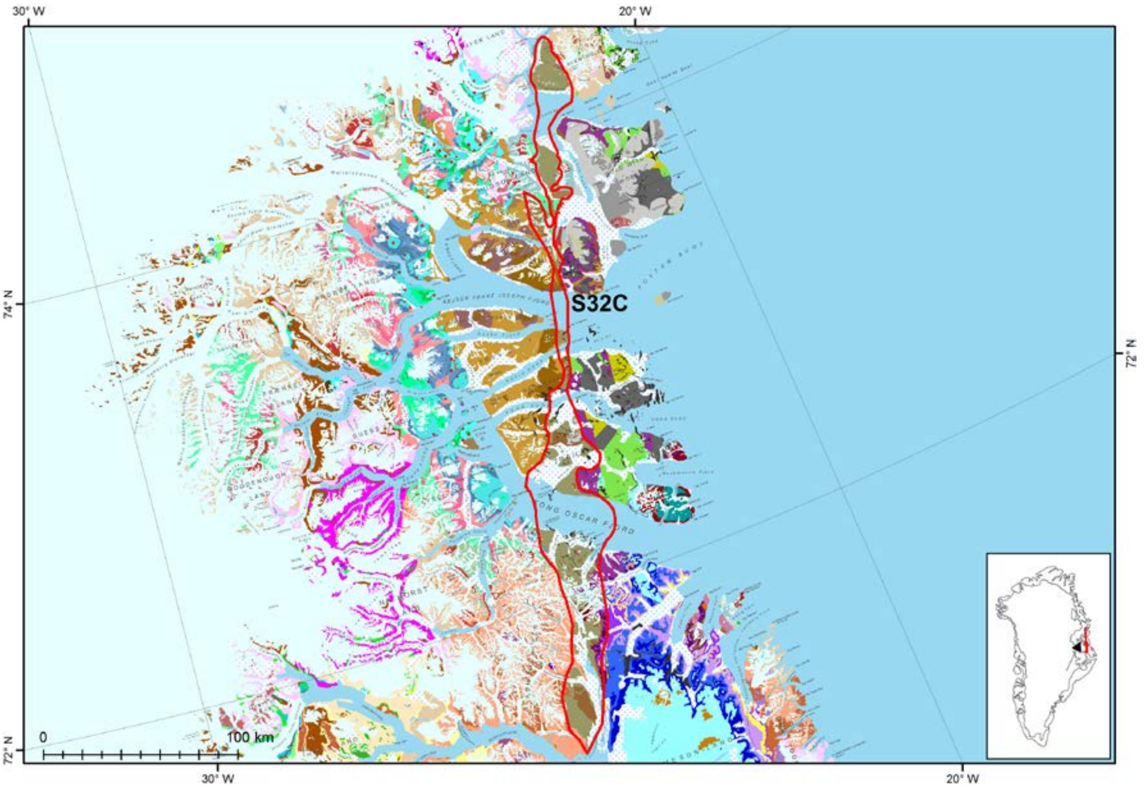

Figure 38. *Tract S32C, Carboniferous East Greenland Basin.*

Table 26. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract S32C, Carboniferous East Greenland Basin.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	0	2	3	5	0.74	1.32	180	0	0.74	1,620	0.00045

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	1	2	3
Individual 2	0	0	1	2	3
Individual 3	0	0	1	4	6
Individual 4	0	1	2	4	6
Individual 5	0	0	1	2	4
Individual 6	0	0	2	4	5
Individual 7	0	0	3	4	6
Individual 8	0	1	3	5	7
Individual 9	0	1	2	4	6
Individual 10	0	0	1	3	5
Individual 11	0	0	0	2	4
Individual 12	0	0	0	1	2
Individual 13	0	0	0	1	2
Individual 14	0	0	0	1	2
Individual 15	0	1	3	4	5
Individual 16	0	1	2	3	4
Consensus	**0**	**0**	**2**	**3**	**5**

Tract S33 – Jameson Land, East Greenland.

This tract includes Devonian to Middle-Jurassic sandstones deposited on Jameson Land. The Devonian and earliest Carboniferous sandstones were deposited during initial rifting as post-Caledonian fluvial sandstones in narrow half-grabens (Surlyk 1990). A hiatus separate these from the late Carboniferous to earliest Permian, which is represented by up to 3000 m of fluvial and lacustrine sediments deposited in active half-grabens (Stemmerik et al. 1991). After another episode of uplift and erosion the Late Permian to early Cretaceous Jameson Land Basin was deposited. The basin is ca. 4500 m thick and characterised by several marine incursions and the sediments are dominated by shallow marine sandstones (Surlyk et al. 1986). There are alluvial fan conglomerates to marginal marine carbonates and evaporates and lacustrine dolomite and shales. The late Jurassic to Cretaceous is mostly mudstone and not included in the tract.
No significant uranium anomalies have been identified within this tract.

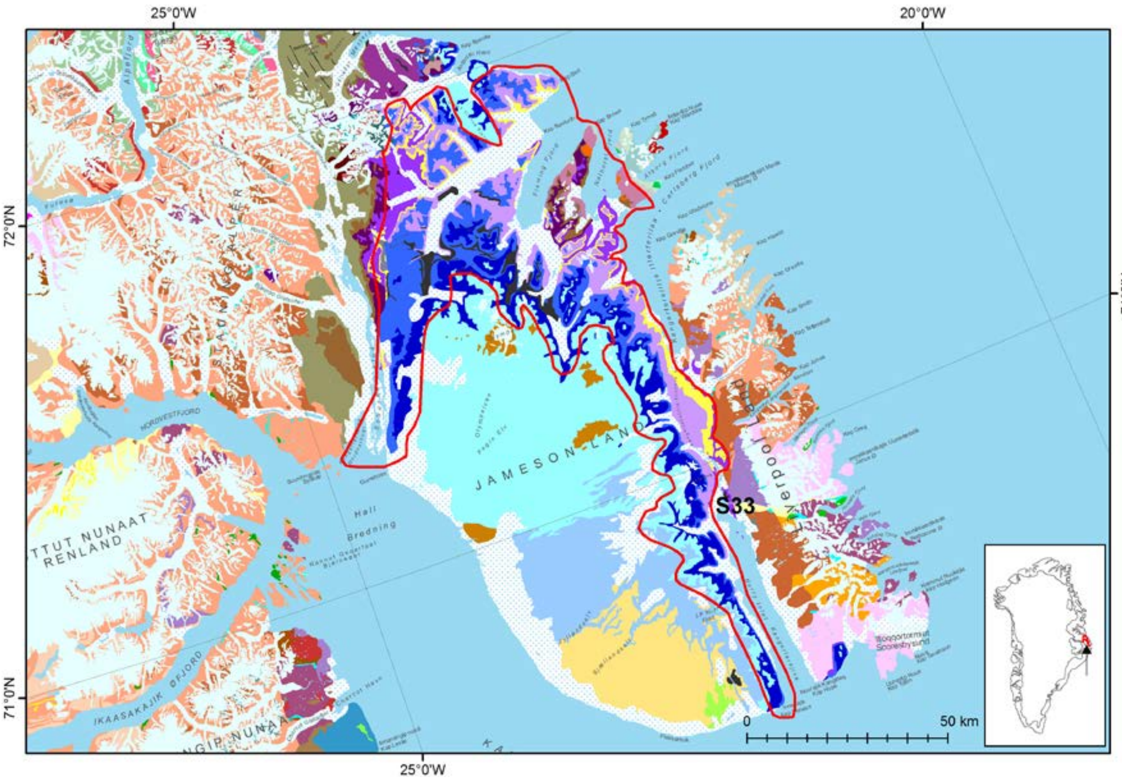

Figure 39. *Tract S33, Jameson Land, East Greenland.*

Table 27. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract S33, Jameson Land.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	0	0	1	2	0.11	0.44	419	0	0.11	2,838	0.000037

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	1	2	3
Individual 2	0	0	0	0	1
Individual 3	0	0	0	0	2
Individual 4	0	0	0	0	2
Individual 5	0	0	0	0	2
Individual 6	0	0	0	1	2
Individual 7	0	0	0	0	1
Individual 8	0	0	1	3	3
Individual 9	0	0	0	1	2
Individual 10	0	0	0	0	1
Individual 11	0	0	0	0	2
Individual 12	0	0	0	0	1
Individual 13	0	0	0	0	1
Individual 14	0	1	2	3	5
Individual 15	0	0	1	4	5
Individual 16	0	0	0	1	2
Consensus	**0**	**0**	**0**	**1**	**2**

Tract S34 – Kangerdlugssuaq Group, East Greenland

The Kangerlussuaq Basin, which is situated in southern East Greenland north-west of Nansen Fjord, contains a c. 1 km thick succession of Cretaceous-Paleogene sediments of the Kangerdlugssuaq Group. The sediments onlap crystalline basement to the east and north, but the base is not exposed in large parts of the basin. The oldest deposits are fluviatile and estuarine sandstones, which are overlain by deep marine sediments. In the early Paleocene an increased sediment input rate related to extensive uplift is recorded by submarine fan sandstones along the northern margin of the basin and mudstones within the basin that are unconformably overlain by fluvial sheet sandstones and conglomerates. The area is covered by Paleogene lavas.

The major part of the sedimentary sequence is covered by the Ryberg Formation, which consists mainly of two facies groups: planar sandstones and calcareous siltstones; feldspathic sandstones. The planar sandstones are medium to coarse well-bedded sandstones, alternating with black shale units. These commonly pass into banded or laminated calcareous siltstones. The feldspathic sandstones are coarse, sometimes conglomeratic, white sandstones, rich in basement-derived feldspar and mica. The sediments are conformably overlain by the basal conglomerate of the mainly basaltic Vandfaldsdalen Formation (Soper et al. 1976; Larsen et al. 1999).

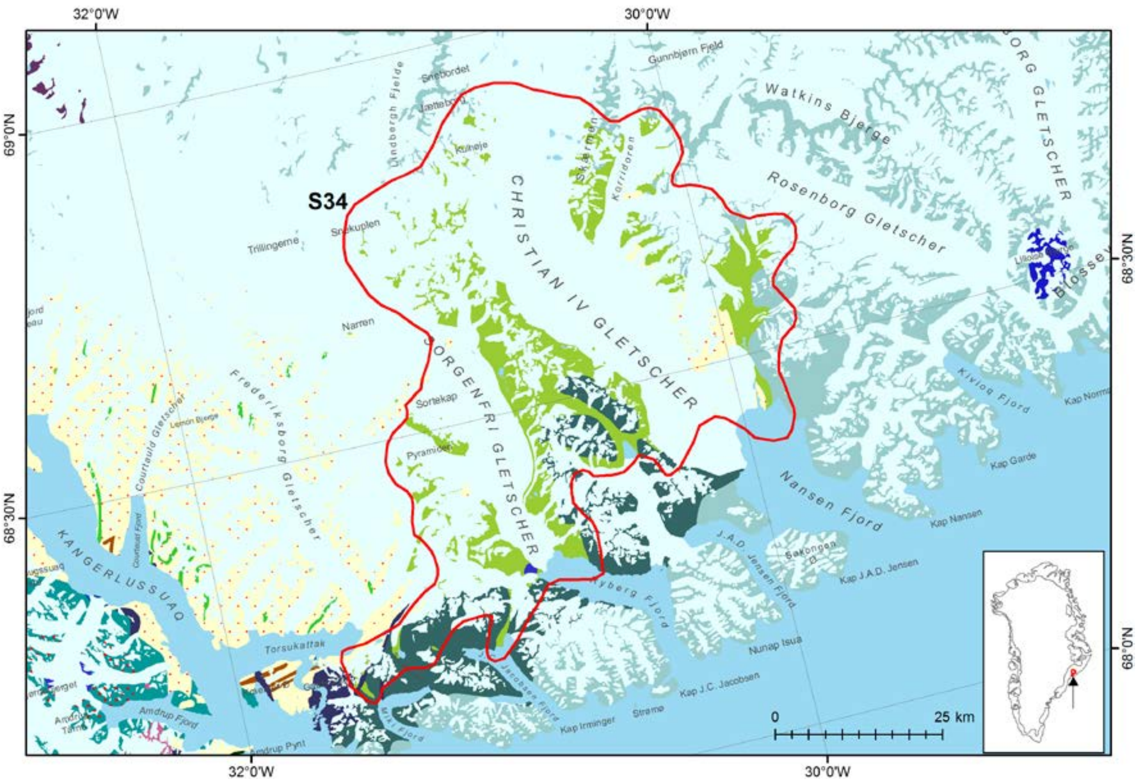

Figure 40. *Tract S34, Kangerdlugssuaq Group, East Greenland.*

The Kangerlussuaq Basin sandstones is estimated to have a low potential to host uranium-bearing sandstones. No information is available on the presence of reducing agents and the porosity of the rocks, but the sandstones are named as the outcropping equivalents to off-shore oil and gas-bearing sandstones in drill cores in the Shetland basin (Larsen et al. 1999).

