DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 2015/84

Field report for the 2014 field season, south East Greenland - intrusions in the larger Tasiilaq region

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GEUS

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Introduction

During GEUS's 2014 SEGMENT field campaign to South East Greenland we investigated a suite of igneous (predominate intrusive) rocks and here we report on the main field observations. The objective of the fieldwork was to study and sample a number of intrusions between Tasiilaq and Kialineq area (Figure 1). The work was focused in two different geological associations, partly Palaeoproterozoic rocks of The Nagssugtoqidian Orogen in the Tasiilaq area including the post-orogenic intrusions, and partly the Paleogene intrusions in the southern part of the North Atlantic Igneous Province. Further details on some of the major research questions that we plan to address are given in an accompanying paper (Kokfelt et al., 2015).

Figure 1. *Geological map of the Tasiilaq area investigated in 2014. The four main study areas are: (1) the Tasiilaq centre of the Ammassalik Intrusive Complex, (2) the Ammassalik batholit, (3) the granite north of Johan Petersen Fjord (Qeertartivatsaap Kangertiva), and (4) the East Sermilik Diorite, or Imersivaq intrusion (see below). Red circles and labels show camp positions and black stars indicate helicopter reco stops.*

The fieldwork was carried out in July and August 2014 from fourteen camps, operating by foot and/or by dinghy, as well as a total of five days of helicopter reconnaissance work. The members of the team were Thomas Kokfelt and Jakob Kløve Keiding both senior researchers at GEUS, Sam Weatherly post doc at GEUS and Trygvi Árting, master student at University of Copenhagen (scheduled to hand in his MSc. thesis in January 2016).

The four main intrusive centres covered in the Tasiilaq area include (Figure 1): (1) The *c.* 1.89 Ga Tasiilaq Centre of the Ammassalik Intrusive Complex (AIC), (2) the *c.* 1.68 Ga Ammassalik batholith, situated to the north of the AIC and dissected by the NW-SE trending Ikaasartivaq fjord, (3) the granite intrusion north of Johan Petersen Fjord (Greenlandic: Qeertartivatsaap Kangertiva) west of Sermilik fjord, and (4) the 'Sermilik East Diorite' situated north of Ammassalik island; the latter two, presumably of similar age as the Ammassalik batholith. The 'Sermilik East Diorite' will here be referred to as the 'Imersivaq intrusion' (named so after the lake in the centre of the intrusion), although this proposed new name will have to await a future journal publication to become official. In general the names used in this report apply to those given in the Greenland Mineral Occurrence Map (GMOM) database.

In addition three Paleogene intrusive complexes were visited in the coastal area some 100 - 150 km north of Tasiilaq, including from south to north: (1) The Sulugssut Intrusive Complex, (2) the Kap Gustav Holm Centre, and (3) the Kialineq Plutonic Centre. Within the Kialineq area brief reco stops were made at the Laube Gletscher Syenite and at a downfaulted sequence of felsic volcanogenic rocks south of Kap Warming (Figure 2).

The work was conducted in close collaboration with Team 7 (referred to as 'T7' in the following), constituting professor Dr. Christian Tegner, professor Dr. Charles ('Chip') Lesher and senior lecturer Dr. Thomas Ulrich, all from Aarhus University. The main focus for the Aarhus group aimed at (1) the Paleogene dykes in the Tasiilaq region, (2) Kap Gustav Holm plutonic centre, and (3) the mingling complexes within the Kialineq area. In addition T7 also made reconnaissance work within the Imersivaq intrusion (Sermilik East Diorite). An unpublished field report by T7 has been finalized.

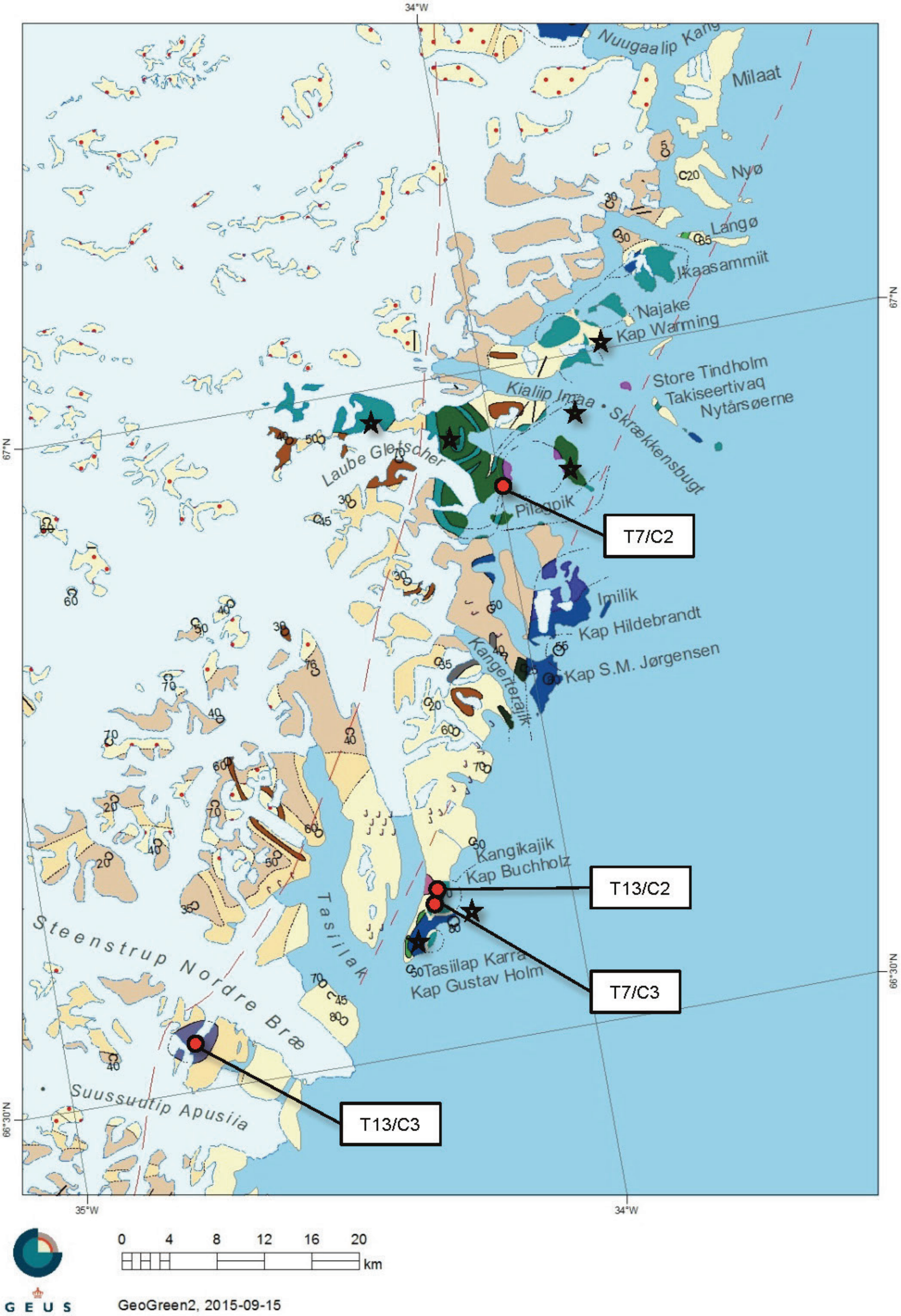


Figure 2. *Map of the northern study area including the three intrusive centres at Sulugssut, Kap Gustav Holm and Kialineq. Red circles and labels show camp positions, black stars indicate helicopter reconnaissance stops. The work in Kialineq area and on Kap Gustav Holm was carried out in collaboration with T7.*

The Tasiilaq Centre of the Ammassalik Intrusive Complex

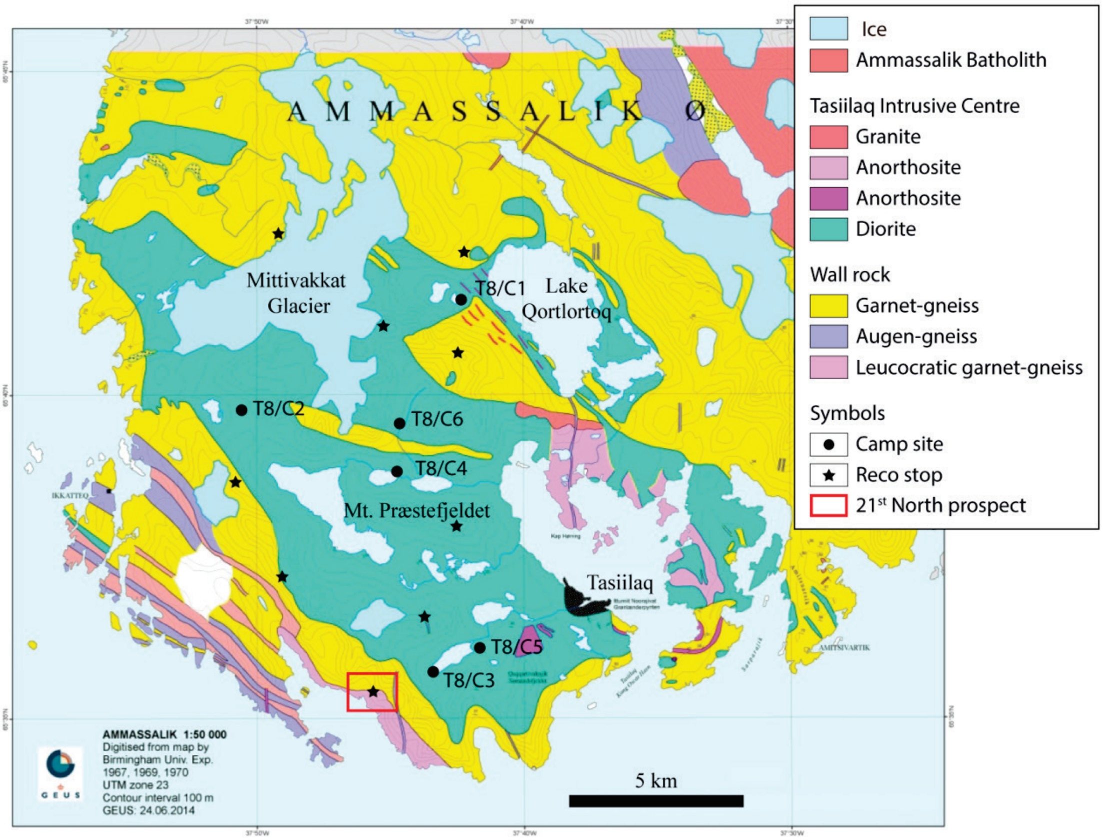


Figure 3. *Detailed map of the Tasiilaq Centre by Wright et al. (1973) that was used as map basis during the fieldwork. Shown are the six field camps, T8/1-T8/6 (black circles) and helicopter reco stops (black stars). Generally the original map of was found to be of good quality, although some minor discrepancies were found. A new updated version of the map of the Tasiilaq Centre will be produced as part of T.B. Árting M.Sc. thesis work (finalised in spring 2016).*

Geological background

The Tasiilaq Centre (TC) belonging to the Ammassalik Intrusive Complex (AIC) was dated to 1886 +/- 2 Ma by zircon U/Pb TIMS dating (Hansen and Kalsbeek, 1986), an age interpreted to represent the intrusion age of the complex. The intrusion was mapped during the expeditions led by the Birmingham University between 1967 and 1970 resulting in the field map shown in Figure 3. The basic geology of the intrusive complex was first described by Wright et al. (1973). Later Andersen et al. (1989) described the TC as comprising mainly leuconorite, that cross-cuts melagabbro, and late anorthosite and hypersthene veins that cross-cut the leuconorite and melagabbro. The wall rock is quartzofeldspathic garnet gneiss, which has granulite facies assemblages close to the contact, and has been mobilized and mixed with the intrusive rock. Based on Cpx-Cpx, Grt-Opx and Grt-Bt thermobarymetry and fluid inclusion data, Andersen et al. (1989) conclude that the intrusion crystallized in the middle to lower crust at a 6-8 Kbar and 1000-1100°C.

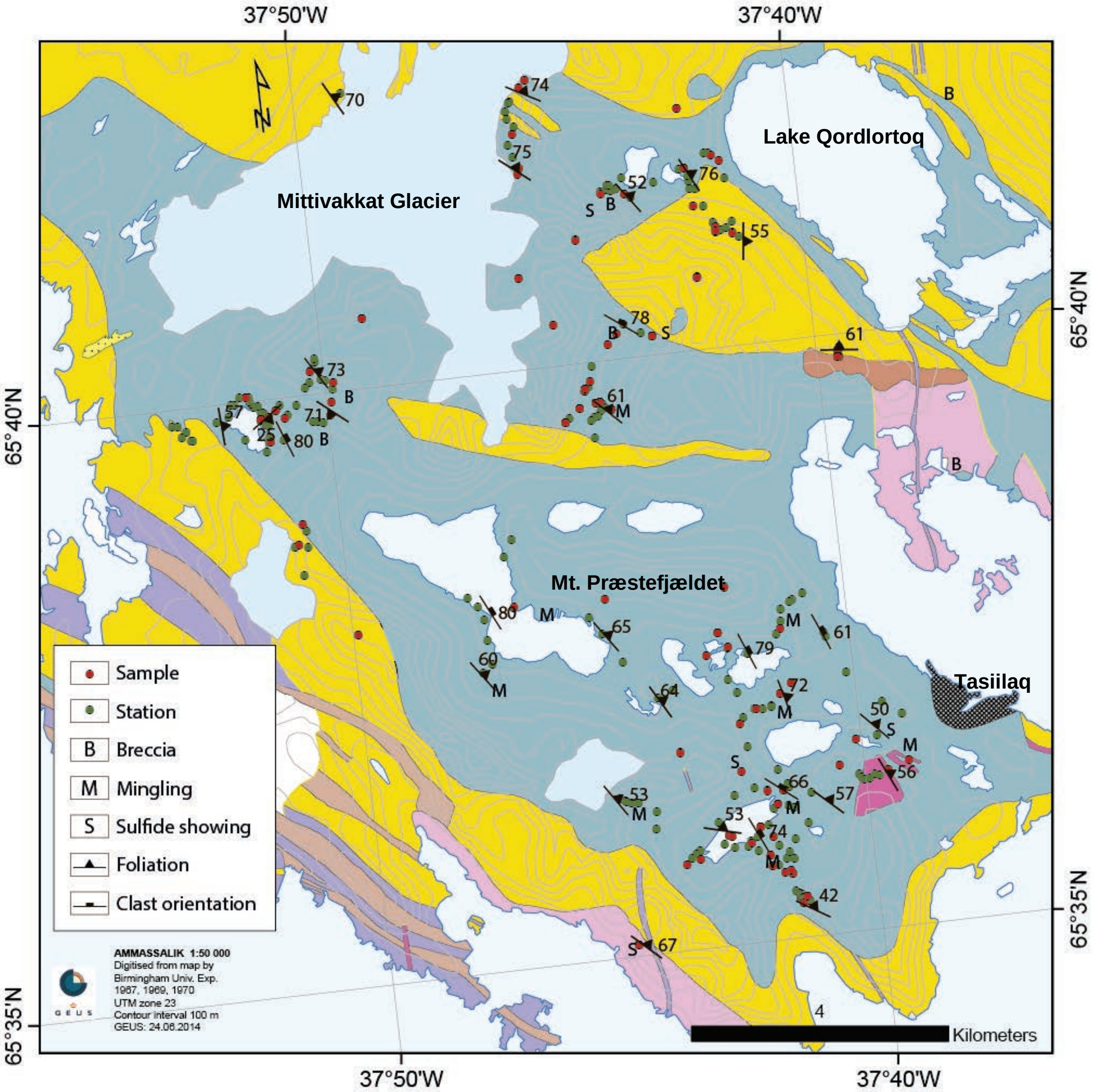


Figure 4. *A cropped version of the geological map (Wright et al., 1973) zooming in on the investigated part of the Tasiilaq Centre. Shown are the field stations (green circles), the sampling sites (added red dots), and the structural measurements with dip/plunge shown as numbers.*

Strategy and coverage

The coverage of the TC was made from 6 camp sites, four within walking distance of the intrusion boundary and two in the central part of the intrusion (Figure 4): T1/C1 (T8C1) in the hanging valley west of Qordlortoq lake close to the northern margin; T8/C2 by a small lake in the central western part of the intrusion; T8/C3 at the southern end of a small lake south of Tasiilaq town; T8/C4 by the western lake north of Præstefjeldet, a polar bear in the vicinity cut the stay at this camp on the first work-day; T8/C5 at the northern end of the lake by T8/C3; T8/C6 in the south facing hanging valley north of Præstefjeldet; and T8/C7, which was at the southern margin of the Ammassalik batholith, where the gneiss was reached. One full day helicopter reconnaissance flight was done in the area to sample the otherwise inaccessible ridges close to the intrusion boundary.

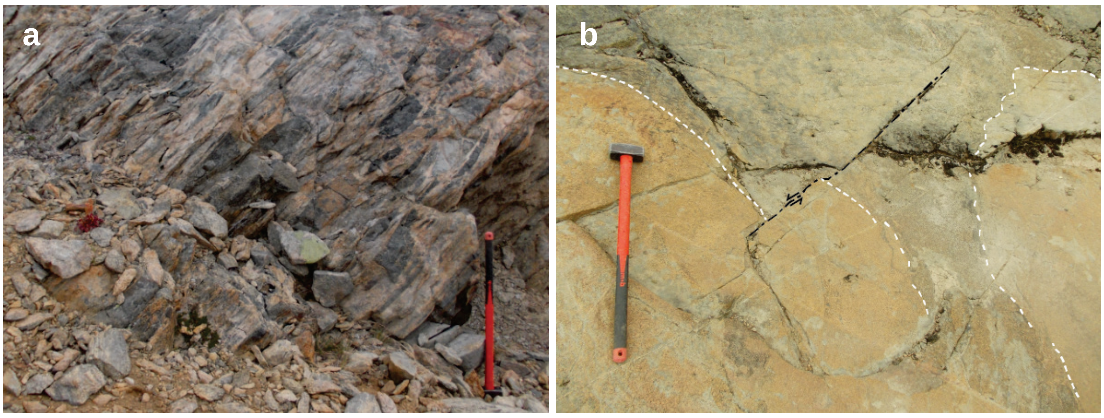


Figure 5. *(a) Melanocratic gabbronorite net-veined by mesocratic gabbronorite in the eastern part of the intrusion by T8/C5 (14TBA135). (b) Contact between the lighter gabbro and slightly darker gabbronorite in the western part of the intrusion, southeast of T8/C2 (14TBA071).*

Gabbroic rocks

Mesocratic gabbronorites comprise the most common rock in the central and eastern part of TC around camps T8/C3, 4, 5, and 6. Around T8/C2 the most common rock is a mesocratic gabbro. However, no mapable boundary between the mesocratic gabbronorite and the gabbros was identified. The gabbroic rocks are generally overprinted by an east-west striking foliation similar to the regional trend. The melanocratic variety of the gabbronorite appears in narrow bands, which are interpreted as being mingling zones within the mesocratic gabbronorite in the eastern part of TC. The melanocratic gabbronorite is typically accompanied by rounded fragments of pyroxenite and microgabbro (Figure 5a). Gabbro was found in contact with melanocratic gabbronorite by the lake west of T8/C2. Here the contact was sharp and cuspate (Figure 5b). Further away from the contact the gabbronorite becomes gradually more leucocratic.

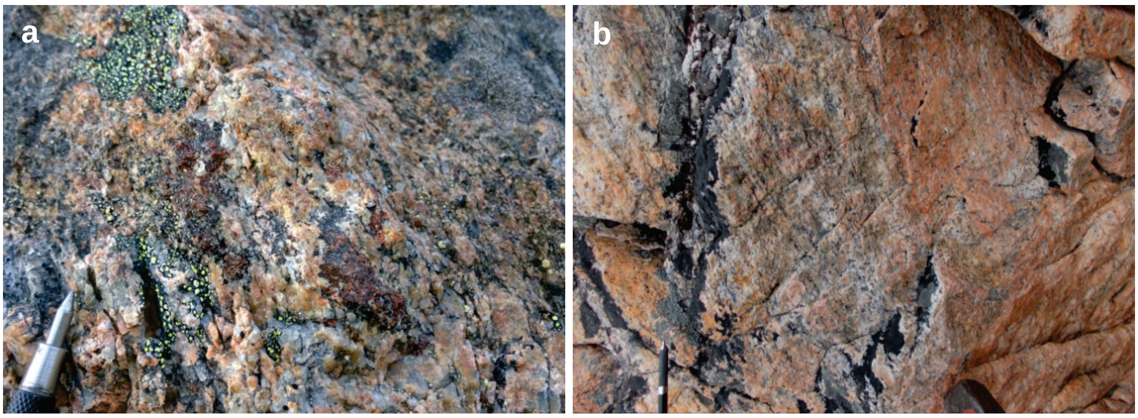


Figure 6. *(a) Disseminated garnet in granite (14TBA267). (b) Variation in granite composition, disseminated garnet south of Tasiilaq town (14TBA166).*

Granitic rocks

Granitic rocks are the dominant rock type in the northern margin of the intrusion as well as around the wall rock raft in the central part of the intrusion at camp site T8/C6. Around the raft there is a gradual increase in the abundance of granitic rocks with disseminated garnet (Figure 6a). Compositions span a continuum from garnet gneiss to pink granite with disseminated garnet. A similar case is seen south of Tasiilaq town where a large body of granite to alkali feldspar granite with disseminated garnet is present (Figure 6b). At the northern margin of the intrusion tonalite and granodiorite constitute the main lithologies. The samples from the reconnaissance stops along the northern ridge were mesocratic gabbronorites, indicating that the granitoid rocks only form a < 1 km band along the intrusive margin.

Ultramafic rocks

Several ultramafic bodies have been observed throughout the intrusion. Green and black pyroxenite form isolated elongated clasts within the mingling zones, cross cut by mesocratic gabbronorite. Several larger, up to 40 m in diameter, ultramafic bodies have also been found around T8/C3 and 5 (e.g. Figure 7). In particular one occurrence close to the south-eastern boundary exhibits modal layering in the relative abundance of mafic phases and plagioclase (Figure 8a). Around T8/C2 smaller ultramafic bodies are commonly present as isolated brecciated clusters. A large 50 x 300 m brecciated ultramafic body striking approximately east – west was found in the hills north of T8/C2. The ultramafic units likely correspond to the melagabbro described by Andersen et al. (1989).

Figure 7. *Ore showing in the eastern part of the intrusion north of T8/C5 (view towards the northwest). A large black pyroxenite unit overlies mesocratic gabbronorite, and gossan in the lower right (14TBA114).*

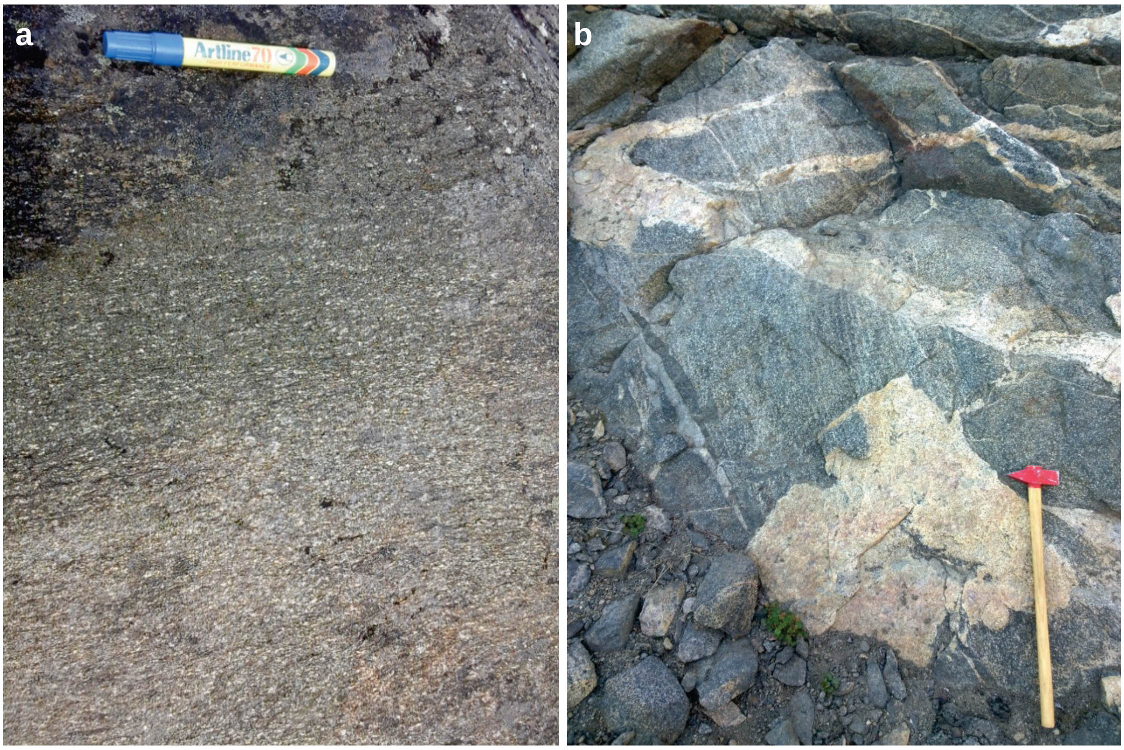


Figure 8. *(a) Modal variation within a 50 by 50 meter pyroxenite body in the southeast part of the intrusion (14TBA227). (b) Rhythmic modal layering in melanocratic gabbro cut by leucocratic gabbronorite in the valley north of Mt. Præstefjeldet (14TBA254).*

Pyroxenite stringers

Thin (up to a few cm wide) stringers of coarse-grained orthopyroxenite within gabbronorite often appear in conjunction with magma mingling zones, but they have also been observed in the absence of mingling within mesocratic gabbronorite by the south-western boundary (Figure 9a). These stringers may have formed by a reaction between the cross-cutting mesocratic gabbronorite and the melanocratic gabbronorite, but this remains for the time being speculative (Figure 9b). At T8/C2 a *c.* 3 cm thick sheet of clinopyroxenite was found to cross-cut the gabbros.

Figure 9. *(a) Pyroxenite stringers in mesocratic gabbronorite (14TBA186). (b) Mesocratic gabbronorite cutting melanocratic gabbro with brown pyroxenite stringers along contacts in the valley north of Præstefjeldet mountain (14TBA256).*

The intrusion margin and the contact to the garnet gneiss

The wall rock is comprised by foliated leucocratic biotite garnet gneiss of possible supracrustal origin. The gneiss contains pods of amphibolite, which to various degrees has been altered to a fine-grained plagioclase–biotite rock. The pods are generally completely altered but some have a core of amphibolite rimmed by the plagioclase-biotite rock. Within the gneiss stepwise offset dykes of crumbly weathering diorite form elongate mounds, up to 2 m wide and up to 10 m long, striking approximately east-west. The boundary south-west of T8/C2, is marked by a gradual increase of quartz in the gabbroic rocks over several hundred meters, the boundary is diffuse over approximately 10 m and is marked by stronger foliation, widespread small scale folding and appearance of disseminated garnet (Figure 10a). By the glacier at the south-western part of the intrusion, the boundary was found to be sharp, with gabbronorite in contact with strongly foliated garnet gneiss (Figure 10b). At the northern margin of the TC by T1/C8 the contact is characterised by an intrusive breccia (Figure 10c).
The northern boundary of the intrusion was found to follow along the ridge south of T1/C1.
On a short reconnaissance stop west of Mittivakkat glacier on central Ammassalik Island (Figure 3), only gneiss was found. This suggests that the western extent of the TC is smaller than indicated on the 1:25.000 and 1:200.000 scale maps, and that the intrusion does not extend further west than the western rim of the Mittivakkat glacier.

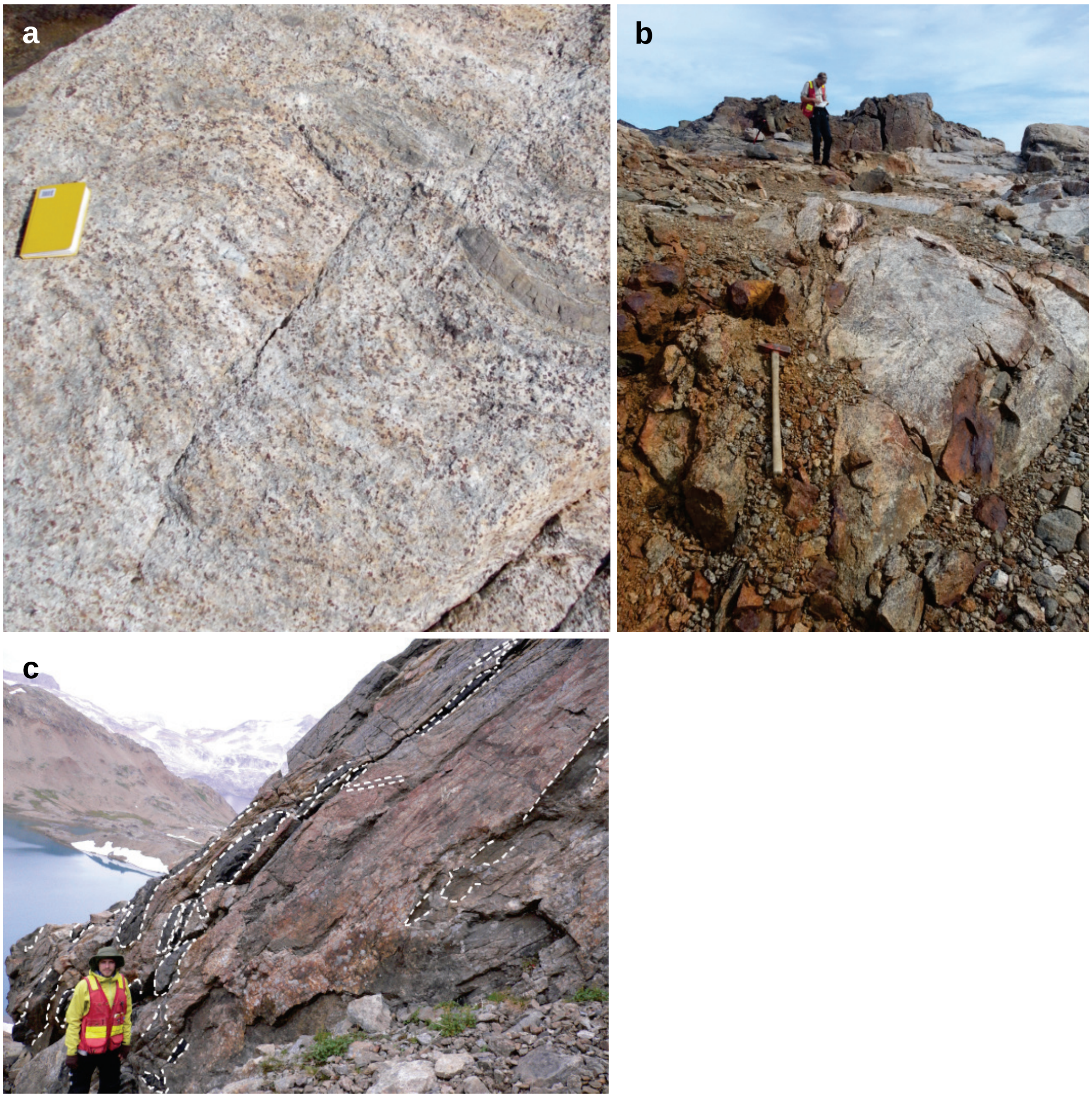


Figure 10. *(a) Garnet gneiss at the southwest margin (14TBA091). (b) Contact between rusty-coloured gabbronorite (left) and pale garnet gneiss (right) at the southwest margin by reconnaissance stop (14TBA184) (c) Intrusive breccia at the northern margin, granodiorite intrudes amphibolite float (14TBA009).*

Mineralisations within the Tasiilaq Centre

Gossaneous material was found in several locations throughout the intrusion. At a sulfide showing in the south-eastern part of the intrusion, the gossaneous rock is porous, possibly indicating leaching of sulfides (Figure 10b). A showing was found north of T8/C6 where samples of semi-massive sulfide were gathered from scree. These samples are likely originating from a large rusty patch in the west-facing mountainside on the eastern ridge. A short helicopter reconnaissance stop was made at the ore prospect held by the company *21st North* on the southern coast (21st North, 2014) (Figure 3).

