DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 2018/10

Summary of the 2014 fieldwork carried out in the Kuummiut Terrane of the Paleoproterozoic Nagssugtoqidian Orogen, South-East Greenland

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Contents

1. Preface

This report presents the results of fieldwork carried out during the 2014 field season in South-East Greenland in the framework of the joint GEUS-MMR ‘SEGMENT’-project (2009-2016), focusing on reassessing the geology and mineral potential of the area between 62°30’N and 66°30’N. The main results of the SEGMENT-project are reported in Kolb et al. 2016 [Kolb, J., Stensgaard, B.M. & Kokfelt, T.F. Danmarks of Grønlands Geologiske Undersøgelse Rapport 2016/38, 157 pp.].

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2. Introduction

This report covers work done during the 2014 SEGMENT expedition to South-East Greenland by Annika Dziggel (ADZ) and Sascha Müller (SMU) (team 2) – both from RWTH Aachen University, Germany. Fieldwork was conducted during four weeks (14.07.14 – 10.08.14) throughout the northern part of the Nagssugtoqidian Orogen (Kuummiut Terrane) in seven different camp sites (Fig. 1), and included several reconnaissance stops.

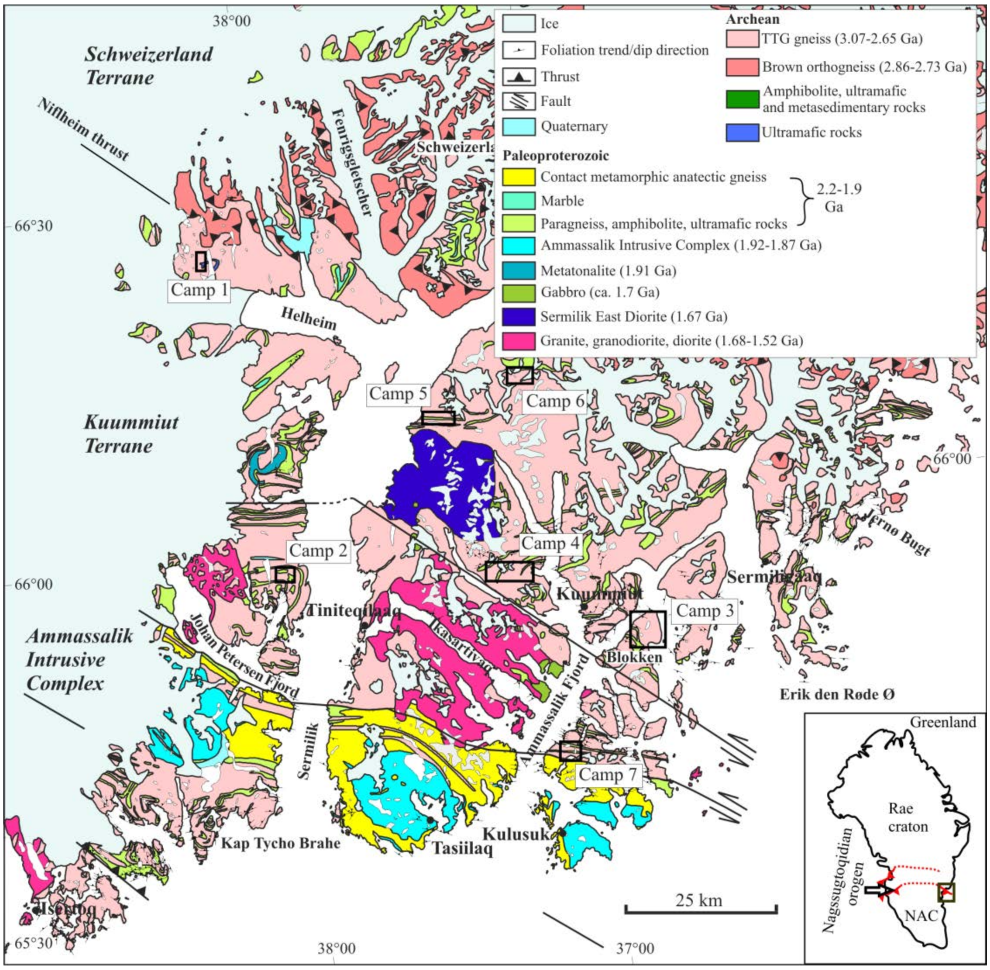

Figure 1. *Geological map of the northern Nagssugtoqidian Orogen in South-East Greenland (modified after Escher, 1990). Rectangles outline the investigated and sampled camp sites.*

The main interest of fieldwork lied on understanding the tectono-metamorphic evolution of the high-pressure rocks preserved in Paleoproterozoic mafic dykes that transect the Archean country rocks (TTG gneiss) of the Kuummiut Terrane (Andrews et al., 1973; Wright et al., 1973; Bridgwater et al., 1990; Kolb, 2014). Fieldwork and sampling therefore concentrated on metamafic dykes either containing eclogite-facies mineral assemblages (mainly garnet and omphacite) or assemblages that have not been affected severely by retrograde metamorphism (i.e. rocks in which relict eclogite-facies minerals or replacement textures are still recognizable). During fieldwork, however, it was noted that relict high-pressure mineral assemblages are also preserved in boudins and boudinaged layers of mafic to ultramafic supracrustal rock of the

Kuummiut Terrane, and consequently these were also sampled. Different camp sites were chosen after detailed literature research and planning in the field, in order to cover as many occurrences of eclogite and its retrogressed equivalents as possible. In addition, the different camp positions (Fig. 1) allowed for an investigation of potential differences in the metamorphic grade and PT evolution of the Kuummiut Terrane.

Three out of the seven camps were (at least for some time) joint camps with other teams. Camp 1 was shared with Kristoffer Szilas (KSZ) – Stanford University, USA, Jonas Tusch (JOT) – University of Cologne, Germany and Sam Weatherley (SMW) – GEUS from team 4, as well as Matti Nellemann Petersen (MNP) – GEUS to help us with the use of the android device and aFieldwork app. In camp 2 we were visited by Jochen Kolb (JKOL) – GEUS and Anne Brandt Johannesen (ABJ) – University of Oulu, Finland from team 1. Vincent van Hinsberg (VIVH) – McGill University, Canada and Majken D. Poulsen (MADP) – GEUS of team 6 shared camp with us at camp 5.

A list of localities, including camp locations with working periods and GPS-data is given in Appendix A. Over the course of the fieldwork, a total of hundred and twelve samples were collected, including gneiss, granite, diorite and carbonate rock (Appendix B). Nevertheless, detailed petrographic and geochemical examinations, such as whole-rock major and trace element analysis as well as EPMA (Electron Probe Micro-Analyzer) mineral-chemical analysis, mostly focus on the collected eclogitic and amphibolitic rocks.

The following sections summarize our main observations during fieldwork for the seven camp sites (chapter 3), as well as the three reconnaissance days (chapter 4). Please note that because the structural geology is complex, it is not possible to correlate the different fabrics across the region, and the $D_{1,2,3}$ nomenclature used to document the sequence of deformation events in each locality only refers to the local structural evolution. More detailed information regarding the mineral textures, geochemistry and PT-history of the variably retrogressed eclogite-facies rocks of the Kuummiut Terrane is presented in Müller et al. (2018), a scientific research paper published in Lithos of which the Abstract is given in Appendix C.

3. Camps

3.1 Camp 1. North of Helheim glacier

Camp 1 covered an area north of the Helheim glacier, in which we worked from July 15 to July 17 2014. The camp area is dominated by dioritic to TTG-type (Trondhjemite-Tonalite-Granodiorite) gneiss and an up to 50 m thick east-northeast to west-southwest trending supracrustal belt made up of ultramafic lithologies and garnet amphibolite. The contact between the TTG gneiss and the mafic to ultramafic sequence is tectonic, primary intrusive contact relationships between the two rock types were not observed. The northern and southern margins of the supracrustal belt are marked by mylonitic shear zones.

The TTG gneiss is fine- to medium-grained, and typically consists of quartz, plagioclase, hornblende, biotite, and, locally, garnet. It contains a well-developed foliation that is defined by a fine layering and the preferred orientation of biotite and hornblende, as well as amphibolitic schlieren and plagioclase-rich leucosomes (Fig. 2a).

Garnet-amphibolite mainly occurs along the southern and northern margin of the supracrustal belt, and has a mineral assemblage of garnet, hornblende, plagioclase, quartz (Fig. 2b), and, locally, clinopyroxene and ferrous sulfides. Leucosomes with concentrations of peritectic garnet and clinopyroxene have also been observed in places (Fig. 2c). Clinopyroxene, however, has mostly been found in layers enriched in amphibole, and is locally associated with chalcopyrite (Fig. 2d). Retrograde epidote is mainly restricted to schistose to mylonitic amphibolite. Large garnet grains (up to 5 cm) in the amphibolite exhibit composition-related zoning and plagioclase coronas along their margins, indicating decomposition during uplift.

Ultramafic lithologies are the dominant rock type within the supracrustal belt. They either occur as schistose or massive units with a general mineral assemblage of olivine, plagioclase, garnet, and hornblende. Several ultramafic units also contain chromite and orthopyroxene, the later forming up to 1 cm large porphyroblasts that stick out due to being more resistant to weathering than the matrix minerals (Fig. 2e).

The whole sequence has been intruded by several generations of pegmatite dykes. Foliation parallel and locally amazonite-bearing pegmatites (Fig. 2f) have been observed as boudinaged layers in mylonitic gneiss and epidote-bearing amphibolite schist. More commonly, pegmatites made up of garnet, biotite, plagioclase, hornblende, and quartz can be observed that crosscut all lithological units. The contact zone to TTG gneiss is marked by a hornblende selvage.