Table 28. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract S34, Kangerdlugssuaq Group.*

Consensus undiscovered deposit estimates					**Summary statistics**					**Tract Area (km^2)**	**Deposit density (N_{total}/km^2)**
N90	**N50**	**N10**	**N05**	**N01**	**N_{und}**	**s**	**Cv%**	**N_{known}**	**N_{total}**		
0	0	0	1	2	0.11	0.44	419	0	0.11	486	0.00022

Estimator	**Estimated number of undiscovered deposits**				
	N90	**N50**	**N10**	**N05**	**N01**
Individual 1	0	0	0	0	0
Individual 2	0	0	0	0	1
Individual 3	0	0	0	0	2
Individual 4	0	0	0	1	3
Individual 5	0	0	0	1	2
Individual 6	0	0	0	0	2
Individual 7	0	0	0	0	0
Individual 8	0	0	0	1	2
Individual 9	0	0	1	1	3
Individual 10	0	0	2	3	4
Individual 11	0	0	0	1	2
Individual 12	0	0	0	0	1
Individual 13	0	0	1	1	2
Individual 14	0	0	1	1	2
Individual 15	0	0	0	1	2
Individual 16	0	0	1	2	3
Consensus	**0**	**0**	**0**	**1**	**2**

Tract S35 – The Princess Islands, North Greenland

The Thyra Ø Formation is the very top of the Wandel Sea Basin in the eastern North Greenland (Dawes & Soper 1973). The sediments are upper Paleocene to lower Eocene fluviatile and marine sandstones dominated by laminated, organic-poor siltstones and fine-grained sandstones with coal seams (Lyck & Stemmerik 2000). The formation covers most of the Princess Islands and peninsula south of the islands.
The Thyra Ø Formation is composed of soft, very poorly exposed shaly heteroliths and fine-grained sandstones with occasional, thin seams of shiny, homogeneous coal. At some levels weakly cemented concretions contain a fairly diverse flora of well-preserved leaves from deciduous trees and carbonised roots have been found in connection with one of the coal seams. The leaves suggest a Paleocene age. Obvious cyclic development is not apparent in the distribution of the sedimentary facies and, for the most part, the sequence was probably deposited in a limnic environment on a broad, low plain. However, in spite of the impression given by the sedimentary facies, some marine influence is evident from the presence of dinoflagellate cysts at some levels. Nothing is at present known about the lower or upper boundaries of the Tyra Ø Formation (Håkansson 1979).

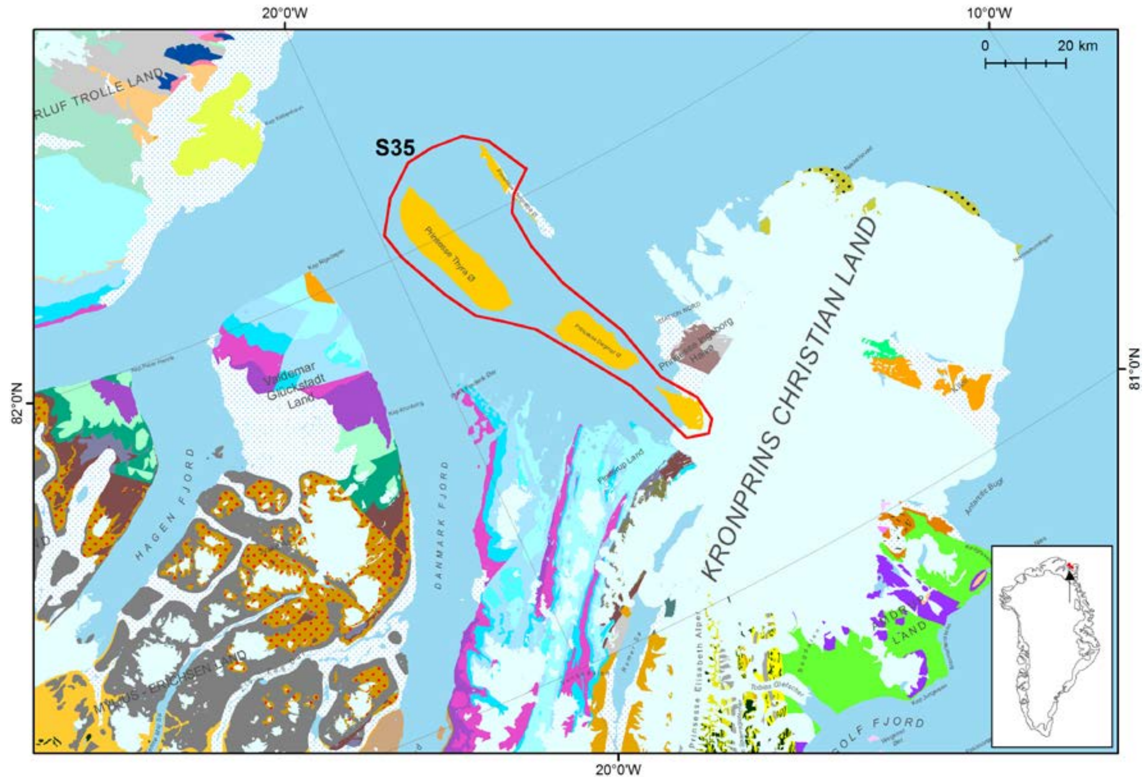

Figure 41. *Tract S35, the Princess Islands, North Greenland.*

Table 29. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract S35, the Princess Islands.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km²)	Deposit density (N_{total}/km²)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	0	0	1	2	0.11	0.44	419	0	0.11	534	0.00020

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	0	0	1
Individual 2	0	0	0	1	2
Individual 3	0	0	1	1	3
Individual 4	0	0	0	1	2
Individual 5	0	0	0	1	2
Individual 6	0	0	0	0	3
Individual 7	0	0	0	0	0
Individual 8	0	0	0	0	1
Individual 9	0	0	0	1	1
Individual 10	0	1	2	3	4
Individual 11	0	0	0	2	3
Individual 12	0	0	0	0	0
Individual 13	0	0	0	1	2
Individual 14	0	0	0	0	2
Individual 15	0	0	1	2	4
Individual 16	0	0	1	2	5
Consensus	**0**	**0**	**0**	**1**	**2**

Assessment of unconformity deposits

Tract distribution

The tracts were based on evaluation of the geology using the 1:500 000 scale geological map. These units were extracted as georeferenced polygons.

Table 30. *Overview of the individual tracts that were assessed for unconformity deposits at the workshop. The tracts in yellow were discussed but not assessed.*

Polygon name	Tract name	Tract size (km^2)	Description	Comments	Metamorphic grade	Setting
U1	Larger Eriksfjord Basin W	7,550	Mesoproterozoic sandstones of the Eriksfjord Formation on Palaeoproterozoic Julianehåb igneous complex, South Greenland	No unconformity present	none	Continental
U2	Central Eriksfjord Basin	1,265		Unconformity still partially present		
U3	Eriksfjord Basin E	1,274		No unconformity present		
U4	Danell Fjord	531	Palaeoproterozoic Danell Fj metaarkose on Palaeoproterozoic basement, South Greenland	Folded, thrusted	low-medium	Continental or shelf
U5	Midternæs	271	Palaeoproterozoic cgl and ss on Archaean basement, South Greenland	qzite-cgl subordinate in shales	low-medium	Continental or shelf
U6	Anap Nuna	106	Palaeoproterozoic metasediments on Archaean basement in NE Disko Bay, West Greenland	Silt- and sandstone	low	Shelf
U7	Karrat Group	5,584	Palaeoproterozoic metasandstone within Karrat Group, West Greenland	Silt- and sandstone, Unconformity between the upper and lower Karrat Group	medium	Shelf-marine basinal
U8 U9 U10	Thule Basin	4,372	Mesoproterozoic Thule Supergroup, NW Greenland	Silt- and sandstone	none	Intracratonic faulted
U11	Independence Fj.	7,470	Paleo-Mesoproterozoic Independence Fjord Group, North Greenland			Intracratonic siliciclastic

Nine different tract for unconformity deposits were identified prior to the workshop, however it was decided during the workshop that one of them were not suited for evaluation. This is marked by yellow in Table 30.

Individual tracts assessed during the workshop

Tract U1 – Larger Eriksfjord Basin West

The sediments of the Mesoproterozoic Eriksfjord Formation, which overlays the Palaeoproterozoic Julianehåb batholith, are described in section on S1-S3 Eriksfjord Basin. Tract U1 represents a doughnut shaped area, not including U2, which is in the middle of U1. Today the Eriksfjord Formation is only present in U2, but the assumption that the basin originally had a much greater extend, makes the large area around U2 interesting. It is likely that the Eriksfjord Basin originally covered the area of U1 and a potential unconformity deposits could therefore be hidden in the basement.

This tract includes a large amount of uranium anomalies and mineralisations in veins and fractures, there is clearly lots of uranium in the system.

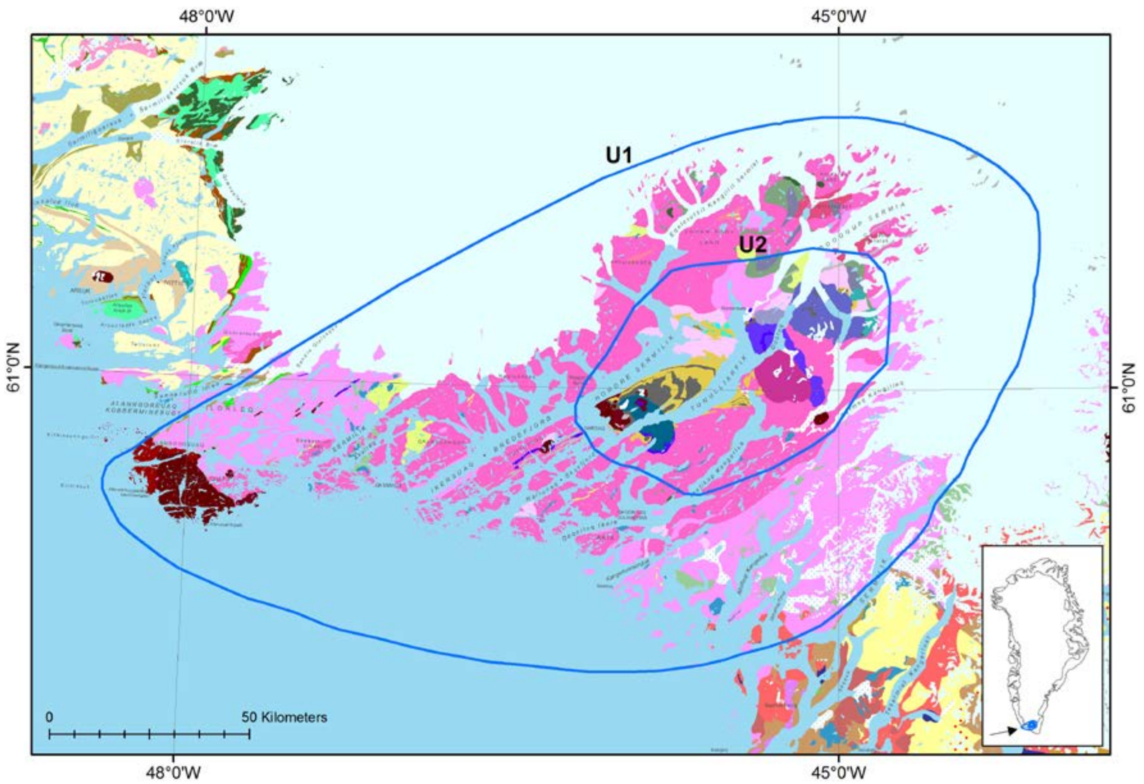

Figure 42. *Tract U1, Larger Eriksfjord Basin West, South Greenland. The tract only covers the doughnut shaped area, U2 is not included.*

Table 31. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract U1, Larger Eriksfjord Basin West.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	1	3	5	7	1.51	1.8	119	0	1.51	7,550	0.00020

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	1	1	2	2
Individual 2	10	12	14	16	20
Individual 3	1	3	3	6	7
Individual 4	0	0	2	6	10
Individual 5	0	0	1	2	5
Individual 6	0	0	2	4	6
Individual 7	0	0	1	5	10
Individual 8	0	0	1	2	2
Individual 9	0	0	1	5	10
Individual 10	0	0	0	3	3
Individual 11	0	1	4	5	6
Individual 12	0	0	0	1	2
Individual 13	0	0	1	2	3
Individual 14	0	0	0	1	2
Individual 15	1	3	10	15	20
Individual 16	0	0	2	5	10
Consensus	**0**	**1**	**3**	**5**	**7**

Tract U2 – Central Eriksfjord Basin

The sediments of the Mesoproterozoic Eriksfjord Formation, which overlays the Palaeoproterozoic Julianehåb batholith, are described in section on S1-S3 Eriksfjord Basin.
The crystalline basement and the overlying sediments are from the most optimal geological time periods for unconformity deposits. The Eriksfjord Formation is deposited in an intracratonic sedimentary basin, in a uranium-rich environment. Some of the known uraninite fracture-hosted occurrences in the Julianehåb igneous complex have been suggested to be unconformity related. Accordingly, the potential for undiscovered uranium deposits in this area was highly ranked.