The Ammassalik batholith

Geological background

The Ammassalik batholith is situated 10-40 km north of Tasiilaq, where it occupies the northern part of Ammassalik Ø and the land immediately north of Ikaasartivaq fjord (Figure 11) that dissects the central part of the batholith in a NW—SE direction. The batholith measures roughly 32 x 25 km in outer dimensions, and is dominated by granitic and dioritic lithologies. Granitic rocks dominate the western and southernmost parts. A separate granite intrusion, the Aria granite is identified at the western end of the Ikaasartivaq fjord (65°54'0.0"N, 37°37'59.9"W) and was previously prospected for as ornamental stone (but remains unexploited). Smaller units of gabbroic to dioritic rock units are also present, particularly in the eastern part of the batholith where the Tasilartik gabbro has been mapped out as a separate entity measuring 6 x 3 km in outcrop scale. The central part of the batholith is constituted by mafic (dioritic) sills and sheets intruded into, or interfingering with, felsic (granitic or granodioritic) lithologies, as can be observed in the upper reaches of the fjord walls. Previous investigations of the Tasiilaq area included detailed mapping of the Ammassalik batholith by the University of Birmingham group from 1967 to 1970. Wright et al. (1973) describe the intrusive complex as a late- to post- orogenic calc-alkaline suite. They note sharp contacts, widespread evidence of stoping and negligible contact or retrogressive metamorphism, and consequentially suggest the batholith was intruded at a relatively high crustal level. An example of one of the field maps of the Birmingham group is shown in Figure 12, illustrating the geological complexity found within the intrusive complex, and which was not transferred onto the official 1:500,000 scale map of Escher (1990).

The complex was first dated to 1685 Ma (Kalsbeek, 1986); more recent zircon U/Pb ages on granites and diorites confirm this age, but also indicate the existence of younger ages within the intrusive complex down to *c.* 1550 Ma in the latest granites (Thrane, unpublished data). This age span places the intrusive complex some 200–350 Ma after the Ammassalik Intrusive Complex and confirms it to be of late- to post- orogenic nature.

Strategy and coverage

The field activities were conducted from four camp sites around Ikaasartivaq Fjord: T13/1 located at the eastern end of Ikaasartivaq Fjord; T13/C6 at the north-western end of Ikaasartivaq Fjord, and T14/C7 plus T14/C8 in the southern part of the intrusive complex (Figure 1). Within the intrusive complex, steep mountainsides separate the coastline from narrow NW–SE oriented ridgelines, which rise to heights of 1000 m above sea level. At T13/C1 many of the ridgelines were inaccessible, but a large expanse of coastal outcrop in the eastern half of Ikaasartivaq fjord was explored through use of a dinghy; at T13/C6 and T13/C7, much of the surrounding area was accessible by foot. Two days of helicopter reconnaissance flights enabled inspection and sampling of several ridges (Figure 1). On an additional reconnaissance flight the entire north wall of Ikaasartivaq Fjord was documented by a continuous sequence of photographs suitable for 3D photogrammetry.

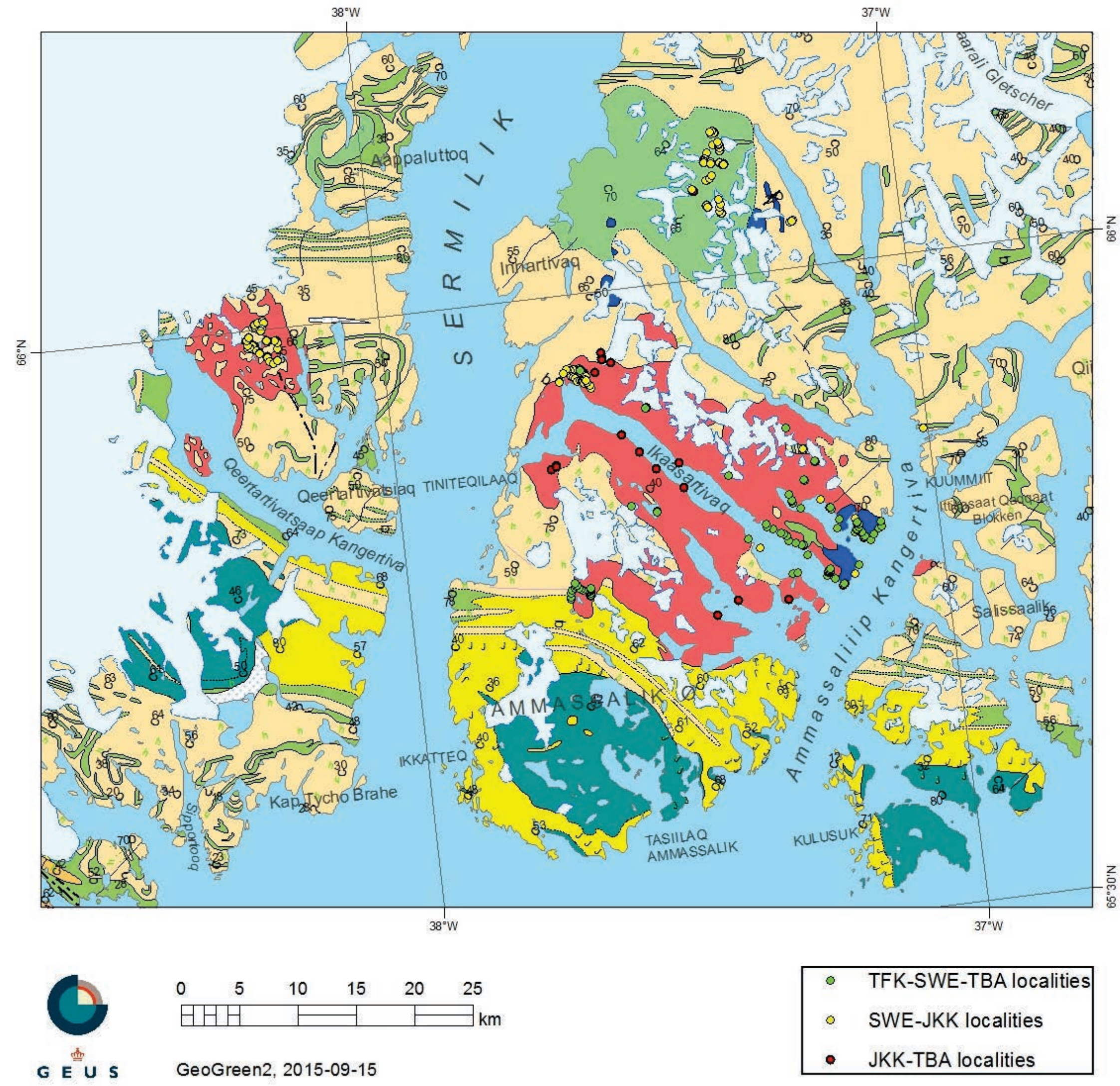


Figure 11. *The geological map of the Tasiilaq area as from the 1:500,000 scale map. The c. 1.68 Ga Ammassalik batholith is situated between the Sermilik and the Ammassalik fjords north of the Tasiilaq centre of the 1.89 Ga Ammassalik Intrusive Complex. The Ammassalik batholith has a roughly rounded outline and is constituted by granite, granodiorite and diorite with minor gabbroic and ultramafic rocks. The Johan Petersen Fjord granite, situated west of Sermilik, resembles the granites from the Ammassalik batholith, and is therefore presumed to be related to these.*

Field observations

The new fieldwork in the area confirmed the complexity of the intrusive complex as it was originally depicted on the field maps from the Birmingham group (Figure 12). The complex is composed of multiple intrusions of mainly granite and diorite, but also gabbroic and ultramafic rock units. In the following each rock group will be briefly described as will the magmatic mingling relations that involve mainly dioritic and granitic compositions.

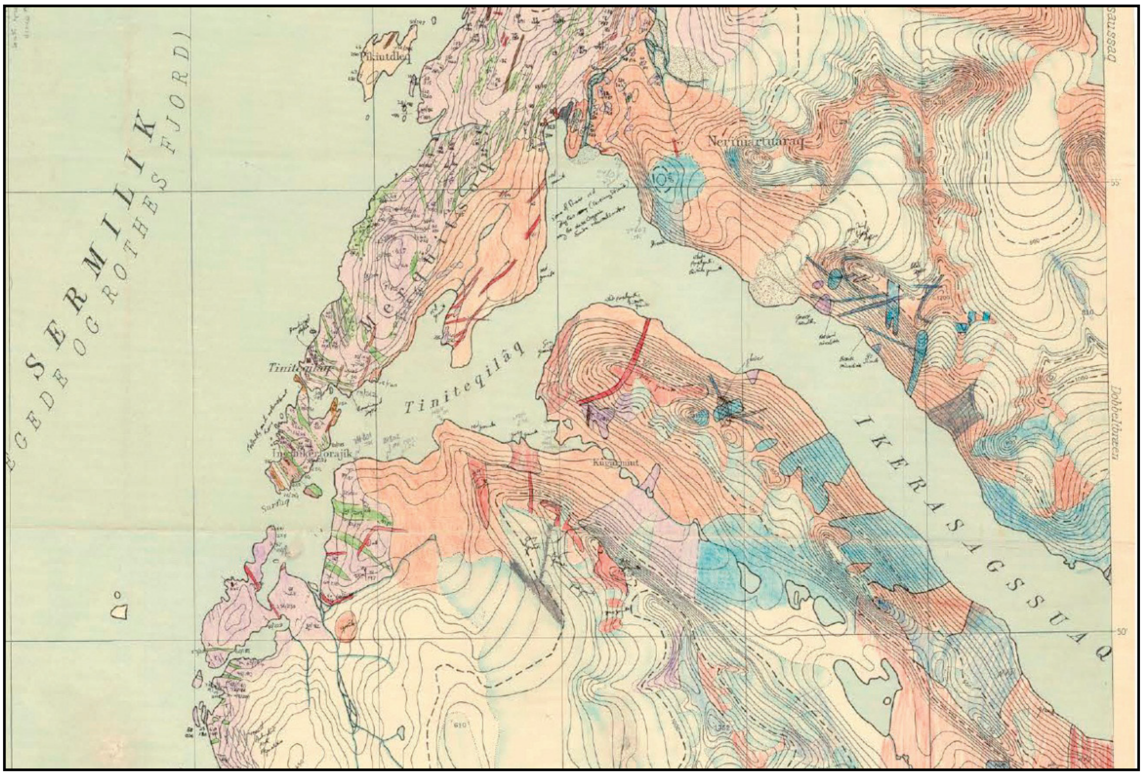


Figure 12. *An example of a field map from the Birmingham group illustrating the complexity of the geology within the Ammassalik batholith (that was not transferred onto the 1:500,000 scale map). The map view shows the western part of the batholith and represents a cropped section of the map 65Ø1_003 from the GEUS map archive. Simplified geological key: Red: granite (grey and pink), blue: diorite, purple: grey gneiss.*

The gabbroic rocks

The gabbroic rocks include norites, gabbronorites and gabbros, that all are subordinate in volume compared to diorite and granite. In the eastern part of the intrusive complex a separate unit of gabbro occurs, the Tasilartik gabbro (Figure 1); this unit and the eastern part of the intrusive complex around the mouth of Ikaasartivaq fjord were investigated using a dinghy from camp T13/C1. The unit is dominated by coarse-grained gabbronorite with an equigranular and homogenous appearance, without any apparent evidence of layering. Within the intrusive complex a small (235 x 200 m) intrusive plug of gabbronorite inside the granite was mapped out on the northern shoreline of the Ikaasartivaq fjord (Figure 13). The intrusion consists of medium to coarse-grained gabbronorite that appears massive with subtle indications of magmatic layering. Towards the sharp contact to the granite the gabbronorite becomes finer -grained in a zone of *c.* 0.5 – 1 m and xenoliths of granite occur, indicating the intrusive relationship of the gabbronorite. Additionally, meter—sized blocks of the gabbronorite are observed within the granite, close to the margins of the gabbronorite plug. Whilst the blocks are generally angular, individual edges can be curved, suggesting that the granitic and gabbronoritic magmas were not completely solid when juxtaposed.

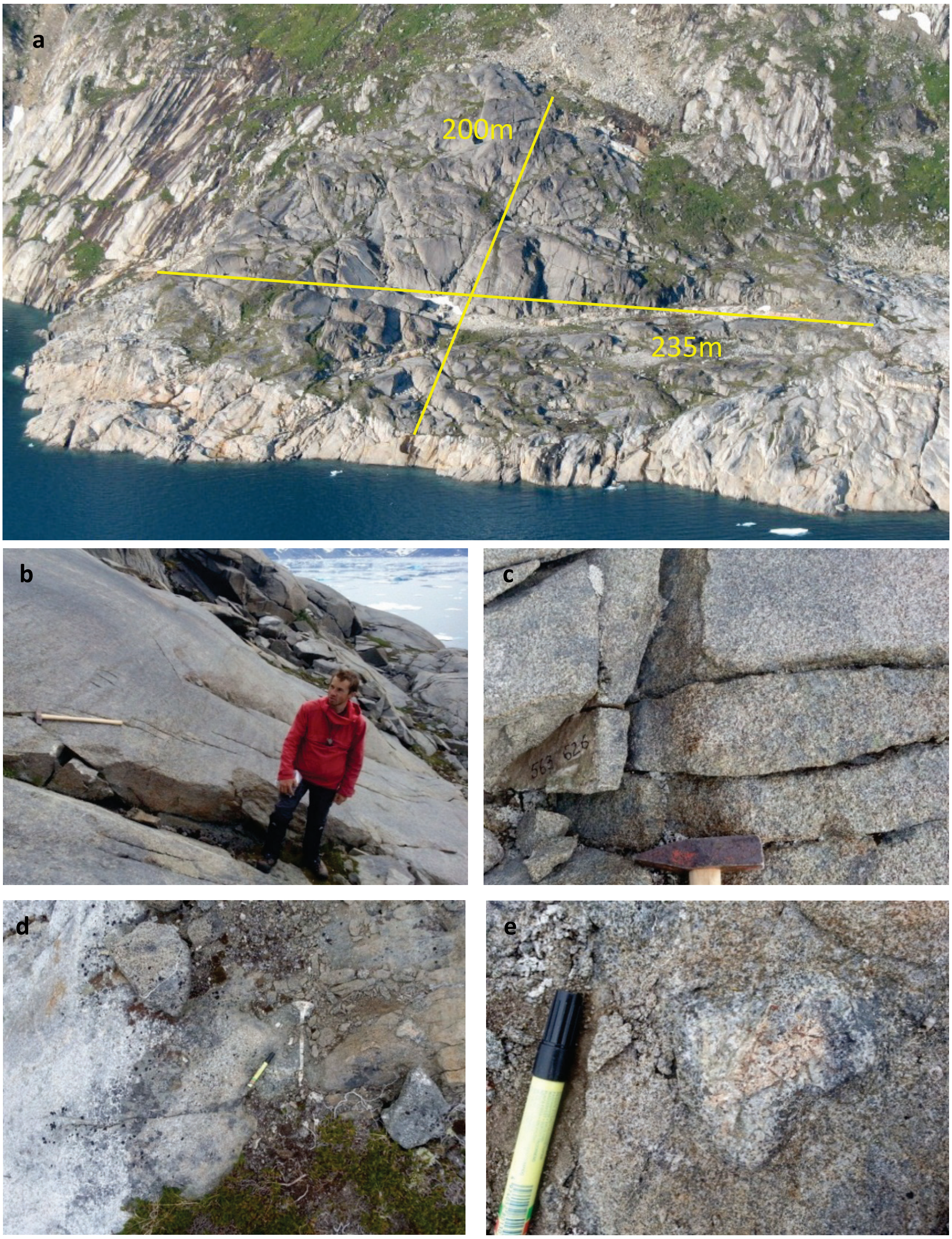


Figure 13. *(a) Top view of a 235 x 200 m intrusive plug of gabbronorite intruding into granite in the north-eastern end of the Ikaasartivaq fjord. (b) – (c) The small intrusion consists of medium – coarse-grained isotropic gabbronorite that appears massive with only subtle indications of magmatic layering (note in (b) striation marks are from glacial origin). (d) – (e) Contact to wall rock granite is sharp with clear intrusive relations including grain size reduction towards the contact and granite xenoliths in the gabbronorite.*

The intermediate rocks

Rocks of intermediate composition are pervasive throughout the Ammassalik batholith, and are often in close spatial association with other rocks of mafic, intermediate and felsic composition. They are mostly mid to light grey in colour, are intermediate – coarse -grained, and have the typical salt and pepper appearance of diorites. The intermediate rocks are typically hosted in small to medium sized bodies and sheets, tens to hundreds of meters in size. These bodies typically share complex intrusive relationships with each other, and also with bodies of felsic and mafic material (Figure 14).

Throughout the Ammassalik batholith, the intermediate rocks show significant variability in modal mineralogy and texture. At the outcrop scale, the intermediate bodies are notably heterogeneous, often comprising several different dioritic lithologies (Figure 15). These observations suggest that the intermediate rocks in the Ikaasartivaq complex are hybrids that have been homogenised to varying extents. The magma mingling and mixing features that characteristic of the intermediate rocks are reported more fully in a separate section below.

Figure 14. *Helicopter reco stop at 14TFK054. (a) Panoramic view looking towards the east. (b) Enlargement of white box in (a) showing the complex intrusive relationships between mafic and felsic magmas. The large scale relationships could support the more detailed observations from elsewhere in the intrusive complex of co-existing magmas of contrasting compositional and rheological properties.*

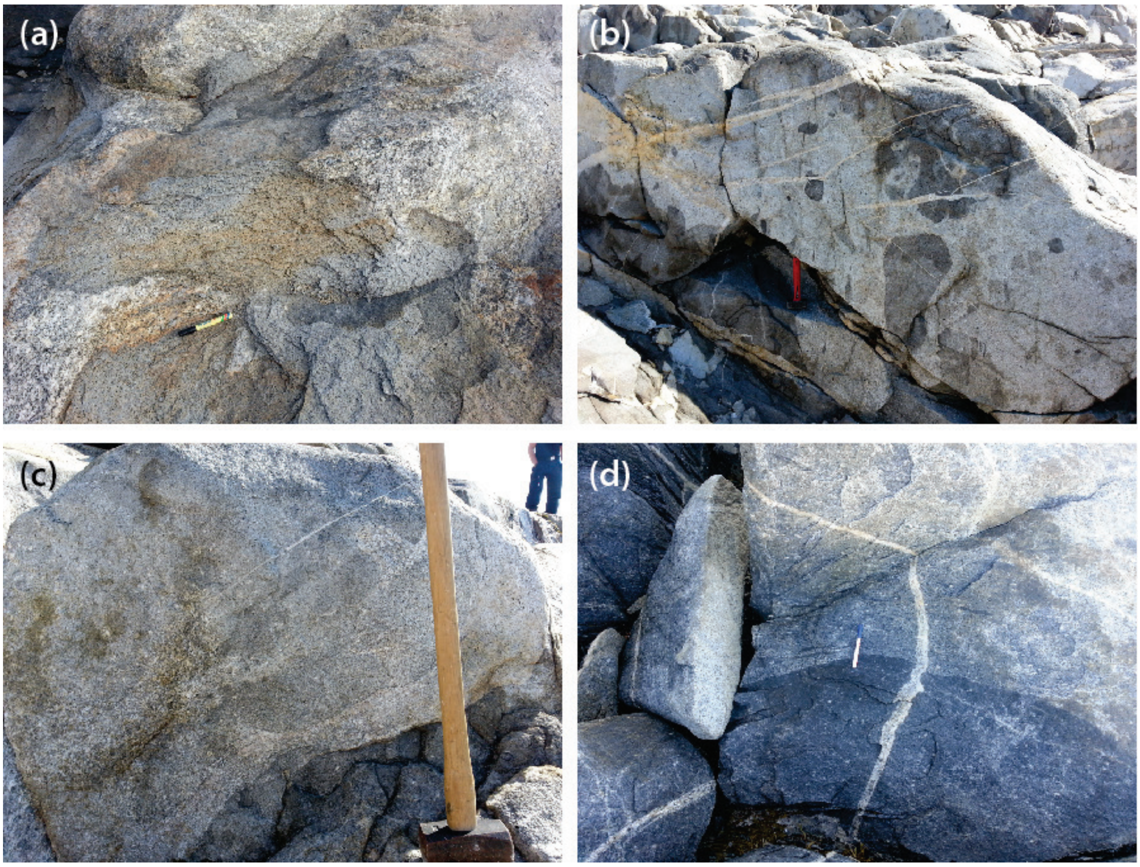


Figure 15. *Examples of intermediate rocks observed in the Ammassalik batholith. (a) Two different rocks of dioritic composition at locality 14SWE196, (b) rounded and variably-sized blobs of dark grey intermediate rock in a lighter grey host at locality 14SWE208, (c) randomly shaped blobs of diorite hosted in a lighter grey coloured diorite, also at 14SWE208, (d) dark grey intermediate rock hosted in a light grey diorite at locality 14SWE200.*

The granitic rocks

The eastern and westernmost parts of the Ammassalik batholith includes extensive outcrops of pink granite which were studied from three different camp locations: T13/C1, T13/C7 and T8/C6 (Figure 1). The outcrop of granite north of Johan Petersen Fjord studied at T13/C4 has a distinct petrological resemblance to the granitic rocks found on the eastern side of Sermiliq Fjord, and it is highly plausible that both granite intrusions are petrogenetically related (see page 28). In all the studied areas the granite constitute fairly homogenous, massive rocks of coarse -grained felsic alkali feldspar dominated granite, with amphibole as the typical mafic phase. The contact relation of the granite to the surrounding gneiss basement was studied at camp T8/C6 in the south-western margin of the intrusive complex, just north of the Ammassalik Intrusion. The contact zone is well defined with sharp (brittle) contacts of granite intruding the garnet gneiss aureole in a sill-like fashion with gently inclined sheets of granite, up to 0.5m thick, that cut orthogonally to the foliation orientation of the gneissic rocks (
Figure 16). Sharp-edged blocks of foliated garnet-bearing gneiss are often seen as xenoliths inside the granite in the contact zone. The contact is at places sub-horizontal, indicating that the level of exposure represents a possible roof zone of the granitic intrusion.

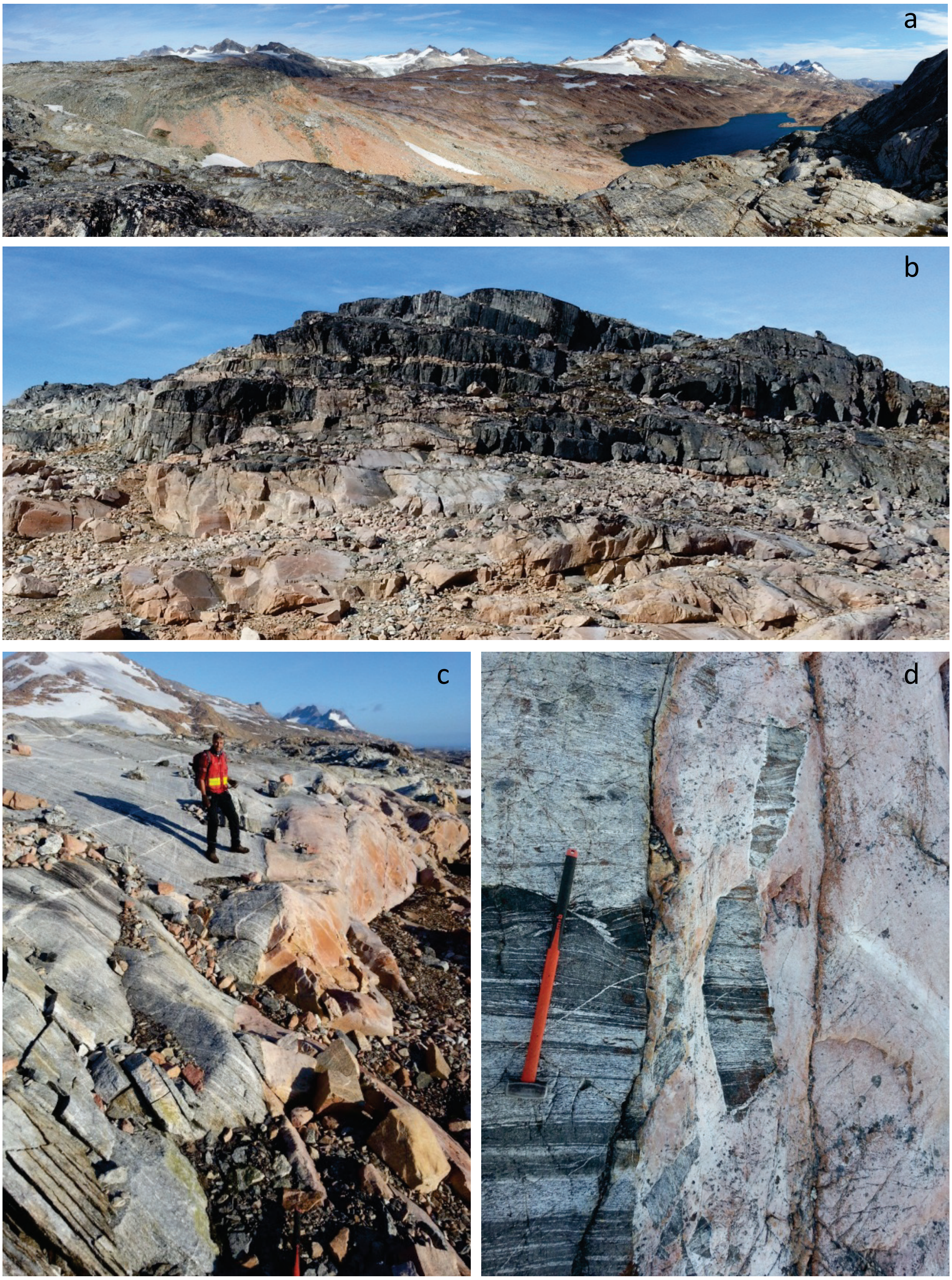


Figure 16. *Intrusive relationships between the pink granite and the garnet-bearing gneiss basement studied at camp T8/C6. The contact is at places sub-horizontal indicating that the uppermost part of the granite intrusion (roof zone) is exposed.*

The internal structures and textures of the granite as well as the contact relationship to the surrounding gneiss basement were examined in some detail at T8/C7. The dominating lithology is a homogeneous, equigranular “pink granite” with alkali feldspar, quartz, plagioclase and very little mafic minerals constituted by amphibole or biotite. At several outcrops greyish granitoid enclaves were found inside the pink granite as rounded bodies or blobs (Figure 17).

Figure 17. *Examples of micro granitoid enclaves in host of pink granite studied at camp T8/C6. (a) Double enclaves in host of ‘pink granite’ (i.e. medium – course -grained, isotropic biotite granite); larger enclave is approximately 1x 0.5 m in dimensions and has distinctly rounded, sharp outer contact to host. (b) Close-up of smaller mafic, tear drop-shaped internal enclave in large enclave. (c) 25 x 20 cm perfectly rounded mafic enclave in pink granite. (d) Micro granitoid enclave, broken up and intruded by host granite (net-veined).*

Magma mixing and mingling relationships

A remarkable and almost ubiquitous observation is evidence for magma mixing and mingling on a wide range of scales. In the main body of the intrusive complex, some of the most convincing evidence is preserved in an extensive suite of dioritic rocks of variable mineralogy and texture (Figure 18-Figure 20). Field observations blobs and globules of one diorite, centimetres to metres in scale, hosted within another (Figure 18a, b); angular fragments of one diorite within another, which in some cases occur alongside rounded droplets

(Figure 18a, c); elongate, wavy wisps of diorite included within diorite of different composition (Figure 18d), and larger dioritic bodies, tens to hundreds of metres in size, hosted within others.