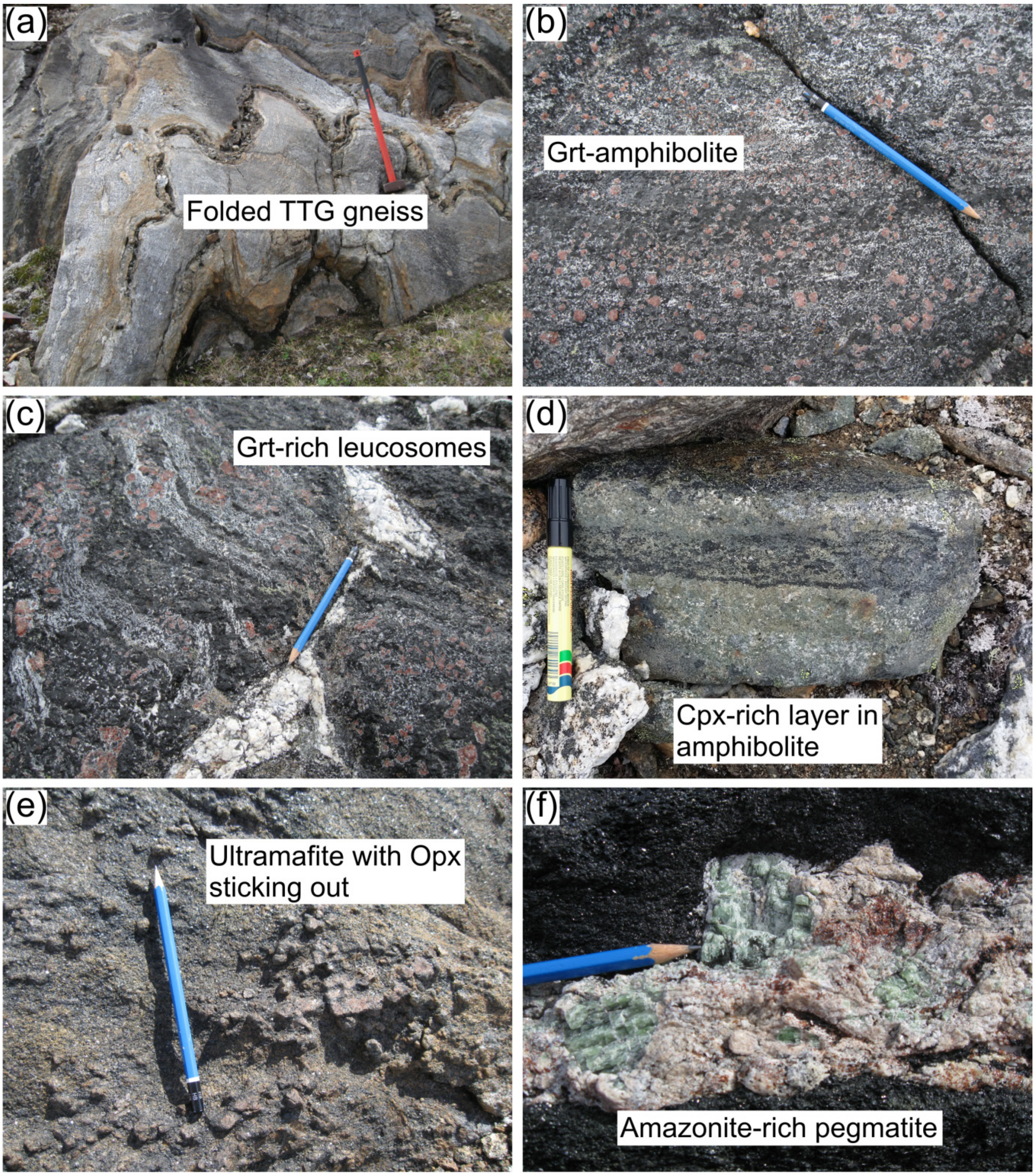

Figure 2. *Field photographs of various rock types and structures in the camp 1 area.*

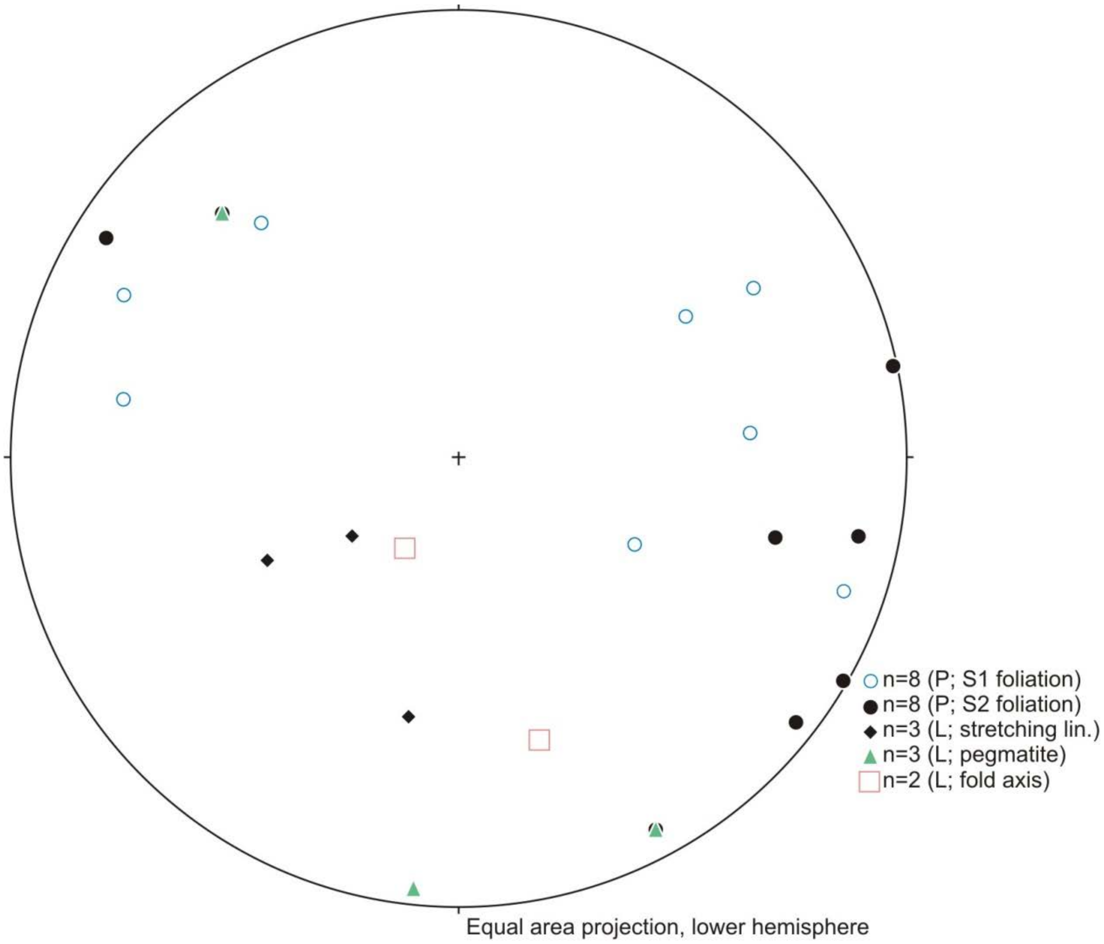

Figure 3. *Stereographic projection of structural data collected at camp 1.*

The earliest fabric preserved in the camp 1 area is a variably developed S_1 foliation that is parallel to the lithological layering, and that dips at moderate to steep angels to the W/NW and E/SE (Fig. 3). The associated mineral stretching lineation plunges at moderate to steep angles to the SW. S-C fabrics and garnet sigma clasts point to an oblique reverse sense of movement that was broadly to the NE. Open to close F_2 folds refold the S_1 foliation. The fold axes plunge at moderate to steep angles to the S and SW, more or less parallel to the mineral stretching lineation. A second foliation (S_2) overprints the S_1 foliation, and is best developed in mylonitic shear zones along the northern and southern margin of the supracrustal belt. Along fold limbs, the S_2 foliation is more or less parallel to S_1, but is usually steeper than the former (Fig. 3). The S_2 foliation is also synchronous with the intrusion of up to several m wide pegmatite dykes that locally crosscut the S_1 foliation.

3.2 Camp 2. North of Johan Petersen Fjord

Camp 2 is located west of the Sermilik Fjord and north of the Johan Petersen Fjord (Fig. 1). We stayed here from July 18 to July 22 2014. Rock types in this area include TTG gneiss, as well as a variety of mafic and ultramafic lithologies that form elongate, up to 100 m wide and folded supracrustal belts, or occur as boudins and boudinaged layers of variable size within the TTG gneiss. In addition, mafic dykes intrusive into TTG gneiss have been observed. In general, the mineral assemblages in all these rock types point to amphibolite-facies conditions, even though mineral textures in some cases indicate a higher-pressure origin.

TTG gneiss is the most dominant type of rock, often occurring as a leucocratic and strongly foliated rock, with a mineral assemblage of quartz, plagioclase, biotite, and, locally, garnet and hornblende (Fig. 4a). Along the contact with mafic and especially ultramafic lithologies, the gneiss is hydrothermally altered and rusty (Fig. 4b).
Gneiss within these rust zones is rich in aluminum and contains high amounts of Al-rich silicates such as garnet, plagioclase, biotite, muscovite, sillimanite, and kyanite. The garnet is purple in color and may have gem-quality, as it has a high clarity and is generally free of inclusions; with grain sizes of up to several cm. Kyanite forms up to several mm large crystals that are translucent to transparent and pale blue in color.

The ultramafic schist in contact with the rusty gneiss is composed of randomly orientated white tremolite, hornblende, olivine, garnet, and an unidentified dark green mineral, most likely clinopyroxene (Fig. 4c). The rock has a garbenschiefer-like texture and is often crosscut by pegmatite dykes.

However, pegmatite dykes are generally widespread and crosscut all rock types including the garnetiferous alteration zones, indicating that the hydrothermal overprint is most likely unrelated to their emplacement. Pegmatite dykes throughout the camp 2 area mostly consist of quartz, plagioclase, biotite and K-feldspar, except for one instance, where a pegmatite with open space quartz growth, muscovite and chlorite has been recorded. Apart from pegmatite, epidote and quartz veins crosscutting the different rock types were also observed.