This tract is smaller than U1 but includes more uranium anomalies and mineralisations in veins and fractures.

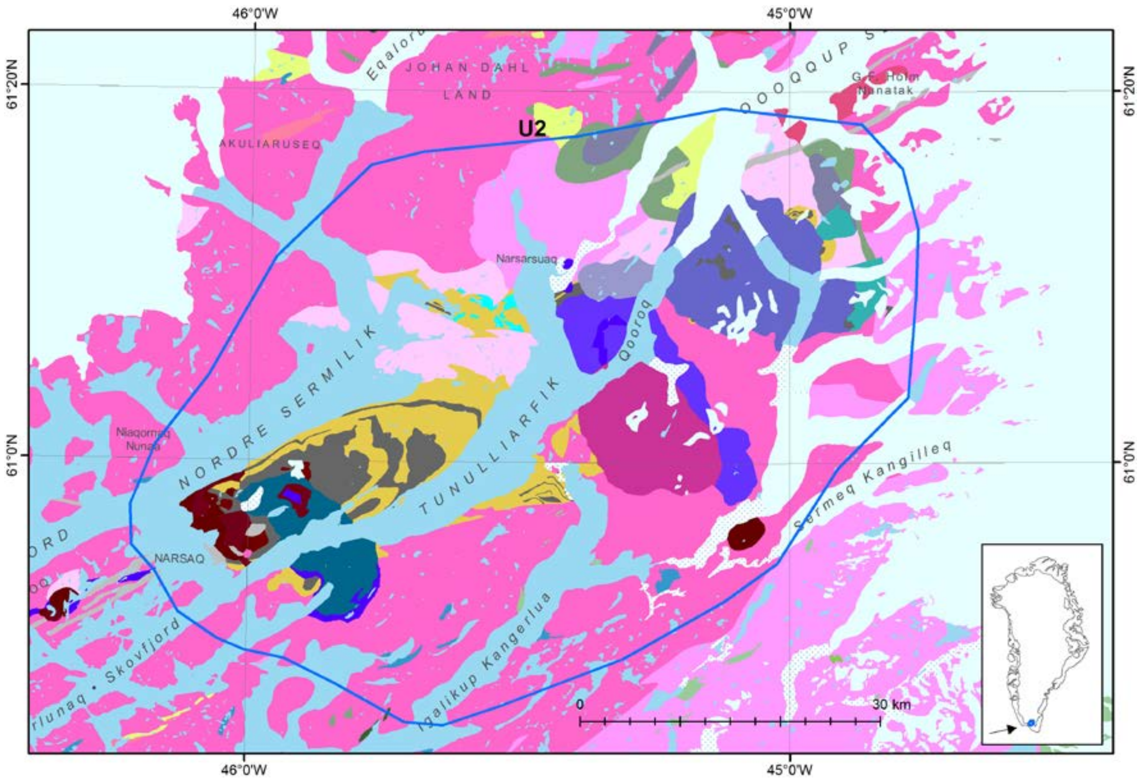

Figure 43. *Tract U2, Central Eriksfjord Basin, South Greenland.*

Table 32. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract U2, Central Eriksfjord Basin.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
1	3	5	7	10	3.17	2.26	71	0	3.17	1,265	0.0025

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	2	3	3	4	4
Individual 2	10	15	20	25	30
Individual 3	2	6	10	12	20
Individual 4	1	2	3	5	9
Individual 5	1	2	4	5	8
Individual 6	1	2	4	6	8
Individual 7	0	1	10	12	15
Individual 8	0	0	1	3	3
Individual 9	0	0	1	5	10
Individual 10	1	2	3	4	5
Individual 11	0	5	6	8	10
Individual 12	1	2	4	6	8
Individual 13	0	1	2	3	4
Individual 14	0	1	1	2	3
Individual 15	1	1	4	6	10
Individual 16	0	1	3	5	10
Consensus	**1**	**3**	**5**	**7**	**10**

Tract U3 – Eriksfjord Basin East

The sediments of the Mesoproterozoic Eriksfjord Formation, which overlays the Palaeoproterozoic Julianehåb batholith, are described in section on S1-S3 Eriksfjord Basin. The Eriksfjord Formation is only present in U2, but the assumption that the basin originally had a much greater extend than today, makes the a larger area (U1 and U3) interesting, and a potential unconformity deposits could be hidden in the basement. The same conditions apply for U3 and U1, but this area is less investigated, lack data and only has few uranium anomalies, therefore the lower ranking.

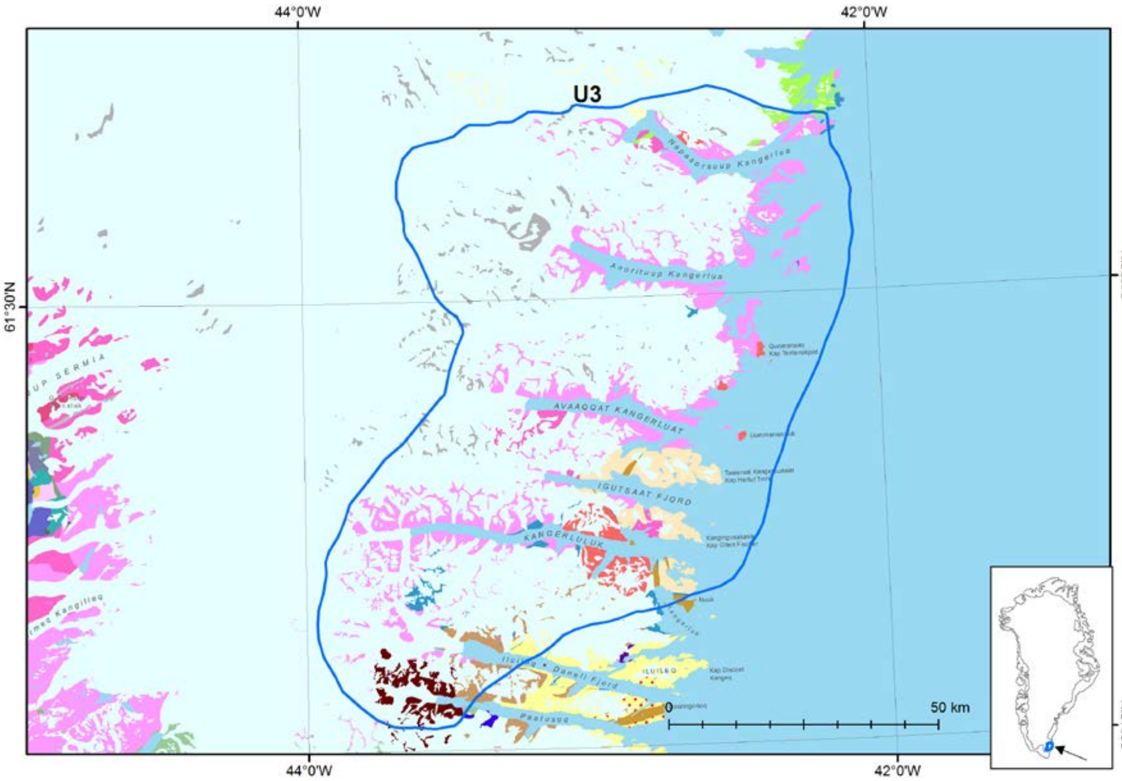

Figure 44. *Tract U3, Eriksfjord Basin East, South Greenland.*

Table 33. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract U3, Eriksfjord Basin East.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	0	1	2	4	0.44	0.94	217	0	0.44	1,274	0.00034

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	0	0	0
Individual 2	0	5	6	7	8
Individual 3	0	0	1	3	5
Individual 4	0	0	0	2	5
Individual 5	0	0	1	3	5
Individual 6	0	0	0	1	2
Individual 7	0	0	0	2	2
Individual 8	0	0	1	2	3
Individual 9	0	0	1	2	3
Individual 10	0	0	0	1	1
Individual 11	0	0	0	1	3
Individual 12	0	0	0	2	3
Individual 13	0	0	1	1	2
Individual 14	0	0	0	1	3
Individual 15	0	0	2	3	4
Individual 16	0	0	0	1	5
Consensus	**0**	**0**	**1**	**2**	**4**

Tract U5 – Midternæs

Midternæs hosts a series of nearly unmetamorphosed and undeformed supracrustal Ketilidian rocks. The lower part of the succession is the sedimentary Vallen Group. It is overlain by the volcanic Sortis Group, which mainly consists of basic pillow lavas and contemporaneous basic sills. The exact age of deposition for the sediments is unknown, but the Sortis Group sediments are over-thrusted by the Vallen Group and intruded by the Ketilidian Granites (Garde et al. 2002b). These granites are associated with the Julianehåb batholith which was emplaced from 1868 Ma onwards (Garde et al. 1998). Kalsbeek & Taylor (1985) report the age of the dolerite dyke in the continuation of those sediments in Grænseland that cross-cut the basement to be 2130 Ma (Rb-Sr whole rock age), but no age of the sediment is indicated.

Bondesen (1970) describes that the Archaean orthogneiss immediately below the contact with the Ketilidian sedimentary rocks was altered to sericite and chlorite, and carbonate-enriched, probably as a result of percolating ground water at the time of deposition of the sediments. The basal conglomerate lies unconformably on the altered basement and consists of unsorted clasts of orthogneiss, pegmatite, vein quartz, dolomite and green mica schist, with a clasts size of up to c. 20 cm in diametre. On top of the conglomerate the Lower Dolomite and Varved Shale Members are laid down; each of these members is c. 15 m thick. The Rusty Dolomite Member is 0.5 to 1 m thick. The overlying unit was named the Ore-Conglomerate Member by Bondesen (1970) and described it as an oligomict conglomerate consisting of boulders of grey to white cherty quartzite set in a matrix of magnetite or locally pyrite. Bondesen (1970) describes the rocks as an accumulation of locally transported material deposited from small streams. The boulders have the composition of Târtoq Group supracrustal rocks and Archaean orthogneiss.

The Palaeoproterozoic Midternæs unconformity has potential to host uranium as this unconformity zone contains chloritisation in the weathered basement overlain by sedimentary rocks. Both the Archaean basement and the overlying sediments are slightly older than what is normally recorded as optimal for uranium occurrences of this type and the Ketilidian sediments were not deposited in an intracratonic basin. The sediments and volcanic rocks continue further to the south as Grænseland (intermediate-grade metamorphic overprint) and can also be found on Arsuk Ø (intensive metamorphic overprint).
The tract received low ratings at the workshop as it is very small, there is no good constrains of the age and only minor uranium anomalies are found.