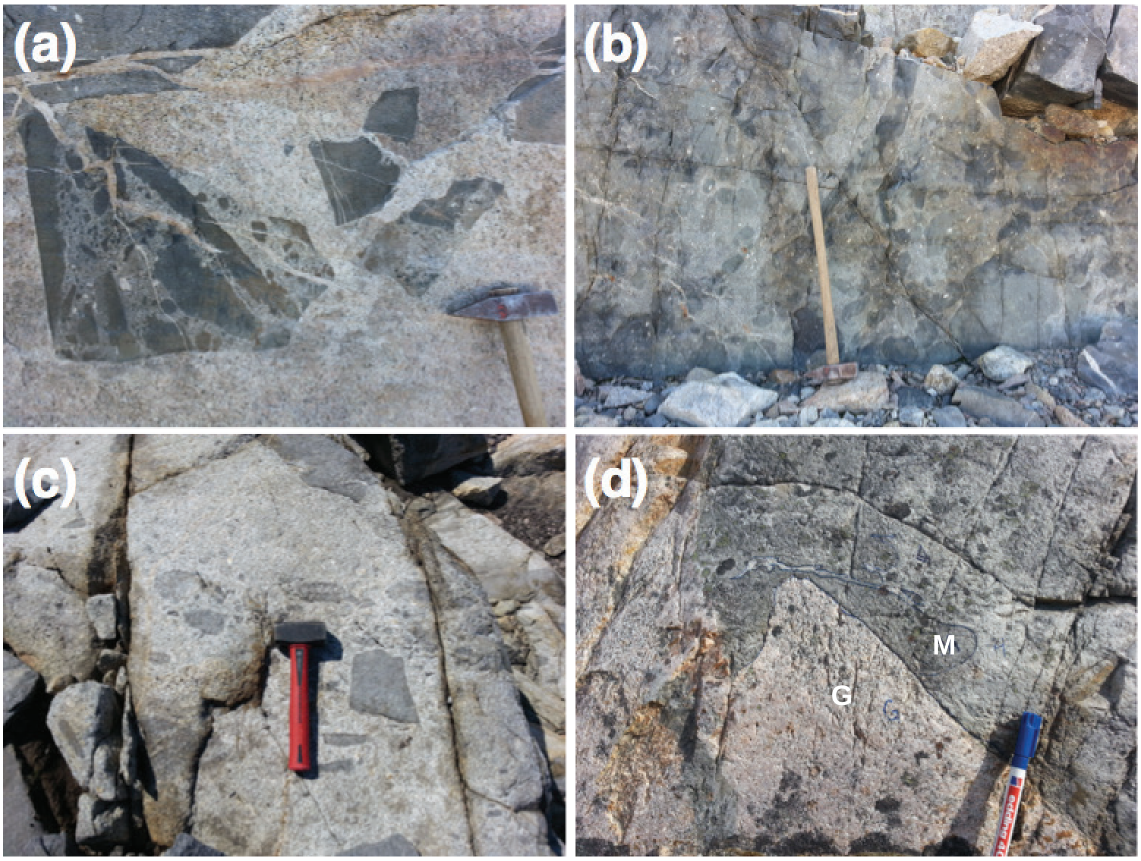


Figure 18. *Examples of mingling and mixing of dioritic and granitic magmas within the Ammassalik batholith. (a) Angular fragments of mafic and hybridized material showing a polygenetic history set in a granitic host. (b) Rounded blobs of a mafic hybrid hosted in a more leucocratic hybrid, (c) sub-angular to sub-rounded fragments of a mafic hybrid within a more leucocratic dioritic host, (d) granitic rock (G), mafic (M) and hybrid material (unmarked) juxtaposed along a sharp contact that is both straight and curved.*

In many instances blobs of magma are concentrated into zones and are particularly notable close to the margins of larger bodies. This suggests that the observations document juxtaposition of two liquids, rather than a liquid and a solid. Field observations generally revealed no notable reduction in grain size towards the margins of magma blobs, indicating that any temperature differences between juxtaposed magmas in the parameter regimes conducive to blob formation were small. Mingling and mixing is also observed between granites in the main body of the intrusive complex, although whether the granites have also been subjected to mixing remains to be determined by subsequent chemical analysis.

The intrusive complex also hosts a range of composite dykes and sills that preserve a wide range of evidence for magma mixing, mingling and hybridization (e.g. Brooks, 1977). Some of the dykes are texturally reminiscent of mafic-felsic complexes sometimes referred to in the literature as net-veined complexes observed in Palaeogene rocks in East Greenland particularly in the Kialineq area also studied during this field season (see page 52) but texturally similar mixed rocks are found many place e.g. Iceland (Weidenforfer et al., 2014; Furman, et al. 1992), New Zealand (Turnbull et al., 2010) and Canada (Wiebe and Hawkins 2015). For the most part, these bodies preserve juxtaposed mafic and felsic magmas, the mafic lithology typically occurring as (sub)centimetre- to metre-scale droplets and pillows within the felsic material. Boundaries and contacts between the mafic and felsic lithologies can be sharp or gradational, and a range of different morphologies can also be observed. Some contacts between mafic bodies and the host granite are cauliflower-type (Figure 19a); others are defined by a smoothly curving surface (Figure 19b). Other contacts are lobate and irregular, and veinlets of felsic material can often be observed to cross-cut mafic pillows (Figure 19c). Some mafic pillows are composed of several different mafic – dioritic lithologies, suggesting that both homogenization and mingling are important processes in the petrogenesis of the observed rocks (Figure 19c). Observations of fine-grained mafic material within the interstitial spaces of a coarse-grained granitic lithology, and associated plagioclase rims on alkali feldspar phenocrysts from the granitic lithology, such as those shown in Figure 20 d could provide a snapshot of mixing and hybridization processes.

Within Ikaasartivaq fjord, two composite dykes were investigated and sampled in detail. The first, observed at the easternmost end of the fjord, was a net-veined mafic / felsic dyke intruded into granite (locality 14TFK009, 14SMW163; 65.7546°N, 37.1947°W). Figure 20 illustrates some of the textural and lithological relationships preserved at the locality. Within the dyke, ellipsoidal blobs of mafic magma are separated by an interconnected film of felsic magma (Figure 20a,b). Figure 20c shows that the dyke has a lobate marginal contact with the host granite, and Figure 20d shows that some crystals of the host granite are included within the marginal zone of the dyke. Reduction of the grain size towards the margin of the dyke suggests a significant temperature difference existed between the magmas when the dyke was emplaced. The dyke also preserves signs of extensive hybridization. This is evidenced by change in colour from light to dark towards the centre of the dyke, observation of several different diorites within the dyke, gradational changes in composition and inclusions of crystals from the granite assemblage within the mafic magma. Contacts between the mafic and felsic material are also variable, ranging from knife sharp to gradational transitions, which show local signs of hybridization.

The second body investigated in detail was a mafic – felsic sheet in the centre of the intrusive complex (locality 14TFK055; 65.9072°N, 37.5200°W). Figure 21 presents a selection of photographs from the locality. The interior of the dyke comprises highly irregular bodies of mafic material hosted within a white-coloured lithology of granitic composition (Figure 21a). Margins of the individual mafic blobs are also highly irregular and are characterized by fingering / dendritic and branching projections that have a regular wavelength (Figure 21b, c, d). Colour changes in both lithologies are commonly observed on either side of the lithological interfaces (Figure 21c). The morphology of the lithological interface resembles fingering instabilities produced by thin film, liquid-liquid reaction (Riolfo et al., 2012). The question of whether the textures observed in Ikaasartivaq are also the product of reaction awaits further investigation. The sheet itself is hosted in gneiss, for which the gneissosity is strongly discordant to the orientation of the sheet. The margins of the sheet are composed exclusively of the granitic phase, which suggests, but does not necessarily mean, that the mafic magma was intruded into the granitic melt. Alternatively, the granitic phase may have been generated by melting of the host gneiss. Further examples of mingling and mixing in composite sheets were observed in the Imersivaq intrusion (see page 28).

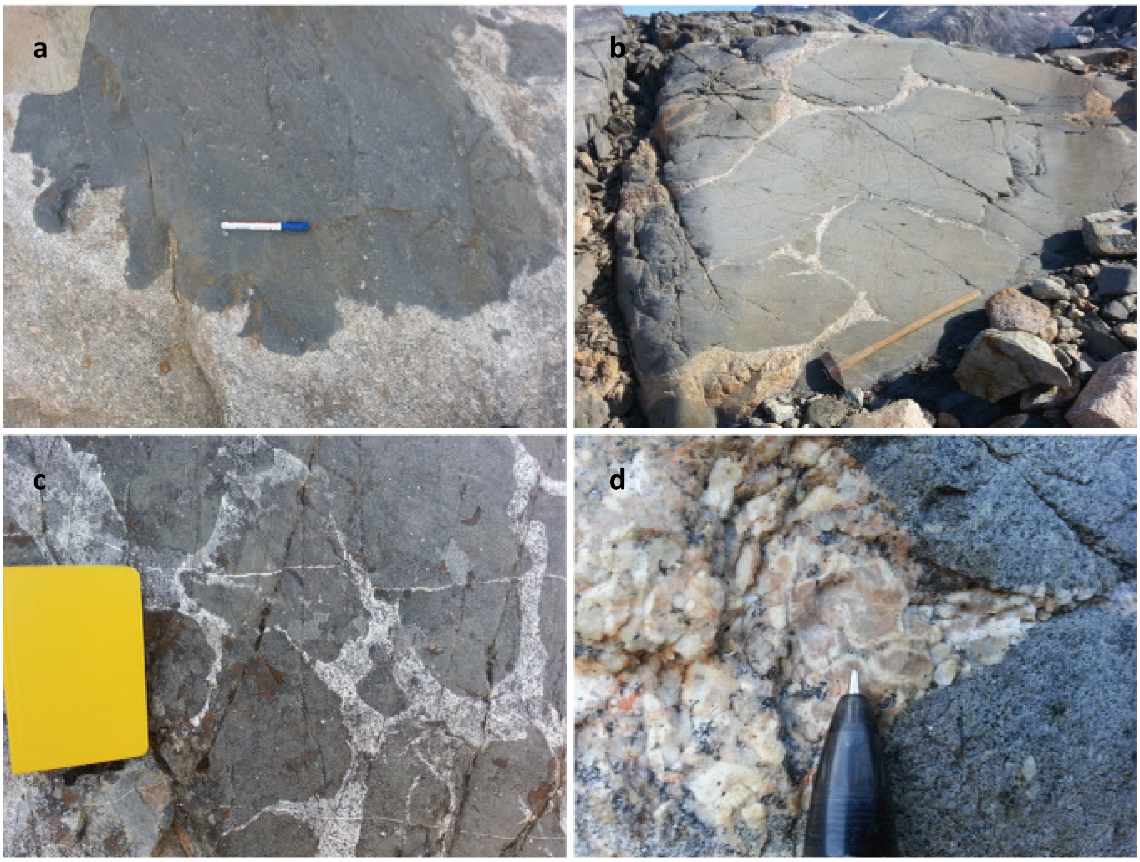


Figure 19. *Examples of juxtaposed mafic and felsic magmas from the Ammassalik batholith. (a) Mafic magma exhibiting a cauliflower-type contact with the host felsic magma. (b) Metre-scale rounded blobs of mafic magma, locally invaded by angular injections of felsic magma. (c) Sub-rounded blobs of mafic magma hosted in felsic magma, and locally cross-cut by centimetre thin veins of felsic magma. (d) Close-up of mafic material filling the pore spaces between crystals in a granitic rock. Note the white plagioclase rims grown on to K-feldspar phenocrysts.*

Figure 20. *14TFK009, 14SMW163 (65.7546°N, 37.1947°W). (a) and (b) Net-veining and mingling of mafic and felsic magmas in a dyke that intrudes into the granite and gneiss basement at the eastern end of the Ikaasartivaq fjord. (c) and (d) Close-up of chilled margin where a lobate contact between the various components of the dykes and the wall rock is observed suggesting the granite to have been only partly solidified upon dyke intrusion. (d) At some parts along the dyke margins alkali feldspar crystals (xenocrysts) from the wall rock granite are seen floating in the fine -grained contact zone indicating that a partial disintegration of the granite into the dyke (contamination). The locality was sampled by rock sawing.*

Figure 21. *Helicopter-reco stop: 14TFK055 (65.9072°N, 37.5200°W). (a) Mingling of mafic (dioritic) and felsic (granitic) magmas in a 5 m wide composite dyke that intrudes into the granite and gneiss basement at the north-western end of the Ikaasartivaq fjord. (b)-(e) Examples of the often crenulated interface between mafic and felsic lithologies indicating that these components were coexisting in a liquid state. Note the grain size reduction (c)-(d) of the diorite towards the granite suggesting the mafic magma was chilled against the cooler granitic magma.*

The Sermilik East Diorite (Imersivaq Intrusion)

Geological background

A relatively large dioritic intrusion (10 x 10 km) is exposed on the eastern shore of the Sermilik Fjord centered about 6 km east of the abandoned settlement Paornakajit. The official name from the GMOM database is the ‘Sermilik East diorite’ but for simplicity we will refer to it as the Imersivaq intrusion named after a lake a little southeast of the intrusion. Compared to other central parts of the Tasiilaq region the intrusion has received relative little attention and remains poorly studied. The intrusion also hosts a number of small gabbroic bodies as well as minor sulphide mineralisations (J. Kolb, personal communication). Interestingly, the location of the intrusion coincides broadly (but is slightly displaced from this) with a large prominent positive magnetic anomaly indicating that the Imersivaq intrusion is just a surface expression of a much larger magmatic system at depth (Figure 22). Previous reconnaissance work suggests, based on deformation of the intrusion, that the intrusion was emplaced early in the Proterozoic evolution of the Tasiilaq region (c.f. Chadwick and Vasudev, 1989) in agreement with a Sm-Nd model age of 2200 Ma by Kalsbeek et al. (1993). However, from our field observations (presented below), it is also clear that many pristine magmatic features are represented within the intrusion, and in many respects it resembles the diorite-granodiorite-granite association of the *c.* 1680 Ma Ammassalik batholith, and so until further U/Pb dating work has been conducted, it remains unclear how the intrusion relates temporally to the other geological units of the region.

Strategy and coverage

The aim of the investigations at Imersivaq was to assess the field relationships in the northwestern part of the intrusion and to sample for geochemistry, geochronology and petrographic studies. Fieldwork at the Imersivaq intrusion was conducted over a four day period. In the course of the present field investigation a representative sample set was collected from the intrusion including basement host rocks but obviously more time is needed to make a more fully study of this intrusion.

The field area was explored on foot in a large N-S trending valley that bisects the intrusion with the camp (Team13/Camp 5) placed close to the northern boundary of the intrusion about two 2 km SW of Cassiope fjeld. Unfortunately, large parts of this valley were covered by moraine and boulders (Figure 23a) at times making it difficult to find good exposed and considerable time was spent hiking, however, good outcrops were exposed at the sides of the valley particularly at higher elevations. At camp move August 3rd, a two-hour helicopter reconnaissance including two stops enabled short investigations of an otherwise inaccessible ridge and to explore a supposedly gabbroic plug close to the eastern intrusion boundary. The northern contact and host rocks of the intrusion were also studied briefly.

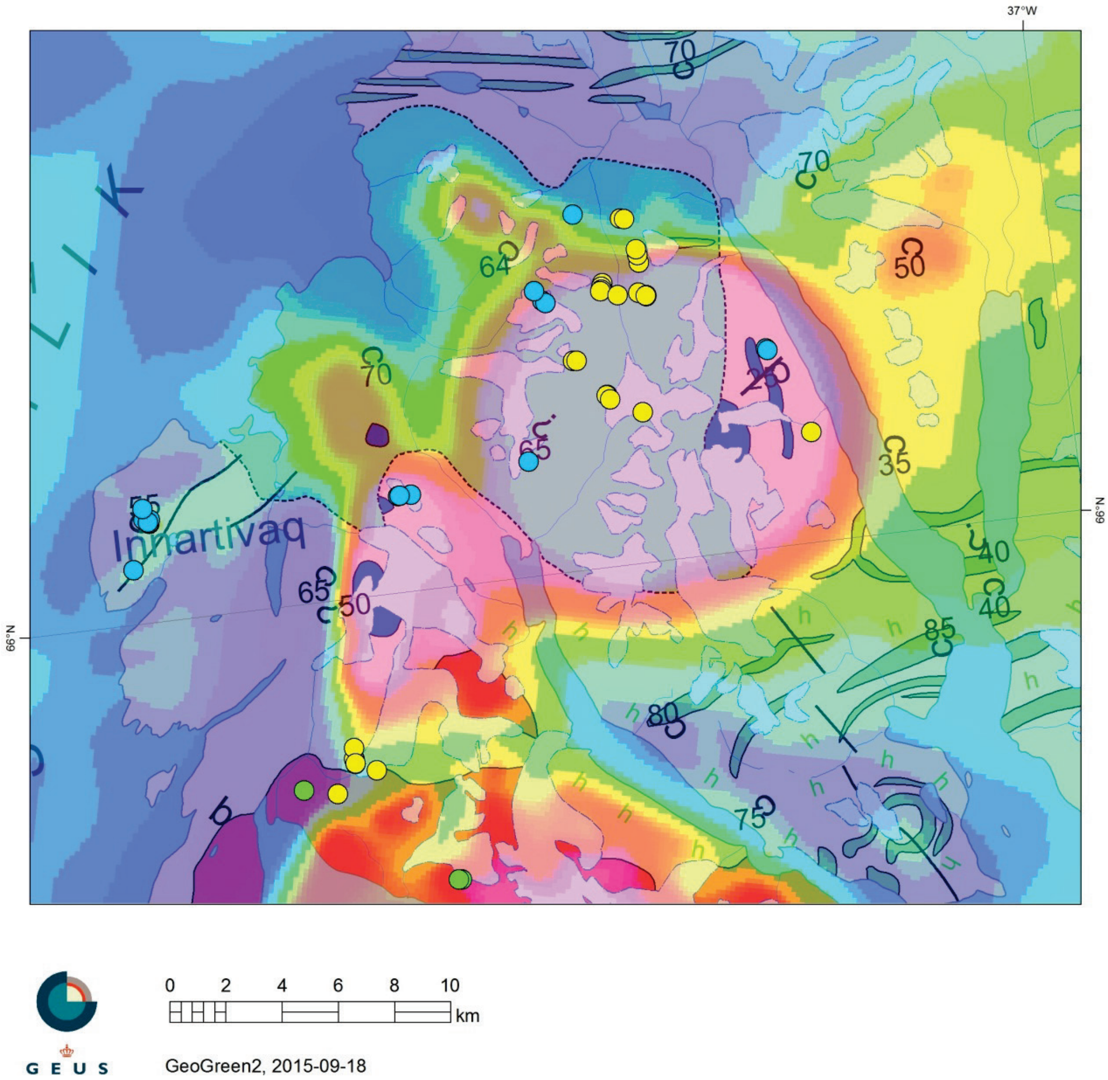


Figure 22. *Aeromagnetic data flown in 2012-2013 are overlain the geological map of the Imersivaq intrusion. A clear circular magnetic anomaly (bulls eye) pattern is seen, which is off-set from the geological boundary of the diorite intrusion. Sample localities are indicated; yellow: T13, blue: T7*

Lithologies

A number of different lithologies ranging from pyroxenites to granites are exposed in the intrusion (Figure 23-Figure 25), but clearly diorite is the dominating rock type in the area investigated by our field team. The diorites are mostly light-coloured having variable grain size but are dominantly medium -grained. At places the diorites have classical salt and pepper textures and appear undeformed but usually the rocks have pervasive but weakly developed foliation. The diorite is heterogeneous with variable content of plagioclase, pyroxene, hornblende, quartz, biotite, and minor K-feldspar and oxides. Some of the more leucocratic rocks seem to be of tonalitic rather than dioritic composition. Although the general impression of the pluton is a significant internal variation of the intrusion, it was not possibly to discern individual intrusive units of different diorites and tonalites.

Figure 23. *The Imersivaq intrusion. (a) View of the main valley explored during the fieldwork looking south from camp. The valley is dominated by moraine and boulder fields. Outcrops explored were mostly exposed on the sides of the valley. (b) Example of diorite the dominant rock type of the intrusion.*

Pyroxenites were just found as loose blocks, however, their high abundance in parts of the valley and that they are found together with diorites with similar textures and mineralogy as those observed in-situ in the Imersivaq intrusion indicate that they are of local origin. Usually the pyroxenites occur as angular blocks hosted in diorites suggesting that they could be xenoliths to the dioritic magma (Figure 24f) and they often contain pockets of gabbro intermingled with the pyroxenites. Sulphide mineralisations are associated with the pyroxenites while no base metal mineralisations were observed in the diorites but have been observed previously (J. Kolb, personal communication).

Felsic and mafic dykes and sheets intruding the plutonic rocks are volumetrically minor in the explored valley but do make up an important proportion of the intrusion at higher elevations. The mafic varieties were just observed from helicopter but appear to be thick (30-40 m wide) subhorizontal sheets at the top of the mountainsides whereas the felsic dykes and sills were seen throughout the intrusion. The latter consist of both pegmatitic and aplitic dykes and sub-horizontal sheets and are of at least three generations: 1) Thin 0.2-3 m wide granitic dykes that are folded. This deformation is possibly related to the development of the foliation fabric in the diorite. 2) Prominent sub-horizontal up to 20 m wide granitic dykes emplaced at the mountaintops and postdating the diorites as well as the majority of the mafic sheets. 3) Late pinkish syenite dykes typically 1-5 m wide are cutting all other lithologies and have an average strike of *c.* 80° N and a dip of 30-60° N.

Mingling textures and characteristics

A conspicuous feature of the intrusion is the common occurrence of mafic-felsic mingled rocks comparable to those observed at the Ammassalik batholith and in the Kialineq area (see below/above?). These mixed rocks appear on various scales from small dykes (30 cm wide) to large outcrops seen in the N-S trending valley and exposed at steep sides at the highest exposed parts of the intrusion (Figure 23). The mingling complex was studied in some detail on the western slope of the valley where it crops out as a larger body possibly defining a sheet or lopolith that can be followed along *c.* 1 km of the valley. The mingled rocks have characteristics of an intrusive pillow complex consisting of dioritic pillows surrounded by co-magmatic granites (Figure 24d). The pillows here are up to *c.* 2 m in diameter, show no preferred orientation and consist of fine-grained diorite often with prismatic plagioclase phenocrysts and are clearly much more mafic than the medium-grained diorite making up the bulk of the intrusion. Back-veining of the granitic material into the diorite pillows is common while occurrences of hybrid rocks are rare. Contacts between the two contrasting rock types are cuspate and often display cauliflower textures. Brittle deformation indicated by the presence of angular mafic enclaves that are separated from each other by felsic veins (net-veining textures) also occur but are subordinate to the pillow type exposures. More fine-scale magma-mingling was observed in composite dyke emplace into the diorite (Figure 24c). These consist of an outer fairly homogenous felsic member of granitic composition and an inner predominantly mafic member, the latter mingled with a minor felsic component locally showing evidence of flow banding. The mafic blebs make up approx. 75 % of this member and are often ellipsoidal and aligned by flow movements while other have more globular shapes.

Basement host rocks and the boundary of the intrusion

The precise boundary of the Imersiviaq intrusion was difficult to establish as the contact to the host basement either appeared diffuse or critical contacts were not seen. Moreover, the outline of the geological map and the geophysical gravity map does not coincide completely, and the general impression is that the boundary of the intrusion on the geological map needs revision. Country rocks were studied north of the intrusion and typical examples are depicted in Figure 25. The basement here consists of strongly deformed pale grey quartzofeldspathic gneiss with well-developed foliation and smaller zones of rusty-brown paragneiss with garnet as the main metamorphic indicator mineral. Boudinage and small isoclinal folds are widespread in these lithologies. Intrusive agmatites of metagabbro and gneiss included in a felsic matrix were observed at one locality. A prominently reddish-brown *c.* 100 x 100 m hill is located on the eastern flank of the valley about 200-300 m outside the intrusion. It is dominated by rusty-stained amphibolite probably owing is colouring to oxidiation related to volatiles mobilized through an E-W trending fault bounding the hill to the south, but also include heterogeneous garnet porphyroblastic gneiss and veins of quartz or garnetiferous quartzite, the latter having mineralisations of pyrite and pyrrhotite.

An interesting occurrence of an ultramafic body was observed about one kilometer north of the boundary of the Imersiviaq intrusion. Other ultramafic rock lenses have previously been reported in the Tasiilaq region by Wager (1934) and Brooks and Stenstrop (1989), but to the best of our knowledge this occurrence is new. Exposures have an overall brown to green appearance from olivine and the ultramafite outcrops as an elongate body that can be followed for approximately 2 km with a width of 50-100 m and a general strike of *c.* 140 °N. It is hosted in grey gneiss but the contacts are poorly exposed due to cover by talus and grass and possibly it consists of a number of lenses rather than being one continuous body. Peridotite (wherlite) is the dominant rock type consisting of large oikocrysts of clinopyroxene up to 5 cm in diameter with chadacrysts of olivine. The mineral assemblage also includes biotite and minor plagioclase, magnetite and serpentine. Thin veins (< 5 cm wide) dominantly of serpentine and talc related to hydrothermal activity were observed in the wherlite, but the general impression is that that the ultramafic body is fresh suggesting relative high emplacement temperature at low water activity.

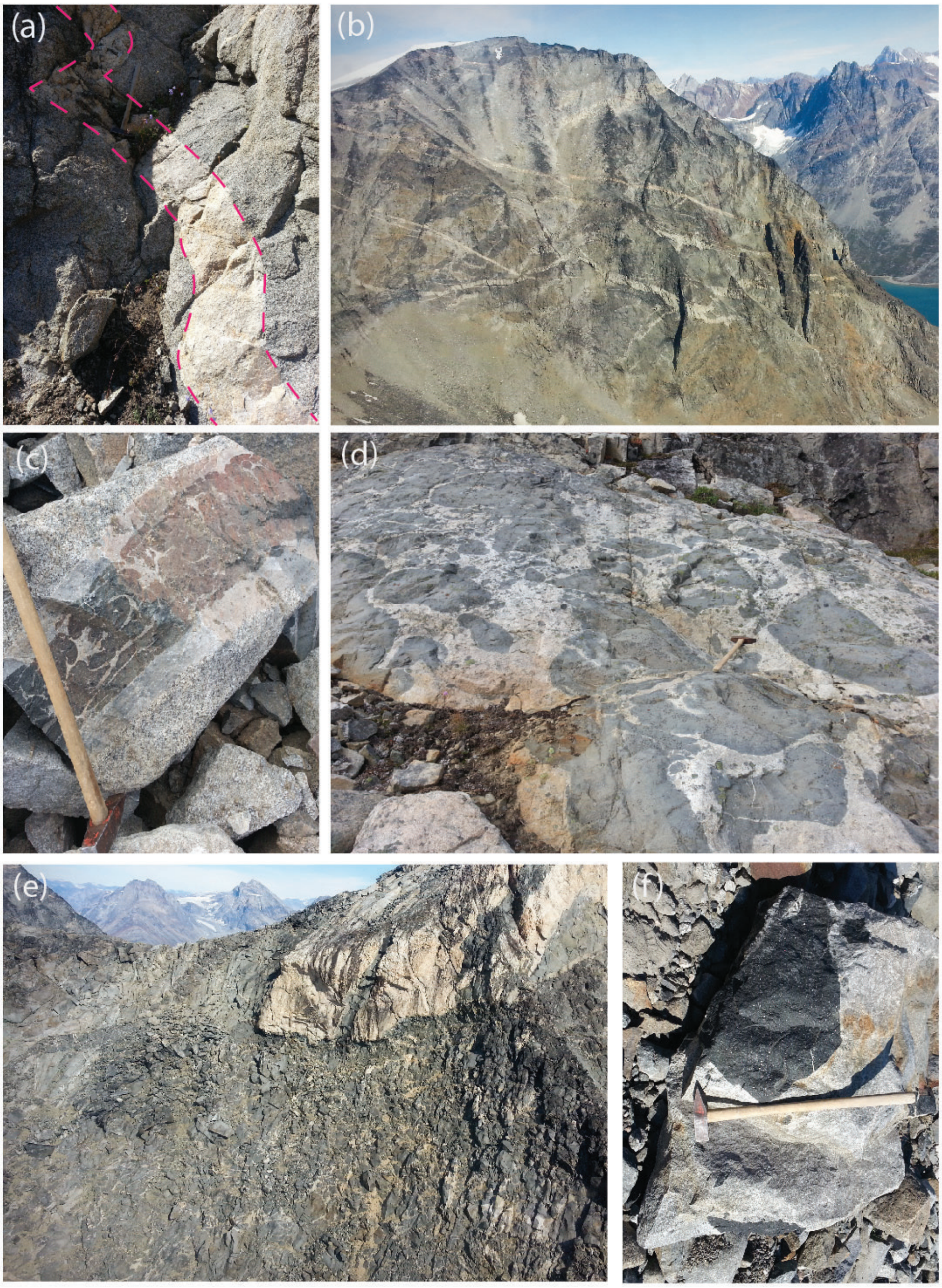


Figure 24. *(a). Folded felsic dyke in the Imersivaq diorite. (b) Mafic sheets (dark grey) towards the top emplaced into diorite. Thinner felsic sheets crosscut the mafic sheets and are of several generations. The prominent buff coloured sheets dipping to the right are the youngest and presumably represent the syenites dykes described in the text. The mountain face is approx. 600 m across. (c) Composite dyke in diorite consisting of an outer felsic member and an inner mafic-felsic mingled member locally having flow textures. (d) Mafic-felsic pillow complex from the Imersivaq intrusion showing mafic diorites in a felsic matrix. (e) Diorite intruded by prominent granite sheet (white-coloured to the top right), and thick mafic dyke (dark grey) dipping to the bottom right of the photo and a mass of net-veined material occupying the lower half of the picture. (f) Angular pyroxenite block in diorite.*

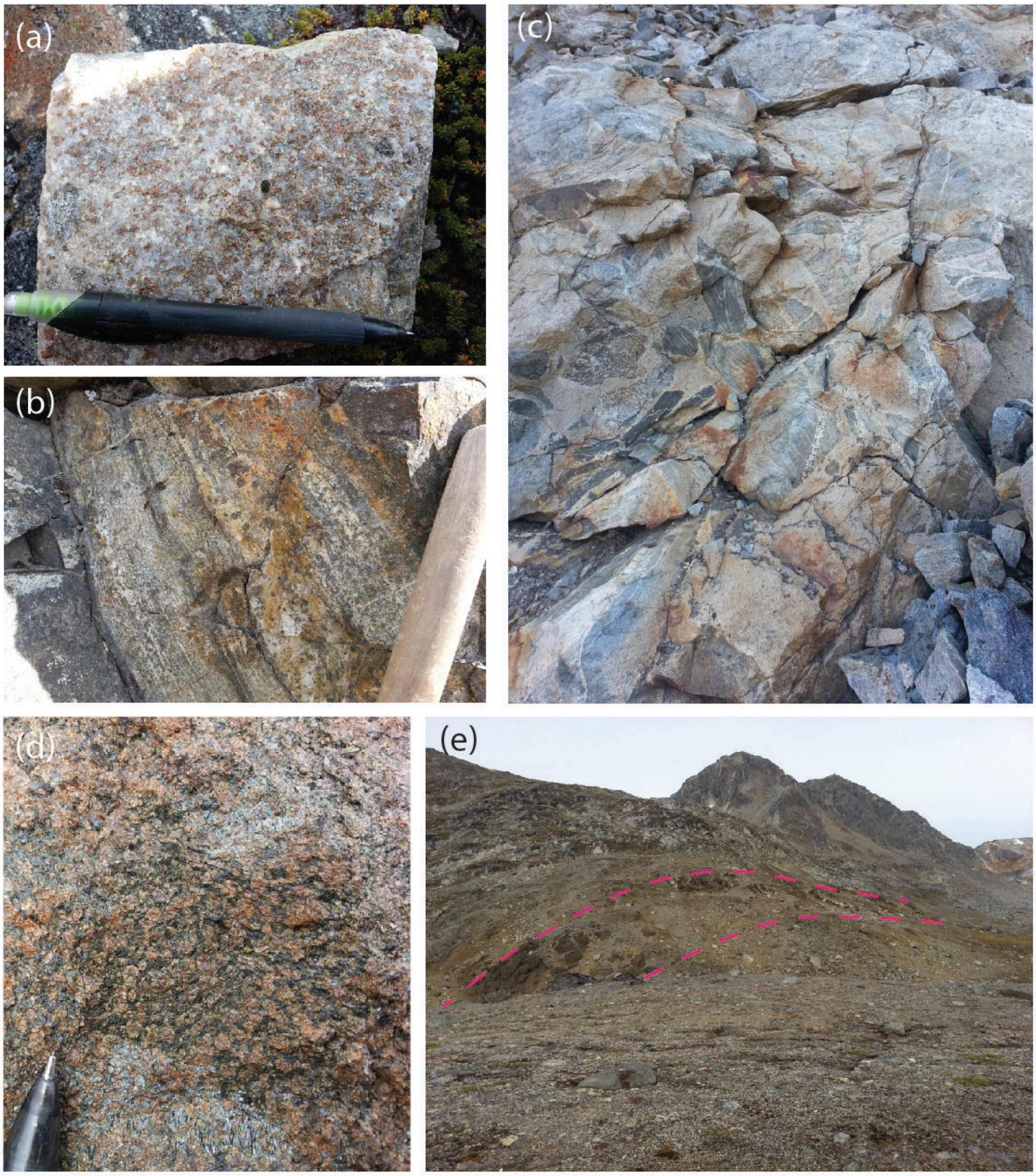


Figure 25. *Examples of basement boundary rocks to the Imersivaq intrusion a) Garnetiferous quartzite with pyrite and pyrrhotite mineralisation from the rusty hill area described in the text. b) garnet porphyroblastic paragneiss. c) Agmatite with breccia-like paleosome of metagabbro and gneiss embedded in granitic leucosome. d) Close-up of wherlite from ultramafic body with poikilitic texture showing a large oikocryst of clinopyroxene (black) with green chadacrysts of olivine. f). Typical outcrop of the wherlite surrounded by the basement gneisses, viewed to the northeast.*

Johan Petersen Fjord Granite

Granites were also studied at the Johan Petersen fjord from Camp T13/C5 (Figure 1). The granite in this area defines a separate body approximately 6 km in diameter separated from the rest of the Ammassalik batholith by the prominent Sermilik fjord as well as basement gneiss and supracrustals. The relationship of this igneous body to the rest of Ammassalik batholith is unclear. Possibly it is a separate intrusion but this unit could also very likely be part of the Ammassalik batholith or a satellite intrusion to this. The intrusion is unnamed in the GMOM database, but are here referred to as Johan Petersen Fjord Granite.