The mineralogy and composition of mafic and ultramafic rocks is variable. Green, clinopyroxene-rich and up to several m large ultramafic boudins made up of clinopyroxene, quartz, plagioclase, and pyrite are locally present in TTG gneiss. The mineral assemblage in these ultramafic boudins is most likely of igneous origin, as indicated by the ophitic texture defined by plagioclase. Other ultramafic rocks are composed of olivine, hornblende, and garnet, and locally contain veinlets of garnet, clinopyroxene and plagioclase.
Several types of mafic rock can be distinguished based on mineral assemblages and textural characteristics. The most common type is a schistose to massive, medium- to coarse-grained amphibolite, consisting of garnet, quartz, plagioclase, hornblende, and, locally, biotite (Fig. 4d). Garnet in this rock is commonly rimmed by plagioclase coronas, indicative of decompression. Some heavily weathered outcrops with honeycomb textures and large garnet sigma clasts contain foliation-parallel epidote layers. Due to a locally intense weathering, biotite within this rock appears green and flaky.

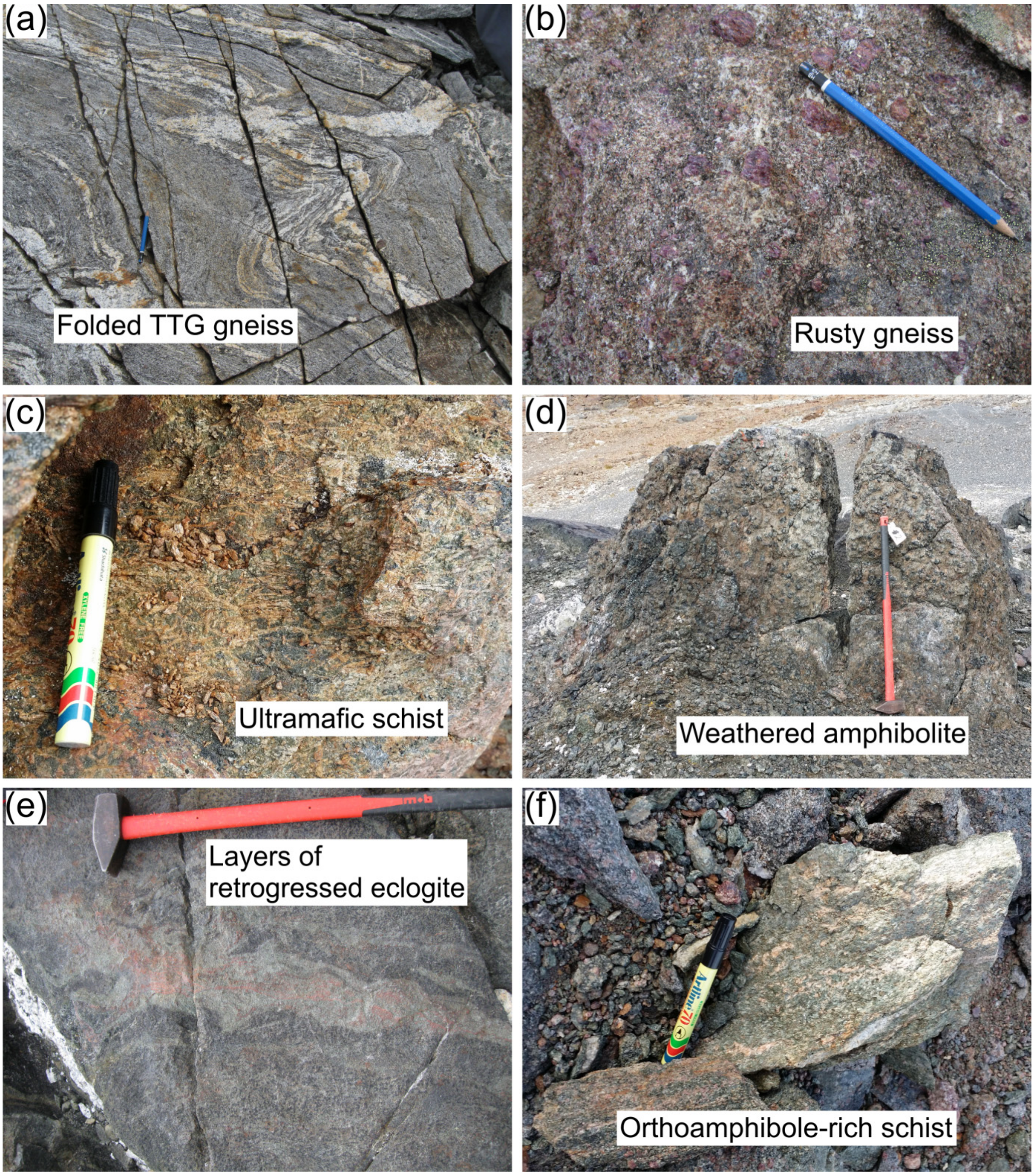

Figure 4. *Field photographs of various rock types and structures in the camp 2 area.*

The second type of mafic rock is massive, medium- to coarse-grained and unfoliated, and occurs both within the supracrustal belts and in the center of boudinaged mafic dyke (Fig. 4e). This type of rock mainly consists of garnet and clinopyroxene that have been variably replaced by amphibolite-facies minerals such as hornblende and plagioclase. Replacement textures indicate that garnet and clinopyroxene represent relict high-pressure minerals, and this type of rock is therefore referred to as retrogressed eclogite (Appendix C).

The third type of mafic rock is a green amphibolite schist that is dominated by orthoamphibole and that contains minor amounts of magnetite and graphite (Fig. 4f).

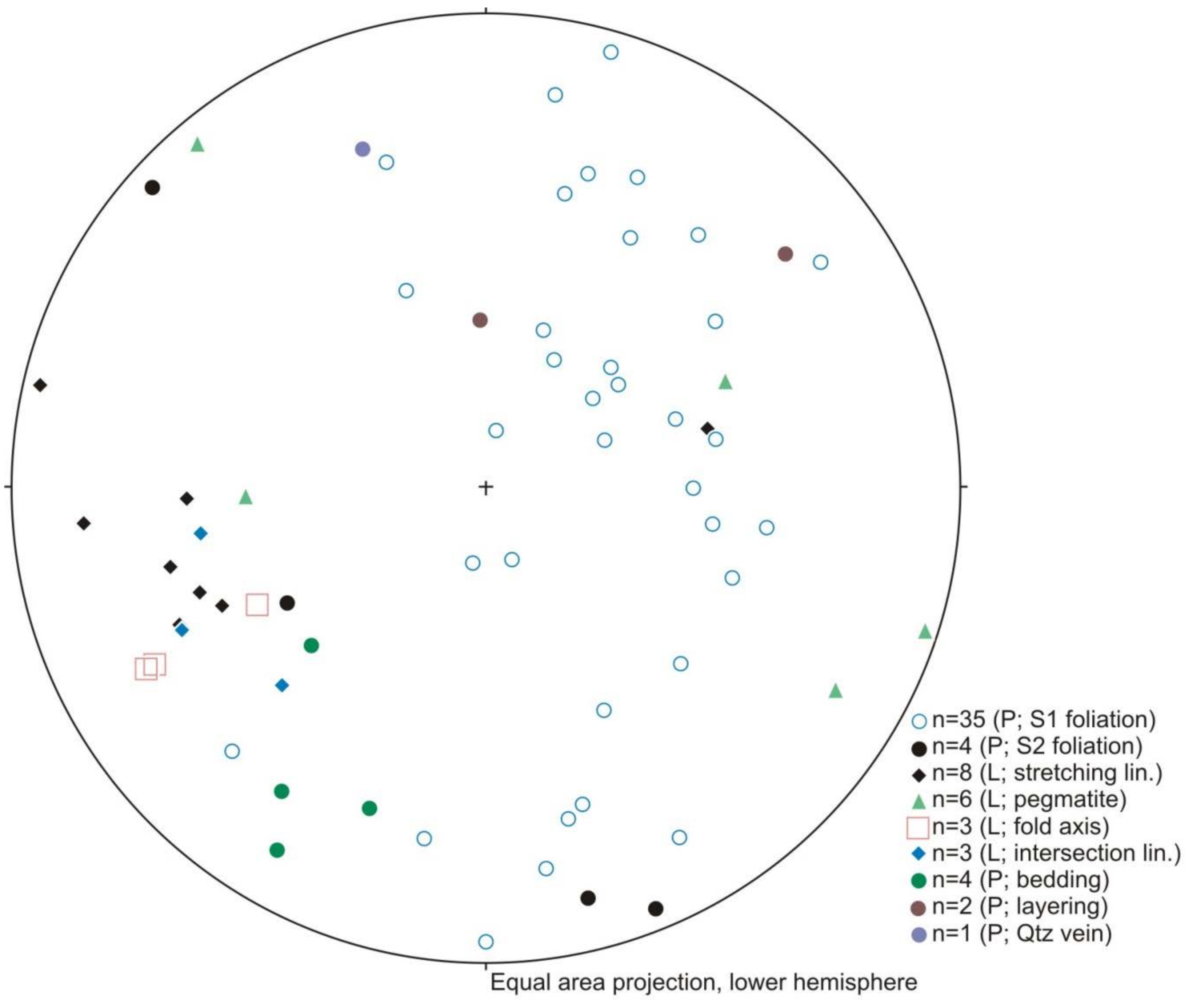

Figure 5. *Stereographic projection of structural data collected at camp 2.*

Due to its position in the hinge zone of a major D_2 fold, the orientation of structures in the camp 2 area is highly variable (Fig. 5). The most prominent fabric is a pervasive S_1 foliation in TTG gneiss and supracrustal lithologies that is parallel to lithological layering, and that is either subhorizontal, or dips at low to moderate angles mainly to the SW and NW. A locally developed mineral stretching lineation plunges at low to moderate angles mainly to the WSW. The S_1 foliation is folded by open to close F_2 folds. The fold axes, as well as the associated intersection lineations, plunge at low to moderate angles to the SW, broadly parallel to the L_1 lineation. A locally developed S_2 foliation overprints the earlier fabric, and dips at moderate to steep angles to the N and NE and to the SE (Fig. 5). Shear sense indicators, such as garnet sigma clasts show a top to the west sense of shear. A conjugate set of pegmatite dykes crosscuts all earlier fabrics, and dips at moderate to steep angles to the NW and SE. It is parallel to S_2 in an SE dipping orientation, where shear sense indicators point to a sinistral sense of shear.