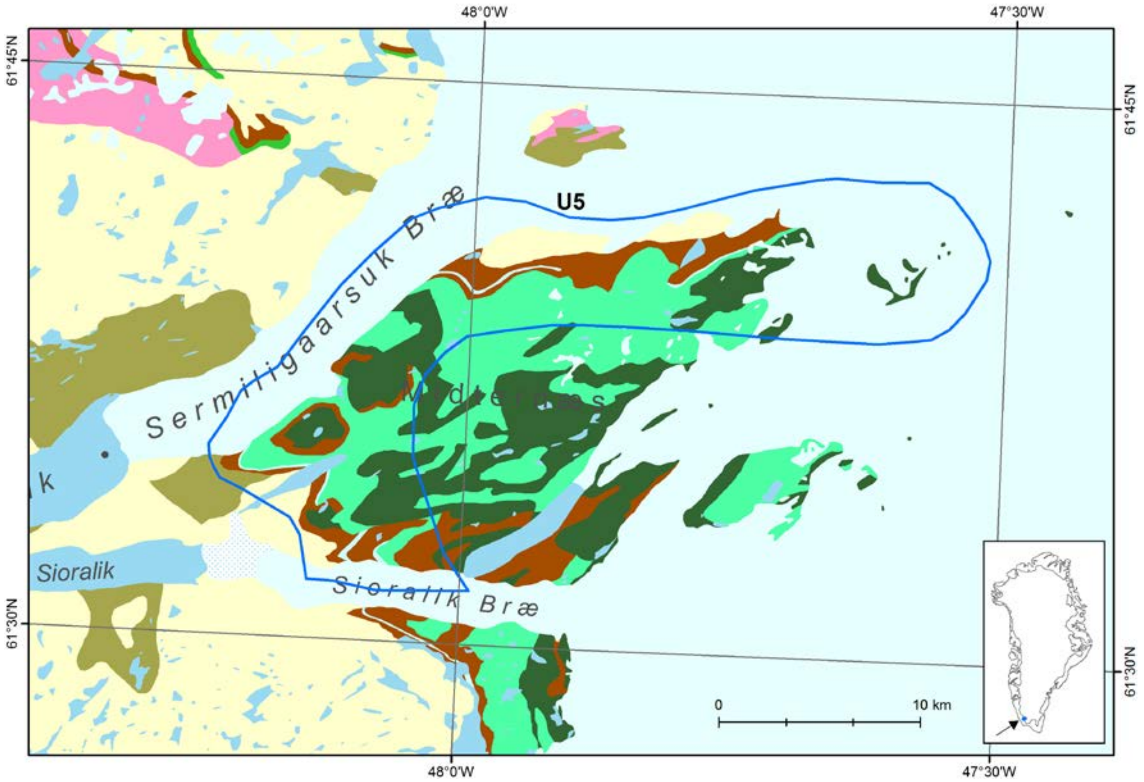

Figure 45. *Tract U5, Midternæs, South Greenland.*

Table 34. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract U5, Midternæs.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	0	0	1	3	0.11	0.44	419	0	0.11	271	0.00039

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	0	0	0
Individual 2	0	0	0	0	0
Individual 3	0	0	0	1	3
Individual 4	0	0	0	1	3
Individual 5	0	0	0	1	2
Individual 6	0	0	0	0	1
Individual 7	0	0	0	1	2
Individual 8	0	0	0	1	3
Individual 9	0	0	0	1	2
Individual 10	0	0	1	1	2
Individual 11	0	0	0	0	1
Individual 12	0	0	1	2	2
Individual 13	0	1	1	2	2
Individual 14	0	0	0	0	2
Individual 15	0	0	0	1	2
Individual 16	0	0	0	1	2
Consensus	**0**	**0**	**0**	**1**	**2**

Tract U6 – Anap Nunâ

The Anap Nunâ Group (Escher & Burri 1967) is a supracrustal belt at Anap Nunaa in the northeastern part of the Disko Bay area. It was tentatively correlated with the Palaeoproterozoic Karrat Group of the Rinkian orogen on the basis of lithotypes (Garde & Steenfelt 1999a). It consists of platform and tidal flat sedimentary rocks that include several metres of basal, cross-bedded and ripple-marked mature quartz sandstone overlain by up to 50 m of marble that is capped by tidal and deeper-water siltstones and fine-grained sandstones with a minimum thickness of 2000 m (Garde & Steenfelt 1999a).

There is a clear depositional unconformity preserved at Anap Nunaa, where the basal rocks were deposited on already deformed, c. 2.8 Ga acid metavolcanic rocks. Several thick basic dykes and sills of presumed Palaeoproterozoic age intruded the Anap Nunâ Group on Anap Nunaa, Qeqertakassak and Qapiarfiit.

East–west-trending, upright, kilometre-scale buckle folds in the Anap Nunâ Group are associated with localized thrusts and brittle faults. These structures are correlated with steep, east–west-trending, northward-intensifying planar fabrics in northern Anap Nunaa, as well as in surrounding Archaean rocks to the west. The Anap Nunâ Group was metamorphosed at lower greenschist facies. The Anap Nunâ Group is interpreted to be Palaeoproterozoic, deposited after ca. 1.9 Ga based on detrital U-Pb zircon analyses. The results reviled a significant component of Archaean detritus comparable to the regional basement and a second component of 2.1-1.9 Ga Palaeoproterozoic zircons (Connelly et al. 2006).

Accepting a Palaeoproterozoic age for the sediments requires that both basement and cover in the northern Ataa domain underwent Palaeoproterozoic deformation (Higgins and Soper 1999).

The tract received low ratings at the workshop as it is very small, and had no uranium anomalies.

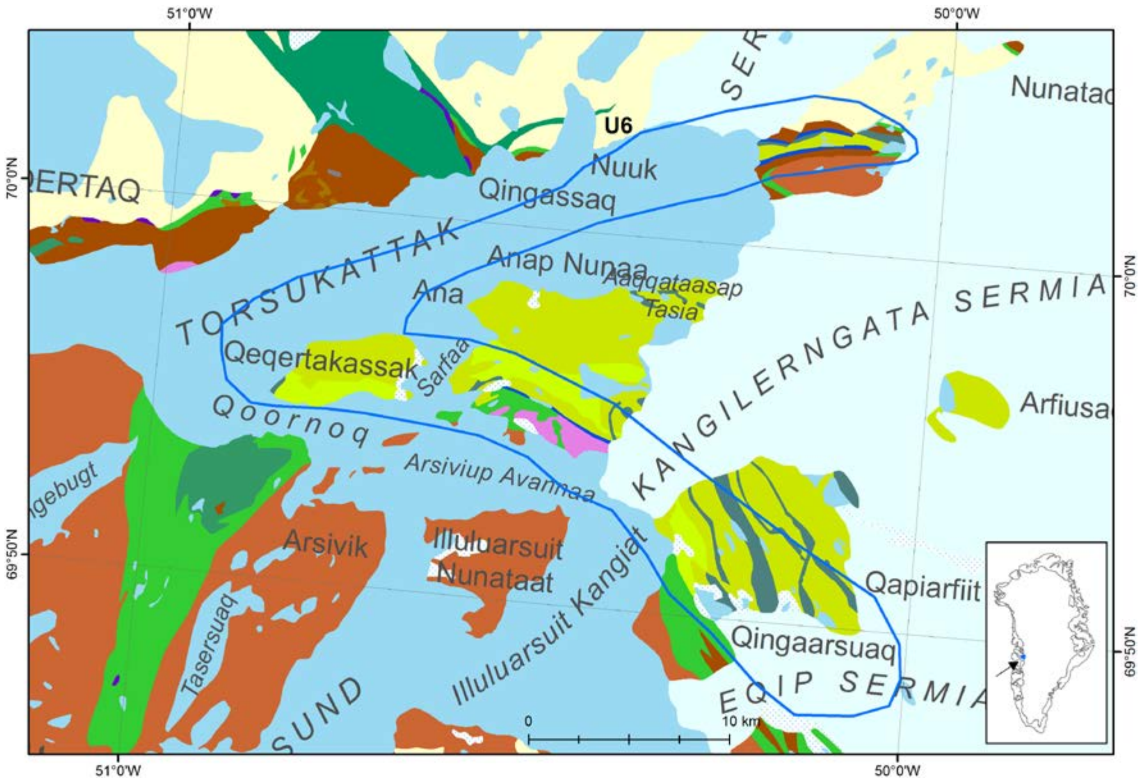

Figure 46. *Tract U6, Anap Nuna, West Greenland.*

Table 35. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract U6, Anap Nuna.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km²)	Deposit density (N_{total}/km²)
N90	**N50**	**N10**	**N05**	**N01**	**N_{und}**	**s**	**Cv%**	**N_{known}**	**N_{total}**		
0	0	0	1	2	0.11	0.44	419	0	0.11	106	0.00099

Estimator	Estimated number of undiscovered deposits				
	N90	**N50**	**N10**	**N05**	**N01**
Individual 1	0	0	0	0	1
Individual 2	0	0	0	0	0
Individual 3	0	0	1	1	2
Individual 4	0	0	0	0	3
Individual 5	0	0	0	0	1
Individual 6	0	0	0	0	2
Individual 7	0	0	2	4	6
Individual 8	0	0	0	1	2
Individual 9	0	0	0	0	1
Individual 10	0	0	1	2	3
Individual 11	0	0	1	2	3
Individual 12	0	0	0	1	2
Individual 13	0	0	0	1	1
Individual 14	0	0	0	0	1
Individual 15	0	0	0	0	2
Individual 16	0	0	1	2	2
Consensus	**0**	**0**	**0**	**1**	**2**

Tract U7 – Karrat Group

The Palaeoproterozoic supracrustal rocks known as the Karrat Group, extends north-south for a distance of approximately 550 km in West Greenland. The Karrat Group rests unconformably on an Archaean gneiss. The group is divided into three formations described by Henderson & Pulvertaft (1987). The carbonate dominated Mârmorilik Formation occurs in the southern part of the Umanak district, whereas the mainly siliciclastic Qeqertarssuaq Formation occurs in the remaining part. The two formations are believed to have been deposited simultaneously in separate sub-basins. The Mârmorilik Formation, which reaches a thickness of 1600 m, consists of calcitic and dolomitic marbles with a thin basal clastic unit (Garde 1978). The Qeqertarssuaq Formation is dominated by impure quartzite's with variable amount of pelitic schists and rare marbles, it thickness varies considerably, from ca. 1 km to a few metres thick. The top of the Formation commonly marked by a thin (c. 200 m) unit of hornblende schist locally recognized to be of volcanic origin. The Mârmorilik and Qeqertarssuaq Formations are overlain the Nukavsak Formation, the most widespread of the three formations. Up to 5 km thick, this dark grey-brown weathering unit comprises monotonous flysch deposits, consisting of metagraywacke-pelite and psammite units. Based on lithology, stratigraphy and extent the Karrat Group is considered to represent a Palaeoproterozoic passive margin sequence (Thrane et al. 2005). There is a current discussion concerning whether there is a regional unconformity between the Qeqertarssuaq and the Nukavsak Formation. The Karrat Group is metamorphosed during the Rinkian-Nagsugtoqidian orogeny (Connelly et al. 2006). The northern part has seen up to granulite facies metamorphism and is therefore not part of the tract. The southern area covered by tract U7 has mainly seen green-schist or lower amphibolite facies metamorphism.

The tectonic setting is similar to the Kiggavik deposit in Canada, and also has younger intrusions which could act as a heat-source. It was given medium rating at the workshop.