The intrusion is dominated by a pinkish granite comprising alkali feldspar, quartz, plagioclase and minor mafic minerals of biotite and/or hornblende. The granite is very homogeneous and lacking enclaves commonly observed elsewhere in the Ammassalik batholith. Basement inliers (xenoliths) are ubiquitous in the granites constituting 30 % or more of the exposures and have variable sizes but are dominated by large angular blocks up to several hundred meters across, comprised of grey othogneisses and garnet porhyroblastic paragneisses. Aplites and pegmatites, some of which seems to be related to the granites, are intruded into many of the basement xenoliths (Figure 26). They essentially consist of very coarse -grained quartz, alkali feldspar, biotite, muscovite and as well as minor, magnetite and apatite. Several of them have well-developed graphic textures of alkali feldspar and exsolved quartz.

Mafic dykes are relative common in the Johan Petersen fjord area and are clearly of several generations as some just occur in xenoliths and other, the more dominant type, intrude both the granites and the xenoliths. These mafic dykes are generally straight-sided, steeply dipping and often have N-S strike orientations. Closely space parallel dykes occur in some instances and south-stepping en echelon relations are also observed. The mineral assemblage consists of plagioclase, pyroxene and Fe-Ti oxides. The dykes are phaneritic and show grain size reduction towards the margins that sometimes are chilled. Both equigranular and porhyritic textures were seen, with the latter type having phenocrysts of plagioclase. Typically the dykes are less than 3 m wide but there are also some larger regional dolerite dykes with widths up to 50 m that can be followed for several kilometers.

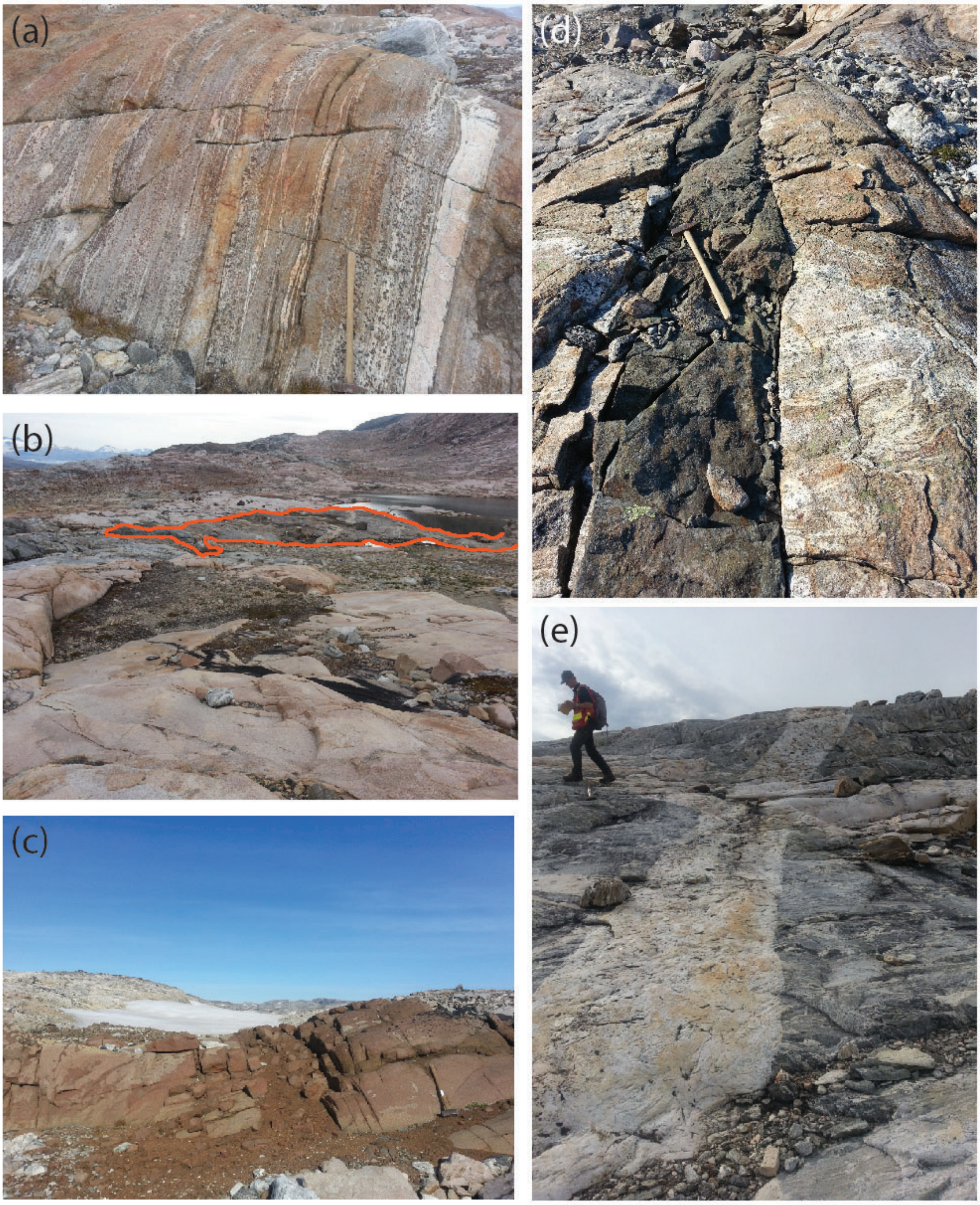


Figure 26. *Representative rock types from the Johan Petersen Fjord area. (a) Banded garnet-rich layers in metapelitic gneiss. (b) Typical outcrop of pinkish granite which is the predominant rock type in the area. Grey area enclosed by red line in the middle ground is basement gneiss xenolith. (c) Large 20-30 meter wide regional dolerite dyke striking NW-SE intruded into granite. The dykes are traceable for more than 5 km to the NW. (d) N-S trending basaltic dyke in large gneiss xenolith. (e) Typical N-S trending pegmatite dyke related to granites and intruded into one of the large grey gneiss xenoliths.*

The Sulugssut Intrusive Complex

Geological background

The Sulugssut Intrusive Complex (SIC) is the southernmost known Paleogene intrusion of East Greenland. Because of its location slightly inland and hidden partly beneath the ice in a semi-nunatak area, it was first discovered in 1986 during a helicopter fly-by (Brooks et al. 1986). The intrusive complex is situated at 66° 30’ N; 34° 45’ W in a fairly inaccessible area between the two glaciers of K.J.V. Steenstrup Søndre and Nordre Bræ (Figure 27). The complex measures *c.* 5 km in diameter and consists of a plutonic core with silica-undersaturated rocks dominated by tinguaites and ijolites, with numerous associated dykes and sheets of silica-undersaturated character. Brooks et al. (1989) described three distinct types of dykes (all <1 m wide) within different areas of the complex: (1) grey porphyritic dykes with alkali feldspar and nepheline in the groundmass, (2) greenish, fine-grained trachytic to phonolitic dykes (tinguaites), and (3) rusty brown-weathering dark coloured porphyritic dykes.

Field observations

In 2014 camp T13/C3 was established on the glacier at 1170 m.a.s.l., close to a sharp ridge that could be accessed from the camp site by traversing a narrow snow field (Figure 28). Whereas the core part of plutonic complex was unreachable from the camp, the neighbouring ridge contained a number of alkaline dykes belonging to the SIC that was targeted during the 2-3 days allocated for the camp. The chosen camp site is near site ‘B’ of Brooks et al. (1989); a site where these authors described a dense dyke swarm of diverse types cutting a dark pyroxene-nepheline rock (ijolite). The dykes noted at locality B was of types (1) and (2) above, as well as “dark highly fissile rocks, grey micro-syenites and a very felsic rock type remarkable for its schillerized feldspars (‘moonstone’).” As described below, we did not encounter all of the rock types described by Brooks et al. (1989), but instead found that the dykes on the investigated ridge cut through gneiss basement rather than ijolite. Another difference compared to Brooks et al. (1989) is that we encountered dykes of lamprophyric and nephelinitic composition with veinlets of carbonatites, which were not described before. In addition to the ground-based work, a short photo-flight was carried out around the central plutonic core upon leaving the camp site (Figure 27).

At the ridge 3-4 smaller (<2m wide) mafic alkaline dykes were found cutting the basement which consisted of felsic, banded gneiss with strongly developed foliation and occasional meta-gabbroic rocks (see below). At the top of the ridge a *c.* 2 m wide composite dyke (135/55°, dip-dip) of fine-grained mafic alkaline rocks were studied and sampled in detail (Figure 29a,b). The main rock constituting the dyke is a fine-grained mafic rock resembling a lamprophyre. It contains small clots of alkali pyroxene/ alkali amphibole and has dark mica (phlogopite) in the groundmass. Parallel to strike two thin veneers of brownish weathering carbonatite-rich material intrudes and infiltrates the mafic dyke; locally it is developed as clusters of larger calcite crystals (up to 1 cm) (Figure 29b). Six samples

(563927-33) were taken evenly across the dyke for closer petrographic and chemical investigations.

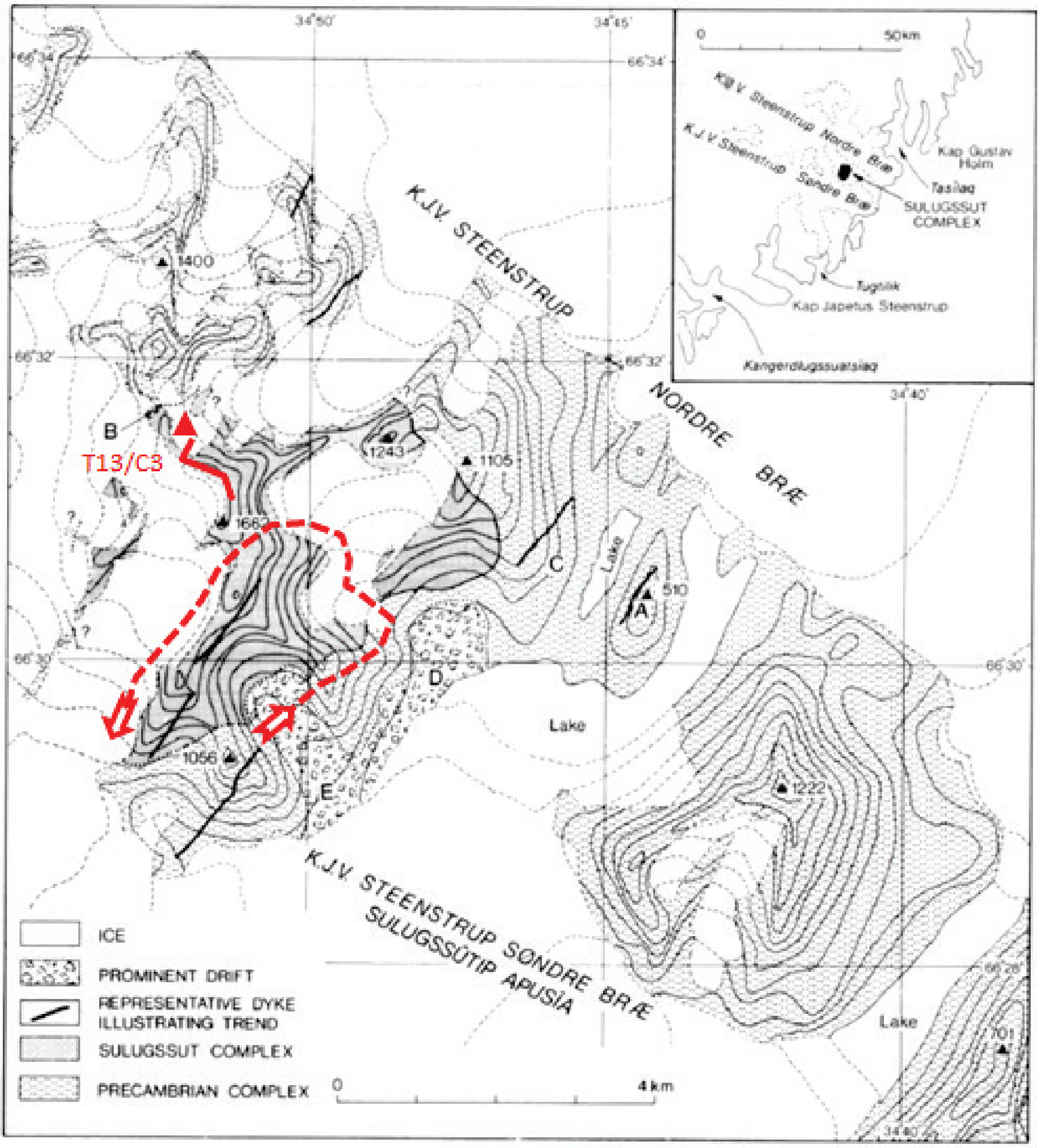


Figure 27. *Map of the SIC from Brooks et al. (1989) showing the T13/C3 camp position (red triangle), operational area (red line) slightly peripheral to the intrusive complex. Also shown is the approximate path for the photo-flight (red stippled line). Localities visited in 1986 by K. Brooks and co-authors are shown by sites "A-E". Contours are 100 m equidistance.*

Figure 28. *(a) Google Earth view towards SW of the Sulugssut Intrusive Complex (66.5412°N, -34.7729°W), showing the location of camp T13/C3 at top of the glacier at c. 1170 m.a.s.l. close to site "B" of Brooks et al. (1989) (see Figure 27). The central part of the intrusion is the darker parts in the left side of the image. The working area was restricted to the ridge placed above the camp to the left. (b) View of the camp from the neighbouring ridge; the tents are placed on snow that covers part of the glacier. (c) Photo of the south-facing slope where peripheral SIC dykes could be accessed and studied.*

Figure 29. *(a) and (b): A c. 1 m wide frost shattered mafic alkaline dyke exposed as a trace on the surface at top of a crest some 200 m SE of camp. The dyke is compositionally zoned comprising mica-bearing mafic rock (melanephelinite) with thin rusty orange-brown irregular veins of carbonate rich material (carbonatites). (c) and (d) Grey nepheline(?) porphyritic dyke, c. 80 cm wide. Close-up photograph showing how the grey dyke locally is infiltrated by a dark rock with voids possibly from dissolved carbonate. (e) Lamprophyre dyke with oblique sheets of carbonatite cutting across and into the wall rock gneisses. (f) Typical basement gneiss is a finely banded, highly fissile gneiss alternating in colour from grey to brown to black. A leucocratic part of the gneiss (sample 563945) was taken for U/Pb geochronology.*

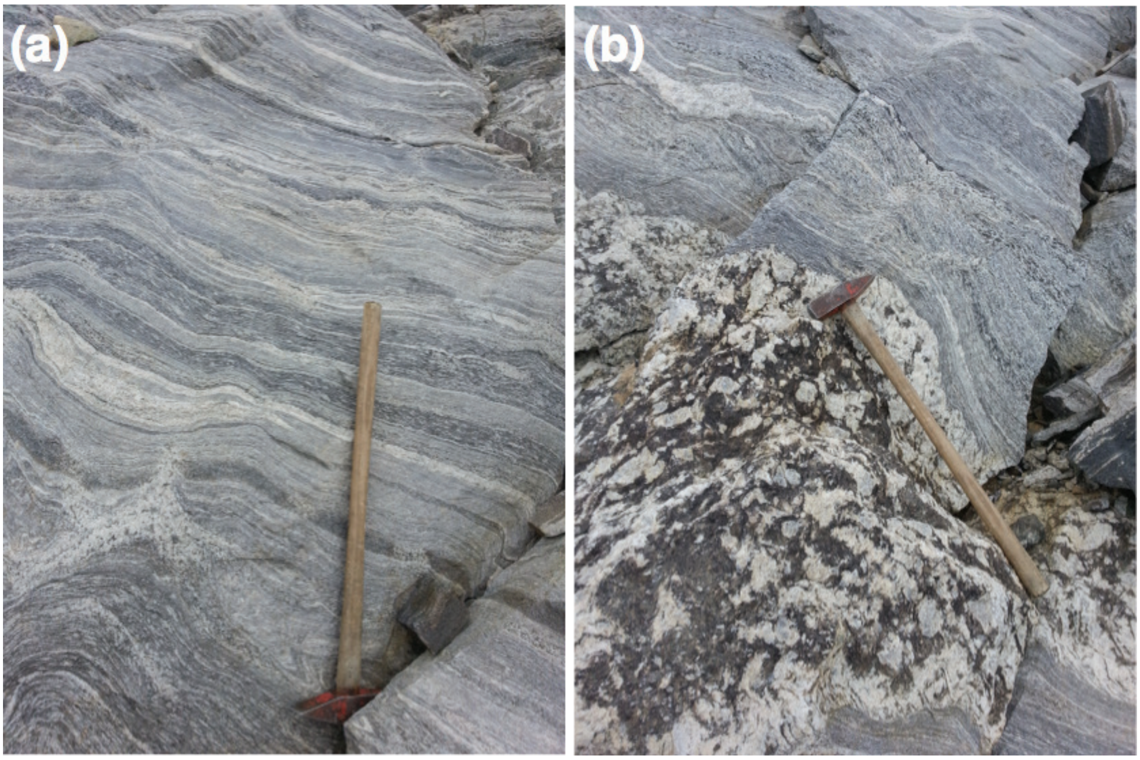


Figure 30. *(a) General view of the host gneiss at Sulugssut showing well developed gneissic fabric (b) Host gneiss and metre-thick sheet of leucogabbroic basement material.*

The Palaeogene dykes observed at camp T13/C3 are hosted in a highly strained, mid-grey granitic gneiss that exhibits a well developed gneissic to locally mylonitic fabric (Figure 30. a). The gneiss includes a metre-thick sheet and enclaves of an augen gneiss of leucogabbroic to anorthositic composition, comprising plagioclase megacrysts of several centimetres in size set in a finer groundmass of biotite and hornblende. The augen gneiss is reminiscent of the Fiskenæsset anorthosite in SW Greenland. A further possible occurrence of this lithology was found at 14BMS012.

A sample of the mylonitic gneiss basement (563945; see Figure 29f) was taken for U/Pb age dating.

The Kap Gustav Holm plutonic centre

Geological background

The Kap Gustav Holm plutonic centre (66° 36' N, 34° 15' W) is exposed on the narrow headland of Kap Gustav Holm and the adjacent island of Nanertalik (Figure 31). The peninsula forms a characteristic camel back shape with an impressive relief, as the two peaks both reach over 1000 m above sea level; especially the western side is very steep and inaccessible for sampling. The plutonic centre is composed of early intrusive units of gabbro followed by later intrusions of monzonite, syenite and granite in the form of cross cutting ring dykes and plugs. The plutonic centre was initially described by L.R. Wager (1934) as a result of the British Arctic Air-Route Expedition in 1930-31. Some 40 years later in 1977 GGU took on a regional mapping program in the area and in 1978 John Myers carried out detailed mapping of the Kap Gustav Holm plutonic centre. During the 1990's the area was revisited by the Danish Lithosphere Centre and collaborative university partners with the purpose of studying the petrogenesis of the intrusive suite (Myers et al. 1993), as well as understanding the hydrothermal alteration history (Kleckner, 1997).

The plutonic rocks at KGH occur in the centre of the Coastal Dyke Swarm, which they intrude into (Figure 32). The dyke swarm outcrops along the East Greenland margin over a distance of *c.* 350 km where they intrude the Archaean basement and overlying cover sequence of late Mesozoic – early Paleogene sediments and basaltic lavas (Figure 31). The various generations of dykes are inclined variably westwards, reflecting the progressive coastal flexuring that associated the initial stages of continental break-up in the NE Atlantic starting at *c.* 55 Ma. The KGH plutonic centre started forming with the emplacement of gabbros into the basement of Archaean quartzo-feldspathic gneisses that were deformed and recrystallized under amphibolite facies metamorphic conditions (Myers et al. 1993). Based on the sagging of the gabbro intrusion and the cross cutting relationship to the coast parallel dyke swarm the KGH gabbros are estimated to have formed slightly after 55 Ma, and the subsequent intermediate to felsic intrusions were dated by Rb-Sr and K-Ar methods, indicating imprecise but overlapping intrusion ages from 53 ± 5 Ma to 49 ± 3 Ma (Myers et al. 1993).

Field observations

During the 2014 field season the KGH plutonic centre was studied by two 3-pax field teams; T7 (Christian Tegner, Thomas Ulrich, Charles Lesher) and T13 (Thomas Kokfelt, Jakob Kløve Keiding, Sam Weatherley) for 3 – 4 days from field camp positions situated in the relatively broad northern saddle point (Figure 31). In addition team T17 worked in the northern saddle point concentrating on the Mesozoic sediments. The main objectives of the fieldwork at KGH were to study and sample as many of the intrusive units as possible, but also the older basalts and sediments (to the extent we came across them), and to improve the geochronological constraints of the plutonic centre by subsequent radiometric dating at GEUS (principally involving zircon U/Pb LA-ICPMS work). The gabbro and southern monzonite pluton units were not readily accessible in the setup for the field work as it did not involve a boat. Consequently the main focus was placed on sampling the intermediate to evolved rocks that could be reached from the northern saddle. Nonetheless, during a short helicopter reco stop on Nanertalik Island situated east of KGH peninsula a few samples of gabbro were collected.

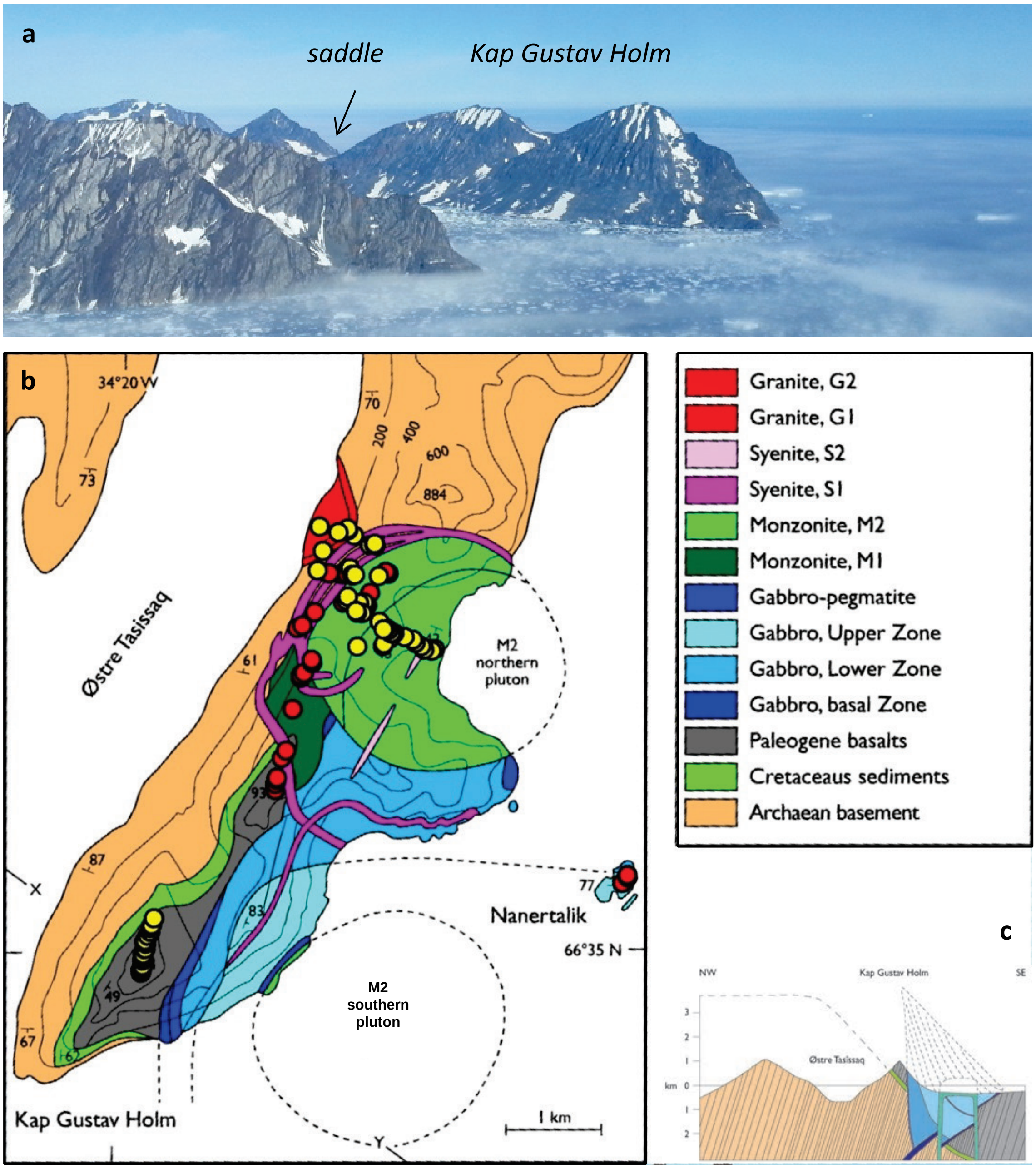


Figure 31. *(a) View of Kap Gustav Holm (KGH) from the SW; white arrow indicates approximately the position of the camp site in northern saddle; to the left, Archaean basement rocks (pale) intruded by various generations of coast-parallel dyke swarms. (b) Geological map of Kap Gustav Holm showing sample localities; red circles: T13, yellow circles: T7. (c) Schematic cross-section through the southern part of the intrusion (profile drawn along line 'x – y' in (b)). (b) and (c) are after Myers et al. (1993).*

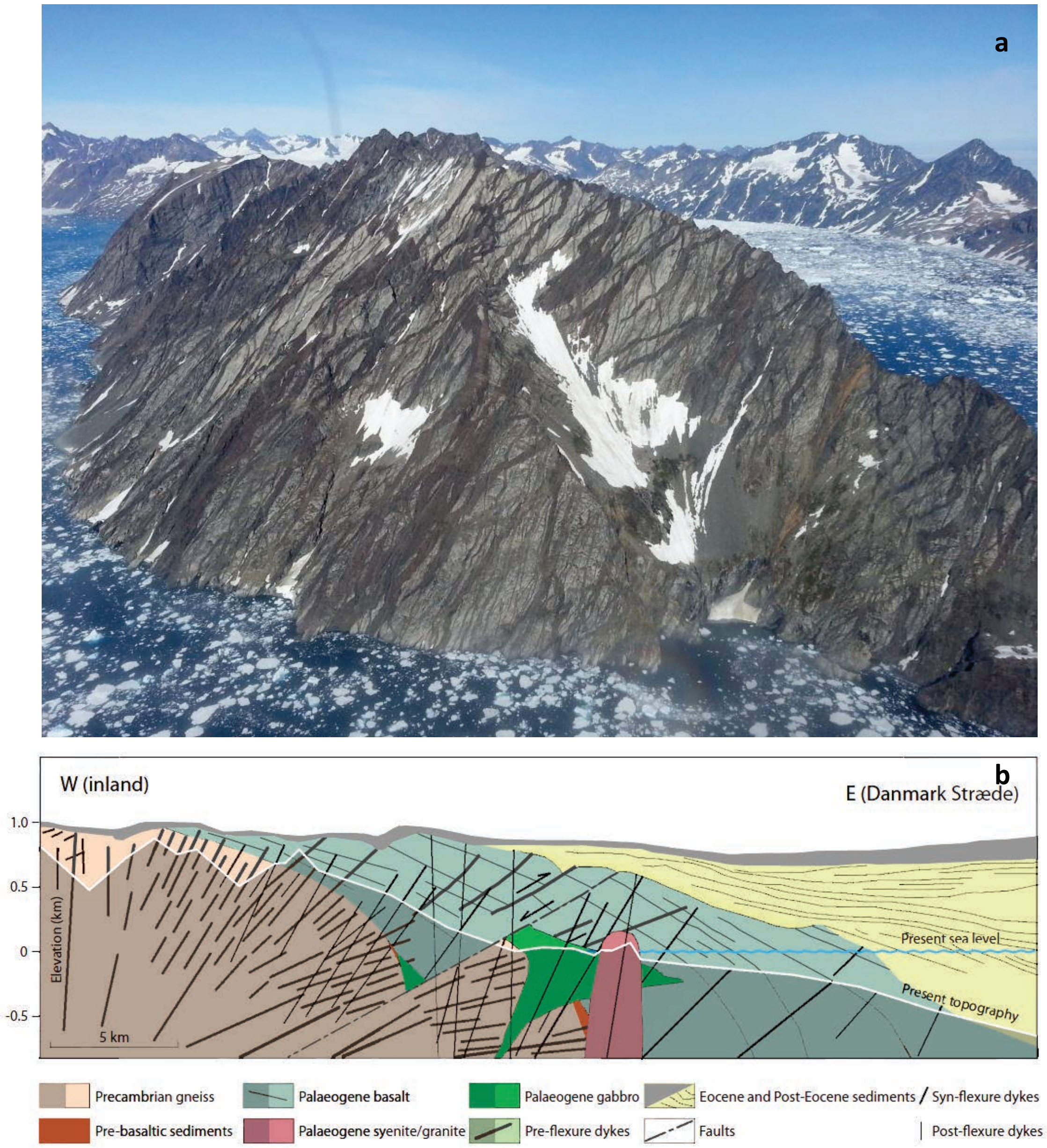


Figure 32. *(a) View of the Coastal Dyke Swarm intruding into Archaean basement gneisses at peninsula immediately to the west of Kap Gustav Holm. (b) Conceptual profile showing the coastal flexure that was generated during the opening phase of the NE Atlantic Ocean. From Brooks (2011).*

Late Mesozoic sediment

Mesozoic sediments are according to the map of J. Myers indicated to outcrop in the southern part of the KGH peninsula as a semi-coherent a few *c.* 100 m thick succession below the basalts. In reality T17 did not find any sediments, which could indicate that the map view is false or at least represents an oversimplification of nature. It should be mentioned however, that the steep topography made it exceedingly difficult to access the area of proposed Mesozoic sediment outcrops (P. Alsen, pers. com.). T13 managed to find two localities where rafts of sediments were included within the syenite ring dyke as rather large xenoliths. The sediments consisted of finely laminated white sandstone and grey siltstone, sometimes with layers of dark organic rich layers (Figure 33).