3.3 Camp 3. Blokken island

The camp 3 area (23.07.14-26.07.14) is situated in the north-eastern part of the island Blokken (Fig. 1). This island is mostly comprised of Archean TTG gneiss, the so-called Blokken gneiss (Bridgwater and Myers, 1979), Paleoproterozoic mafic dykes containing variably retrogressed eclogite, as well as supracrustal belts made up of amphibolite and kyanite-garnet schist.

The Blokken gneiss is schistose to mylonitic, and appears as a white (Fig. 6a) or rusty (Fig. 6b) unit with a common mineral assemblage of quartz, plagioclase, biotite, hornblende and locally garnet. Foliation-parallel quartz veins and pegmatitic layers were observed in a few localities (Fig. 6c), as well as epidote veins of different orientations in others. The pegmatitic layers in the Blokken gneiss contain, in addition to quartz, plagioclase, and hornblende, garnet, and K-feldspar.

Boudinaged and locally eclogitic mafic dykes intrusive into the Blokken gneiss are more common than in other areas. Retrogressed eclogite north of the camp site occurs as green-red, fine- to medium-grained, massive to weakly foliated bodies within the Blokken gneiss (Fig. 6d). The rock has a mineral assemblage of garnet, clinopyroxene, hornblende, plagioclase and quartz. To the south, the retrogressed eclogite locally also contains biotite. The boudins are frequently crosscut by pegmatite dykes, which are made up of quartz, plagioclase and biotite.

The garnet-amphibolite occurs as fine- to medium-grained, boudinaged and foliation-parallel layers within gneiss (Fig. 6e). Apart from clinopyroxene, it has a similar mineral assemblage as the retrogressed eclogite and often contains leucosomes. However, in contrast to the mafic dykes, the amphibolite is strongly foliated and associated with kyanite-garnet-schist. Garnet within the amphibolite shows plagioclase coronas and exhibits leucosome tails showing a top to the NE sense of movement. The kyanite-garnet schist is made up of garnet, kyanite, plagioclase, quartz, biotite, muscovite, and sillimanite (Fig. 6f).

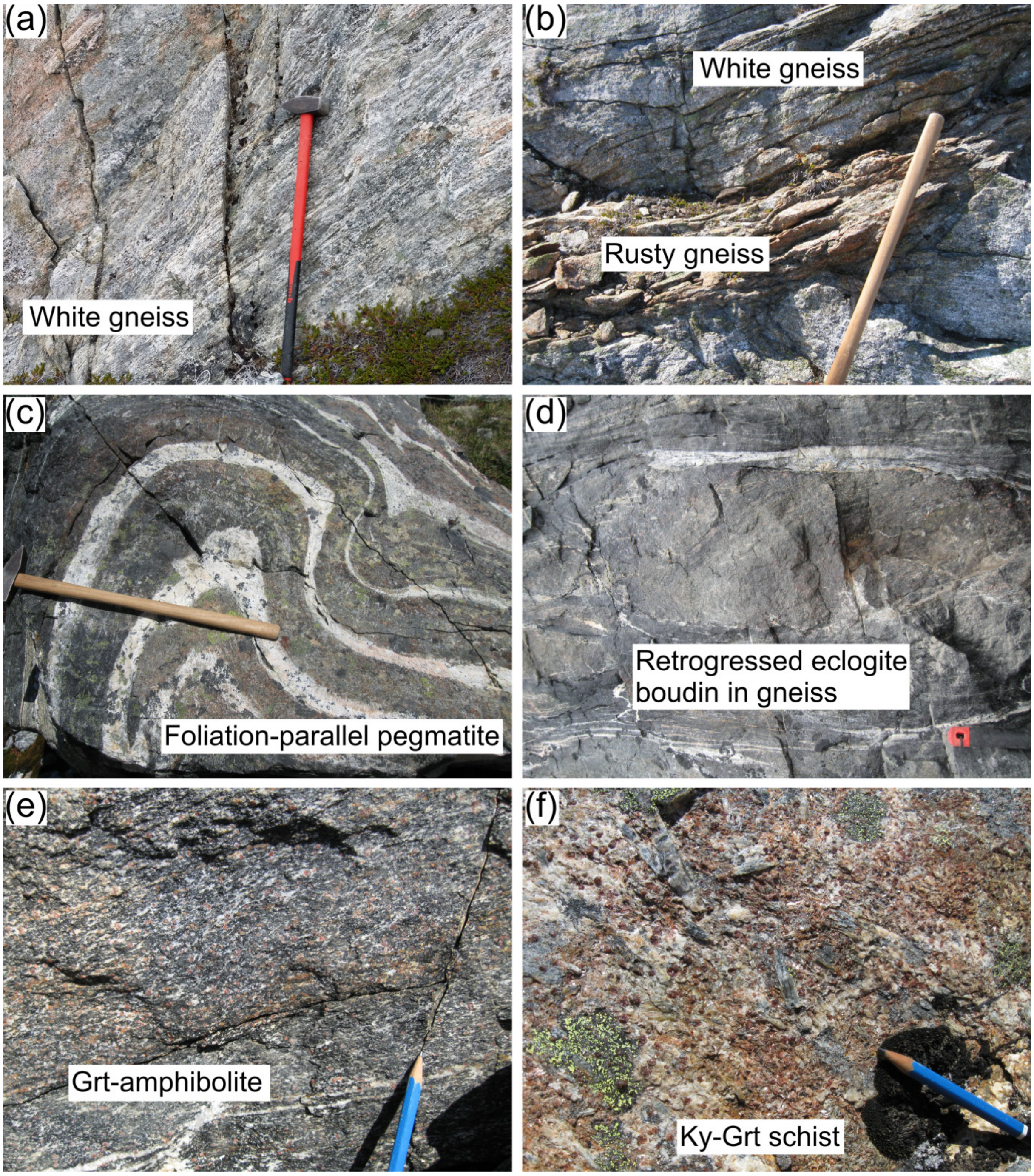

Figure 6. *Field photographs of various rock types and structures in the camp 3 area.*

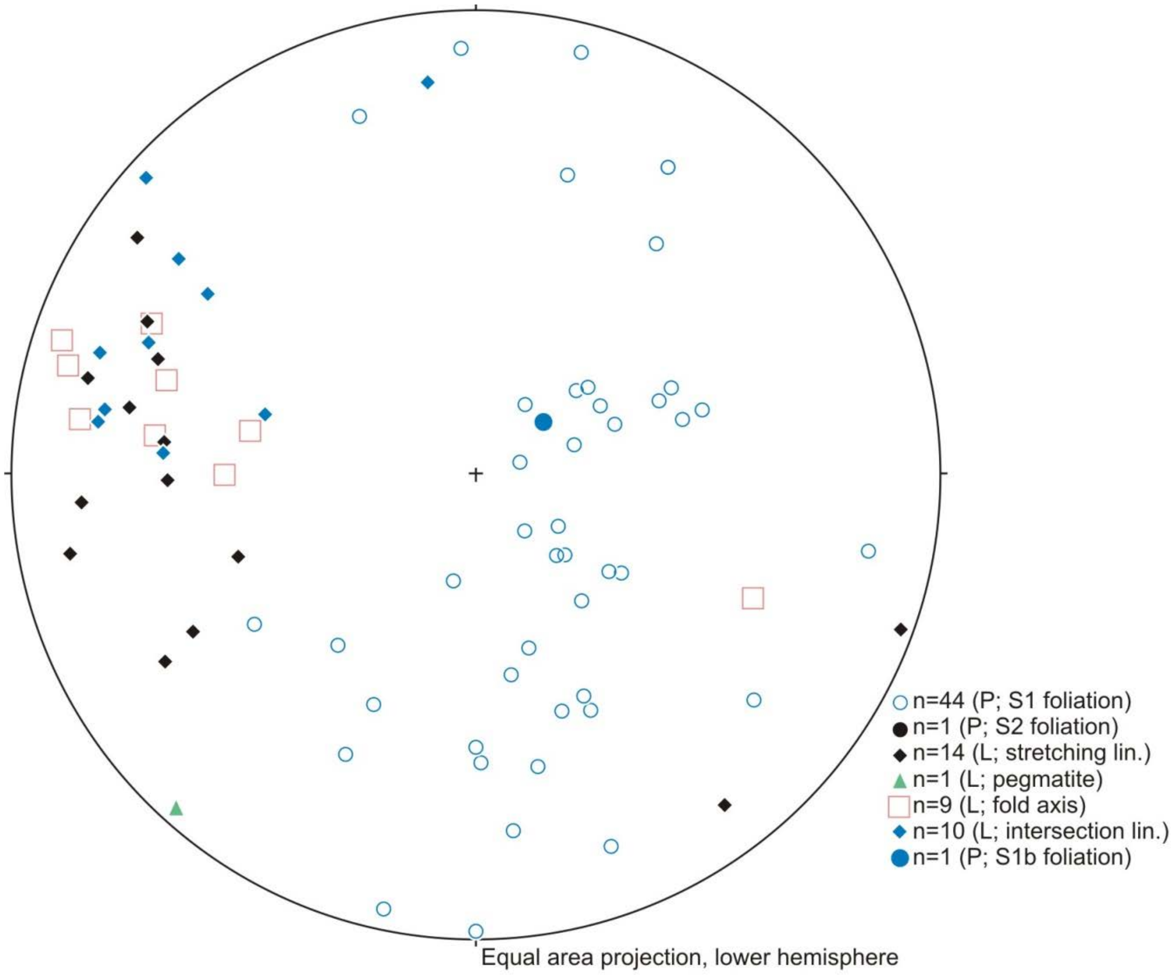

Figure 7. *Stereographic projection of structural data collected at camp 3.*

The S_1 foliation in the camp 3 area dips at low to moderate angles mainly to the NW and SW (Fig. 7). The associated mineral stretching lineation is near downdip, and mainly plunges at low to moderate angles in a westerly direction, or to the SE. Shear sense indicators, such as S-C fabrics and leucosome tails around garnet point to a top-to-the east and northeast sense of movement. A locally developed S_{1b} foliation dips at shallow angles to the SW; S-C fabrics again indicate thrusting towards the NE (Fig. 7). The fold axes of the open to close F_2 folds, as well as intersection lineations, plunge to the WNW, and are either parallel or slightly oblique to the mineral stretching lineation (Fig. 7). A pegmatite dyke with a steeply NE dipping S_2 foliation was observed crosscutting an eclogite dyke at one locality. S-C fabrics indicate a dextral sense of shear during S_2 shearing.