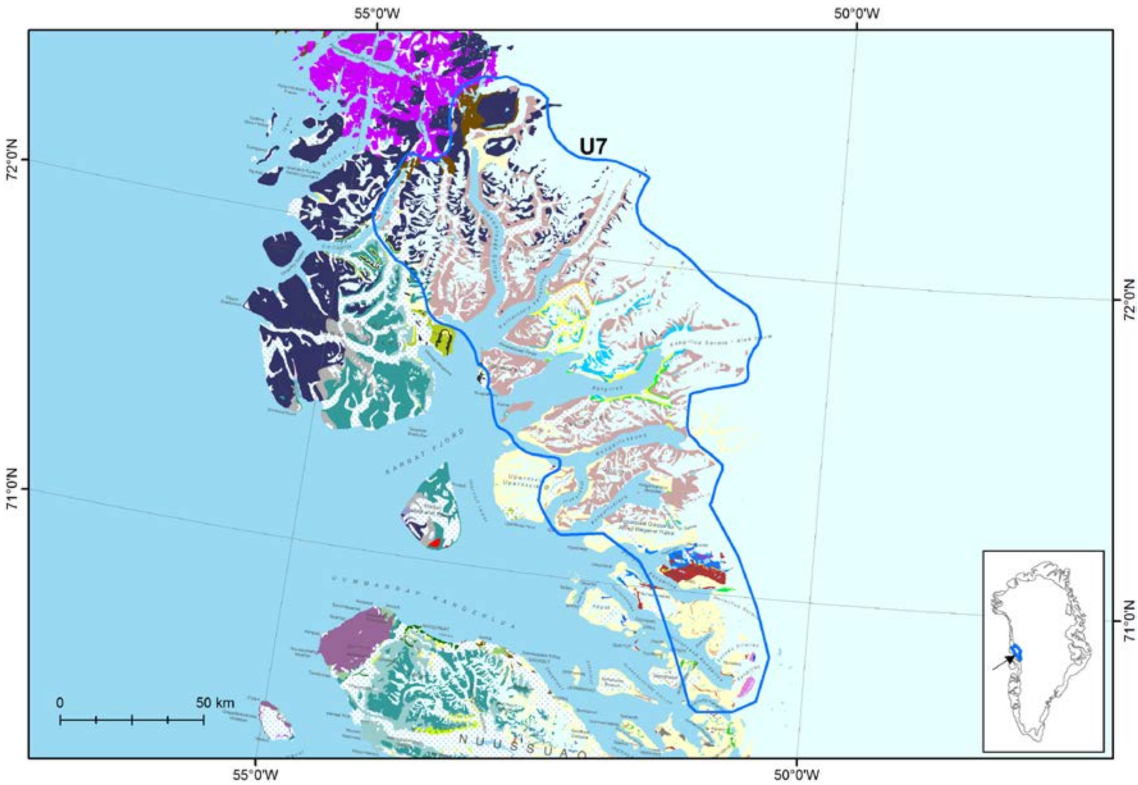

Figure 47. *Tract U7, Karrat Group, West Greenland.*

Table 36. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract U7, Karrat Group.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	0	2	3	4	0.71	1.20	170	0	0.71	5,584	0.00013

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	1	2	3	3
Individual 2	0	1	2	3	4
Individual 3	0	1	3	3	5
Individual 4	0	0	1	2	4
Individual 5	0	1	2	2	4
Individual 6	0	0	2	4	6
Individual 7	0	1	4	6	8
Individual 8	0	0	1	3	5
Individual 9	0	0	1	2	5
Individual 10	0	0	0	0	1
Individual 11	0	1	2	3	4
Individual 12	0	1	2	3	4
Individual 13	0	1	1	2	2
Individual 14	0	0	1	2	4
Individual 15	0	0	1	3	5
Individual 16	0	0	1	2	4
Consensus	**0**	**0**	**2**	**3**	**4**

Tract U8-U10 – Thule Basin

The Thule Supergroup was discussed under tract S7-S12. The Smith Sound Group, Northumberland Formation of the Nares Strait Group and the Wolstenholme Formation of the Baffin Bay Group form the base of the Thule Supergroup. The Mesoproterozoic sediments in the units at the base of the Thule Supergroup contain clay minerals, especially in the Smith Sound Group and the Wolstenholme Formation. The sediments were deposited in an intracratonic fracture basin. The basement on which these sediments were deposited consists of Palaeoproterozoic and Archaean gneisses and high grade metamorphic sediments. Alteration and reduction features have been observed in the basement near the contact with the sediments. The unconformity at the base of the Thule Supergroup, as well as the basement below, represents a favourable structural setting for unconformity-type uranium mineralisation and the potential for undiscovered deposits was ranked as relatively high. However, contrary to the situation in the Eriksfjord Formation, only very uranium values have been recorded in the stream sediments and scintillometer surveys over the Thule Supergroup, and no indications for uranium enrichment in the surrounding basement rocks have been recorded. Nevertheless, the tract was considered to have a good potential for containing undiscovered deposits.

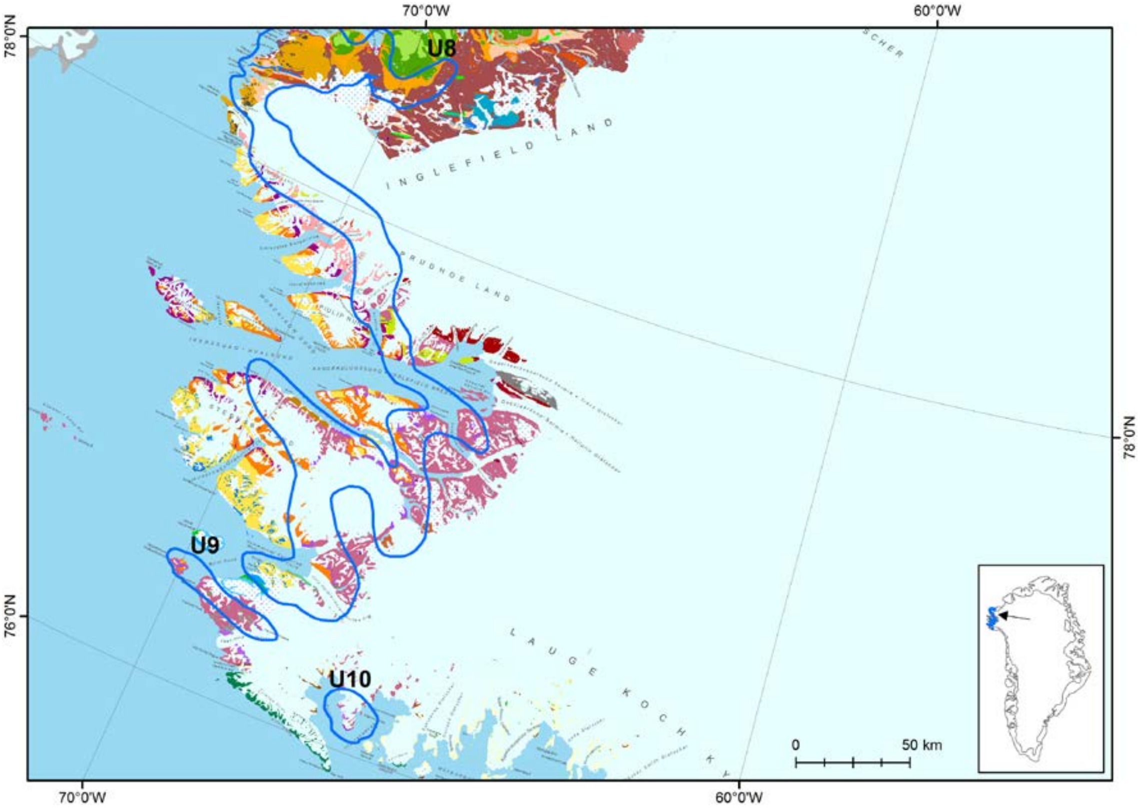

Figure 48. *Tract U8-U10, Thule Basin, North Greenland.*

Figure 49. *Mesoproterozoic gneiss overlain by unmetamorphosed strata of the Thule Basin.*

Table 37. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract U8-10, Thule Basin.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	2	3	5	8	1.94	1.83	94	0	1.94	4,372	0.00044

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	1	2	2
Individual 2	0	0	3	6	10
Individual 3	2	4	4	8	10
Individual 4	1	2	4	6	8
Individual 5	0	1	3	4	6
Individual 6	0	0	2	3	4
Individual 7	0	2	4	10	15
Individual 8	0	1	2	3	5
Individual 9	0	1	2	3	5
Individual 10	0	3	3	4	5
Individual 11	1	5	7	10	15
Individual 12	0	1	2	3	3
Individual 13	0	1	1	2	2
Individual 14	0	2	3	5	10
Individual 15	2	4	8	14	20
Individual 16	0	0	2	5	10
Consensus	**0**	**2**	**3**	**5**	**8**

Tract U11 – Independence Fjord Group

Independence Fjord Group is the oldest sedimentary basin phase in North Greenland. It is a cratonic, middle Proterozoic sequence of mainly alluvial sandstones, at least 2 km thick. It has been recognised over an area of 80 by 300 km and a much larger extension of the basin has been indicated. In the easternmost part, the Independence Fjord Group is deformed and metamorphosed during the Caledonian orogeny, therefore this part is not included in the tract. The base of the group is not exposed but is inferred to lie unconformably upon crystalline basement. The bulk of the group is made up by medium to coarse-grained sandstones. The sandstone beds are separated thin silt-dominated units that is suggested to represent epithermal lakes (Collinson 1980; Sønderholm & Jepsen 1991). The development of extensive lacustrine conditions suggest that sedimentation was controlled by basin-wide changes in subsidence rate (Collinson 1983). Radiometric dating by Larsen and Graff-Petersen (1980) indicated a middle Proterozoic age (about 1380 Ma) for the diagenesis, but more recent SHRIMP U-Pb dates from intercalated volcanics in similar sandstones suggest that they were deposited before 1740 Ma ago (Kalsbeek et al. 1999).
There is no evidence of elevated uranium in this area, however, only very limited work has been done here, and therefore limited information is available. The age of the rocks and the tectonic setting is suitable for an unconformity deposit.

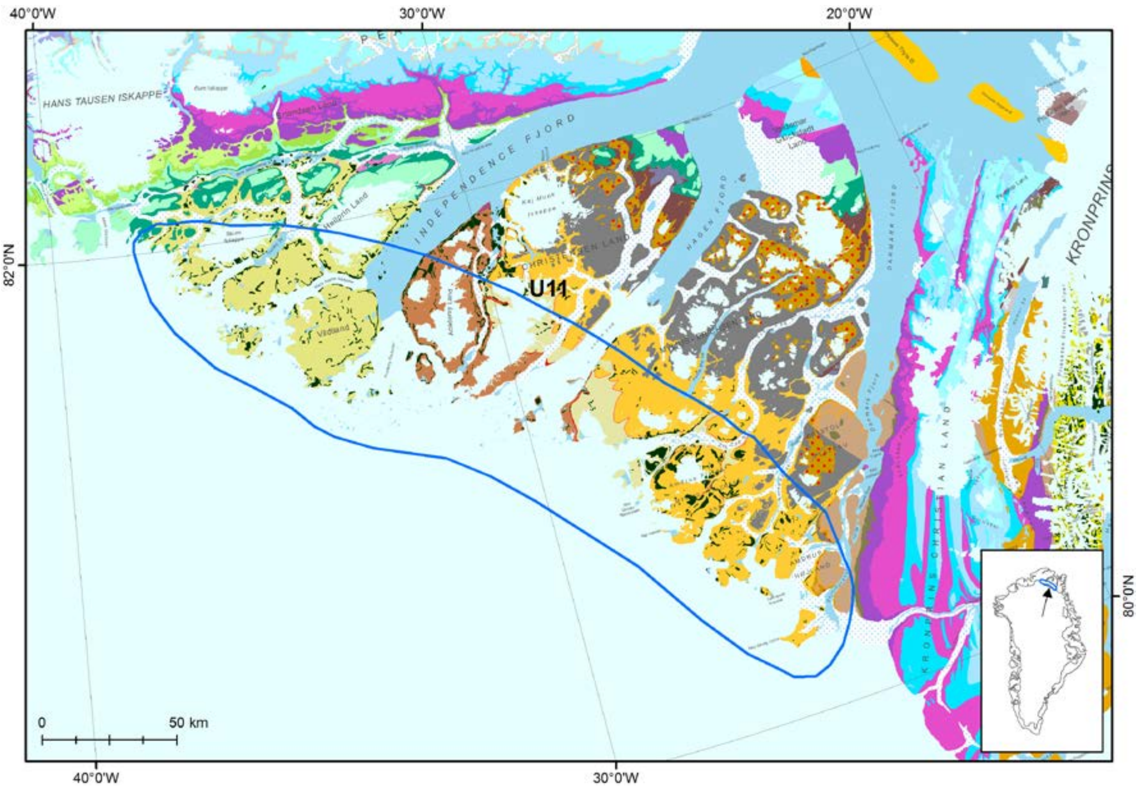

Figure 50. *Tract U11, Independence Fjord, North Greenland.*

Table 38. *Undiscovered deposit estimates, deposit numbers, tract area and deposit density for tract U11, Independence Fjord.*

Consensus undiscovered deposit estimates					Summary statistics					Tract Area (km^2)	Deposit density (N_{total}/km^2)
N90	N50	N10	N05	N01	N_{und}	s	Cv%	N_{known}	N_{total}		
0	1	2	4	6	1.21	1.42	118	0	1.21	7,470	0.00016

Estimator	Estimated number of undiscovered deposits				
	N90	N50	N10	N05	N01
Individual 1	0	0	1	2	3
Individual 2	0	0	3	6	12
Individual 3	0	2	4	4	8
Individual 4	2	3	4	6	8
Individual 5	0	0	2	3	5
Individual 6	0	0	0	1	3
Individual 7	0	0	3	4	5
Individual 8	0	0	2	2	4
Individual 9	0	0	0	1	3
Individual 10	0	0	8	9	10
Individual 11	0	0	2	3	4
Individual 12	1	2	3	3	3
Individual 13	0	1	1	2	2
Individual 14	0	0	1	2	4
Individual 15	0	1	2	4	8
Individual 16	0	0	1	5	10
Consensus	**0**	**1**	**2**	**4**	**6**

Conclusions

Greenland holds one large tonnage/low-grade measured reserve of intrusive type uranium which has been advanced toward production (pending permission), in addition to several identified uranium occurrences. In combination with favorable geology the uranium potential in Greenland is considered relatively high.