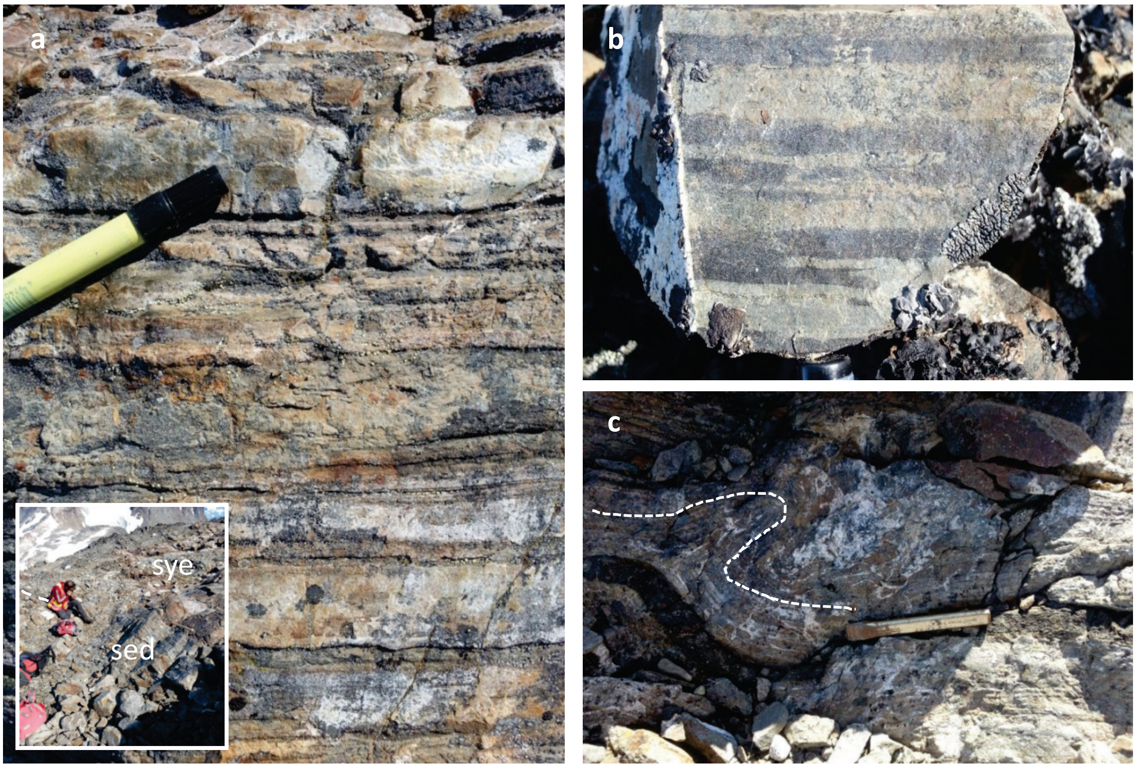


Figure 33. *Mesozoic sediment at KGH plutonic centre. (a) Finely laminated sandstone/ silt-stone as xenolith raft in syenite (insert: outcrop scale; sed = sediment, sye = syenite). (b) Baked laminated sediment with pale and dark layers (c) Fold structure in sandstone above dark con-cordant (organic-rich?) layer.*

Basalts

Basalt make up the basement cover and form a coherent outcrop along the ridge in the southern part of the KGH peninsula. Due to the coastal flexure the basalts now lie with a 40° angle dipping towards SE overlying the Mesozoic sediments. The basalts have been proposed as equivalent to the Lower Basalt Formations of the Kangerdlugssuaq region (Nielsen et al. 1981). Within the intrusive units of the KGH plutonic centre numerous xeno-liths occur that are variably hornfelsed by contact metamorphism. The basalts at the north-ern crest are comparatively well preserved and have preserved identifiable textures and structures including vesicles (now zeolite-filled) and chilled pillow-like structures (Figure 34), the latter indicating formation in a submarine environment. A systematic sampling of the basalts was undertaken by T7 along the southernmost crest during a half-day drop off. Generally the basalts are plagioclase-bearing without notable olivine, indicating that these lavas most probably represent relatively evolved basalts. Further investigations of the bas-alts including petrographic and chemical analyses will clarify whether the basalt sequence at KGH indeed can be regarded as Lower Basalt equivalents.

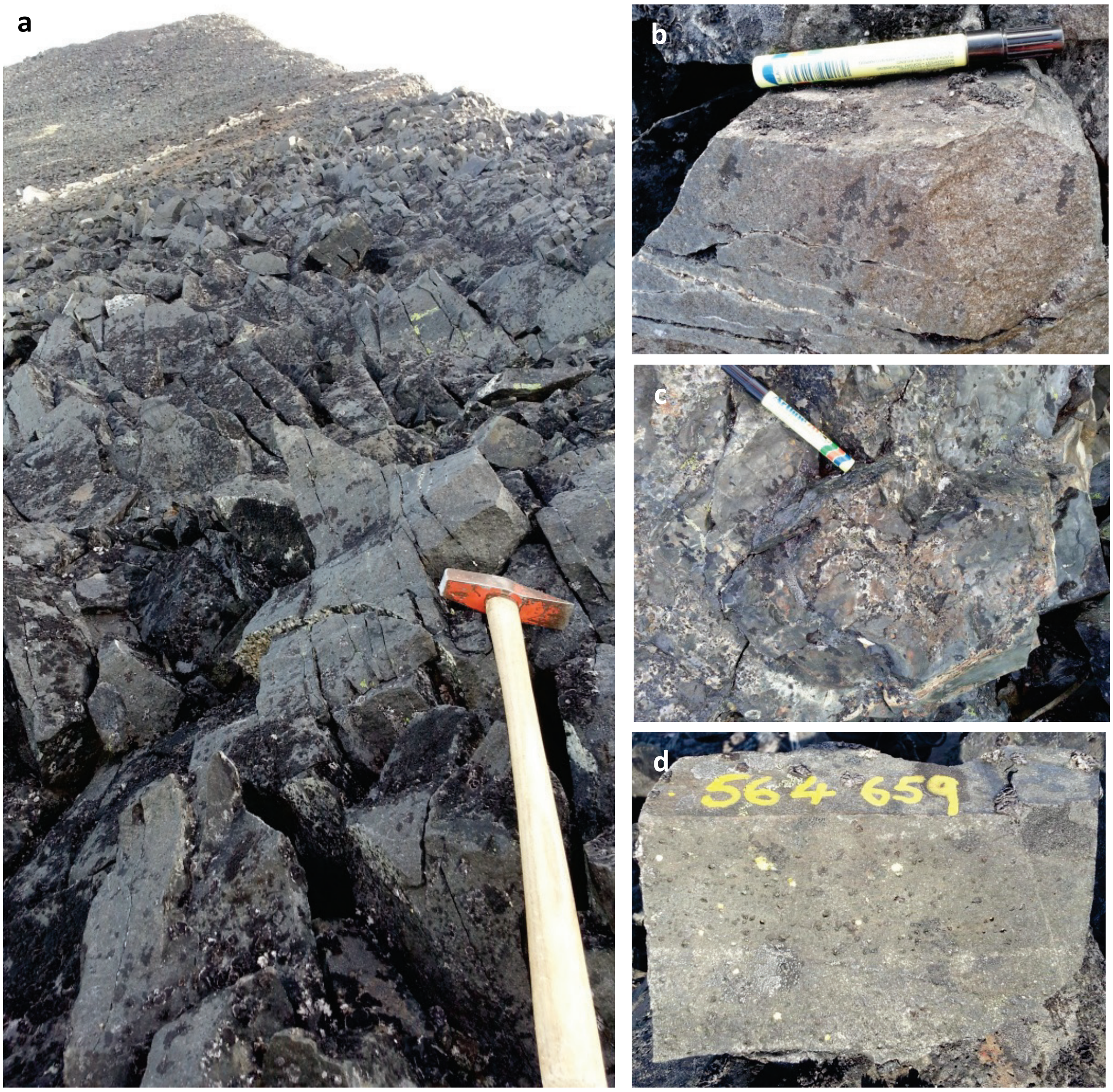


Figure 34. *(a) View towards S along the northern crest, which consists of basalts that are tilted c. 40 degrees towards SE (the jointing plane stands roughly orthogonally to the surface of the flows). Note white patch in mid distance, which is a syenitic dyke intrusion with brecciated dioritic component (see also Figure 37). (b) Plagioclase-bearing basaltic lava with vesicles partly filled out by zeolites. (c) Pillow-like structure indicating formation in contact with water. (d) Vesicular basaltic lava with a greenish colour sampled for chemical analysis.*

Gabbros

The KGH gabbro intrusion cuts across the Archaean gneisses, the late Mesozoic – early Paleocene sandstones and volcanic rocks, and the Coastal Dyke Swarm (Figure 32). The gabbros comprise a layered sequence of plagioclase-pyroxene-olivine-magnetite cumulates that according to Myers et al. (1993) has been subdivided into three lithostratigraphic units: (1) a Basal Contact Zone, (2) a Lower Zone and (3) an Upper Zone. In addition non-layered intrusive sheets and pipes of late gabbro pegmatite constitute part of the KGH gabbro intrusion. All of the layered units show more or less well developed magmatic layering that consistently dip steeply towards SE, indicating that the gabbro intrusion was tilted after emplacement. The time gap between the emplacement of the gabbro and the subsequent untilted, more evolved rock units of monzonite, syenite and granite is currently unconstrained due to the relatively large uncertainty of existing age data (Myers et al. 1993).

The Basal Contact Zone

This zone consists of deformed, fine- to medium-grained foliated gabbro up to 100 m thick. The gabbros of this unit comprise zoned plagioclase, augite and hornblende with minor orthopyroxene and biotite.

The Lower Zone

This zone comprises 250 – 1500 m thick unit of fairly massive, medium-grained olivine gabbro with pronounced igneous lamination of plagioclase. Magmatic layering is often poorly developed as defined by subtle variations in the ratio between felsic and mafic minerals. Late stage reactions are prevalent near the base of the Lower Zone, where brown hornblende rims augite and opaque minerals and fills interstices.

The Upper Zone

This zone consists of medium-grained gabbro with a minimum thickness of between 500-700 m (top is eroded away). Small-scale magmatic layering is prominent and well-developed, and often of great lateral extent. Individual layers are often mineral-graded and some show igneous lamination of plagioclase. The mineralogy of the gabbro is similar to that of the Lower Zone except that late-stage reactions are less advanced and amphiboles are accordingly less prevalent.

Gabbro pegmatite

Gabbro pegmatite forms a number of sheets up to 150 m thick that are broadly concordant with the igneous layering of the layered sequence (now steeply dipping). The sheets consist of massive coarse-grained gabbro with abundant vugs, possibly representing slowly cooled trapped magma, and leucocratic patches that may represent contamination wall rock (dissolved xenoliths) or in situ differentiation into more evolved magma.

During the fieldwork part of the KGH gabbro was studied during a short helicopter landing on the island of Nanertalik (66.591 N; -34.197 W), where the contact between Lower Zone and Upper Zone gabbros is indicated on the map (Figure 31). The rock types collected included medium – coarse-grained regular gabbro and a more pegmatitic variety (Figure 36). The contact between the two units of gabbro was not readily apparent, which could indicate that it is not sharp and well defined. A *c.* 4 m wide WSW-ENE trending plagioclase porphyric mafic dyke was also sampled at its eastern margin.

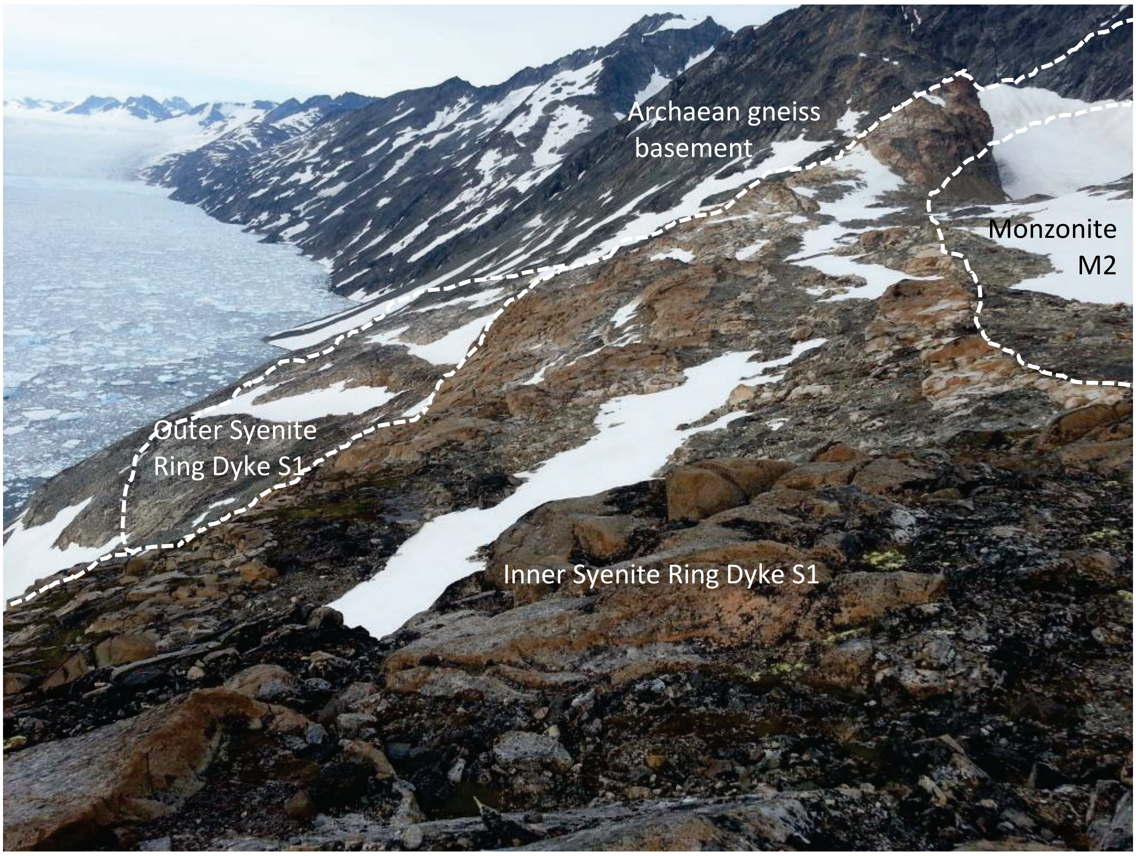
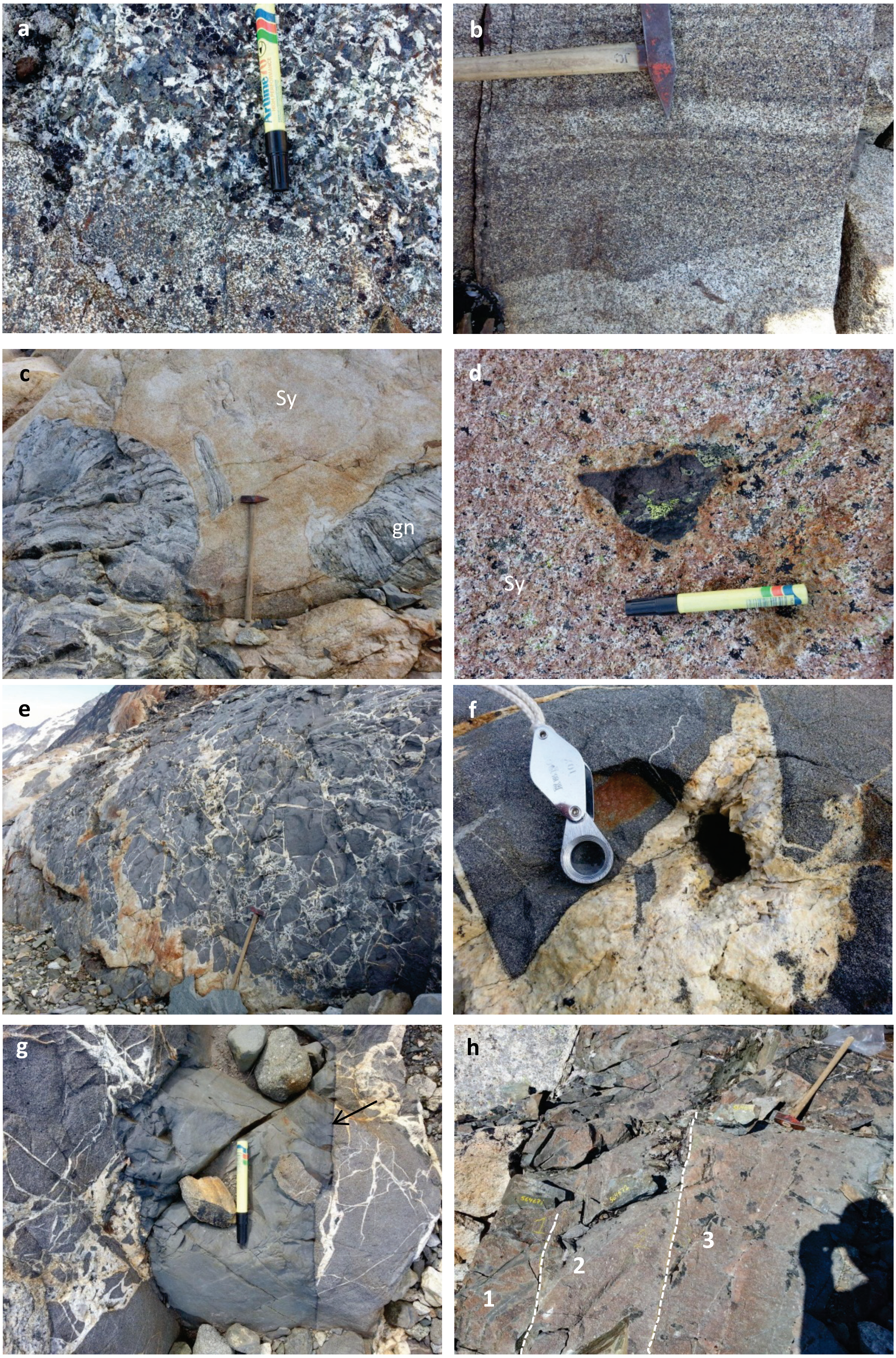


Figure 35. *View towards north showing the western part of the northern M2 monzonite surrounded by several generations of S1 syenitic ring dykes (inner and outer).*

Figure 36. *(next page). Intrusive rocks of the KGH plutonic centre investigated during the GEUS 2014 field season. (a) Gabbro pegmatite/aplite, Nanertalik island. (b) Monzonite (M2) northern unit showing magmatic layering. (c) Ring dyke syenite with xenoliths of gneiss basement. (d) Coarse -grained syenite ring dyke with chilled and partially dissolved/disseminated mafic enclave (note train of smaller mafic pods in syenite). (e) Syenite ring dyke with brecciated blocks of metabasalt. (f) Syenite with a 2-3 cm large miarolithic cavity intruding and brecciating sharp blocks of metabasalt. (g) Aphanitic mafic dyke with distinct chilled margin (arrow) cutting syenite with brecciated blocks of metabasalt. (h) Composite dyke, c. 4 m wide, intruding into syenite ring dyke; at least three generations of magma injections are identified and sampled (labelled 1 - 3).*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Monzonite

Monzonite, syenite and granite form ring dykes and circular plug-like plutons. Similar to in many other of the Paleogene intrusive complexes along the east coast of Greenland these relatively evolved intrusions cut the gabbros and post-date these, and also show little evidence for being tilted seawards. The intrusion style with ring dykes and central plutons indicate that the plutons were emplaced by a combination of stoping and cauldron subsidence. At KGH two types of monzonite occur, M1 and M2. M1 is a medium -grained hornblende monzonite with plagioclase, K-feldspar, biotite, clinopyroxene, magnetite and apatite. It forms a steep-sided pluton, only part of which is exposed as a wedge between younger syenite ring dykes and the northern M2 monzonite pluton, which truncates it (Figure 35). The main M2 monzonite forms a major circular pluton 2.5 km in diameter that was intruded into the northern part of the gabbro. The monzonite is coarse -grained, consisting of olivine, poikilitic hornblende, with plagioclase, K-feldspar, clinopyroxene, orthopyroxene and magnetite. It contains abundant inclusions of basaltic lava and tuff as rafts and smaller xenoliths. The inclusions are angular and net-veined by the monzonite. The walls of the intrusion are vertical, but within the pluton igneous layering and xenolith trains of volcanic rocks dip inwards toward the centre of the pluton, defining an internal saucer-shaped structure. The abundance of volcanic inclusions and circular shape suggests that the pluton was emplaced mainly by a combination of cauldron subsidence and stoping into the base of the volcanic pile that crops out on the adjacent mountain top some 200–300 m above the highest present level of exposure of the monzonite.

The northern M2 pluton is divided into a Lower Zone and an Upper Zone; in the former volcanic inclusions comprise *c.* 50%, whereas in the latter they occur in subordinate amounts relative to monzonite. The Upper Zone is more iron-rich as witnessed by numerous thin layers rich in magnetite. In the Upper Zone the monzonite has well-developed magmatic layering with mineral grading and igneous lamination of plagioclase laths, but also shows numerous examples of sedimentary structures, such as erosional channels, cross-bedding and load-casts (Figure 36b). A similar but less well-preserved plug-like pluton of M2 monzonite (M2 southern pluton) is inferred to intrude in the south-eastern part of the complex (Figure 31). Team 7 conducted a systematic sampling along an E – W oriented profile across the northern M2 pluton (Figure 31).

Figure 37. *(next page) Intrusive syenitic breccia intruded as a c. 5-10 m irregular dyke into the basalts near the northern peak. (a) View of outcrop. (b) Heterolithic syenite with sharp edged xenoliths/blocks of basalt, tuff and more rounded blobs of coarse-grained gabbroic rocks. (c) Intermediate hybrid rock (monzonite?) with more mafic (dioritic?) blobs. (d) Semi-rounded mafic blob with chilled margins enclosed in syenitic matrix. (e-g) Samples collected from the locality: 564662 – 564670.*


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Syenite

Two types of syenite, called S1 and S2, were earlier identified (Myers et al. 1993); both syenite types occur as vertical or sub-vertical ring dykes, or partial ring dykes, which both cut and encircle the northern M2 pluton (Figure 35 and Figure 36). The syenites are generally uniform and coarse -grained. In some cases well developed miarolitic cavities are observed indicating relatively shallow crustal levels (Figure 36). Away from contacts the syenite units are generally free of xenoliths, but locally angular xenoliths of gneiss, metabasalt, or monzonite occur (Figure 36). The S2 syenite forms short vertical dykes cutting the upper part of the northern M2 monzonite pluton (Figure 31).

Granite

Granite occurs as a semi-circular, dome-shaped pluton and associated ring dyke complex in the extreme NW of the KGH centre, and also as numerous sheets and ring dykes cutting gabbro around the southern M2 monzonite pluton (Myers et al. 1993). The granite pluton consists of a core of uniform coarse -grained biotite granite, G2, enclosed successively by ring dykes of fine -grained, grey granite, G1, and microdiorite. The contact between G1 and G2 is partly sharp, with evidence of stoping of solid G1 by molten G2, and partly cuspate, suggesting that both magmas co-existed in an unconsolidated state (Myers et al. 1993). Team T7 sampled in the contact zone between G1 and G2 lithologies.

Dykes

Besides the ring dykes a number of straight, steeply dipping dykes of microdiorite occur with strikes mainly sub-parallel to the Coastal Dyke Swarm, i.e., NNE – SSW. These dykes cut the monzonite plugs as well as the syenite ring dykes and often show very well developed chilled margins (Figure 36). In addition, trains of disrupted microdiorite dykes also occur in the syenites and monzonites, which suggest that these dykes intruded into unconsolidated rock, and therefore presumably were closely related in time to the ring dyke intrusions. A composite microdiorite dyke that cut the inner syenite ring dyke in the northern part of the KGH plutonic centre was sampled for petrography and chemistry. The dyke is *c.* 4 m wide and contains three generations of intrusive pulses, each marked by chills (Figure 36).

Intrusive breccia

Near the top of the northern peak an intrusive syenitic breccia intrudes as a *c.* 5-10 m irregular dyke into the basalts (Figure 37). The various components of the intrusive breccia system were sampled for chemical characterisation and for zircon U/Pb age dating.

The Kialineq area

Geology of the Kialineq Plutonic Centre

The Kialineq Plutonic Centre (KPC) is situated at *c.* 67°N on the east coast of Greenland some 200 km north of Ammassalik in an extremely mountainous area. The centre includes several associated plutons of dioritic to quartz syenitic and granitic compositions that intruded the basement rocks between 35 and 40 Myr ago (Brooks, 1977; Brown and Becker, 1986; Nielsen, 2002) Figure 38. The major intrusions represent a subvolcanic (cauldron) environment with emplacement as ring dykes and bell jar plutons. Associated with these intrusions is an extensive acid-basic mixed magma complex that instructively demonstrate the coexistence of mafic (basic) and felsic (acidic) liquids, where the former magma is being chilled against the latter forming a net-veining and mingling complex. The KPC includes the following intrusive units (descriptions from GEUS intrusion data sheet by Nielsen (2002)):

Aliuarssik granite intrusion

The Aliuarssik granite intrusion is exposed on Nuluk headland and the west coast of Aliuarssik island. The contacts are steep on Nuluk, but dip 30° outward on Aliuarssik. The granite is believed to form a *c.* 5 km wide stock. Unpublished age information (K-Ar and Rb-Sr) suggests an age around 35 Ma (D.C. Rex, pers. comm., 1985). Gleadow & Brooks (1979) give fission track ages between 36 and 39 Ma. Detailed descriptions are given by Brown & Becker (1986).

Pueratse complex

The Pueratse complex is not well defined. Two ring dykes, Pueratse Syenite 1 and Pueratse Syenite 2 are emplaced into dioritic breccias and commingled acid and basic melts. The breccias and commingled melts are all part of the 'Skrækkensbugt complex', but they may constitute an intrusion of 'Kialineq Diorite' in its own rights. Bernstein & Bird (2000) shows the ellipsoidal outline of a plutonic centre at the head of Pueratse bay. The complex would be *c.* 5.5 km N-S and 4 km E-W. The syenitic ring dykes are shown in the unpublished sketch map (D.C. Rex, pers. comm., 1985). The outer ring dike (Pueratse Syenite 1) almost circumscribes the entire complex and is up to 2 km wide. The second ring dike (Pueratse Syenite 2) is only partially developed in the central part of the complex and only up to 0.5 km wide.

Pilagpik syenite intrusion

Little-known up to ca. 14 km long and 1 km wide syenite ring dike. The dike cuts through Pilagpik Island, follows the south coast of Suvtiutsarqorôq bay and swings northwest and north toward the south margin of Laube Gletscher. The ring dike seems intruded in the western contact between basement and the Kialineq diorite. In accordance with the field information a K-Ar hornblende age of 32 Ma is suggested (D.C. Rex. pers. comm., 1985). Rex also gives a mineral isochron with an age of 37+/-2 Ma. This age is probably too old. No detailed information is published.

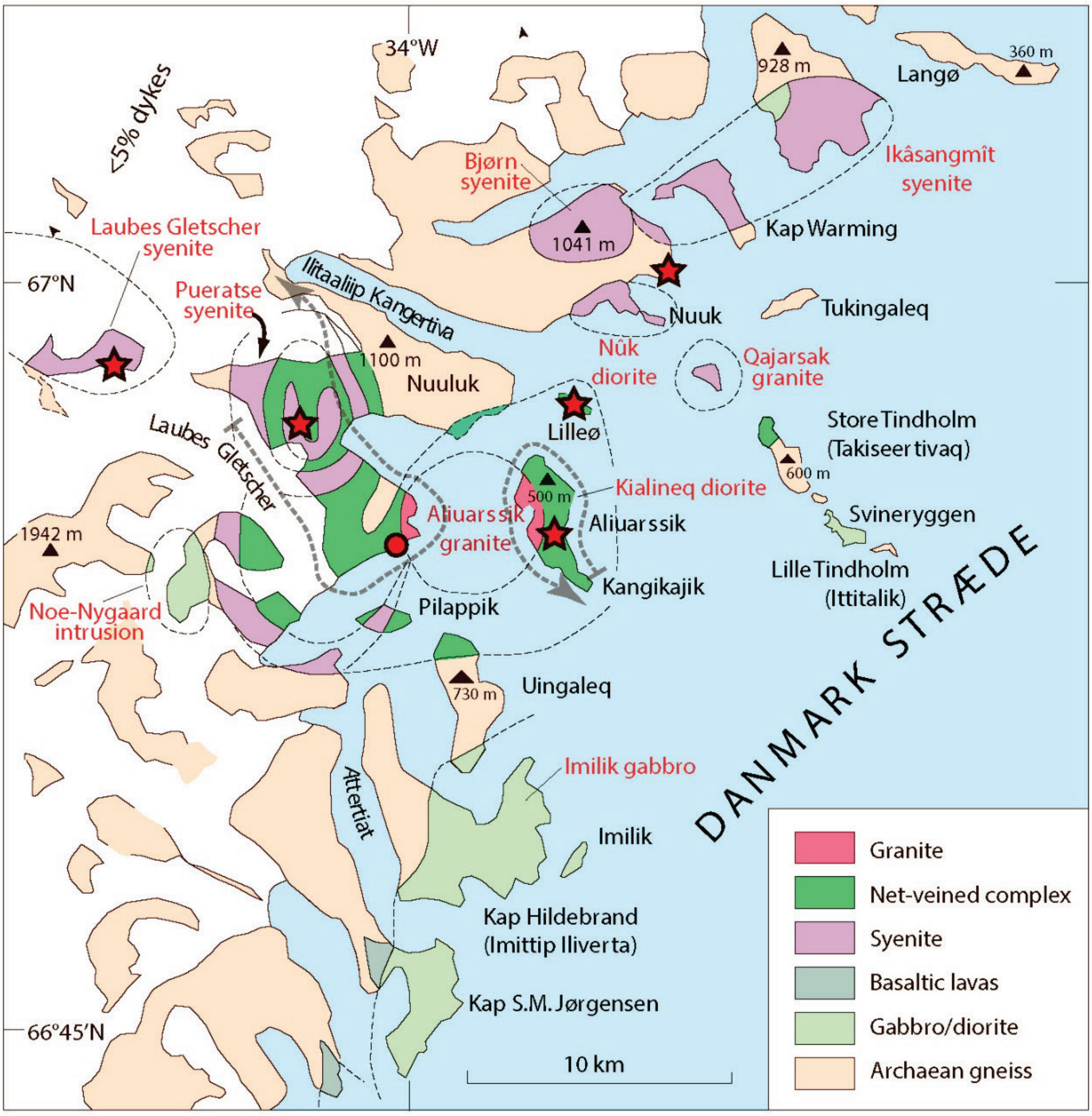

Figure 38. *Geological map of the Kialineq area. Geological localities in red and corresponding geographical names in black. Red stars mark reco stops, red circle marks camp T7/C3. Grey stippled lines mark photo-flight lines. Map is from Brooks (2011), after Bernstein & Bird (2000) based on D. Rex, 1985, unpublished.*

Qajarsaq granite intrusion

Little-known part of granite intrusion on Qajarsaq island (e.g., Deer, 1976). The name 'Matikalaq' has been adopted by J.S. Myers. The intrusion is on publication maps (e.g., Bernstein & Bird, 2000) shown as a circular, plug-like intrusion with a diameter of *c.* 5 km. This is only an educated guess as all contacts are below sea level. Studies are restricted to investigations of grab samples. Unpublished age information (K-Ar and Rb-Sr) suggests an age of 38-40 Ma. (D.C. Rex, pers. comm., 1985). Gleadow & Brooks (1979) give a zircon fission track age of 34.5 +/- 0.9 Ma.