3.4 Camp 4. Valley west of basecamp

The camp 4 area is located northwest of camp 3, in a valley west of the basecamp at the settlement of Kuummiut. Here, we conducted fieldwork between July 27 and July 29 2014. Contacts between different lithological units are mainly tectonic, and are generally very well exposed. Intrusive contacts are only preserved around late- to post-tectonic, granitic and dioritic intrusions next to orthogneiss.

The dominant rock type in the camp 4 area is Archean TTG gneiss, which consists of biotite, garnet, plagioclase, quartz, and hornblende, and commonly contains leucosomes (Fig. 8a). In addition, pegmatite and amphibolite occur as boudins and foliation-parallel layers within the often layered TTG gneiss.

Supracrustal rocks are mainly preserved in up to 100 m wide east-west trending supracrustal belts. The supracrustal belts are dominated by amphibolite (Fig. 8b, made up of hornblende, plagioclase, quartz, and, locally, garnet) and garnet-kyanite schist of the general composition garnet, kyanite, (locally up to 20 cm large), biotite, quartz, and hornblende (Fig. 8c). Garnet-bearing amphibolite contains plagioclase coronas around garnet. Biotite is the main dark mineral in the garnet-kyanite schist, though its contents may vary from outcrop to outcrop and very biotite-garnet rich rocks locally occur. Some garnet-kyanite schist also contains plagioclase and sillimanite, either as matrix minerals or bright rims around garnet and kyanite, indicative of decompression. The schist has a rusty color in contrast to the bright gneiss and often contains foliation-parallel quartz veins and leucosomes. The garnet-kyanite schist and amphibolite are interlayered with TTG gneiss.

In the main valley of the camp 4 area close to a glacier stream, a highly silicic, layered rock consisting of almost pure quartz with traces of biotite and sulfides has been detected (Fig. 8d). The rock has a gossan-like weathering color, and may reflect a laminated quartz vein or highly silicified layered rock.

Eclogitic mafic dykes are locally preserved in TTG gneiss, and are best exposed in steep cliffs in the western and eastern parts of the camp 4 area. The dykes are boudinaged and oriented more or less parallel to the main foliation, indicating that they intruded pre- to syn-tectonically. Retrogressed eclogite sampled from gravel below a steep cliff with a large, subvertical mafic dyke hosted by TTG gneiss (Fig. 8e), shows a mineral assemblage of garnet, clinopyroxene, quartz, plagioclase, and hornblende.
Further high-pressure mineral assemblages were observed in the core of a garnet-pyroxenite boudin hosted by TTG gneiss (Fig. 8f), which is mainly composed of garnet, orthopyroxene, clinopyroxene and hornblende. Along the contact with TTG gneiss, amphibolite-facies mineral assemblages have been identified.

Additional intrusive rocks in the camp 4 area comprise pegmatite dykes (Fig. 8f), as well as late- to post-tectonic diorite and granite. The pegmatite dykes are syn-tectonic, and either occur as foliation-parallel and commonly boudinaged layers within the orthogneiss, or crosscut the earliest fabric, and locally brecciate more competent lithologies such as mafic and ultramafic boudins. The youngest record of igneous activity is marked by late- to post-tectonic diorite and granite intrusions that crosscut the orthogneiss and pegmatite dykes. Within one intrusive body, a graduation from diorite to granite was observed, suggesting that they formed contemporaneously.

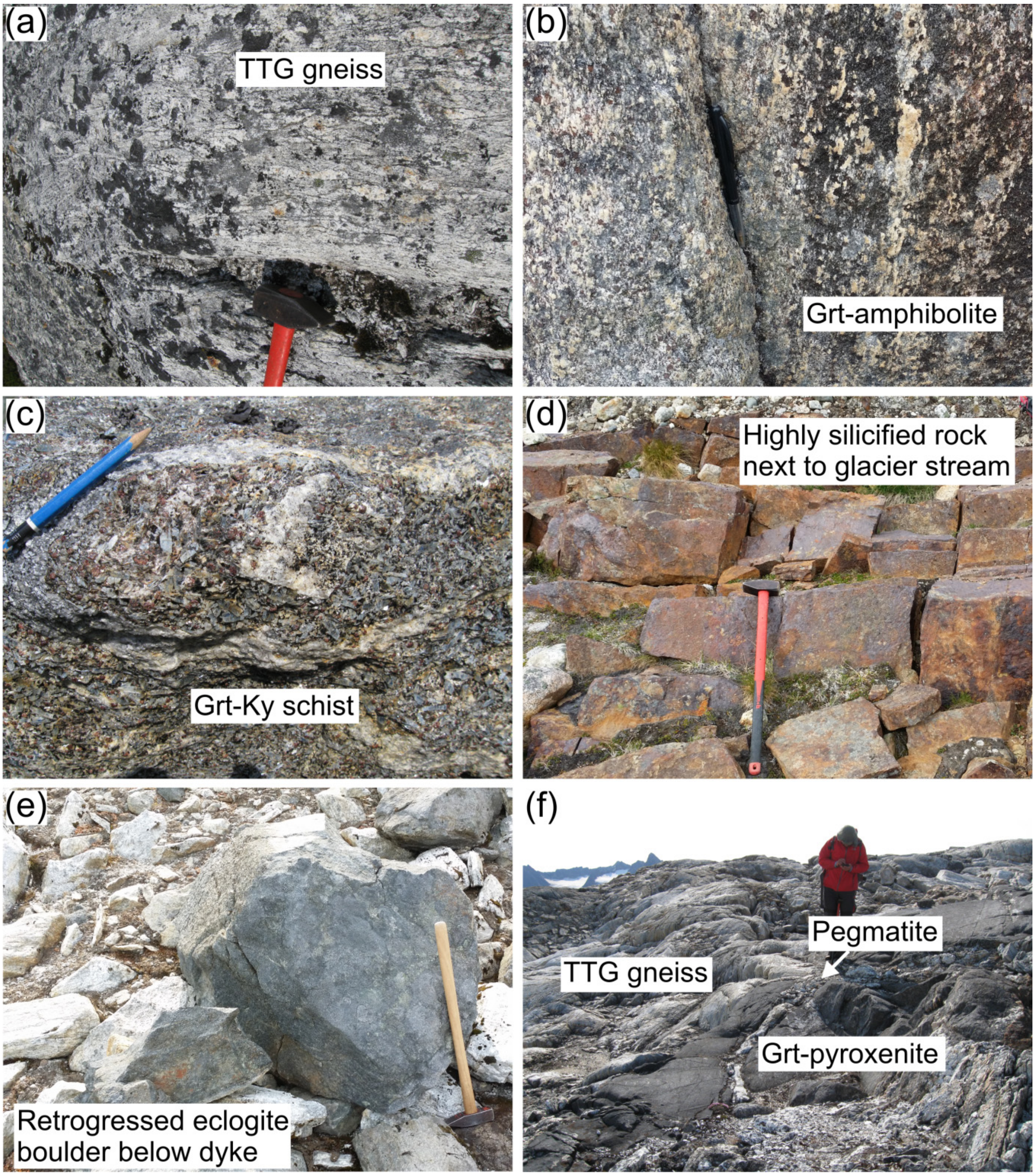

Figure 8. *Field photographs of various rock types and structures in the camp 4 area.*