In the course of the workshop a total of 35 tracts were assessed for undiscovered uranium deposits, of these three tracts were estimated to have 1-2 undiscovered uranium deposits with 90% confidence. Additional five tracks were estimated to have 1-2 undiscovered uranium deposits at 50% confidence.

Highest ranked tracts for undiscovered ***intrusive-type uranium deposits*** were the Mesoproterozoic Ilímaussaq and Motzfeldt peralkaline igneous intrusions, which already have a JORC compliant reserve and additional indicated and inferred resources, respectively (Tracts I2, I11). In addition, both the Central Domain and the Southern Domain of South Greenland were ranked as having a high potential for containing undiscovered intrusive deposits (I9 and I1).

Presently, no carbonatites are being explored for uranium anywhere in the world. Pyrochlore hosted uranium is in general not interesting to the companies as beneficiation of pyrochlore is very difficult, making the carbonatites less attractive exploration targets. The Sarfartoq intrusion (I5) is rated higher than the other carbonatites, as it has higher U values. This is most likely due to that Sarfartoq is intruding into amphibolite facies basement rocks whereas the remaining carbonatites are intruding into granulite facies rocks and the uranium would have been mobilised during the granulite facies event.

None of the tracts considered as possible hosts for ***sandstone-type deposits*** attained high ranks at the workshop and the potential for such kind of uranium deposits seems very low in Greenland. The areas with the highest potential are found to be the Devonian and Carboniferous sandstone unites in the basins in central East Greenland. The known placer deposit on Milne Land is located in the latter area. The presence of coal and investigations for oil in these areas show that plant debris was deposited in the area where the rocks are permeable, and that reducing conditions prevailed.

The Cretaceous to Paleogene Nuussuaq Group sandstones in central West Greenland as well as the Carboniferous Sortebakker Formation in North Greenland was also ranked as having some potential for undiscovered deposits.

The highest ranked tracts defined for ***unconformity-type deposits*** comprise the two Mesoproterozoic basin formations in Greenland that rest unconformably on Palaeoproterozoic or Archaean basement, namely the Eriksfjord Formation in South Greenland (U1, U2) and the Thule Supergroup (U8-10) in North Greenland. Also the Independence Fjord group (U11) in North Greenland was ranked fairly high.

Some of the most productive uranium deposits worldwide occur in the basement below or at the unconformable base of Mesoproterozoic continental sandstones (Athabasca Basin, Canada). No unconformity related uranium occurrences have been found in Greenland, even though Greenland has large Mesoproterozoic sedimentary deposits lying unconformably on Palaeoproterozoic or Archaean basement. Hence, a potential for unconformity related uranium deposits exists in Greenland.

Existing evidence from aeroradiometric and drainage surveys combined with field investigations etc. points to South Greenland as the most prospective region in Greenland for additional hidden or unrecognised uranium occurrences, especially of the intrusive-type.

Given the very limited uranium exploration carried out in Greenland to date, a greater potential is presumed to exist based on current observations and the knowledge of favourable geological environments.

Table 39. *Summary of assessment results including undiscovered deposit estimates, deposit numbers, tract area and deposit density for tracts. While the assessment process is formalised, the estimated total should be used with caution and should be regarded as an estimate that reflects the present level of knowledge and investigations that have been undertaken in the assessed tracts. New information, new discoveries, new investigations etc. within a tract should thus, whenever possible, be taken into account while evaluating an area, as this could either decrease or increase its estimated potential.*

Tract No.	Tract name	Tract Area (km²)	Consensus bits on undiscovered uranium deposit estimates					Number of un-known deposits	Deposit density
			N90	N50	N10	N05	N01		
Intrusive deposits									
I1	Southern domain, SG	5,401	0	2	3	4	6	1.84	0.000340
I2	Motzfeldt	282	1	2	3	4	5	2.04	0.007227
I3	Tikiusaaq	50	0	0	0	0	2	0.06	0.001200
I4	Qaqarssuk	10	0	0	0	1	3	0.14	0.013500
I5	Sarfartoq	200	0	0	1	2	3	0.41	0.002025
I6	Nuuk region	1,482	0	0	1	3	4	0.48	0.000324
I7	Werner Bj., Kap Simpson & Kap Parry	712	0	0	0	1	2	0.11	0.000147
I8	Kangerdlugssuaq intrusion	182	0	0	0	0	1	0.03	0.000165
I9	Central Domain SVG	8,815	0	2	2	4	5	1.58	0.000179
I10	Central Domain SEG	1,274	0	0	2	3	4	0.71	0.000553
I11	Ilímaussaq	78	2	3	4	5	7	3.00	0.076936
Sandstone deposits									
S1-3	Eriksfjord Basin	167	0	0	0	1	2	0.11	0.000629
S6	Nuussuaq Basin	289	0	0	1	2	4	0.44	0.001505
S7-12	Thule Basin	2,398	0	0	0	1	4	0.17	0.000069
S13-15	Franklinian shelf	2,574	0	0	0	2	3	0.18	0.000070
S16-18	Independence Fjord Group	7,987	0	0	0	0	1	0.03	0.000004
S19	Hagen Group	1,790	0	0	0	1	3	0.14	0.000075
S20	Dunken & Parish Bj. Fm	505	0	0	0	1	1	0.08	0.000149
S21	Ladegårdsåen Fm	131	0	0	0	1	2	0.11	0.000802
S22	Kap Rigsdagen	29	0	0	0	0	1	0.03	0.001034
S23	Kilen	117	0	0	0	1	2	0.11	0.000897
S24	Sortebakker Fm	39	0	0	1	1	2	0.33	0.008462
S32D	Dev. East Greenland Basin	3,225	0	0	2	2	3	0.63	0.000195
S32C	Carb. East Greenland Basin	1,620	0	0	2	3	5	0.74	0.000454
S33	Jameson Land	2,838	0	0	0	1	2	0.11	0.000037
S34	Kangerdlugssuaq Group	486	0	0	0	1	2	0.11	0.000216
S35	Princess Islands	534	0	0	0	1	2	0.11	0.000197
Unconformity related deposits									
U1	Larger Eriksfjord Basin W	7,550	0	1	3	5	7	1.51	0.000200
U2	Central Eriksfjord Basin	1,265	1	3	5	7	10	3.17	0.002508
U3	Eriksfjord Basin E	1,274	0	0	1	2	4	0.44	0.000341
U5	Midternæs	271	0	0	0	1	2	0.11	0.000387
U6	Anap Nuna	106	0	0	0	1	2	0.11	0.000991
U7	Karrat Group	5,584	0	0	2	3	4	0.71	0.000126
U8-U10	Thule Basin	4,372	0	2	3	5	8	1.94	0.000444
U11	Independence Fjord	7,470	0	1	2	4	6	1.21	0.000162

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References

Allaart, J.H. 1973: Julianehåb 60 V.2 Nord. Descriptive Text. Geological Map of Greenland 1:100 000. Geological Survey of Greenland, Copenhagen, 41 pp.

Allaart, J.H. 1983: Geological Map of Greenland 1:100 000. Descriptive Text. Narsarssuaq 61 V.3 Syd. Geological Survey of Greenland, Copenhagen, 20 pp.

Armour-Brown, A. 1986: Geology and evaluation of the uranium mineral occurrence at Igdlorssuit, South Greenland. The South Greenland Exploration Programme 1984 - 1986, Report No. 2. Open File Series Grønlands Geologiske Undersøgelse 2, 60 pp.

Armour-Brown, A. & Wallin, B. 1985: Ketilidian uranium mineral occurrences in South Greenland. Rapp. Grønl. Geol. Unders. 125, 66–74.

Armour-Brown, A., Steenfelt, A. & Kunzendorf, H. 1983a: Uranium districts defined by reconnaissance geochemistry in South Greenland. J. Geochem. Explor. 19, 127–145.

Armour-Brown, A., Tukiainen, T. & Wallin, B. 1982a: The South Greenland uranium exploration programme. Final report, 95 pp. Unpublished report, Grønlands Geologiske Undersøgelse.

Armour-Brown, A., Tukiainen, T. & Wallin, B. 1982b: Pitchblende vein discoveries in the Proterozoic Ketilidian granite of South Greenland. Geol. Rundsch. 71, 73–80.

Armour-Brown, A., Tukiainen, T., Wallin, B., Bradshaw, C. & Emeleus, C.H. 1983b: Uranium exploration in South Greenland. Rapp. Grønl. Geol. Unders. 115, 68–75.

Armour-Brown, A., Tukiainen, T., Nyegaard, P. & Wallin, B. 1984: The South Greenland regional uranium exploration programme. Final Report of Progress 1980–1983. Geological Survey of Greenland, Copenhagen, Denmark (130 pp.).

Berrangé, J.P. 1966: The bedrock geology of Vatnahverfi, Julianehåb district, South Greenland. Rapp. Grønl. Geol. Unders. 3 (48 pp.).

Bondesen, E. 1970: The stratigraphy and deformation of the Precambrian rocks of the Grænseland area, South-West Greenland. Bulletin Grønlands Geologiske Undersøgelse 86, 210 pp. (also Meddelelser om Grønland 185(1)).

Bruneton, P., Cyney, M, Dahlkamp, F. & Zaluski, G. (in press): IAEA geological classification of uranium deposits.

Chadwick, B., Claeys, P. & Simonson, B. 2001: New evidence for a large Palaeoproterzoic impact: spherules in a dolomite layer in the Ketilidian orogen, South Greenland. Journal of the Geological Society (London) 158, 331–340.

Clemmesen, L.B. & Jepsen, H.F. 1992: Lithostratigraphy and geological setting of Upper Proterozoic shoreline-shelf deposits. Hagen Fjord Group, eastern North Greenland. Rapport Grønlands Geologiske Undersøgelse 157, 27pp.

Collinson, J.D. 1980: Stratigraphy of the Independence Fjord Group (Proterozoic) of eastern North Greenland. Rapport Grønlands Geologiske Undersøgelse 99, 7-23.

Collinson, J.D. 1983: Sedimentology of unconformities within a fluvio-lacustrine sequence; Middle Proterozoic of eastern North Greenland. Sedimentary Geology 34, 145-166.

Collinson, J.D., Kalsbeek, F., Jepsen, H.F, Pedersen, S.A.S. & Upton, B.G.J. 2008: Paleoproterozoic and Mesoproterozoic sedimentary and volcanic successions in the northern parts of the East Greenland Caledonian orogen and its foreland. In: Higgins, A.K., Gilotti, J.A. and Smith, M.P. (eds.): The Greenland Caledonides: evolution of the northeast margin of Laurentia. Geological Society of America Memoir 202, 73-89.