Nûk intrusion

Complex of diorite breccias on the headland northwest of Qajarsaq. Breccias and dykes and sheets of commingled felsic and mafic magmas appear to overlie a biotite-bearing microdiorite. Brooks (1977) described samples from Nuuk. The inland areas of the intrusion towards the Bjørn syenite intrusion have not been mapped. No age has been published, but the intrusion is believed to be around 35 Ma old.

Field observations

The following descriptions are based on two days of helicopter reco flying in the Kialineq area, first on July 28th with T7 and then on August 3rd with Bo Møller Stensgaard. The joint helicopter reco with T7 included two 1-2 hours drop offs within the Kialineq Plutonic Centre, on Lille Ø and on Aliuarssik island. The helicopter reco flying on the July 28th also included a 1-hour drop off at a coastal outcrop of Palaeogene volcanics north of the old settlement of Nuuk (see below). The helicopter reco on August 3rd included two drop-offs on top of the Pueratse Syenite and at the Laube Gletscher Syenite (see below). Two consecutive photo-flights were conducted on both reco days, one flight around the island of Aliuarssik and another in the central part of the Pueratse diorite-syenite complex (Figure 38).

Lille Ø

Lille Ø consists mainly of diorite (or quartz diorite) that is intruded by series of inclined sheets of syenite and in which co-mingled mafic and felsic magmas occur (Figure 39). The morphological features include crenulated interfaces and cusp boundaries at margin of the sheets and interior mafic pillows that consist elongate trains over tens of meters (Figure 39a,b). The sheets are typically 3-5 m wide each occurring every *c.* 50 m. They have a general NW-SE orientation and shallow dip of 15-20°. The “host” diorite is typically medium -grained, massive with plagioclase, biotite and amphibole. In several areas the diorite host contains blobs of slightly darker diorite indicating several mafic magmas co-existed at a liquid state (Figure 39c). A NE-SW trending mafic (brown) dyke, *c.* 1-2 m wide was seen to cut the diorite-syenite complex (Figure 39d). Samples taken during the reco stop were allocated to T7 docket book and include GGU-numbers: 563520-563529.

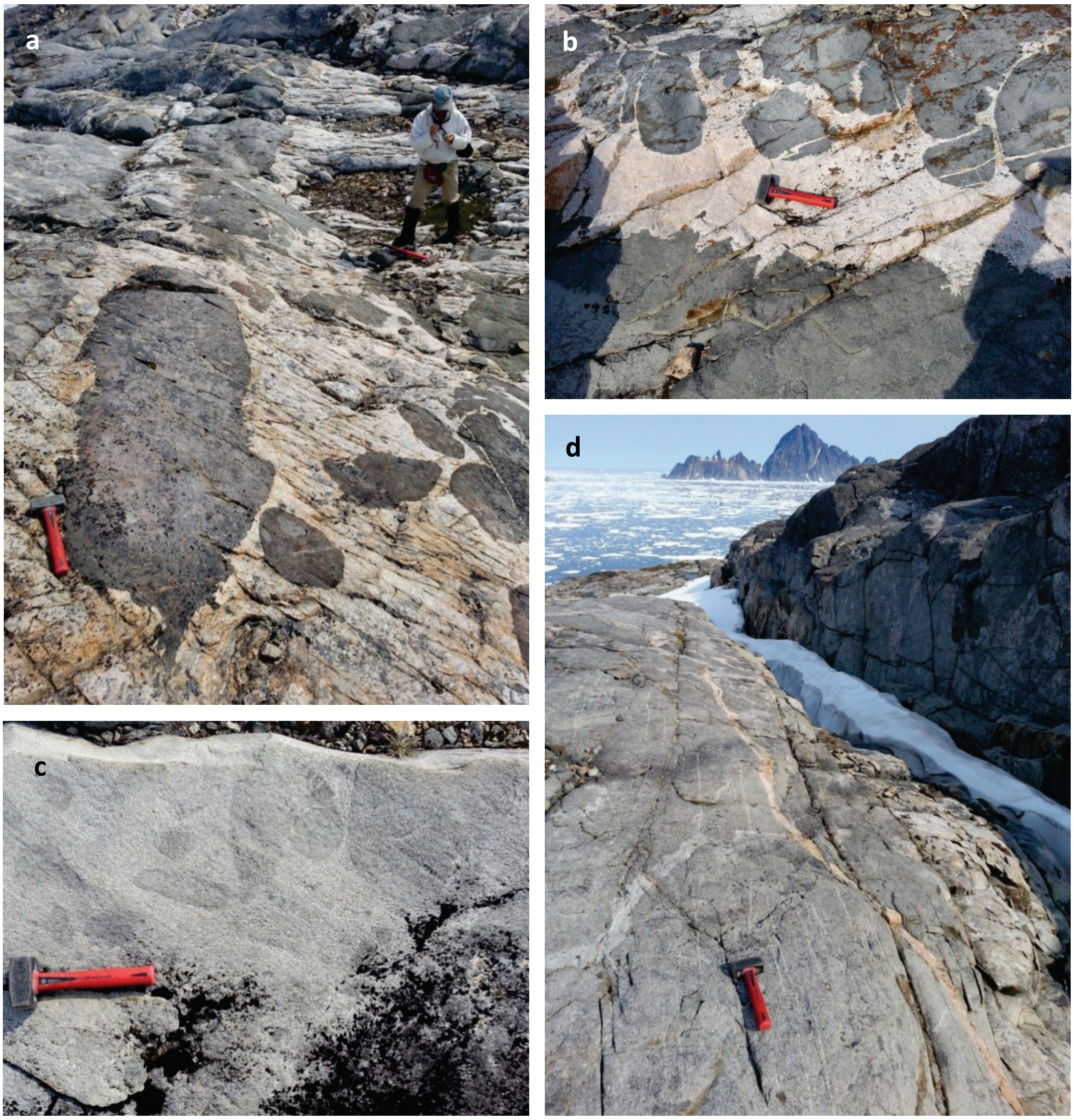

Figure 39. *Rocks of the Kialineq Plutonic Centre as studied on Lille Ø during a 1.5 hours reco drop off on the island (14TFK066-069). (a) c. 3-4 m wide inclined syenitic sheet with parallel oriented trains of dioritic pillows, up to 2-4 m in size. (b) Close-up of the contact of a syenitic sheet showing a sharp cuspate marginal contact, a zone of "pure" syenite followed by interior part with large proportion of dioritic pillows. (c) Within the diorite away from the syenitic sheets, dioritic blobs with a slightly more mafic composition are seen as blobs in a matrix of lighter diorite(?). (d) The diorite is cut by late stage syenitic veins (reddish vein) and by a later 1-2m wide brown mafic dyke striking c. 65° (dyke orientation defined by the snow fan); Store Tindholm is seen in the background.*

Figure 40. *Rocks of the Kialineq Plutonic Centre on Aliuarssik island (14TFK070-071). (a) Overview photograph of the island looking towards west; note the flat-lying brighter syenitic (sy) sheets in the darker diorite (di), and the up-doming of the sheets closer to the granite intrusion (gr); arrow indicates main sampling area. (b) Medium – coarse -grained syenite with few mafic phases. (c) Medium -grained massive diorite. (d) Co-mingling of diorite and syenite at interface of flat-lying syenitic sheet. (e) A c. 2 m wide olivine-plagioclase bearing mafic dyke containing inclusions of basement gneisses (not shown) and magnetite-rich gabbroic rock (cumulate?).*

Aliuarssik

Aliuarssik island is composed of much the same rock types as found on Lille Ø, namely a ‘host’ diorite intruded by gently inclined syenitic sheets of *c.* 3-5 m width (Figure 40). The western part of the island exposes the Aliuarssik granite, which however was inaccessible from the landing site. Based on the map of Bernstein & Bird (2000) (Figure 38) this granite intrudes the diorite-syenite mingling complex, which in the field is seen by an up-doming of the mingling complex towards the granite as seen by a steeper inclination of the sheets (Figure 40a). The landing site included the exposure of a semi-planar surface defining an interface between a syenite sheet and diorite. The syenitic sheets include different varieties with variable amounts of mafic minerals, but generally the syenites appear to be somewhat coarser -grained than on Lille Ø. Similar to Lille Ø the interface between the syenitic sheets and diorite is crenulated, cuspate indicating co-mingling of magmas with contrasting rheological properties (Figure 40d). A 1-2 m wide mafic olivine-plagioclase dyke with abundant inclusions of gneissic basement rocks and gabbroic magnetite-rich cumulates was seen to cut the diorite-syenite complex (Figure 40e). Samples taken during the reco stop were allocated to T7 docket book and include GGU-numbers: 563530-563537.

Pueratse Syenite Complex

A helicopter drop off lasting 1 hour was dedicated to study the interior parts of the Pueratse Syenite Complex as a complement to the investigations carried out along the coast by T7. The investigation area constituted a relatively flat plateau at *c.* 1000 m altitude near the proposed inner ring dyke (the 'Pueratse Syenite 2'), and enabled us to study and sample the contact relationships between the syenitic and dioritic rocks of the complex (Figure 39). Observations along a *c.* 200m NNW-SSE transect revealed medium to coarse -grained syenite to be the dominant lithology. Towards the southern end of the transect line, co-mingled relationships between syenite and diorite were seen (Figure 39b-d). Loose blocks of coarse -grained syenite with large euhedrale quartz crystals set in miarolitic cavities were also found, indicating a relatively shallow level for this part of the magmatic system. Overall the reco stop did not clarify the exact architecture of the complex, with respect to whether the inner syenite ring dyke indeed exists as depicted on the geological map of Bernstein & Bird (2000) based on D. Rex (unpublished). To further resolve this question a photo-flight was flown around the Pueratse syenite obtaining a good coverage of the central part of the complex (grey stippled line on Figure 38).

Figure 41. *Reco stop in the inner part of the Pueratse Syenite at c. 1000 m.a.s.l. (14TFK111-113). (a) Panoramic view of the plateau looking towards NW to E. (b) Diorite (di) intruded and brecciated by syenite (sy) that forms fine veins in the diorite. (c) Same as (b) but here the interface between diorite and syenite is clearly crenulated indicating co-mingling of magmas. (d) Medium -grained syenite with dispersed cm-sized droplets of fine -grained diorite illustrating mingling of magmas (loose block of local origin). (e) Cm-sized euhedrale quartz crystals set in a medium -grained syenite, presumably constituting a miarolitic cavity (loose block of local origin).*

Geology of the Laube Gletscher Syenite Intrusion

The Laube Gletscher Syenite Intrusion is situated in the nunatak area inland from the KPC and constitutes a large lens shaped intrusion that measures *c.* 11 x 3.5 km in outline (Figure 38). Due to its rather inaccessible location the intrusion has not been investigated in any greater detail; Nielsen (2002) mentions an unpublished K-Ar age by Dave Rex of *c.* 35 Ma, but otherwise little is known. Accordingly the purpose of a reco visit was to obtain samples for petrology, geochemistry and geochronology purposes.

On the helicopter reco on August 3rd T13 together with BMST made a challenging toe down landing on the Laube Gletscher Syenite in a saddle along a narrow (30 x 3 m) ledge (Figure 42a). TFK and JKK investigated and collected rocks along the ledge for *c.* 45 minutes while the helicopter went away for refuelling and doing a photo-flight of the KPC. The landing site proved to be highly fortuitous and interesting from a geological perspective as it contained a wide range of rock types, including rocks of felsic to intermediate composition. The overwhelmingly dominant rock type in visual distance of the landing site was a coarse -grained brownish weathering syenite (Figure 42b), which seems to constitute the bulk part of the intrusion. On the ledge, however, a local occurrence of mixed and mingled rock types occurred. Although the intrusion geometry was difficult to establish with confidence, it seemed likely that the mixed rocks had been emplaced within a dyke-like structure cutting the main syenite, and oriented at a high angle to the outer boundary of the Laube Gletscher Intrusion. The lithologies hosted within the dyke include a fine-medium -grained syenite (Figure 42c) that is intermingled with a medium -grained feldspar porphyric diorite (Figure 42e). The boundaries between the felsic and mafic end members are rounded and smooth, indicating the coexistence of these magmas of contrasting composition. Various degrees of hybridisation occur within the dyke evidenced by rocks of intermediate colour (Figure 42d). This hybridization is likely to have occurred at various deeper levels of the magma plumbing system, rather than *in situ*.

The ledge locality was sampled in order to obtain a good representation of the lithological and chemical diversity and to include as many of the textural varieties as possible. In total 14 samples (563911 – 563923) were selected for bulk rock chemical analyses and petrographical thin sections. In view of the currently poor age constraints (by K-Ar) on the Laube Gletscher Intrusion a subset of three samples from the sample suite was furthermore selected for zircon separation with respect to carrying out U/Pb age dating at GEUS. Two samples returned zircons and are in process of being dated (autumn, 2015).

Figure 42. *Helicopter drop-off (14TFK114) at the eastern contact of the Laube Gletscher Syenite Intrusion. (a) The sharp ledge at which sampling was carried out (site for toe-in landing behind person). Typical coarse-grained brownish weathering syenite in background and foreground is cut by a dyke-like composite intrusion (centre of photograph) that hosts mingled felsic and mafic magmas. (b) Typical coarse-grained brownish weathering syenite. (c)-(e) Mafic and felsic components of the dyke include (c) Medium-grained syenite, and (e) medium-grained feldspar porphyric diorite. (d) Evidence for mingling and hybridization of the mafic and felsic magmas is abundant within the dyke. Hybridization gives rise to rocks of intermediate colour and composition.*

Rhyolitic agglomerate deposit

The helicopter reco in the Kialineq district on July 28th with T7 included a stop at a coastal outcrop of Paleogene volcanic rocks *c.* 2.5 km WSW of Kap Warming and *c.* 3 km east of Bjørn Syenite (Figure 38). The locality (67.01196° N, 33.75360° W) was reached by landing the helicopter on the boulder beach at low tide, with the tide turning an hour was spent to study and sample the rocks. The sequence of felsic volcanic rocks are exposed along a *c.* 400 m stretch of the beach and it extends for *c.* 200 m up the coastal cliff side, which becomes progressively steeper and higher towards the south. The southern contact is defined by a steep fault zone, along which a rather intensive yellowish staining of the rocks is seen. The staining results from alteration and weathering of semi-massive sulfides and presumably reflects a more intense alteration towards the more fluid permeable fault zone. The northern termination of the volcanics was not visited.

Previous work in the area is sparse and does not include a proper mapping of the volcanic outcrop. Brown and Becker (1986) noted that the volcanics encompass a variety of rock types conspicuous among which is flow banded, devitrified, rhyolite. They also presented a single chemical analysis of a rock sample (their sample #7716), demonstrating that the composition is mildly peralkaline (i.e. with normative acmite). Brown and Becker (1986) also noted that the presence of siliceous and fragmentary intermediate extrusive rocks of alkaline nature is in keeping with the rock types found in the nearby Kialineq plutonic complex. In relation to the widespread sulfides in the rocks, Brooks (1972) recommended to perform a gold assay on samples from the pyritized rhyolites.

The typical rock is heterolithic with a range of types and sizes of clasts placed in a greenish matrix of devitrified glas (Figure 43). Locally a flow banding can be observed to wrap around clasts. The clasts vary with respect to shape, size and composition and include rounded and angular types of different color and composition. Some clasts are juvinile magmatic components, others are of rudimentary origin (lithic fragments). Usually the juvinile components are in the lapilli size range, but they may reach up to *c.* 1 m large bombs (Figure 43d), suggesting proximal conditions for the extrusion. In case of the larger bomb these are elongated possibly reflecting distortion during transportation in the air and subsequent flattening during flow and compaction. We did not observe pinched lapilli pumice, or fiamme, indicating that the flow is not an ignimbrite proper. The lithic fragments consist of wall rock lithologies, mostly granitoid varieties including isotropic and gneissic textures. Some of these are angular, others rounded due to erosion transport.

The outcrop seems to represent an agglomerate desposit where the juvinile clasts represent bombs that have been distorded and flattened during transport (in the air?) and during flow. Alternatively the outcrop could reflect a lahar deposit, but this would arguably not result in flow banding features observed.

Sulfides in form of disseminated chalcopyrite, pyrite ± pyrrhortite, along with malachite, occur throughout the various lithologies of the outcrop. These sulfides are likely to reflect redeposition after extrusion caused by hydrothermal activity under influence of meteoric water or seawater.

Six samples were taken (564701-564706), representing the matrix as well as the various types of clasts residing in the matrix (Figure 43f). These rocks will be analyzed for bulk rock chemistry and three of them have been separated for zircon with the prospect of doing U/Pb age dating by LA-ICPMS at GEUS. Such U/Pb ages will help to constrain the source of the volcanics, and possibly confirm the proposed genetic relationship to the Kialineq plutonic centre. In addition to the outcrop depicted in Figure 43f, samples from the sulfide-stained zone at the southern termination were sampled by T7 (Thomas Ulrich samples 563513-563519). Some of these samples are being analysed for precious metal contents at a commercial laboratory.

It should be mentioned that the short stop at the locality was insufficient to obtain a more detailed insight into the outcrop morphology, size and shape, including identification of one or several flow units. Additional work was scheduled in the field but this had to be abandoned due to problems with polar bears in the area.

Figure 43. *Down-faulted volcanic rocks exposed along a coastal outcrop north of the old settlement at Nuuk (14TFK065). (a) Outcrop scale of green heterolithic altered tuff (agglomerate). (b) Close-up showing rotation of rounded lithic clast in matrix that also contain numerous smaller angular clasts. (c) Variously shaped clasts set in a green matrix of altered ash with occasional flow bands draping around the clasts. (d) A 1 x 0.4 m large felsic clast showing signs of flattening. (e) Lithic clasts of basement rocks, rounded and angular in rhyolite tuff. (f) Six samples were taken (564701-564706; note the sample numbers initially given were later changed) representing some of the variation in clast lithologies. Additional samples from the site were taken by T7 (see T7 field report).*

References

21st North, 2014: The Ammassalik Prospect, Komatiite Hosted Nickel-Copper-PGE Mineralisation in Southeast Greenland, http://21stnorth.com/PDF-filer/The%20Ammassalik%20Prospect.pdf.

Andersen, T., H. Austrheim, & D. Bridgwater., 1989: P-T Evolution of the Angmagssalik ‘Charnokite’ Complex, SE Greenland, In: Bridgwater (Ed.), Fluid Movements - Element Transport and the Composition of the Deep Crust, Kluwer Academic Publishers, 71–94.

Bernstein, S. & Bird, D.K. 2000: Formation of wehrlites through dehydration of metabasalt xenolith in layered gabbros of the Noe-Nygaard intrusion, Southeast Greenland. Geological Magazine 137(2), 109-128.

Brooks, C.K. 1977: Example of magma mixing from the Kialineq district of East Greenland. Bull. Geol. Soc. Denmark, vol. 26, 77-83.

Brooks, C.K. 2011: The East Greenland rifted volcanic margin. Geological Survey of Denmark and Greenland Bulletin 24, 96 pp.

Brooks, C.K., Dawes, P.R., Soper, N.J. 1989: The Sulugssut intrusive complex: a new Paleogene alkaline centre in East Greenland, In: F. Kalsbeek (ed.) Rapport 146, Geology of the Ammasalik region, South-East Greenland, Grønlands Geologiske Undersøgelse, , 95-103.

Brooks, C.K. and Stenstrop, G. 1989: The Ivnartivaq complex, Sermilik, Ammassalik. Grønlands Geologiske Undersøgelse rapport 146. 87-89

Brown, P.E. & Becker, S.M. 1986: Fractionation, hybridisation and magma-mixing in the Kialineq centre, east Greenland. Contributions to Mineralogy and Petrology 92, 57-70.

Brown, P.E., van Breeman, O., Noble, R.H. & Macintyre, R.M. 1977: Mid-Paleogene igneous activity in East Greenland - the Kialineq complex. Contributions to Mineralogy and Petrology 64, 109-122.

Chadwick, B. & Vasudev, V.S. 1989: Some observations on the structure of the early Proterozoic, Ammassalik mobile belt in the Ammassalik region, Sout-East Greenland. Grønlands Geologiske Undersøgelse rapport 146, 29-40.

Deer, W.A. & Kempe, D.R.C. 1976: Geological investigations in East Greenland. Part XI. The minor peripheral intrusions, Kangerdlugssuaq, East Greenland. Meddelelser om Grønland 197(4), 25 pp.

Deer, W.A. 1976: Paleogene igneous rocks between Scoresby Sund and Kap Gustav Holm, East Greenland. In Escher, A. & Watt, W.S. (eds) Geology of Greenland, 404-429. Copenhagen: Grønlands Geologiske Undersøgelse.

Escher, J. (1990). Map sheet no. 14, Skjoldungen Compilation by J. C. Escher, 1990. 67° 00' N - 62° 30' N; 43° 15' W - 35° 50' W

Friend, C.R.L. & Nutman, A.P. 1989: The geology and structural setting of the Proterozoic Ammassalik Intrusive Complex, East Greenland. Rapport Grønlands Geologiske Undersøgelser 146, 41–45.

Furman, T., Frey, F. & Meyer, P. S. 1992: Petrogenesis of evolved basalts and rhyolites at Austurhorn, southeastern Iceland: the role of fractional crystallization. Journal of Petrology 33, 1405-1445.

Gleadow, A.J.W. & Brooks, C.K. 1979: Fission track dating, thermal histories and tectonics of igneous intrusions in east Greenland. Contributions to Mineralogy and Petrology 71, 45-60.

Hansen, B. & Kalsbeek, F. 1989: Precise age for the Ammassalik Intrusive Complex. Rapport Grønlands Geologiske Undersøgelser 146, 46–47.

Kalsbeek, F., Austrheim, H., Bridgwater, D., Hansen, B.T., Pedersen, S. & Taylor, P.N., 1993: Geochronology of Archaean and Proterozoic events in the Ammassalik area, South-East Greenland, and comparisons with the Lewisian of Scotland and the Nagssugtoqidian of West Greenland. Precambrian Research **62**, 239-270.

Kleckner, A. 1997: Petrogenetic implications of the presence of meteoric water in the northern monzonite intrusion of Kap Gustav Holm and other nearby East Greenland intrusions. Unpublished M.Sc. thesis. Stanford University, 87 pp.

Kokfelt, T.F., Weatherley, S., Keiding, J.K., Árting, T.B. 2015: Magma mixing, mingling and hybridisation at different crustal levels: Snapshots from 1.9 billion years of magmatism in south-eastern Greenland. Geological Survey of Denmark and Greenland Bulletin. 33, 45-48.

Myers, J.J.S., Gill, R.C.O., Rex, D.C. & Charnley, N.R. 1993: The Kap Gustav Holm Tertiary Plutonic Centre, East Greenland. Journal of the Geological Society 150, 259-276, doi:10.1144/gsjgs.150.2.0259.

Nielsen, T.F.D., Soper, N.J., Brooks, C.K., Faller, A.M., Higgins, A.C., Matthews, D.W., 1981: Pre-basaltic sediments and the lower basalts of Kangerdlugssuaq, East Greenland: The stratigraphy, lithology, paleomagnetism, and petrology, Meddelelser om Grønland, Geoscience, 6, 1-25.

Nielsen, T. F., 2002: Palaeogene intrusions and magmatic complexes in East Greenland, 66 to 75° N, Danmarks og Grønlands Geologiske Undersøgelse Rapport 2002/113, 249 pp.

Riolfo, L.A. et al, 2014: Experimental reaction-driven liquid film fingering instability, Chemical Physical Letters 534, 13-18.

Turnbull, R., Weaver, S., Tulloch, A., Cole, J., Handler, M. and Ireland, T., 2010: Field and geochemical constraints on mafic-felsic interactions, and processes in high-level arc magma chambers: An example from the Halfmoon Pluton, New Zealand. Journal of Petrology, 51, 1477-1505.

Wager, L. R., 1934: Geological investigations in East Greenland, part 1. General geology from Angmagssalik to Kap Dalton. Meddelelser om Grønland 105, 46 pp.

Weidendorfer, D., Mattsson, H.B. and Ulmer, P. 2014: Dynamics of magma mixing in partially crystallized magma chambers: Textural and petrological constraints from the Basal Complex of the Austurhorn Intrusion (SE Iceland). Journal of Petrology 55, 1865-1903

Wiebe, R.A. & Hawkins, D. P 2015: Growth and Impact of a mafic–silicic layered intrusion in the Vinalhaven Intrusive Complex, Maine. Journal of Petrology 56, 273-298.

Wright, A.W., Tarney, J., Palmer, K.F., Moorlock, B.S.P., Skinner, A.C. 1973: The geology of the Ammassalik area, East Greenland and possible relationships with the Lewisian of Scotland, In: Park R.G. & Tarney, J. (Eds.), The Early Precambrian of Scotland and Related Rocks in Greenland, University of Keele 157-177.

Appendices

Day-by-day account by TFK (T13, T8)

(22/7- 5/8; T8: 6/8-18/8)

<u>20/7:</u> Very sunny and warm day in DK (28° C).
Departure from home address in Espergærde @ 16.00. Ø-train to CPH airport, departure with FI213 at 19.45 to Reykjavik together with Holger Paulick. Arrival in Keflavik at *c.* 20.30, taking the airport shuttle to Nordica Hotel Hilton where we stayed for the night for onwards transport to Kulusuk the following day. Made arrangements with Marco Fiorentini and Nico Theibault (University of Western Australia, Perth) who travelled by themselves to Iceland ahead of us.

<u>21/7:</u> Flight from Reykjavik @ 10.15 to Kulusuk landing 10.05 Greenlandic time. Weather in Kulusuk was sunny and *c.* 8° C, no wind.
Got local transport by Bent to the oil harbour at Kulusuk for further transportation to Kummuit by speedboat with Dan. Got close to a couple of gentle giants, two majestic hump back whales swimming in the Ammasalik fjord. Arrived at base camp and met with Bo, Michael and Rune. Sorted out the camp with Sam, who in the meantime had got the rubber boat in a operational mode. Left for T13 /camp 1 in the afternoon with Sam and Matti. Established camp in the beginning of the smaller fjord to the north of Ikaasartivaq within the gabbro unit mapped out on the 1:500,000-scale map.

<u>22/7:</u> Very nice weather, warm sunny and little wind.
Experienced an Earthquake swarm of *c.* 9-10 quakes, starting from 06.31 a.m. to 07.56 a.m. each quake being accompanied by a roaring sound with the shaking. The intensity was generally around 2-3, possibly with some >3, on the open Richter scale. Reported the swarm over the Racal radio, but no other teams had apparently felt the quake, indicating it to be fairly local. In the morning we went NW of camp on foot to look at the gabbro, which generally is rather homogenous, at places possibly with at weak foliation. It is uncertain if the gabbro is magmatically layered; weak striations on the surface could be possibly be interpreted as minute variations in modal abundances of minerals. After lunch we went in rubber boat to the fjord NW of camp to find the contact to the granite and to the basement.
Samples taken: **564601-564609**.

<u>23/7:</u> Rainy night and morning, clearing somewhat during the day. Rubber boat to eastern end of Ikaasartivaq fjord, where we made a detailed sampling of a composite dyke with globule texture that cuts the granite and basement. The dyke includes two hybrid rocks types (+/- fsp phyric) and an end member mafic rock mostly occurring as a chilled contact of the dyke. Planning to revisit for sampling with saw by help of Michael. Continued after lunch along the north side of the fjord towards west where granite is dominant on map. In reality a large proportion of mafic rocks also occur. We went ashore and found a previously unmapped intrusion of gabbronorite intruding unto granite. The outline of the intrusion is oval and measures *c.* 200x100 m (was mapped out). The gabbronorite showed some mineralogical variation. Plan is to do a rough sampling of it on the 24/7. A reco in the area is scheduled for the 25/7.
Samples taken: **564610-564623** and **563627-563630**.

24/7: Cloudy but no rain, fine for boat work.
Boat work in Ikaasartivaq fjord starting with collecting a sample profile of 6 samples through the small mafic intrusion from rim to rim. Continued westwards along the northern shore observing and collecting the lithologies. Granite occurs at shore side as according to the map until. A funnel shaped mafic intrusion stands up the cliff to the east of the place where supracrustal rocks meet the shore on the map (green map unit).West of here diorite (+/- fsp porphyric) is the dominant rock type and occurs often associated with a more coarse - grained fsp rich granodiorite as an intermingled texture (globules and cauliflower) indicating that both rocks being present as melts simultaneously.
Samples taken: **563621-563637**.

25/7: Blue sky and sunny from morning to evening, slight breeze from the sea with fug moving in along the fjords further to the south.
T13 helicopter reco together with Bo, Lærke and Matti to the northern side of the Ikaasartivaq fjord starting from camp 1 at 9.40 a.m. and ending at 17.45 with five stops in total. Stop 1: at top NW of camp in what should be granite but was banded basement gneiss locally intruded by coarse-grained granite. Samples taken: 563638 and 563639. Stop 2: Sam and Bo jumped off and the rest flew to other side of valley (stop 3). Pinkish coloured granite sheets in gneiss. Samples taken: 563640-563642. Stop 3: Tubular granite body intruded by diorite. Samples taken: 563643 & 563644. Stop 4 (lunch stop): two diorites intermingling with granite. Samples taken 563645-563658. Stop 5: Composite 4-5 m wide inclined sill/dyke with mingled mafic and felsic components cross-cutting gneiss basement.
Samples taken: **563638-563660**.