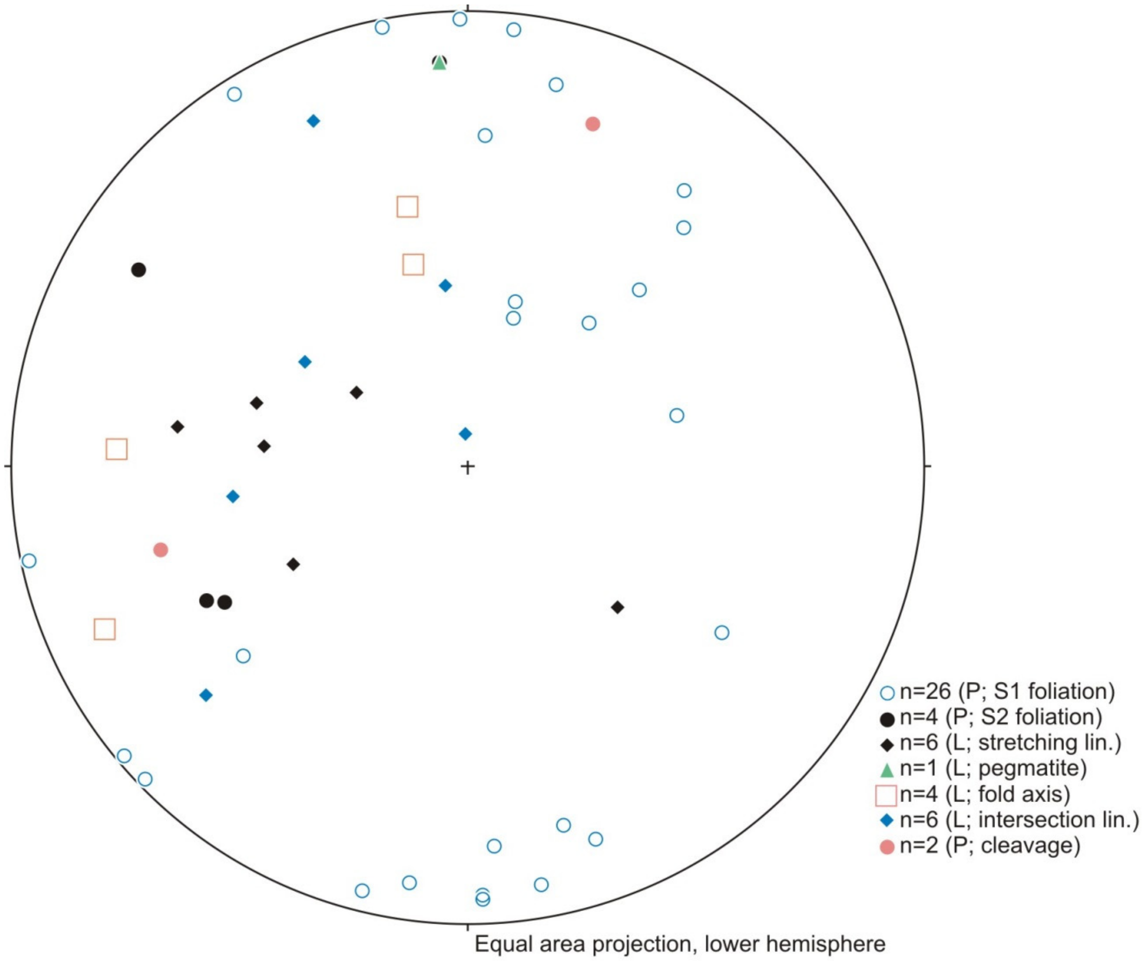

Figure 9. *Stereographic projection of structural data collected at camp 4.*

The structural inventory of the camp 4 area can be explained in terms of three deformation events (Fig. 9). The earliest fabric is an E-W striking S_1 foliation, which is parallel to lithological layering, and which dips at moderate to steep angles mainly to the N and S (Fig. 9). This early foliation is locally associated with rootless isoclinal F_1 folds, and the associated mineral stretching lineation plunges at moderate angles mainly to the W (Fig. 9). Shear sense indicators, such as S-C fabrics point to a north-block-up sense of movement, with a dextral strike-slip component. The S_1 foliation has been folded by close to tight F_2 folds (Fig. 9), which fold axes plunge at moderate angles mainly to the W, parallel to the intersection lineations. At some localities, especially in the north-western part of the camp 4 area, the S_1 foliation dips at moderate to high angles to the NW and SE, and the fold axes plunge to the N and NW. Locally, the S_1 foliation is crosscut by a moderately to steeply E and S dipping S_2 foliation, which was sometimes observed to be synchronous with pegmatite intrusion.

3.5 Camp 5. North of the Sermilik East Diorite

Camp 5 is situated to the north of the Sermilik East Diorite (Fig. 1). Fieldwork was carried out from July 30 to August 01 2014. The area is dominated by TTG gneiss that encloses several east-west trending supracrustal belts made up of aluminous gneiss, marble and calcsilicate rock, as well as amphibolite schist.

The TTG gneiss is white to dark grey in color (Fig. 10a). The rock is characterized by an mm- to cm-scale intercalation of felsic and mafic layers, and primarily composed of biotite, quartz, plagioclase and hornblende. Epidote stringers were observed in one locality. The TTG gneiss often contains foliation-parallel and/or crosscuttting pegmatite dykes and veinlets, as well as boudins and boudinaged layers of amphibolite.
Pegmatite dykes and veinlets are generally composed of quartz, plagioclase and biotite, but granitic compositions with K-feldspar have also been observed.

The aluminous gneiss (Fig. 10b) is more homogeneous than TTG gneiss, and mainly occurs at the contact between TTG gneiss and marble. The rock has a rusty weathering color, and a mineral assemblage of biotite, plagioclase, quartz, sillimanite, kyanite, muscovite, and garnet. Garnet is often replaced by plagioclase and may occur as lens-shaped porphyroblasts that stick out due to weathering.

Marble is massive to schistose and layered, and occurs in relatively thick sequences (sometimes more than 30 m) of interlayered calcareous and siliceous rock units. It has a bluish color on fresh surfaces (Fig. 10c) and is mainly composed of calcite and dolomite, with minor amounts of siderite and ankerite. Locally, marble is monomineralic and entirely composed of calcite. Monomineralic marble is interlayered with a darker type of carbonate rock, which contains variable amounts of white mica and biotite. Growth of siderite usually occurs in certain layers and on foliation planes along lithological contacts (Fig. 10d). Thin layers of calcsilicate rock predominantly occur at the contact between the marble and rusty gneiss. The calcsilicate rock mainly consists of quartz, carbonate, and, locally, clinopyroxene and/or wollastonite, and is locally associated with foliation-parallel laminated quartz-veins (Fig. 10e).

The amphibolite schist is fine-grained to mylonitic, and often contains mm-wide leucocratic layers that possibly represent leucosomes (Fig. 10f). It is usually composed of garnet, plagioclase, quartz, and hornblende, and locally contains boudinaged pegmatites and quartz veins, as well as plagioclase coronas and leucosome tails around garnet.

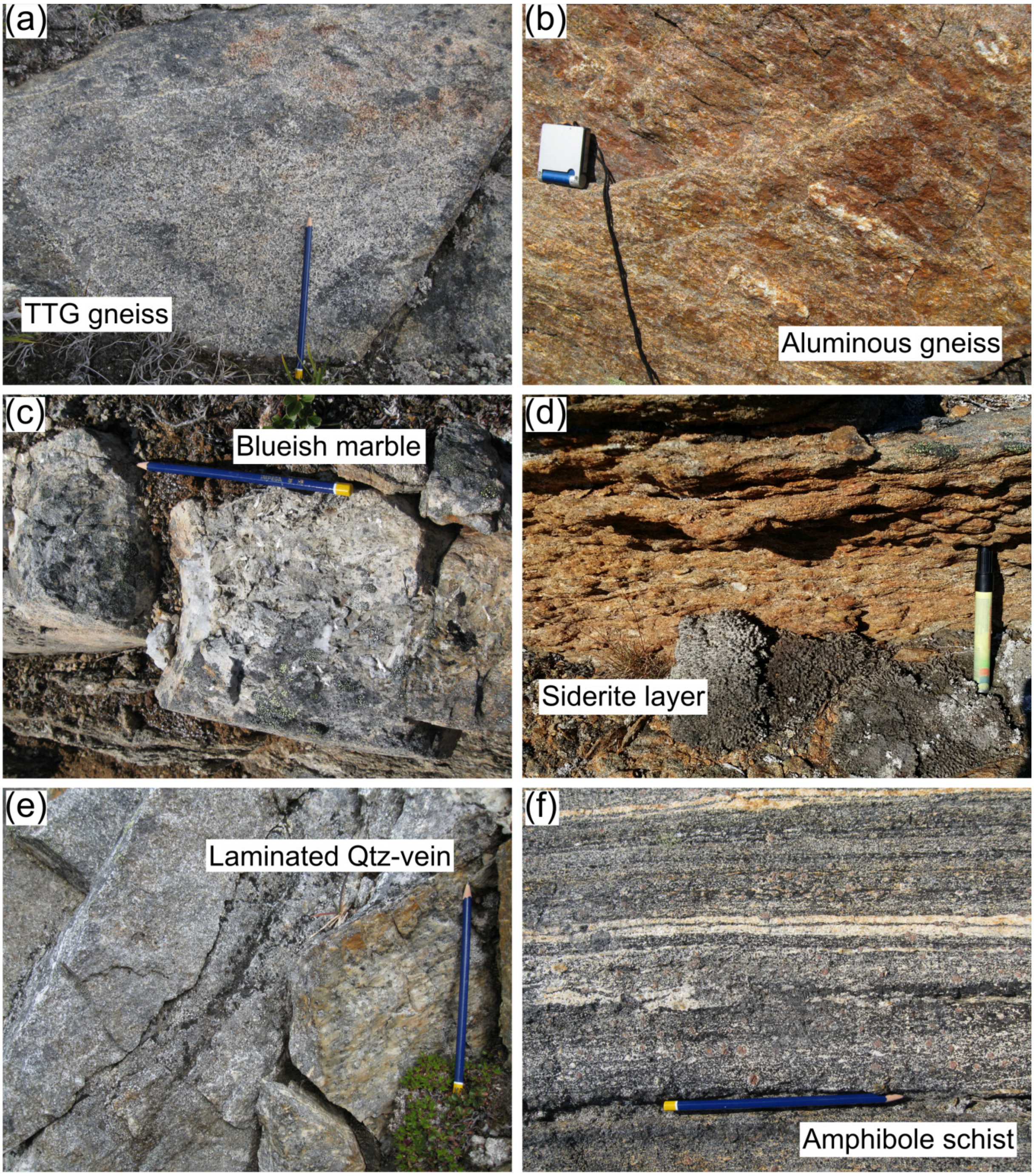

Figure 10. *Field photographs of various rock types and structures in the camp 5 area.*