Connelly, J.N., Thrane, K., Krawiec, A.W & Garde, A. 2006: Linking the Palaeoproterozoic Nagsugtoqidian and Rinkian orogens through the Disko Bugt region of West Greenland. Journal of the Geological Society, London 163, 319-335.

Dalhoff, F. & Stemmerik, L. 2000: Depositional history of the fluvial Lower Carboniferous Sortebakker Formation, Wandel Sea Basin, eastern North Greenland. In: Stemmerik, L. (ed.): Palynology and deposition in the Wandel Sea Basin, eastern North Greenland. Geology of Greenland Survey Bulletin 187**,** 65–77.

Dalhoff, F., Vigran, J.O. & Stemmerik, L. 2000: Stratigraphy and palynology of the Lower Carboniferous Sortebakker Formation, Wandel Sea Basin, eastern North Greenland. In: Stemmerik, L. (ed.): Palynology and deposition in the Wandel Sea Basin, eastern North Greenland. Geology of Greenland Survey Bulletin 187**,** 51–63.

Dam, G., Pedersen, G.K., Sønderholm, M., Midtgaard, H.H., Larsen, L.M., Nøhr-Hansen, H. & Pedersen, A.K. 2009: Lithostratigraphy of the Cretaceous-Paleocene Nuussuaq Group, Nuussuaq Basin, West Greenland. Geological Survey of Denmark and Greenland Bulletin, 19, 173 pp.

Dawes, P.R. 1997: The Proterozoic Thule Supergroup, Greenland and Canada: history, lithostratigraphy and development. Geology of Greenland Survey Bulletin 174, 150 pp.

Dawes, P.R. 2004: Explanatory notes to the Geological map of Greenland, 1:500 000. Humboldt Gletscher, Sheet 6. Geological Survey of Denmark and Greenland Map Series 1**,** 48 pp.

Dawes, P.R. 2006: Explanatory notes to the Geological map of Greenland, 1:500 000. Thule, Sheet 5. Geological Survey of Denmark and Greenland Map Series 2**,** 97 pp.

Dawes, P.R. & Soper, J. 1973. Pre-Quaternary history of North Greenland. Mem. Ass. Petrol. Geol. 19, 117-134.

Duval, J.S. 2012: Version 3.0 of EMINERS—Economic Mineral Resource Simulator: U.S. Geological Survey Open-File Report 2004–1344.

Escher, A. & Burri, M. 1967: Stratigraphy and structural development of the Precambrian rocks in the area north-east of Disko Bugt, West Greenland. Rapport Grønlands Geologiske Undersøgelse, 13.

Garde, A.A. 1978: The Lower Proterozoic Marmorilik Formation, east of Marmorilik, West Greenland. Meddelelser om Grønland 200, 71 pp.

Garde, A.A., Chadwick, B., Grocott, J., Hamilton, M.A., McCaffrey, K.J.W. & Swager, C.P. 2002: Mid-crustal partitioning and attachment during oblique convergence in an arc system, Palaeoproterozoic Ketilidian orogen, southern Greenland. Journal of Geological Society of London 159, 247–261.

Garde, A.A., Chadwick, B., McCaffrey, K., & Curtis, M. 1998: Reassessment of the north-western border zone of the Palaeoproterozoic Ketilidian orogeny, South Greenland. Geology of Greenland Survey Bulletin 180, 111–118.

Garde, A.A., Hamilton, M.A., Chadwick, B., Grocott, J. & McCaffrey, K.J.W. 2002: The Ketilidian orogeny of South Greenland: geochronology, tectonics, magmatism, and forearc accretion during Palaeoproterozoic oblique convergence. Canadian Journal of Earth Sciences 39, 765-793.

Garde, A.A. & Steenfelt, A. 1999: Precambrian geology of Nuussuaq and the area north-east of Disko Bugt. In: Kalsbeek, F. (ed.) Precambrian Geology of the Disko Bugt Region, West Greenland. Geology of Greenland Survey Bulletin, 181, 6–40.

Gotheborg, J. & Pedersen, J.L. 1975: Exploration of the Qaqarssuk carbonatite complex 1975, part II. Kryolitselskabet Øresund A/S, unpublished company report.

Håkansson, E. 1979: Carboniferous to Tertiary development of the Wandel Sea Basin, Eastern North Greenland. Rapport Grønlands Geologiske Undersøgelse 88, 73-83.

Håkansson, E., Birkelund, T., Heinberg, C., Hjort, C., Mølgaard, P. & Pedersen, S.A.S. 1993: The Kilen Expedition 1985. Bulletin Geological Society of Denmark 40, 9-32.

Håkansson, E. Heinberg, C. & Stemmerik, L. 1991: Mesozoic and Cenozoic history of the Wandel Sea Basin area, North Greenland. In: Peel, J.S. and Sønderholm, M. (eds): Sedimentary basins of North Greenland. Bulletin Grønlands Geologiske Undersøgelse 160, 153-164.

Harpøth, O., Pedersen, J.L., Schønwandt, H.K. & Thomassen, B. 1986: The mineral occurrences of central East Greenland. Meddelelser om Grønland, Geoscience 17, 139 pp.

Henderson, G. & Pulvertaft, T.C.R. 1987: Geological map of Greenland 1:100000. Descriptive text. Mârmorilik 71 V.2 Syd, Nugatsiaq 71 V.2 Nord, Pangnertoq 72 V.2 Syd. Lithostratigraphy and structure of a Lower Proterozoic dome and nappe complex, 72. Copenhagen: Grønlands Geologiske Undersøgelse.

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

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

Higgins, A.K., Ineson, J.R., Peel, J.S., Surlyk, F. & Sønderholm, M. 1991: Lower Palaeozoic Franklinian Basin of North Greenland. In: Peel, J.S. & Sønderholm, M. (eds): Sedimentary basins of North Greenland. Bulletin Grønlands Geologiske Undersøgelse 160, 71-139.

Higgins, A.K. & Soper, N.J. 1999: The Precambrian supracrustal rocks of Nunataq, north-east Disko Bugt, West Greenland. In: Kalsbeek, F. (ed.) Precambrian Geology of the Disko Bugt Region, West Greenland. Geology of Greenland Survey Bulletin, 181, 79–86.

Hollis, J.A., Schmid, S., Stendal, H., van Gool, J.A.M. & Weng, W.L. 2006: Supracrustal belts in Godthåbsjord region, southern West Greenland. Danmarks og Grønlands Geologiske Undersøgelse Rapport 2006/7, 171 pp.

Hovikoski, J., Pedersen, G.K., Alsen, P., Lauridsen, B.W, Svennevig, K., Nøhr-Hansen, H.,Sheldon, E., Dybkjær, K., Bojesen-Koefod, J., Piasecki, S., Bjerager, M. & Ineson, J. (2018): The Jurassic–Cretaceous lithostratigraphy of Kilen, Kronprins Christian Land, eastern North Greenland. Bulletin of the Geological Society of Denmark 66, 61-122.

Kalsbeek, F., Larsen, L.M. & Bondam, J. 1990: Geological Map of Greenland, 1:500 000, Sydgrønland, Sheet 1. Descriptive Text. Geological Survey of Greenland, Copenhagen (36 pp).

Kalsbeek, F., Nutman, A.P., Escher, J.C., Friderichsen, J.D, Hull, J.M., Jones, K.A. & Pedersen, S.A.S. 1999: Geochronology of granitic and supracrustal rocks from the northern part of the East Greenland Caledonides: ion microprobe U-Pb zircons ages. Geology of Greenland Survey Bulletin 184, 31-48.

Kalsbeek, F. & Taylor, P.N. 1985: Isotopic and chemical variation in granites across a Proterozoic continental margin – the Ketilidian mobile belt of South Greenland. Earth and Planetary Science Letters 73, 65-80.

Kalvig, P. 1983: Preliminary Mining Assessment of the Uranium Resource at Kvanefjeld. 109 pp. Risø National Laboratory.

Keulen, N., Thrane, K, Stensgaard B.M. & Kalvig, P. 2014: An evaluation of the potential for uranium deposits in Greenland. MIMA report, 2014/1

Knudsen, C. 1991: Petrology, geochemistry and economic geology of the Qaqarssuk carbonatite complex, southern West Greenland. Monograph Series on Mineral Deposits 29, 1-110.

Larsen, L.M., Rex, D.C. & Secher, K. 1983: The age of carbonatites, kimberlites and lamprophyres from southern West Greenland: recurrent alkaline magmatism during 2500 million years. Lithos 16, 215-221.

Larsen, O. & Graff-Petersen, P. 1980: Sr-isotopic studies and mineral composition of the Hagen Bræ Member in the Proterozoic clastic sediments at Hagen Bræ Member in the Proterozoic clastic sediments at Hagen Bræ, eastern North Greenland. Rapport Grønlands Geologiske Undersøgelse 99, 111-118.

Larsen, M. Hamberg, L., Olaussen, S., Preuss, T. & Stemmerik, L. 1999: Sandstone wedges of the Cretaceous-Lowe Tertiary Kangerlussuaq Basin, East Greenland – outcrop analogues to the offshore North Atlantic. Petroleum Geology Conference series.5; 337-348.

Larsen, P.-H., Olsen, H., Clack & J.A. 2008: The Devonian basin in East Greenland-Review of basin evolution and vertebrate assemblages. In: Higgins, A.K., Gilotti, J.A., and Smith, M.P., eds., The Greenland Caledonides: Evolution of the Northeast Margin of Laurentia: Geological Society of America Memoir 202, 273-292.

Lorenzen, J. 1881: Undersøgelse af mineralierne I Sodalith-Syeniten fra Julianebaabs district. Meddelselser om Grønland 2, 43-80.

Lyck, J.M. & Stemmerik, L. 2000: Palynology and deposition history of the Paleocene? Thyra Ø Formation, Wandel Sea Basin, eastern Norh Greenland. In: Stemmerik, L. (eds): Palynology and deposition in the Wandel Sea Basin, eastern North Greenland. Geology of Greenland Survey Bulletin 187, 21-49.

Nielsen, B.L. 1980: The uranium potential of Greenland – a geological analysis of favourability. IAEA-SM-239/4, 18pp.

Nielsen, B.L. & Løvborg, L. 1976: Radiometric survey between Scoresby Sund and Hold with Hope, central East Greenland. Rapport Grønlands Geologiske Undersøgelse 76, 44 pp.

Nielsen, T.F.D. 1987: Tertiary alkaline magmatism in East Greenland: a review. In. Fitton, J.G. & Upton, B.G.J. (eds.): Alkaline Igneous Rocks. Geological Society Special Publication 30, 489-515.

Nielsen, B.L. & Steenfelt, A. 1977: Distribution of radioactive elements and the recognition of uranium mineralizations in East Greenland. In: Recognition and evaluation of uraniferous areas. International Atomic Energy Agency, Vienna (IAEA-TC-25/3), 87-105.

Nyegaard, P. 1985: Uranium exploration in the Qagssiarssuk area, South Greenland. Rapp. Grønlands Geol. Undersøgelse 125, 74–78.

Nyegaard, P. & Armour-Brown, A. 1986: Uranium occurrences in the Granite zone. Structural setting – genesis – exploration methods. The South Greenland Exploration programme 1984–1986. Report No. 1. Open File Series Grønlands Geologiske Undersøgelse 86/1 (138 pp.).

Nyegaard, P., Armour-Brown, A. & Steenfelt, A. 1986: Vein-type uranium mineral occurrences in South Greenland. In: Fuchs, H.D. (Ed.), Vein Type Uranium Deposits. International Atomic Energy Agency, Vienna, pp. 43–55.

OECD/NEA-IAEA, Uranium 2014: Resources, production and demand (the Red Book). A Joint Report by the OECD Nuclear Energy Agency and the International Atomic Energy Agency. OECD Paris (2014).

OECD/NEA-IAEA, Uranium 2016: Resources, production and demand (the Red Book). A Joint Report by the OECD Nuclear Energy Agency and the International Atomic Energy Agency. OECD Paris (2016).