26/7: Sunny with little wind.
Worked in fjord north of camp and studied the relationship between the diorite and granite.
Samples taken: **564624-564634**.

27/7: Sunny with little wind.
Michael Nielsen arrived with hired boat at camp with equipment for sawing rocks at two localities north of camp and one at the composite/mingling dyke at NE part of Ikaasartivaq fjord. Locality 14TFK058: Three samples cut across granite with dioritic material splaying into the granite along a fan shaped shear zone: 564635-637. One sample cut across mafic rounded enclave in granite: 564638. Locality 14TFK057: Contact zone between gabbronorite and granite is in part lobate. Mgr gabbronorite with irregular veins of cgr granite into the gabbronorite. Up to m sized sharp edged gneiss xenoliths occur in granite, and are particularly abundant in contact zone to gabbronorite. Two cut samples cut taken in contact zone: 564639-640. Locality 14TFK009: Sampling across composite mafic dyke at NE Ikaasartivaq fjord shore side. Three samples cut: 564641: southern margin; 564642: in centre of dyke; 564643: across northern margin. Returned to camp by 16:00 where Michael was picked up and sailed back to base camp by hired boat.
Samples taken: **564635-564643**.

28/7: Helicopter reco to the Kialineq area together with T7 (CT, TU, CL). Weather sunny and perfect for reco work both around Kummiut and as it turned out at Kialineq.

Flew to T7/C2 at shore near contact btw diorite and granite of the Kialineq Plutonic Complex (KPC).
Stop 1 (14TFK065): On rocky beach where a down faulted block of heterolithic volcanics are preserved some *c.* 300m along the coast and *c.* 200m up in the coastal cliff. Sam returned to help pilot with slinging the rubber boat at T7/C2 to new T13 camp site at Nûk 2.8 km SSW of locality. Six samples taken by TFK representing the main lithologies present: **564701-564706**. Additional samples taken by TU (563513-563519, see T7 field report); together with Chip Lesher TU sampled the volcanics at the southern contact, where intense rust-staining reflects local oxidation of sulfide minerals.
Stop 2 (14TFK066-69): Lilleø. Sam and TU returned with pilot to sling fuel barrels at depot site at Imilik further to the south (fuel to be used in spring 2015 by the polar bear crew). Zone of mainly diorite of the KPC, but with sheets of Qtz syenite that show profound mingling features with diorite indicating coexisting magmas. Several types of diorites (some possible hybrids?) occur with lobate internal contacts. TU samples taken: 563520-563529 (see T7 field report).
Stop 3 (14TFK070-71): Kangikajik (larger island south of Lilleø): TU + SW returned, CT took off with pilot to move T7 camp to C3 position at KGH (northern saddle). Same lithologies and internal mingling features as seen on Lilleø, but with comparatively larger proportions of syenite. A mafic dyke crosscuts the complex containing coarse-grained gabbroic Mt cumulate rock + gneiss basement. TU samples taken: 563530-563533 (see T7 field report). Returned with CL and TU to KGH to drop off, and continued back to T13/C1.

29/7: Sunny, some high clouds and with fresh wind from the south.
Had camp picked up by helicopter in late afternoon and returned to base camp for the night. Met there with JKK and prepared for going to T13/C2 at KGH the 30/7. Until pick up, worked with dinghy E and NE of camp to map out contact between gabbro and basement. Had leak in bottom of dinghy and spent 2 hours repairing the whole – which was successful. The two pilots arrived with Rune; Joachim and Rune sailed the dinghy back to base camp.
Samples taken: **564644-564650**.

30/7: Sunny, some high clouds.
Flew to KGH and established T13/C2 in northern saddle some 500 m north of T7/C3. Investigated the area around camp and the monzonite, which dominates the geological map of J. Myers. The monzonite contains abundant rafts of meta-basalt (hydrothermally altered Lower Basalt) and is crosscut by multiple mafic dykes (often Plg-phyric and with distinct chilled margins). Went for 4 hours hike to the W syenitic ring dyke and followed the contact to monzonite as far south as safely possible.
Samples taken: **564651-564652**.

31/7: Sunny and high blue sky. Had a decent breakfast with eggs and bacon and headed out from camp at around 10:00 climbing the northern summit of KGH (1000 m.a.s.l.) – some 700 m above the camp position. Returned late after radio hour making a call to announce this in due time. On the ascent the inner monzonite was sampled in a layered version. Blocks and rafts up to 5x30m of finely laminated Cretaceous meta-sediments (sandstone/siltstone) in meta-basalts were sampled towards the outer ring dyke syenite. Left samples for picking up on the return way. On the last part to the top fairly fresh Paleogene

basalts (possibly equivalent of "Lower Basalts" of the Kangerdlussuaq region) outcrop to form a wedge-shaped ridge with a dramatic steep western mountainside and a more moderately sloping eastern side. Sampled a pillow basalt with zeolite fillings along veins and cracks; basalts appear fairly fresh and unmetamorphosed. Near the top an intrusive breccia dyke with mingling and hybridization zone of diorites, monzonites and syenites were studied and intensively sampled. Made it back to camp at 21:00 after a short visit to T7/C3 (CT, CL, TU), who had been making an E-W traverse across the monzonite into the ring dyke syenites and northwestern granite intrusion.
Samples taken: **564653-564662**.

<u>1/8:</u> Sunny, but bitterly cold with stiff wind from the E.
Worked W of camp in the contact zone between the M2 monzonite plug and the syenite ring dykes. Sampled three generations of a late composite mafic dyke showing internal chills.
Samples taken: **564671-564677**.

<u>2/8:</u> Sunny weather, little wind.
Did the last sampling within the M2 monzonite close to camp before packing down the camp for a planned camp move to Nûk in the Kialineq area. Short helicopter reco stop on Nanertalik Island where the gabbro and a mafic Plg-phyric dyke were sampled. Thereafter TFK and Jan Erik (pilot) went ahead with camp. Stopped to refuel at depot at Imilik and collect gasoline for boat. The gasoline depot however had been dowsed by a polar bear mother and her cub (judging from fresh set of foot prints) and tossed the fuel barrel for the boat engine into the sea (had been left on a ledge close to water, but was now missing). There were bite and claw marks on the motor oil bottles (leaking oil) and the alu-box was tossed upside down. Despite of this we flew to the planned camp site 9 km further northwards at Nûk – just to find that the rubber boat had been demolished by a(nother?) polar bear; all compartments of the boat had been punctured and upon the later return of the boat to base camp several claw marks were spotted leaving no doubt of the guilty... In view of the conditions (no boat to operate in) I decided to fly back towards KGH, inform the rest of T13 on the way, and further southwards to Sulugssut to establish a camp there instead. The conditions at Sulugssut were/are however challenging for camping (while still being in reach of the intrusion), but a camp site at top of the glacier was chosen in *c.* 1400 m.a.s.l.. The camp was unloaded and we returned to pick up Jakob and Sam and then relocate to our new icy camp position. Jakob and Sam were somewhat surprised by the exotic position of the camp site, but took it with great spirits.
Samples taken: **564678-564686**.

<u>3/8:</u> Decent weather with some sun, but also some wind from NE coming up over the glacier.
On Aug 3rd T13 + BMST did a helicopter reco in the Kialineq area with three stops: (1) Imilik island to refuel and eat lunch, (2) Top of Kialineq plutonic centre where TFK, JKK and SWE got dropped off to do work for 1 hour, (3) Laube Gletscher syenite where TFK and JKK were dropped off for *c.* 45 minutes on a steep ledge at a toe-in landing while SWE and BMST made a photo flight around KPC.
Samples taken: Reco stop 2: **563901-563910**; Reco stop (3): **563911-563923**.

4/8: Partly overcast, moderately strong wind from the E.
We went across the snow fan south of camp to the nearby ridge where we went on to investigate the outcrops on the southern slope. The area that could be reached was somewhat peripheral to the main intrusion (which lies some 500m towards NE). The main lithology on the ridge is strongly foliated gneissic basement. Several occurrences of alkaline dykes presumed to be related to the Sulugssut Intrusive Complex were found and sampled, some contained conspicuous carbonate-rich veneers inside as a late magmatic phase. Some dyke rocks carried dark mica in the matrix resembling lamprophyres. Returned to camp for lunch and carried on after lunch at the same ridge further towards SE. Dyke samples of the SIC and a few samples of the basement were taken.
Samples taken: **563925-563926** and **563938-563948**.

5/8: Unfriendly weather during the night with gale wind, flapping tents and even some snow. Luckily the wind died down a bit in the morning and cloud base remained high making a camp move by helicopter possible. Packed down camp and returned to base camp, while doing a brief photo flying around the central part of Sulugssut on the way back. Jakob and Sam were flown to T13/C4 in the 2200 Ma diorite in a boulder field. I stayed in base camp overnight and prepared to go to T8/C5 for a joined reco on the following day.

6/8: Nice sunny weather. Move to T8/C5. Joined helicopter reco for 6 hours in the Tasiilaq Centre with Trygvi, Benedikte, Tomas and Kristine. Tomas and Benedikte went “peak jumping” around the intrusion (11 stops, 9 samples), while Trygvi, Kristine and TFK made two traverses in the central and SW part of the intrusion by foot (drop offs). First traverse was near a large Gt gneiss xenolith with Gt bearing granodiorite (hybridized rock?), grading into mesocratic gabbronorite. Second traverse near SW contact to Gt gneiss basement.
Samples taken: 562852-562863

7/8: Nice weather, sunny and little wind. Went for a hike to NW of camp looking at the relationship between the course-grained mesogabbronorite and more melanocratic medium-grained gabbronorite. Evidence for mingling was found, but textures are overprinted by the regional deformation (all rocks are variably foliated). Sampled a presumed Paleogene Plg-porphyric dyke NW of pump station by lake. The melanocratic gabbronorite variety seems to be aligned along E-W trending bands within the mesocratic ditto, in up to 50m wide bands/zones spaced up to several hundred metres apart.
Samples taken: 562864-562875

8/8: Nice weather, sunny and little wind. Went *c.* 1.7 km SW of camp along the lake and onto the steep mountainside where the contact to the Gt gneiss is mapped out.
Samples taken: **562876-562881**.

9/8: Nice weather, sunny and little wind.
Went *c.* 1.6km SE of camp towards the contact to the Gt gneiss.
Samples taken: **562894-562899 + 565801-565803**.

10/8: Sunny, mild breeze from changing directions during the day.
Had a camp move at 12:20 to 7 km north of present camp in valley surrounded by high mountains to the W, N and E. Established camp in the afternoon and did some office work.

11/8: Nice sunny weather. Went N of camp along W wall. Found and sampled one of the flat lying leucocratic pegmatite's that cut at various levels in the W valley wall. The pegmatite is <1m wide often very coarse-grained and contains abundant Kfsp, Qtz, Plg and mica. Two or three types of mica were sampled: a white, a black (Bt), and a green (only seen in one place). Also in one location was found cm sized rhomb dodecahedron of garnet, as well as up to cm sized black tourmaline. All was sampled. Trygvi injured his knee from carrying a too heavy backpack.
Samples taken: **565805-565827**. (565822-565827 is scree slope samples for Benedikte below rusty zone in NE valley side; see TBA for details).

12/8: Nice sunny weather.
Went S along the W valley side to the pegmatite, and further on to an outcrop of pyroxenite. Went back, across the river and sampled a rust zone opposite the camp (E side).
Samples taken: **565828-565839**.

13/8: High clouds but mostly sunny and wind picking up from the south during the day.
Had camp move at 11:15 to the SW part of the Ammassalik batholith (in granite) and went directly thereafter on a helicopter reco to the Ammassalik batholith together with T13 (Sam Weatherly and Jakob Kløve Keiding). Four stops were made, each approximately of 1 hour duration: Stop 1: Valley running E–W south of Ikaasartivaq fjord by lake: Coarse-grained granodiorite cuts a more mafic diorite; both are cut by granitic aplite (samples 563672-563674). Stop 2: Half way up on adjacent southern valley side shows mingling between mafic diorite and Kfsp porphyric diorite in an intimate net-veining style. Some hybridization is also observed as diorites with large Kfsp crystals (samples 563676-563678). Stop 3: In granite in NE part of the Ammassalik batholith. Pink coarse-grained granite dominates the area, with scattered enclaves or pods of medium-grained greyish granodiorite (samples 565879-565880). Stop 4: In the N part of the noritic Tasiilaq Centre; landed at contact according to 1:500 000 scale map, but was clearly within the garnet gneiss (contact must be several 100m further to the S). Sampled the Gt gneiss and amphibolite of the gneiss (samples 565840-565841).
Samples taken: **563672-563680** and **565840-565841**.

14/8: Windy night but waking up to a clear sunny sky with some wind from the S.
Some of the other teams (T3 & T9) had had problems during the night with strong winds/storm and shattered kitchen tent. Clouds moved in during the late afternoon, but no rain. Hike to the W and SW of camp. The pink granite has sporadic rounded enclaves of up to m sized granodioritic bodies (or blebs) and occasional basement xenoliths. The contact to the gneiss basement is clearly exposed as sharp sub-horizontal granite veins/sills into the overlying gneiss, indicating a local roof zone of the granite intrusion. The contact can be followed over 300-400m. Aplitic granite/granodiorite(?) veins cut the granite sub-parallel to the granite/gneiss contact (sample 564683). The basement should be the "Sgn" unit on map but looks more like the Gt gneiss, thought with variable contents of Gt aligned in parallel stringers. Walked along the granite/gneiss contact towards S and sampled the Gt gneiss at a place with abundant Gt (sample 565842).
Samples taken: **564683-564687** and **565842**.

15/8: Sunny and little wind.
Went E of camp to map out contact to basement. Pink granite looks similar throughout the area with scattered rounded enclaves of granodiorite and occasional xenoliths of basement gneisses.
Samples taken: **564688-564695**.

16/8: Return to base camp.
Office work, field diary notes etc. + washing clothes and preparing for going home Monday.

17:8: Help around base camp with packing and writing of field diary.

18/8 & 19/8: Return to Cph via Kulusuk (14:05) - Reykjavik (18:00) - dinner down town-Keflavik (01:00) arriving on the 19/8 @06:00. Home in Espergærde @08:30 on the 19/8.

Links to aFieldWork data and field photographs

Digital aFieldWork data a can be reached via the GEUS intranet under the folders:
\\NETAPP2P\PM_workspace_01\10_projects\11724_SEGMENT\10_data\95_GanFeld_fielddata\14_Fieldwork_2014_GanFeld_files\02_GanFeld_files_2014_ORIG_2_Oracle\TFK-OK
\\NETAPP2P\PM_workspace_01\10_projects\11724_SEGMENT\10_data\95_GanFeld_fielddata\14_Fieldwork_2014_GanFeld_files\02_GanFeld_files_2014_ORIG_2_Oracle\SWE-OK
\\NETAPP2P\PM_workspace_01\10_projects\11724_SEGMENT\90_users\TBA\14_fielddata\TBA-data_compilation.xlsx

Field photographs taken by the authors of this report can be found under the folders:
\\NETAPP2P\PM_workspace_01\10_projects\11724_SEGMENT\10_data\96_locality_photos\04_MRAPSEG-2014_Locality_photos\TFK
\\NETAPP2P\PM_workspace_01\10_projects\11724_SEGMENT\10_data\96_locality_photos\04_MRAPSEG-2014_Locality_photos\SWE
\\NETAPP2P\PM_workspace_01\10_projects\11724_SEGMENT\10_data\96_locality_photos\04_MRAPSEG-2014_Locality_photos\JKK
\\NETAPP2P\PM_workspace_01\10_projects\11724_SEGMENT\10_data\96_locality_photos\04_MRAPSEG-2014_Locality_photos\TBA

Allocated docket book numbers

563601-699 (SMW)
563901-999 (JKK)
564601-699 (TFK)
564701-706 (TFK)
562801-899 (TBA)
565801-899 (TBA)

Lists of samples taken

SEG 2014 samples, Thomas F. Kokfelt (TFK)

Sample	Latitude	Longitude	Location	Rock type	PTS	Geochem	U/Pb
564651	66.61527	-34.27336	Kap Gustav Holm	Cgr syenite	x	x	x
564652	66.61363	-34.27716	Kap Gustav Holm	Mafic dyke	x	x	
564653	66.61078	-34.27325	Kap Gustav Holm	Cgr monzonite	x	x	
564654	66.61051	-34.27308	Kap Gustav Holm	sedimentary-sandstone			x
564655	66.60903	-34.27549	Kap Gustav Holm	leucocratic dyke		x	
564656	66.60610	-34.27703	Kap Gustav Holm	mafic dyke		x	
564657	66.60610	-34.27703	Kap Gustav Holm	cgr syenite, outer ring dyke	x	x	
564659	66.59944	-34.27982	Kap Gustav Holm	basalt		x	
564660	66.59906	-34.27988	Kap Gustav Holm	basalt		x	
564661	66.59962	-34.27973	Kap Gustav Holm	dyke-mafic dyke		x	
564662	66.60147	-34.27890	Kap Gustav Holm	Syenitic dyke w. mafic blebs & brecciated basalt xenoliths	x	x	x
564663	66.60147	-34.27890	Kap Gustav Holm	mgr hybrid (monzonite?)	x	x	
564666	66.60147	-34.27890	Kap Gustav Holm	Mafic/felsic mingled rock	x	x (mafic part)	
564667	66.60147	-34.27890	Kap Gustav Holm	fsp porphyric monzonite	x	x	
564669	66.60147	-34.27890	Kap Gustav Holm	Hybrid rock w. smal mafic bleb	x	x	
564670	66.60147	-34.27890	Kap Gustav Holm	Late felsic aplite vein	x	x	x
564671	66.61890	-34.26744	Kap Gustav Holm	dyke-mafic dyke		x	
564672	66.61890	-34.26744	Kap Gustav Holm	dyke-mafic dyke		x	
564673	66.61890	-34.26744	Kap Gustav Holm	dyke-mafic dyke		x	
564674	66.61884	-34.26494	Kap Gustav Holm	dyke-mafic dyke		x	
564675	66.61884	-34.26494	Kap Gustav Holm	Younger dyke w plg/cpx phenocrysts	x	x	
564676	66.61884	-34.26494	Kap Gustav Holm	gneiss basement		x	x
564677	66.61884	-34.26494	Kap Gustav Holm	mgr-cgr syenite	x	x	x
564678	66.61739	-34.26059	Kap Gustav Holm	dyke-leucocratic dyke, aplite			x
564680	66.61942	-34.25721	Kap Gustav Holm	Cgr UM rock (hornblendite?)	x	x	
564681	66.61942	-34.25721	Kap Gustav Holm	(Meta?)monzonite	x	x	
564682	66.59187	-34.19728	Kap Gustav Holm, Nanertalik	mgr-cgr gabbro	x	x	
564683	66.59187	-34.19728	Kap Gustav Holm, Nanertalik	Plg-phyric dyke with aphanitic chill	x	x (chill)	
564684	66.59187	-34.19728	Kap Gustav Holm, Nanertalik	Mgr mesogabbro	x	x	
564685	66.59247	-34.19617	Kap Gustav Holm, Nanertalik	Gabbro pegmatite	x	x	
564686	66.59265	-34.19618	Kap Gustav Holm, Nanertalik	fgr mesogabbro	x	x	
564701	67.01196	-33.75360	South of Bjørn Syenite	Heterolithic ash flow (matrix)	x	x	x
564702	67.01196	-33.75360	South of Bjørn Syenite	Plg-phyric trachyte	x	x	
564703	67.01196	-33.75360	South of Bjørn Syenite	fgr mafic rock, Cu mineralised	x	x	
564704	67.01196	-33.75360	South of Bjørn Syenite	Leucocratic xenolith, + mafic clasts	x	x	x
564705	67.01196	-33.75360	South of Bjørn Syenite	Basalt w. dessiminated chalcopyrite	x	x	
564706	67.01196	-33.75360	South of Bjørn Syenite	Ignimbrite, syenitic	x	x	x
564601	65.79704	-37.15139	Ikaasartivaq	Fgr leucogabbro	x		
564603	65.79704	-37.15139	Ikaasartivaq	porphyric floworientated bt-rich dyke	x		
564604	65.79875	-37.15064	Ikaasartivaq	porphyric floworientated bt-rich dyke	x	x	
564605	65.79875	-37.15064	Ikaasartivaq	aplite			x
564610	65.75449	-37.19472	Ikaasartivaq	Mingled dyke	x		
564611	65.75449	-37.19472	Ikaasartivaq	Mingled dyke, heterog. with blobs	x		
564612	65.75449	-37.19472	Ikaasartivaq	dyke-mafic dyke		x	
564613	65.75449	-37.19472	Ikaasartivaq	Mingled dyke, hybrid 2, cgr	x	x	
564614	65.75449	-37.19472	Ikaasartivaq	Mingled dyke, near contact	x		
564616	65.75449	-37.19472	Ikaasartivaq	dyke-mafic dyke		x	
564617	65.75449	-37.19472	Ikaasartivaq	Granite host of mingled dyke	x	x	x
564620	65.75395	-37.19372	Ikaasartivaq	dyke-leucocratic dyke		x	x
564622	65.75395	-37.19372	Ikaasartivaq	plutonic-subalkaline granite		x	x
564623	65.75981	-37.20764	Ikaasartivaq	mafic component	x	x	
564624	65.80507	-37.18703	Ikaasartivaq	granite >20 Qtz;65-90 Kfs		x	x
564626	65.81459	-37.20076	Ikaasartivaq	dolerite		x	

564627	65.81459	-37.20076	Ikaasartivaq	Melagabbro	x	x	
564628	65.81459	-37.20076	Ikaasartivaq	Cgr red granite w. mafic enclave	x		
564629	65.82128	-37.26857	Ikaasartivaq	Mgr mesogabbro	x	x	
564630	65.82268	-37.27034	Ikaasartivaq	dyke-leucocratic dyke		x	x
564631	65.82268	-37.27034	Ikaasartivaq	Cgr meso/melanogabbro	x	x	
564632	65.82313	-37.27053	Ikaasartivaq	gabbro <Qtz;< 10 Kfs;An >50		x	
564634	65.82855	-37.27478	Ikaasartivaq	cgr leucogabbro	x	x	x
564644	65.79239	-37.14763	Ikaasartivaq	Cgr - mgr leucogabbro	x	x	
564645	65.79455	-37.15589	Ikaasartivaq	mgr leucogabbro	x	x	x
564646	65.79455	-37.15589	Ikaasartivaq	mgr-cgr bt-bearing mesogabbro	x	x	
564647	65.79455	-37.15589	Ikaasartivaq	mgr-cgr bt-bearing mesogabbro	x		
564648	65.79455	-37.15589	Ikaasartivaq	mgr felsic sheet	x	x	
564687	67.01196	-33.75360	Ikaasartivaq	fgr felsic aplite	x	x	
564688	67.01196	-33.75360	Ikaasartivaq	grey gneiss basement (+/- gt)		x	x
564689	67.01196	-33.75360	Ikaasartivaq	Cgr pink granite (-bt)	x	x	x
564690	67.01196	-33.75360	Ikaasartivaq	fgr granite	x	x	
564691	67.01196	-33.75360	Ikaasartivaq	Cgr pink granite (+bt)	x	x	x
564692	67.01196	-33.75360	Ikaasartivaq	Mgr gray granite			x
564693	65.76977	-37.66484	Ikaasartivaq	aplite vein wt bt		x	

SEG 2014 samples, Sam Weatherley (SMW)

Sample	Latitude	Longitude	Place	Rock type	PTS	Geochem	U/Pb
563621	65.76546	-37.21872	Ikaasartivaq	granite >20 Qtz;65-90 Kfs	x	x	x
563622	65.76546	-37.21872	Ikaasartivaq	norite			
563623	65.76569	-37.21887	Ikaasartivaq	norite	x	x	
563624	65.76595	-37.21803	Ikaasartivaq	norite	x	x	
563625	65.76626	-37.21783	Ikaasartivaq	norite	x	x	
563626	65.76643	-37.21722	Ikaasartivaq	norite	x	x	
563627	65.76688	-37.21635	Ikaasartivaq	norite	x	x	
563628	65.76688	-37.21635	Ikaasartivaq	norite	x	x	
563629	65.76688	-37.21635	Ikaasartivaq	norite	x		
563630	65.76688	-37.21635	Ikaasartivaq	norite	x		
563631	65.76542	-37.21911	Ikaasartivaq	granite >20 Qtz;65-90 Kfs	x	x	x
563632	65.76542	-37.21911	Ikaasartivaq	aplite	x	x	x
563633	65.78843	-37.25789	Ikaasartivaq	metamorphic-gneiss (schist>1cm)			x
563634	65.79671	-37.28749	Ikaasartivaq	diorite <Qtz;<10 Kfs;An <50	x	x	
563635	65.79849	-37.29304	Ikaasartivaq	leucogabbro globules in diorite	x	x	
563636	65.79831	-37.35867	Ikaasartivaq	aplite			x
563637	65.76799	-37.28493	Ikaasartivaq	granite >20 Qtz;65-90 Kfs		x	
563638	65.85084	-37.21829	Ikaasartivaq	granite >20 Qtz;65-90 Kfs	x	x	x
563639	65.85084	-37.21829	Ikaasartivaq	metamorphic-gneiss (schist>1cm)	x		x
563640	65.86053	-37.23603	Ikaasartivaq	metamorphic-gneiss (schist>1cm)			
563641	65.86053	-37.23603	Ikaasartivaq	granite		x	x
563642	65.86169	-37.23708	Ikaasartivaq	granite >20 Qtz;65-90 Kfs			
563643	65.83728	-37.24216	Ikaasartivaq	diorite <Qtz;<10 Kfs;An <50	x	x	
563644	65.83728	-37.24216	Ikaasartivaq	granite >20 Qtz;65-90 Kfs		x	x
563645	65.84819	-37.38139	Ikaasartivaq	aplite	x		x
563646	65.84819	-37.38139	Ikaasartivaq	mafic, lobate contact against granite	x	x	
563647	65.84819	-37.38139	Ikaasartivaq	mafic, black porphyroclasts	x	x	
563648	65.84819	-37.38139	Ikaasartivaq	mafic, with ?epidote			
563649	65.84819	-37.38139	Ikaasartivaq	mafic, with felsic pegmatite and blue aplite	x		
563650	65.84819	-37.38139	Ikaasartivaq	diorite <Qtz;<10 Kfs;An <50	x	x	
563651	65.84819	-37.38139	Ikaasartivaq	diorite <Qtz;<10 Kfs;An <50			
563652	65.84819	-37.38139	Ikaasartivaq	diorite <Qtz;<10 Kfs;An <50	x		
563653	65.84819	-37.38139	Ikaasartivaq	aplite		x	
563654	65.84819	-37.38139	Ikaasartivaq	diorite <Qtz;<10 Kfs;An <50	x	x	
563655	65.84819	-37.38139	Ikaasartivaq	granite >20 Qtz;65-90 Kfs		x	
563656	65.84819	-37.38139	Ikaasartivaq	pegmatite			
563657	65.84819	-37.38139	Ikaasartivaq	metallic selvedge in mafic rock			
563658	65.84819	-37.38139	Ikaasartivaq	macrotextures between mafic component and diorite			

563659	65.90730	-37.52200	Ikaasartivaq	Gneiss basement contact with intruding granite		x	
563660	65.90730	-37.52200	Ikaasartivaq	Gneiss, leucocratic component	x	x	x
563661	65.90751	-37.52038	Ikaasartivaq	metamorphic-gneiss (schist>1cm)	x		
563662	65.90751	-37.52038	Ikaasartivaq	darkest component of sill	x	x	
563663	65.90751	-37.52038	Ikaasartivaq	darkest component of sill and mingling texture with felsic material		x	
563664	65.90751	-37.52038	Ikaasartivaq	texture of coexisting mafic and felsic melts	x		
563665	65.90751	-37.52038	Ikaasartivaq	leucocratic / felsic component, sample I	x		
563666	65.90751	-37.52038	Ikaasartivaq	leucocratic / felsic component, sample II	x	x	
563667	65.90751	-37.52038	Ikaasartivaq	mingling textures between mafic and felsic	x		
563668	65.90751	-37.52038	Ikaasartivaq	bench sample: gneiss + felsic + mafic + mingling			
563669	65.90751	-37.52038	Ikaasartivaq	aplite	x		x
563670	65.90751	-37.52038	Ikaasartivaq	mafic material	x		
563671	65.90600	-37.51947	Ikaasartivaq	Granite sheet	x	x	
563672	65.82730	-37.52212	Ikaasartivaq	granodiorite >20 Qtz;10-35 Kfs			
563673	65.82730	-37.52212	Ikaasartivaq	diorite <Qtz;<10 Kfs;An <50			
563674	65.82730	-37.52212	Ikaasartivaq	aplite			
563675	65.83346	-37.56995	Ikaasartivaq	diorite <Qtz;<10 Kfs;An <50, type 1			
563676	65.83346	-37.56995	Ikaasartivaq	diorite <Qtz;<10 Kfs;An <50, type 2			
563677	65.83346	-37.56995	Ikaasartivaq	gabbro <Qtz;< 10 Kfs;An >50			
563678	65.83346	-37.56995	Ikaasartivaq	granite >20 Qtz;65-90 Kfs			
563679	65.87889	-37.26471	Ikaasartivaq	granite >20 Qtz;65-90 Kfs			
563680	65.87889	-37.26471	Ikaasartivaq	granodiorite >20 Qtz;10-35 Kfs			
563681	65.93580	-37.64658	Ikaasartivaq	gabbro <Qtz;< 10 Kfs;An >50		x	
563682	65.93580	-37.64658	Ikaasartivaq	gabbro <Qtz;< 10 Kfs;An >50			
563683	65.93580	-37.64658	Ikaasartivaq	gabbro <Qtz;< 10 Kfs;An >50			
563684	65.93387	-37.63697	Ikaasartivaq	diorite <Qtz;<10 Kfs;An <50			
563685	65.93367	-37.63327	Ikaasartivaq	granite >20 Qtz;65-90 Kfs		x	x
563686	65.93337	-37.63316	Ikaasartivaq	granite >20 Qtz;65-90 Kfs	x	x	
563687	65.93154	-37.63015	Ikaasartivaq	gabbro <Qtz;< 10 Kfs;An >50		x	
563688	65.93154	-37.63015	Ikaasartivaq	intermediate hybridised material		x	
563689	65.93154	-37.63015	Ikaasartivaq	granite >20 Qtz;65-90 Kfs		x	
563690	65.93154	-37.63015	Ikaasartivaq	granite >20 Qtz;65-90 Kfs	x		
563691	65.93154	-37.63015	Ikaasartivaq	juxtaposed mafic and intermediate hybrid	x		
563692	65.94015	-37.62838	Ikaasartivaq	gabbro <Qtz;< 10 Kfs;An >50		x	
563693	65.94015	-37.62838	Ikaasartivaq		x		
563694	65.94015	-37.62838	Ikaasartivaq	granite >20 Qtz;65-90 Kfs	x	x	
563695	65.93892	-37.62732	Ikaasartivaq	granite >20 Qtz;65-90 Kfs			
563696	65.93783	-37.62647	Ikaasartivaq	gabbro <Qtz;< 10 Kfs;An >50			
563697	65.93745	-37.62658	Ikaasartivaq	hybrid material with zoned phenocrysts	x		
563698	65.93739	-37.62670	Ikaasartivaq	unknown lithology, from float	x		
563699	65.93690	-37.62596	Ikaasartivaq	gabbro <Qtz;< 10 Kfs;An >50	x	x	
565001	65.93476	-37.62772	Ikaasartivaq	granite >20 Qtz;65-90 Kfs	x		
565002	65.92918	-37.61975	Ikaasartivaq	granite >20 Qtz;65-90 Kfs	x		
565003	65.92966	-37.62052	Ikaasartivaq	intermediate hybrid with mafic material	x		
565004	65.93194	-37.62426	Ikaasartivaq	intermediate hybrid with mafic material	x		
565005	65.93194	-37.62426	Ikaasartivaq	intermediate hybrid with mafic material			
565006	65.93194	-37.62426	Ikaasartivaq	intermediate hybrid with mafic material			