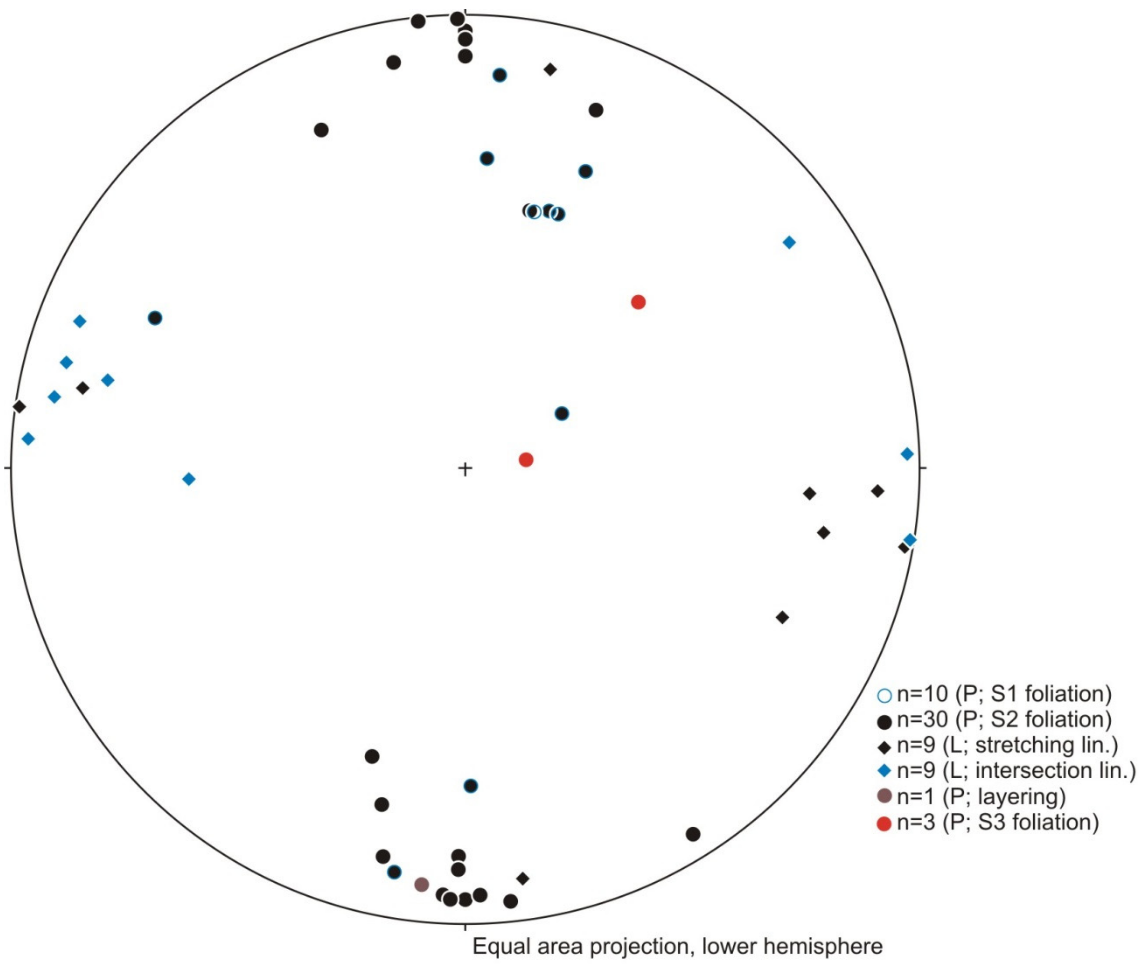

Figure 11. *Stereographic projection of structural data collected at camp 5.*

The camp 5 area is dominated by an EW trending and up to 1 km wide strike-slip shear zone. Within this shear zone, the foliation dips subvertically to the N and S (Fig. 11), whereas outside the shear zone moderate dips are recorded. Based on its orientation and the presence of subhorizontal mineral stretching lineations, we interpret the shear zone to have formed during the regional D_2 deformation (Kolb, 2014). Away from the shear zone, the dominant fabric preserved in the gneiss is less steep and locally contains an early mineral stretching lineation. This fabric is therefore referred to as an S_1 foliation. Within the shear zone, the S_1 foliation is only preserved in the hinges of close to tight F_2 folds, and is otherwise transposed into the S_2 foliation. Locally, two different foliations that are slightly oblique to each other have been recorded. The L_2 lineations are subhorizontal, and plunge at low angles to the WNW and ESE, parallel to the intersection lineations (Fig. 11). Shear sense indicators variably point to a dextral or sinistral sense of shear, the latter of which seems to dominate.

3.6 Camp 6. South of the Niflheim thrust

Camp 6 (02.08.14-05.08.14) is situated in an east-west trending valley a few km south of the Niflheim thrust that forms the contact between the Kuummiut and Schweizerland Terranes (Fig. 1). Glacial gravel with boulder sizes of up to several meters occupies large areas where the glaciers have retreated. In contrast to all other camp sites, the gravel not only includes TTG gneiss, amphibolite or retrogressed eclogite, but also granulite-facies gneiss (clinopyroxene + orthopyroxene + leucosomes), which is likely derived from the Archean Schweizerland Terrane to the north.

The camp 6 area is comprised of four dominant rock types, including TTG gneiss, ultramafic rock, aluminous gneiss, and garnet amphibolite. Mafic dykes intrusive into the TTG gneiss also occur, but could not be sampled as they are only exposed in steep cliffs of the surrounding mountains.

The TTG gneiss is strongly layered, and has a general mineral assemblage of biotite, plagioclase, quartz, and garnet (Fig. 12a), locally with hornblende. The layering is defined by foliation-parallel leucosomes, and is particularly well-developed in garnet-rich varieties. In addition, the rock contains boudins and layers of amphibolite, ultramafic rock, and pegmatite. Crosscutting and foliation-parallel quartz veins are locally abundant.

The ultramafic rock appears as an up to several 100 meters thick, coarse-grained and massive, unfoliated to foliated unit, ranging in color from greenish to brown and locally black (Fig. 12b). In some cases, a rusty weathering color was observed. Tremolite, hornblende, clinopyroxene, olivine, orthopyroxene and plagioclase constitute the dominant mineral assemblage. Except for local occurrences of magnetite, the ultramafic rock is non-magnetic. Along the contact of intruding pegmatite dykes and other felsic intrusive rocks, the ultramafic rock is rich in biotite.

The aluminous gneiss has a rusty weathering color, and consists of quartz, plagioclase, muscovite, biotite and, locally, garnet and sillimanite (Fig. 12c). Quartz veins either crosscut the foliation, or occur as foliation-parallel stringers and veinlets.

The garnet amphibolite is schistose to mylonitic, and mainly consists of hornblende, plagioclase, quartz, and garnet (Fig. 12d). Garnet is often rimmed by plagioclase coronas and in some cases partially pseudomorphed by plagioclase-hornblende symplectites. The rock contains up to 15 cm thick layers rich in garnet- and clinopyroxene and is crosscut by pegmatite and quartz veins. Garnet and clinopyroxene in amphibolite of the camp 6 area are associated with leucosomes, suggesting partial melting at upper amphibolite-facies conditions and a peritectic origin of garnet and clinopyroxene. The leucosomes form foliation-parallel stringers and are locally associated with pegmatite seams (Fig. 12e), indicating that at least some of the pegmatite intruded during high-temperature metamorphism. More commonly, however, the up to one meter thick pegmatite dykes crosscut the foliation in the amphibolite. At one locality, up to several decimeters large carbonate and calcsilicate boudins hosted by amphibolite have been observed (Fig. 12f). The boudins are mainly made up of calcite and dolomite, and locally contain azurite along their margins.
Pegmatite crosscutting all units is generally composed of quartz, plagioclase and biotite, as well as hornblende in some localities.

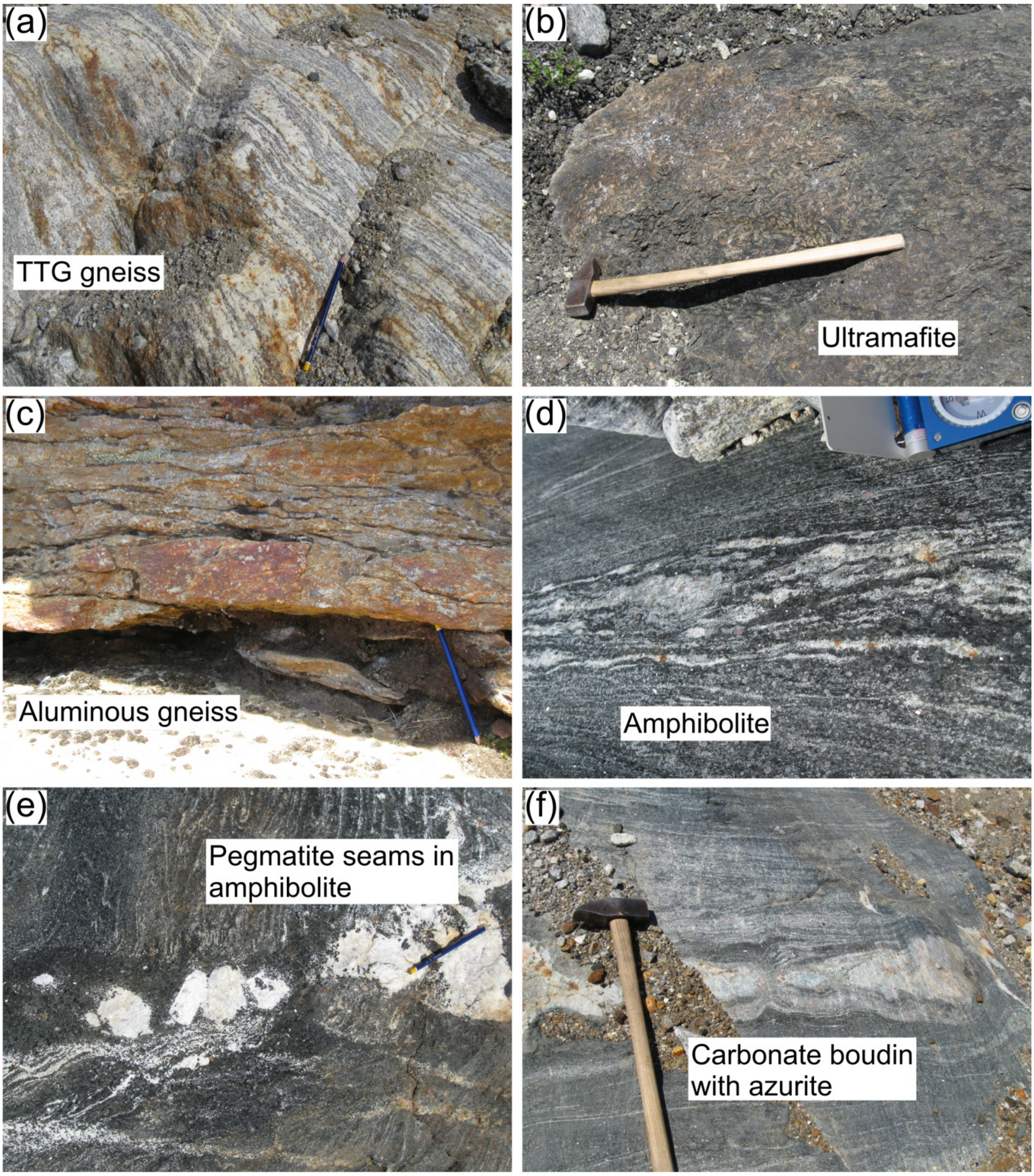

Figure 12. *Field photographs of various rock types and structures in the camp 6 area.*