OECD/NEA-IAEA, Uranium: Resources, production and demand (the Red Book), in press.

Olsen, H. & Larsen, P.-H. 1993: Lithostratigraphy of the continental Devonian sediments in North-East Greenland. Grønlands Geologiske Undersøgelse 165, 108.

Pankhurst, R.J., Beckinsale, R.D. & Brooks, C.K. 1976: Strontium and oxygen isotope evidence relating to the petrogenesis of the Kangerdlugssuaq Alkaline Intrusion, East Greenland. Contribution to Mineralogy and Petrology 54, 17-42.

Schjøth, F., Garde, A.A., Jørgensen, M.S., Lind, M., Moberg, E., Nielsen, T.D.F., Rasmussen, T.M., Secher, K., Steenfelt, A., Stendal, H., Thorning, L. & Tukiainen, T. 2000: Mineral resource potential of South Greenland: the CD-ROM. Danmarks og Grønlands Geologiske Undersøgelse Rapport 2000/57 (36 pp., 1 CD-ROM).

Secher, K. 1976: Airborne radiometric survey between 66° and 69°N, southern and central West Greenland. Grønlands Geologiske Undersøgelse rapport 80, 65-67.

Secher, K. 1980: Distribution of radioactive mineralisation in central West Greenland. Rapport Grønlands Geologiske Undersøgelse 100, 61–65.

Secher, K. 1986: Exploration of the Sarfartoq carbonatite complex, southern West Greenland. In: Kalsbeek, F. & Watt, W.s. (eds): Developments in Greenland geology. Rapport Grønlands Geologiske Undersøgelse 128, 89-101.

Secher, K. & Larsen, L.: 1980: Geology and mineralogy of the Sarfartoq carbonatite complex, southern West Greenland. Lithos 13, 199-212.

Secher, K. Heaman, L.M., Nielsen, T.F.D., Jensen, S.M., Schjøth, F. & Creaser, R.A. 2009: Timing of kimberlite, carbonatite, and ultramafic lamprophyre emplacement in the alkaline province located 64-67N in southern West Greenland. Lithos 122, 400-406.

Soper, N.J., Higgins, A.C., Downie, C., Matthews, D.W. & Brown, P.E. 1976: Late Cretaceousearly Tertiary stratigraphy of the Kangerdlugssuaq area, east Greenland, and the age of opening of the north-east Atlantic. Journal of the Geological Society 132, 85-102.

Steenfelt, A. 2001: Geochemical atlas of Greenland — West and South Greenland. Danmarks og Grønlands Geologiske Undersøgelse Rapport 2001/46, 39 pp.

Steenfelt, A. 2014: Uranium data for Greenland registered by GEUS: data acquisition, coverage and special uranium variation. Danmarks og Grønlands Geologiske Undersøgelse rapport 2014/28, 48 pp.

Steenfelt, A., Hollis, J.A. & Secher, K. 2006: The Tikiusaaq carbonatite: a new Mesozoic intrusive complex in southern West Greenland. Geological Survey of Denmark and Greenland Bulletin 10, 41–44.

Steenfelt, A., Kolb, J. & Thrane, K. 2016: Metallogeny of South Greenland: a review of geological evolution, mineral occurrences and geochemical exploration data. Ore Geology Reviews 77, 194-245.

Steenfelt, A., Nielsen, B.L. & Secher, K. 1977: Uranium geology and prospecting in Greenland. In: Jones, M.J. (ed): Geology mining and extractive processing of uranium, 8 pp. London: Institution of Mining and Metallurgy.

Steenfelt, A., Secher, K. & Garde, A.A. 2007: An overview of pegmatite occurrences in Greenland and their economic potential. Danmarks og Grønlands Geologiske Undersøgelse rapport 2007/2.

Stemmerik, L. & Håkansson, E. 1989: Stratigraphy and depositional history of the Upper Palaeozoic and Triassic sediments in the Wandel Sea Basin, central and eastern North Greenland. Rapport Grønlands Geologiske Undersøgelse 143, 21-45.

Stemmerik, L., Larsen, B.D. & Dalhoff, F. 2000: Tectono-stratigraphic history of northern Amdrup Land, eastern North Greenland: implications for the northernmost East Greenland shelf. In: Stemmerik, L. (eds): Palynology and deposition in the Wandel Sea Basin, eastern North Greenland. Geology of Greenland Survey Bulletin 187, 7-19.

Stemmerik, L., Vigran, J.O. & Piasecki, S. 1991: Dating of late Palaeozoic rifting events in the North Atlantic: new biostratigraphic data from the uppermost Devonian and Carboniferous of East Greenland. Geology 19, 218-221.

Surlyk, F. 1990: Timing, style and sedimentary evolution of Late Palaeozoic – Mesozoic extensional basins of East Greenland. In: Hardman, R.F.P and Brooks, J. (eds): Tectonic events responsible for Britian’s oil and gas reserves. Geological Society Special Publication (London) 55, 107-125.

Surlyk, F. Hurst, J.M., Piasecki, S., Rolle, F., Scholle, P.A., Stemmerik, L. & Thomsen, E. 1986: The Permian of the western margin of the Greenland Sea – a future exploration target. In: Halbouty, M.T. (eds): Future petroleum provinces of the world. American Association of Petroleum Geologists Memoir 40, 629-659.

Sønderholm, M., Frederiksen, K.S., Smith, M.P. & Tirsgaard, H. 2008: Neoproterozoic sedimentary basins with glacigenic deposits of the East Greenland Caledonides. In: Higgins, A.K., Gilotti, J.A. & Smith, M.P (eds): The Greenland Caledonides: evolution of the northeast margin of Laurentia. Geological Society of America Memoir 202, 99-136.

Sønderholm, M. & Jepsen, H.F. 1991: Proterozoic basins of North Greenland. In Peel, J.S. and Sønderholm, M. (eds.): Sedimentary basins of North Greenland. Bulletin Grønlands Geologiske Undersøgelse 160, 49-69.

Sørensen 2001: The Ilimaussaq alkaline complex, South Greenland: status of mineralogical research with new results. Edited by Sørensen H. Geology of Greenland Survey Bulletin 190, 167 pp.

Thomassen, B. 1988: The Motzfeldt 87 Project. Final report. Grønlands Geologiske Undersøgelse. Openfile series No. 88/1, 81 pp.

Thomassen, B. & Nilsson, 1982: Prospecting for Cu-Pb-Zn-Au-Ag in the Clavering Ø, Giesecke Bjerge and Canning Land areas. Nordisk Mineselskab A/S, 1/81, 59 pp.

Tirsgaard, H. & Øxnevad, I.E.I. 1998: Preservation of pre-vegetational mixed fluvio–aeolian deposits in a humid climatic setting: an example from the Middle Proterozoic Eriksfjord Formation, Southwest Greenland. Sedimentary Geology 120**,** 295-317.

Thrane, K., Baker, J., Connelly, J. & Nutman, A. 2005: Age, petrogenesis and metamorphism of the syn-collisional Prøven Igneous Complex, West Greenland. Contrib Mineral Petrol. 149, 541-555.

Tukiainen, T. 1986: Pyrochlore in the Motzfeldt Centre of the Igaliko nepheline syenite complex, South Greenland. Final report. Grønlands Geologiske Undersøgelse, 98 pp.

Tukiainen, T., Bradshaw, C. & Emeleus, C.H. 1984: Geological and radiometric mapping of The Motzfeldt Centre of the Igaliko Complex, South Greenland. Rapp. Grønl. Geol. Unders. 120, 78–83.

Ussing, N.V. 1912: Geology of the country around Julianehaab, Greenland. Meddelelser om Grønland 38, 1–376.

Vestergaard C. & Thomasen G. 2015: Governing uranium in the Danish Realm. DIIS report 2015:17.

Appendix A: Bibliography

Sandstone hosted:

Kyser, K. Cuney & Michel, 2008: Sandstone-hosted uranium deposits. Chapter 9 in Short course co-sponsored by the SGA and MAC, Québec City, May 2008, p. 221-240.

IAEA-TECDOC-328, 1985: Geological environments of sandstone-type uranium deposits. Report of the working group on uranium geology organised by the International atomic energy agency and lead by Warren Finch. IAEA, Vienna, 1985.

Unconformity hosted:

Alexandre, P., Kyser, K., Thomas, D., Polito, P. & Marlat, J. 2007: Geochronology of unconformity-related uranium deposits in the Athabasca Basin, Canada and their integration in the evolution of the basin. Mineral Deposita (doi:10.1007/s00126-007-0153-3).

Jefferson, C.W., Thomas, D.J., Gandhi, S.S., Ramaekers, P., Delaney, G., Brisbin, D., Cutts, C., Portella, P. & Olson, R.A. 2007a: Unconformity-associated uranium deposits of the Athabasca Basin, Saskatchewan and Alberta. In EXTECH IV: Geology and uranium Exploration TECHnology of the Proterozoic Athabasca Basin, Saskatchewan and Alberta (ed.) C.W. Jefferson and G. Delaney; Geological Survey of Canada, Bulletin 588, p.23-67.

Jefferson, C.W., Thomas, D.J., Quirt, D., Mwenifumbo, C.J. & Brisbin, D. 2007b: Empirical models for Canadian unconformity-associated uranium deposits. In "Proceedings of Exploration 07: Fifth Decennial International Conference on Mineral Exploration" edited by B. Milkereit, 2007, p. 741-769.

Kotzer, T.G & Kyser, T.K. 1995: Petrogenesis of the Proterozoic Athabasca Basin, northern Saskatchewan, Canada, and its relation to diagenesis, hydrothermal uranium mineralization and paleohydrogeology. Chemical Geology 120, 45-89.

Mercadier, J., Richard, A. & Cathelineau M. 2012: Boron- and magnesium-rich marine brines at the origin of giant unconformity-related uranium deposits: δ11B evidence from Mg-tourmalines. Geology 40, 231-234.

Polito, P.A., Kyser, T.K. & Stanley, C. 2009: The Proterozoic, albitite-hosted, Valhalla uranium deposit, Queensland, Australia: a description of the alteration assemblage associated with uranium mineralisation in diamond drill hole V39. Mineral Deposita 44, 11-40.

Richard, A., Rozsypal, C., Mercadier, J., Banks D.A., Cuney M., Boiron M. & Cathelineau M. 2011: Giant uranium deposits formed from exceptionally uranium-rich acidic brines. Nature geoscience 5, 142-146.

Appendix B: CD-ROM - Presentations from the workshop

Presenter	Title	Presentation number (on CD)
Kristine Thrane (GEUS)	Background, objective and procedure	1
Bo M. Stensgaard (EIT)	Objectives of the workshop and procedure for the assessment	2
Mark Mihalasky (USGS)	Outline of the USGS 3-part form of quantitative mineral resource assessment	3
Mark Mihalasky (USGS)	An Assessment of Undiscovered uranium resources in the Texas Gulf coast	4
Martin Fairclough (IAEA)	The IAEA UDEPO database Classification	5
Julien Mercadier	Unconformity-related U deposits	6
John Robbins (AREVA)	You have uranium… Welcome to the Game!	7
Remy Chemillac (AREVA)	Sandstone hosted uranium deposits, feedback from AREVA experience	8
Agnete Steenfelt (GEUS)	Overview of geochemical and radiometric data indicative of uranium enrichment in Greenland	9
Thomas Kokfelt (GEUS)	Geology of South-West Greenland	10
Nynke Keulen, (GEUS)	Sarfartoq	11
Joshua Hughes (Nanoq Resources)	The Jurassic Qeqertaasaq (“Qaqarssuk”) Carbonatite Complex, West Greenland and The Jurrassic Tikiusaaq Carbonatite Complex, South West Greenland	12
Sam Weatherley (GEUS)	Geology of South Greenland	13
Sam Weatherley (GEUS)	Ilímaussaq Complex	14
Ashlyn Armour-Brown (Consultant)	U-mineral showing in South Greenland	15
Bjørn Thomassen (GEUS)	Proterozoic basins of North Greenland	16
Kristian Svennevig (GEUS)	Wandel Sea Basin	17

Pierpaolo Guarnieri (GEUS)	Geology of East Greenland: an introduction	18
Kristine Thrane (GEUS)	Geology of the central West Greenland	19