565007	65.94249	-37.63476	Ikaasartivaq	granite >20 Qtz;65-90 Kfs			x
565008	65.94306	-37.65965	Ikaasartivaq	metamorphic-gneiss (schist>1cm)			x
565009	65.94338	-37.65977	Ikaasartivaq	gabbro <Qtz;< 10 Kfs;An >50	x		
565010	65.94338	-37.65977	Ikaasartivaq	granite >20 Qtz;65-90 Kfs	x		
565011	65.94338	-37.65977	Ikaasartivaq	granite >20 Qtz;65-90 Kfs	x		
565012	65.94338	-37.65977	Ikaasartivaq	intermediate hybrid material	x		
565013	65.94338	-37.65977	Ikaasartivaq	contact between granite and intermediate hybrid	x		
565014	65.93507	-37.67643	Ikaasartivaq	granite >20 Qtz;65-90 Kfs			
565015	65.93463	-37.67681	Ikaasartivaq	granite >20 Qtz;65-90 Kfs			
565016	65.93463	-37.67681	Ikaasartivaq	intermediate hybrid	x		
565017	65.93463	-37.67681	Ikaasartivaq	gabbro <Qtz;< 10 Kfs;An >50			
565018	65.93463	-37.67681	Ikaasartivaq	unidentified, diopside + qtz + melt in mafic host	x		
565019	65.93463	-37.67681	Ikaasartivaq	unidentified, showing mingling / immiscible texture	x		

SEG 2014 samples, Jakob Kløve Keiding (JKK)

Sample	Latitude	Longitude	Location	Rock type	PTS	Geochem	U/Pb
563901	66.94584	-34.07147	Pueratse syenite	syenite	x	x	(x)
563902	66.94584	-34.07147	Pueratse syenite	syenite		x	
563903	66.94580	-34.07154	Pueratse syenite	monzonite			
563904	66.94592	-34.07171	Pueratse syenite	diorite w. miaolitic cavaity with qz	x		
563905	66.94595	-34.07180	Pueratse syenite	fgr. syenite (aplite) w. mafic xenoliths	x		
563906	66.94595	-34.07180	Pueratse syenite	fgr. Syenite (aplite)		x	
563907	########	-34.07210	Pueratse syenite	monzonite <5 Qtz;35-65 Kfs	x	x	x
563908	66.94672	-34.07320	Pueratse syenite	basaltic dyke crosscuting diorite		x	
563909	66.98041	-34.21500	Pueratse syenite	basaltic dyke crosscuting diorite	x	x	
563910	66.98041	-34.21500	Pueratse syenite	mozonite with elongate mafic enclaves	x	x	
563911	66.98040	-34.21499	Laube Gletscher	syenite	x	x	(x)
563912	66.98040	-34.21499	Laube Gletscher	cgr. "host" syenite	x	x	x
563913	66.98040	-34.21499	Laube Gletscher	contact between different syenites	x		
563914	66.98040	-34.21499	Laube Gletscher	syenite w/ abundant inclusions and mixing	x	x	x
563915	66.98040	-34.21499	Laube Gletscher	SAMPLE MISSING (dropped at helicopter pick-up)			
563916	66.98040	-34.21499	Laube Gletscher	heterogeneous diorite	x		
563917	66.98040	-34.21499	Laube Gletscher	mafic- felsic contact of syenite and diorite	x		
563918	66.98040	-34.21499	Laube Gletscher	diorite w/ fsp xenoliths	x		
563919	66.98040	-34.21499	Laube Gletscher	heterogeneous diorite with "pillow structure"	x	x	
563920	66.98040	-34.21499	Laube Gletscher	vesicular diorite	x		
563921	66.98040	-34.21499	Laube Gletscher	vesicular diorite	x	x	
563922	66.98040	-34.21499	Laube Gletscher	diorite-syenite co-exisiting rock	x	x	
563923	66.98041	-34.21500	Pueratse syenite	plag phyric basaltic dyke	x		
563924	66.98041	-34.21500	Pueratse syenite	plag phyric basaltic dyke		x	
563925	66.54019	-34.77412	Sulugssut	basement gneiss	x		
563926	66.54019	-34.77412	Sulugssut	mylonitic diorite (basement)	x	x	
563927	66.54018	-34.77381	Sulugssut	lamprophyre dyke E contact w/ basement xenoliths	x	x	
563928	66.54018	-34.77381	Sulugssut	lamprophyre dyke outer member	x	x	
563929	66.54018	-34.77381	Sulugssut	lamprophyre dyke calcite zone	x	x	
563930	66.54018	-34.77381	Sulugssut	lamprophyre dyke	x	x	
563931	66.54018	-34.77381	Sulugssut	lamprophyre dyke; grading into calcite zone	x	x	
563932	66.54018	-34.77381	Sulugssut	lamprophyre dyke; thin calcite zone			

563933	66.54018	-34.77381	Sulugssut	lamprophyre dyke; outer member	x	x	(x)
563934	66.54018	-34.77381	Sulugssut	lamprophyre dyke; fissle and fgr part			
563935	66.54018	-34.77381	Sulugssut	lamprophyre dyke; contact to basement more cgr.	x		
563936	66.54018	-34.77381	Sulugssut	lamprophyre dyke w./ large phlog. crys.	x	x	
563937	66.54018	-34.77381	Sulugssut	basement gneiss; host rock for the lamprohyre dyke	x	x	
563938	66.53986	-34.77455	Sulugssut	grey alkaline(?) dyke	x	x	
563939	66.53983	-34.77442	Sulugssut	augen gneiss	x	x	
563940	66.53962	-34.77429	Sulugssut	alkaline/carbonatite dyke	x	x	
563941	66.53947	-34.77417	Sulugssut	porphy. alkaline dyke xhill w./ xenoliths	x	x	
563942	66.53947	-34.77417	Sulugssut	alkaline dyke (central part)	x	x	
563943	66.53942	-34.77430	Sulugssut	lamprophyre dyke	x	x	
563944	66.53941	-34.77431	Sulugssut	augen gneiss	x	x	
563945	66.53941	-34.77431	Sulugssut	leucocratic gneiss	x	x	x
563946	66.54008	-34.77460	Sulugssut	metagabbro (basement)	x	x	
563947	66.54018	-34.77449	Sulugssut	dolerite dyke	x	x	
563948	66.54047	-34.77426	Sulugssut	dolerite dyke	x	x	
563949	66.09126	-37.35410	Imersivaq	mafic-felsic contact of mingled complex			
563950	66.09126	-37.35410	Imersivaq	qtz-monzonite (or granite?) - felsic comp of mingled complex		x	
563951	66.09126	-37.35410	Imersivaq	fgr diorite - mafic comp. of mingled complex		x	
563952	66.09010	-37.35509	Imersivaq	Hbl-bio diorite in contact w. bio-monzonite		x	
563953	66.08923	-37.35548	Imersivaq	granodiorite w./ thin felsic veins			
563954	66.08875	-37.35611	Imersivaq	diorite		x	
563955	66.08869	-37.35625	Imersivaq	felsic dyke (syenitic or granitic)		x	
563956	66.08678	-37.34323	Imersivaq	Mafic part of composite mafic-felsic mingled dyke		x	
563957	66.05553	-37.36083	Imersivaq	mgr-cgr slightly magnetic diorite		x	x
563958	66.05537	-37.36138	Imersivaq	felsic (granitic?) 40 cm wide folded dyke in diorite		x	x
563959	66.05399	-37.35901	Imersivaq	pyroxenite block (float) w./ sulphides in thin veins and dissiminated in the rock			
563960	66.04873	-37.33486	Imersivaq	diorite titonalite with biotite and traces of sulphides		x	
563961	66.04873	-37.33486	Imersivaq	melanocratic mgr diorite-gabbro with metalling staining and			
563962	66.08682	-37.32652	Imersivaq	bio-hbl diorite		x	
563963	66.08563	-37.32081	Imersivaq	mgr diorite		x	
563964	66.08545	-37.32084	Imersivaq	fgr-mgr sheet of diorite intrude into mgr diorite (sample #563963)			
563965	66.08552	-37.32105	Imersivaq	qtz-diorite with spotted texture defined by mafic minerals	x	x	x
563966	66.09633	-37.32337	Imersivaq	ortho-gneiss foliation 128/68 S.		x	
563967	66.09635	-37.32350	north of Imersivaq	mica bearing monzonite (or syenite?) dyke 1.5-5 wide intruding the basement		x	
563968	66.09869	-37.32375	north of Imersivaq	silicified rusty amphibolite w. dissiminated sulphides		x	
563969	66.10071	-37.32423	north of Imersivaq	leucocratic garnet rich gneiss			
563970	66.10071	-37.32423	north of Imersivaq	grt grey gneiss	x	x	
563971	66.11097	-37.33369	north of Imersivaq	wherlite (olv-rich) from ultramafic lens		x	
563972	66.11073	-37.33080	north of Imersivaq	wherlite from ultramafic lens		x	

563973	66.06776	-37.38402	RECO stop 1 (Imersivaq)	spotted diorite			
563974	66.06762	-37.38130	RECO stop 1 (Imersivaq)	plag-phyric basaltic comp. of mafic-felsic mingled dyke. (for geochem).		x	
563975	66.06762	-37.38130	RECO stop 1 (Imersivaq)	contacts of host diorite and mafic-felsic dyke for petrography. Dyke 40 cm wide			
563976	66.06762	-37.38130	RECO stop 1 (Imersivaq)	granitic comp. of mafic-felsic dyke (for geochem.)		x	
563977	66.03576	-37.20502	RECO stop 2 (Imersivaq)	gneiss			
563978	66.03576	-37.20502	RECO stop 2 (Imersivaq)	gneiss tonalite layer contact			
563979	66.03576	-37.20502	RECO stop 2 (Imersivaq)	mafic-leucocractic contact hosted in foliated basement gneiss			
563980	66.03576	-37.20502	RECO stop 2 (Imersivaq)	contact between mafic globules and gneiss			
563981	65.97946	-38.21570	Johan Petersen Fjord	grt gneiss			
563982	65.97826	-38.21593	Johan Petersen Fjord	grt gneiss	x	x	
563983	65.97565	-38.19892	Johan Petersen Fjord	40-50 cm wide pegmatite cutting grey gneiss. 15/54 E	x		
563984	65.99036	-38.19661	Johan Petersen Fjord	grt amfibolite-hornblendite			
563985	65.98918	-38.19394	Johan Petersen Fjord	granite take a few meter to contact w./ metasediments		x	
563986	65.99103	-38.21535	Johan Petersen Fjord	pale pink bio granite sample taken 50 m form basement xenolith		x	x
563987	65.99539	-38.24844	Johan Petersen Fjord	plag phyric dolerite dyke in granite, traces of pyrite	x	x	
563988	65.99539	-38.24844	Johan Petersen Fjord	mgr-cgr granite from central part of large granite exposure			
563989	66.00323	-38.23500	Johan Petersen Fjord	granite		x	
563990	66.00455	-38.23368	Johan Petersen Fjord	Regional dolerite dyke >20 m wide	x	x	
563991	66.00523	-38.21701	Johan Petersen Fjord	qtz-rich pink granite		x	x
563992	65.99964	-38.22322	Johan Petersen Fjord	pink granite			
563993	65.99263	-38.25120	Johan Petersen Fjord	pink granite from large	x	x	
563994	65.98782	-38.24815	Johan Petersen Fjord	mafic regional dyke(5 m wide) Sample taken from central part of the dyke	x	x	
563995	65.98804	-38.23909	Ikaasartivaq	granite taken close to w. grey leuco-gneiss			
563996	65.98804	-38.23909	Ikaasartivaq	grey gneiss at contact to granite. Foliation 92/73 N.		x	
563997	65.93909	-37.60818	Ikaasartivaq	pink granite	x	x	
563998	65.94519	-37.57568	Ikaasartivaq	basement gneiss			
563999	65.94519	-37.57568	Ikaasartivaq	granite	x	x	
564001	65.94519	-37.57568	Ikaasartivaq	amphibolite		x	
564002	65.94519	-37.57568	Ikaasartivaq	amfibolite w/ tonalite veins			
564003	65.94965	-37.59187	Ikaasartivaq	mafic pillow w. plag rimmed K-fsp phenocrysts in dioritic matrix	x	x	
564004	65.94966	-37.59225	Ikaasartivaq	contact of felsic (hybrid rock?) and dioritic pillow	x		
564005	65.94966	-37.59225	Ikaasartivaq	granite-diorite contact in mingled complex	x		
564006	65.95307	-37.59148	Ikaasartivaq	dioritic dyke (20-30 wide)			
564007	65.94802	-37.59166	Ikaasartivaq	host gneiss to the mafic-felsic complex		x	
564008	65.94806	-37.59170	Ikaasartivaq	granite with zoned k-fsp from mafic-felsic complex	x	x	
564009	65.94806	-37.59170	Ikaasartivaq	mafic diorite from mafic-felsic complex		x	
564010	65.94806	-37.59170	Ikaasartivaq	contact between mafic-felsic mingled rocks	x		

564011	65.86890	-37.71073	Ikaasartivaq	mafic sheet			
564012	65.86890	-37.71073	Ikaasartivaq	granodiorite		x	
564013	65.86890	-37.71073	Ikaasartivaq	granite		x	
564014	65.87110	-37.70058	Ikaasartivaq	Prominent 20-25 wide dyke that can be traced to the other side of the fjord	x	x	
564015	65.87098	-37.70040	Ikaasartivaq	cgr granite		x	
564016	65.88904	-37.57241	Ikaasartivaq	monzonite		x	
564017	65.88904	-37.57241	Ikaasartivaq	qtz-rich microgranite	x	x	
564018	65.88904	-37.57241	Ikaasartivaq	mgr qtz monzonite with porphyritic K-fsp crystals	x	x	
564019	65.88904	-37.57241	Ikaasartivaq	pegmatite			
564020	65.87481	-37.54170	Ikaasartivaq	diorite		x	
564021	65.87481	-37.54170	Ikaasartivaq	monzonite	x	x	
564022	65.86051	-37.51437	Ikaasartivaq	aplite w/ sugary texture		x	
564023	65.86051	-37.51437	Ikaasartivaq	diorite	x	x	
564024	65.86051	-37.51437	Ikaasartivaq	pegmatite w./ large epidote and actinolite crystals			
564025	65.84365	-37.46824	Ikaasartivaq	contact qtz-diorite and monzonite			
564026	65.84365	-37.46824	Ikaasartivaq	qtz diorite		x	
564027	65.84365	-37.46824	Ikaasartivaq	monzonite w. alkali fsp phenocrysts		x	
564028	65.86258	-37.47173	Ikaasartivaq	melanocratic gabbro		x	
564029	65.86258	-37.47173	Ikaasartivaq	diabase		x	
564030	65.86258	-37.47173	Ikaasartivaq	bio bearing monzonite	x		
564031	65.86258	-37.47173	Ikaasartivaq	K-fsp phyric grey monzonite. Hybrid rock		x	
564032	65.86258	-37.47173	Ikaasartivaq	qtz-diorite		x	
564033	65.86258	-37.47173	Ikaasartivaq	contact of fgr diorite and hybrid rock	x		
564034	65.86258	-37.47173	Ikaasartivaq	Sharp contact between diabase and cgr. monzonite			
564035	65.86258	-37.47173	Ikaasartivaq	inclusion of fgr qtz monzonite in diorite	x		
564036	65.86258	-37.47173	Ikaasartivaq	graditional contact betwen hybrid rock and granite	x		
564037	65.86258	-37.47173	Ikaasartivaq	cgr bio granite		x	
564038	65.74870	-37.29750	Ikaasartivaq	qtz-monzodiorite	x	x	
564039	65.74870	-37.29750	Ikaasartivaq	hybrid rock of granodioric composition w. K-fsp zone phenocrysts		x	
564040	65.74870	-37.29750	Ikaasartivaq	granitic hybrid rock w. k-fsp zone phenocrysts		x	
564041	65.74870	-37.29750	Ikaasartivaq	hybrid rock of qtz monzonite w. mafic enclaves	x		
564042	65.74870	-37.29750	Ikaasartivaq	contact of hybrid rock and mafic pillow	x		
564043	65.74870	-37.29750	Ikaasartivaq	dolerite dyke (10 wide)		x	
564044	65.74870	-37.29750	Ikaasartivaq	dioritic dyke (20-30 wide)		x	
564045	65.75227	-37.39158	Ikaasartivaq	diorite		x	
564046	65.75227	-37.39158	Ikaasartivaq	cgr granite		x	
564047	65.74311	-37.43346	Ikaasartivaq	cgr granite			
564048	65.74311	-37.43346	Ikaasartivaq	aplite vein in granite			
564049	65.98975	-36.49984	Kuummiut region	peridotite from float but unit could be seen higher on the rock face			
564050	66.08678	-37.34323	Imersivaq	felsic part of mingled composite dyke (sample# 563956)		x	
564051	66.08678	-37.34323	Imersivaq	host diorite to mingled composite dyke (sample# 563956)		x	

SEG 2014 samples, Trygvi B. Árting (TBA)

Sample	Latitude	Longitude	Location	Rock type	PTS	Geochem	U/Pb
562801	65.6868	-37.7026	Tasiilaq Centre	Gabbroic plug	x	x	
562802	65.6896	-37.7253	Tasiilaq Centre	Gt-granodiorite	x	x	
562803	65.69	-37.7332	Tasiilaq Centre	Bt-gt-gneiss			
562804	65.707	-37.7544	Tasiilaq Centre	Tonalite			
562805	65.706	-37.7567	Tasiilaq Centre	Gabbroic mylonite			
562806	65.6997	-37.7607	Tasiilaq Centre	Tonalite			
562807	65.6948	-37.7598	Tasiilaq Centre	Gt-granodiorite	x		
562808	65.6941	-37.7605	Tasiilaq Centre	Bt-norite	x	x	
562809	65.6836	-37.6958	Tasiilaq Centre	Gt-granodiorite		x	
562810	65.6834	-37.696	Tasiilaq Centre	Gt-granodiorite	x	x	
562811	65.6829	-37.696	Tasiilaq Centre	Gt-granite			
562812	65.6927	-37.6921	Tasiilaq Centre	Quartz diorite			
562813	65.6936	-37.6946	Tasiilaq Centre	Qz-norite		x	
562814	65.6922	-37.7042	Tasiilaq Centre	Bt-gt-gneiss	x	x	x
562815	65.6922	-37.7042	Tasiilaq Centre	Amphibolite	x	x	
562816	65.6636	-37.8327	Tasiilaq Centre	Bt-gabbro			
562817	65.6639	-37.8482	Tasiilaq Centre	Melagabbro		x	
562818	65.6653	-37.832	Tasiilaq Centre	Amphibolite		x	
562819	65.668	-37.8307	Tasiilaq Centre	Bt-gabbro			
562820	65.6699	-37.8381	Tasiilaq Centre	Diorite		x	
562821	65.6651	-37.8511	Tasiilaq Centre	Diorite			
562822	65.6651	-37.8511	Tasiilaq Centre	Diorite			
562823	65.6643	-37.8536	Tasiilaq Centre	Gabbro		x	
562824	65.6641	-37.8563	Tasiilaq Centre	Melanorite	x		
562825	65.6641	-37.8563	Tasiilaq Centre	Pyroxenite	x	x	
562826	65.6641	-37.8563	Tasiilaq Centre	Bt-norite		x	
562827	65.6641	-37.8563	Tasiilaq Centre	Anorthositic vein			
562828	65.6607	-37.8539	Tasiilaq Centre	Pyroxenite	x		
562829	65.6673	-37.8606	Tasiilaq Centre	Pyroxenite			
562830	65.6067	-37.6753	Tasiilaq Centre	Gabbro		x	
562831	65.6101	-37.6688	Tasiilaq Centre	Granodiorite		x	
562832	65.6042	-37.6951	Tasiilaq Centre	Leuconorite	x	x	(x)
562833	65.6042	-37.6951	Tasiilaq Centre	Bt-hbl-melanorite	x	x	x
562834	65.6044	-37.7005	Tasiilaq Centre	Quartz pegmatite		x	
562835	65.6074	-37.7085	Tasiilaq Centre	Gt-granite			
562836	65.6042	-37.6951	Tasiilaq Centre	Leuconorite and melanorite	x	x	x
562837	65.6023	-37.6976	Tasiilaq Centre	Leuconorite and micronorite	x	x	
562838	65.6023	-37.6976	Tasiilaq Centre	Gossaneous gabbroic rock			
562839	65.6023	-37.6976	Tasiilaq Centre	Gossaneous gabbroic rock			
562840	65.5927	-37.6977	Tasiilaq Centre	Gossaneous gabbroic rock			
562841	65.5939	-37.7017	Tasiilaq Centre	Melanorite			
562842	65.585	-37.7496	Tasiilaq Centre	Pyroxenite			
562843	65.585	-37.7496	Tasiilaq Centre	Pyroxenite			
562844	65.585	-37.7496	Tasiilaq Centre	Amphibolite			
562845	65.585	-37.7496	Tasiilaq Centre	Semimassive sulfide			
562846	65.585	-37.7496	Tasiilaq Centre	Gossaneous sulfide sample			
562847	65.6141	-37.7072	Tasiilaq Centre	Gossaneous microgabbro			
562848	65.6339	-37.7785	Tasiilaq Centre	Gabbro		x	
562849	65.6054	-37.659	Tasiilaq Centre	Gt-granite		x	
562850	65.6064	-37.6518	Tasiilaq Centre	Gt-granite			
562851	65.6267	-37.6899	Tasiilaq Centre	Gossaneous melanorite			
562852	65.66488	-37.65892	Tasiilaq Centre	Bt-gt-gneiss			
562853	65.66442	-37.65955	Tasiilaq Centre	Bt-norite	x	x	
562854	65.66442	-37.65955	Tasiilaq Centre	Pyroxenite	x	x	
562855	65.66353	-37.65942	Tasiilaq Centre	Bt-gt-gneiss		x	
562856	65.66353	-37.65942	Tasiilaq Centre	Bt-anorthosite		x	
562857	65.64571	-37.84969	Tasiilaq Centre	Bt-gt-gneiss		x	
562858	65.64571	-37.84969	Tasiilaq Centre	Garnet rich bt-gt-gneiss			
562859	65.64571	-37.84969	Tasiilaq Centre	Qz-leuconorite		x	
562860	65.64571	-37.84969	Tasiilaq Centre	Gt-bt-gabbro		x	
562861	65.64571	-37.84969	Tasiilaq Centre	Pyroxenite		x	

562862	65.64596	-37.84836	Tasiilaq Centre	Norite		x	
562863	65.64873	-37.84624	Tasiilaq Centre	Leuconorite and micronorite	x		
562864	65.60422	-37.69498	Tasiilaq Centre	Pyroxenite	x	x	
562865	65.60422	-37.69498	Tasiilaq Centre	Leuconorite and microgabbro	x	x	
562866	65.60422	-37.69498	Tasiilaq Centre	Micronorite contact	x		
562867	65.60422	-37.69498	Tasiilaq Centre	Leuconorite and micronorite	x		
562868	65.61759	-37.69243	Tasiilaq Centre	Leuconorite	x	x	
562869	65.61898	-37.68834	Tasiilaq Centre	Bt-leuconorite	x		
562870	65.62503	-37.70812	Tasiilaq Centre	Micronorite		x	
562871	65.62712	-37.711	Tasiilaq Centre	Basaltic dyke			
562872	65.62712	-37.711	Tasiilaq Centre	Melanorite		x	
562873	65.62712	-37.711	Tasiilaq Centre	Pyroxenite	x		
562874	65.62415	-37.71572	Tasiilaq Centre	Micronorite		x	
562875	65.61598	-37.70099	Tasiilaq Centre	Bt-hbl-melanorite	x	x	
562876	65.59946	-37.70425	Tasiilaq Centre	Norite		x	
562877	65.59732	-37.70787	Tasiilaq Centre	Pegmatite			
562878	65.59879	-37.71511	Tasiilaq Centre	Micronorite	x	x	
562879	65.59849	-37.71407	Tasiilaq Centre	Hbl-norite	x	x	
562880	65.5953	-37.73029	Tasiilaq Centre	Microgabbro	x		
562881	65.59596	-37.7255	Tasiilaq Centre	Bt-gt-gneiss		x	
562882	65.6796	-37.7641	Tasiilaq Centre	Bt-anorthosite	x	x	
562883	65.6796	-37.7641	Tasiilaq Centre	Bt-gabbro	x	x	
562884	65.684	-37.7435	Tasiilaq Centre	Mesocratic norite			
562885	65.6769	-37.704	Tasiilaq Centre	Gabbro			
562886	65.6769	-37.704	Tasiilaq Centre	Bt-gt-gneiss			
562887	65.6725	-37.7543	Tasiilaq Centre	Bt-hbl-melanorite	x	x	
562888	65.6764	-37.8184	Tasiilaq Centre	Qz-norite	x	x	
562889	65.6764	-37.8184	Tasiilaq Centre	Pyroxenite	x	x	
562890	65.6326	-37.8319	Tasiilaq Centre	Qz-norite	x	x	
562891	65.6111	-37.7283	Tasiilaq Centre	Qz-leuconorite	x	x	
562892	65.6334	-37.707	Tasiilaq Centre	Leuconorite	x	x	
562893	65.6336	-37.7476	Tasiilaq Centre	Mesocratic gabbro			
562894	65.59782	-37.70031	Tasiilaq Centre	Leuconorite and mesocratic norite	x		
562895	65.59246	-37.69515	Tasiilaq Centre	Microgabbro			
562896	65.59246	-37.69515	Tasiilaq Centre	Anorthosite	x	x	
562897	65.58819	-37.69267	Tasiilaq Centre	Bt-gt-gneiss		x	
562898	65.58907	-37.69119	Tasiilaq Centre	Pyroxenite		x	
562899	65.58907	-37.69119	Tasiilaq Centre	Bt-hbl-melanorite	x	x	
565801	65.58907	-37.69119	Tasiilaq Centre	Tonalitic vein			
565802	65.59291	-37.69568	Tasiilaq Centre	Bt-hbl-melanorite	x	x	
565803	65.5954	-37.70196	Tasiilaq Centre	Anorthositic vein	x		
565804	65.66101	-37.74165	Tasiilaq Centre	Gossaneous gabbroic rock			
565805	65.66101	-37.74165	Tasiilaq Centre	Gossaneous melagabbro			
565806	65.66101	-37.74165	Tasiilaq Centre	Gossaneous gabbroic rock			
565807	65.66092	-37.7429	Tasiilaq Centre	Bt-anorthosite	x	x	
565808	65.66092	-37.7429	Tasiilaq Centre	Gt-granodiorite	x	x	(x)
565809	65.66092	-37.7429	Tasiilaq Centre	Bt-anorthosite	x	x	(x)
565810	65.66281	-37.74622	Tasiilaq Centre	Pegmatite			
565811	65.66281	-37.74622	Tasiilaq Centre	Pyroxenite	x	x	
565812	65.66281	-37.74622	Tasiilaq Centre	Calc-silicate xenolith	x		
565813	65.66317	-37.74596	Tasiilaq Centre	Mineral: Biotite			
565814	65.66317	-37.74596	Tasiilaq Centre	Mineral: Biotite			
565815	65.66317	-37.74596	Tasiilaq Centre	Mineral: Unknown red mineral			
565816	65.66317	-37.74596	Tasiilaq Centre	Pegmatite with garnet			
565817	65.66317	-37.74596	Tasiilaq Centre	Mineral: Garnet			
565818	65.66317	-37.74596	Tasiilaq Centre	Mineral: Tourmaline			
565819	65.66414	-37.74406	Tasiilaq Centre	Pegmatite with altered wall rock			
565820	65.66895	-37.73686	Tasiilaq Centre	Bt-hbl-melanorite	x	x	
565821	65.67024	-37.73346	Tasiilaq Centre	Bt-leuconorite	x	x	
565822	65.66934	-37.7215	Tasiilaq Centre	Pyroxenite		x	
565823	65.66934	-37.7215	Tasiilaq Centre	Gossaneous gabbroic rock			
565824	65.66934	-37.7215	Tasiilaq Centre	Gossaneous gabbroic rock			
565825	65.66934	-37.7215	Tasiilaq Centre	Gossaneous gabbroic rock			

565826	65.66934	-37.7215	Tasiilaq Centre	Gossaneous gabbroic rock			
565827	65.66934	-37.7215	Tasiilaq Centre	Gossaneous gabbroic rock			
565828	65.66053	-37.7486	Tasiilaq Centre	Mineral: Magnetite			
565829	65.66053	-37.7486	Tasiilaq Centre	Hbl-bt-gabbro	x	x	
565830	65.66053	-37.7486	Tasiilaq Centre	Pegmatite and altered wall rock			
565831	65.65872	-37.75388	Tasiilaq Centre	Bt-pyroxenite	x	x	
565832	65.65872	-37.75388	Tasiilaq Centre	Pyroxenite			
565833	65.65872	-37.75388	Tasiilaq Centre	Melanorite	x		
565834	65.65872	-37.75388	Tasiilaq Centre	Bt-gt-gneiss	x	x	
565835	65.65872	-37.75388	Tasiilaq Centre	Gt-granite	x	x	
565836	65.65872	-37.75388	Tasiilaq Centre	Gt-granite			
565837	65.65986	-37.73811	Tasiilaq Centre	Gossaneous microgabbro			
565838	65.65986	-37.73811	Tasiilaq Centre	een pyroxenitic xenolith with plg ve	x		
565839	65.65986	-37.73811	Tasiilaq Centre	Green pyroxenitic xenolith		x	
565840	65.70058	-37.70438	Tasiilaq Centre	Bt-gt-gneiss		x	
565842	65.77811	-37.68974	Tasiilaq Centre	Bt-gt-gneiss	x	x	
565841	65.76994	-37.70066	Tasiilaq Centre	Amphibolite	x	x	