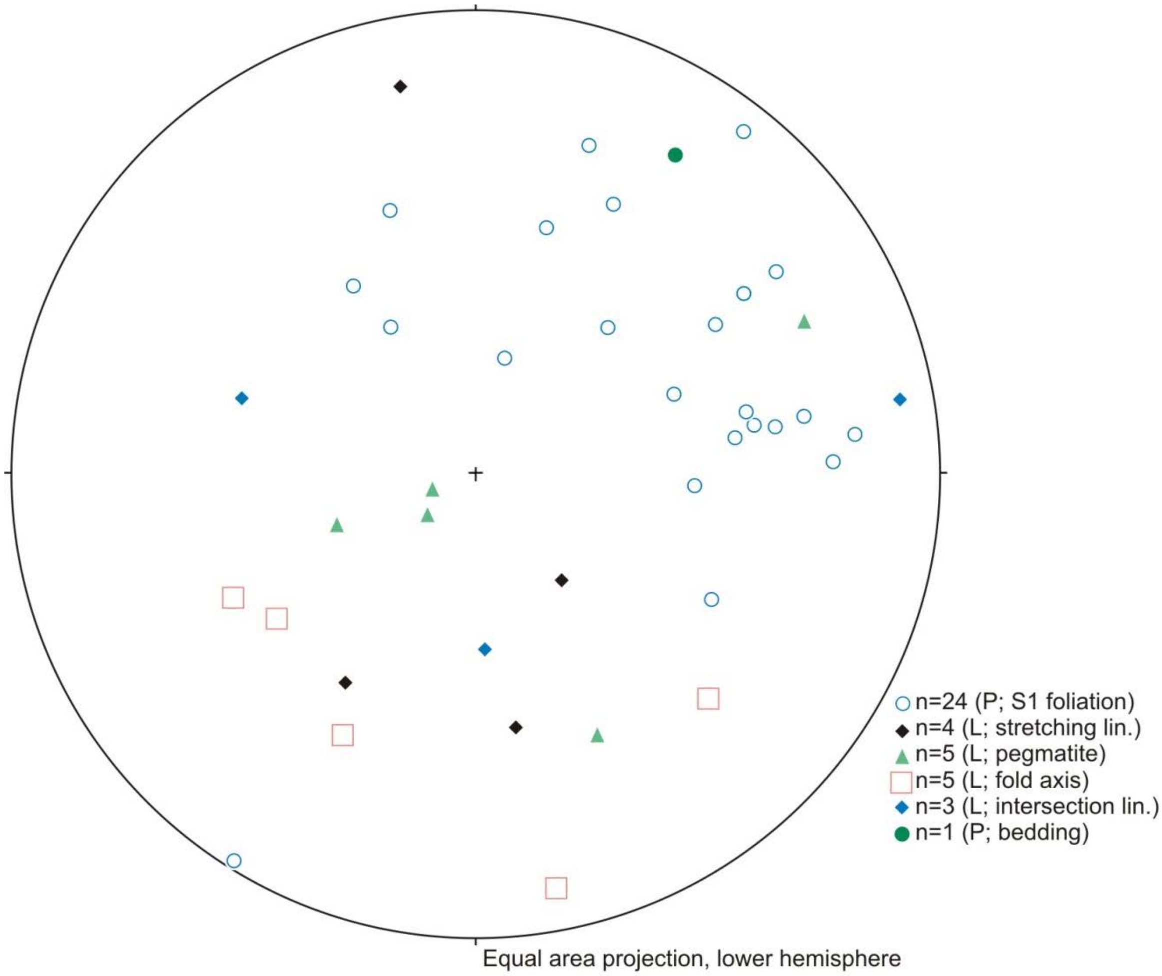

Figure 13. *Stereographic projection of structural data collected at camp 6.*

The dominant fabric in the camp 6 area is a moderately, mainly W to SW dipping S_1 foliation (Fig. 13). Where present, the associated mineral stretching is either downdip, or plunges at low angles to the N. Shear sense indicators in the western part of the camp 6 area point to a top-to-the east and north-east sense of movement, whereas in the east, a north- or east-block-up sense of movement (i.e. extensional shearing) is indicated. The L_1 lineation is more or less parallel to the axes of close to tight F_1 (or F_2) folds. A conjugate set of crosscutting pegmatite dykes dips at low to moderate angles to the NE, NW, and SW (Fig. 13). The NW dipping pegmatite has a weak foliation along its margin and S-C fabrics point to a dextral shear sense, whereas the foliation in the NE dipping pegmatites indicates a sinistral shear sense.

3.7 Camp 7. Contact between the Kuummiut Terrane and Ammassalik Intrusive Complex

The last camp (05.08.14-07.08.14) is situated close to the contact between the Ammassalik Intrusive Complex and the Kuummiut Terrane east of the Ammassalik Fjord (Fig. 1). In this camp, we mainly examined TTG gneiss and ultramafic rock of the Kuummiut Terrane.

The TTG gneiss is layered and has a typical mineral assemblage of quartz, garnet, biotite, plagioclase, and hornblende. The garnet content within the TTG gneiss varies, from very garnet-rich gneiss (Fig. 14a), to gneiss in which garnet is either absent (Fig. 14b) or restricted to certain layers. Rusty colored gneiss, interlayered with light grey to white gneiss, is more aluminous and contains sillimanite, as well as a higher amount of garnet. Where present, garnet is locally rimmed by biotite or hornblende and rich in inclusions. It is also often associated with leucosomes and shows leucosome tails (Fig. 14c). In highly sheared units, garnet is largely weathered out and leaves a honeycomb texture. The TTG gneiss contains amphibolitic (garnet, hornblende plagioclase, quartz), gabbroic (biotite, hornblende, plagioclase, olivine, pyroxene), and ultramafic layers and lenses of variable size.

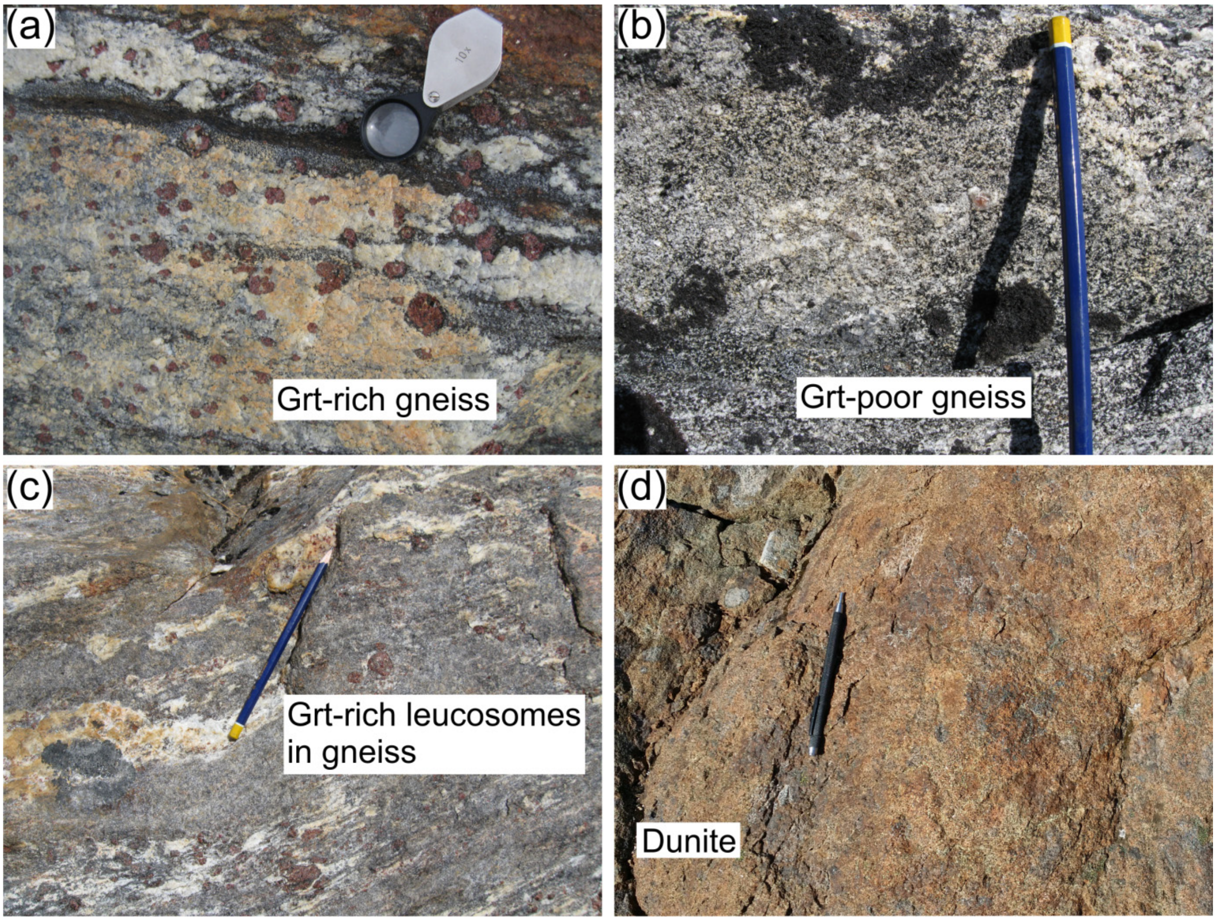

Figure 14. *Field photographs of various rock types and structures in the camp 7 area.*

As in other camp areas, the gneiss in the camp 7 area commonly contains both foliation parallel and crosscutting pegmatite dykes. They have a mineral composition of plagioclase, quartz, biotite, garnet and K-feldspar.

Ultramafic rock occurs as elongate, up to 100 m long bodies or as variably sized boudins within the gneiss (Fig. 14d). Most of the ultramafic rock is strongly weathered, with a brown, gossan-like weathering color. It has a lherzolitic mineral assemblage of olivine, orthopyroxene, garnet, clinopyroxene, and biotite, though olivine and garnet-contents vary. Some of the ultramafic boudins are crosscut by quartz veins and pegmatite dykes. Along the margins of the dykes, the ultramafic rock is more mafic in composition, as indicated by the presence of quartz and a higher garnet abundance. More mafic compositions were also observed at the contact to the surrounding gneiss.

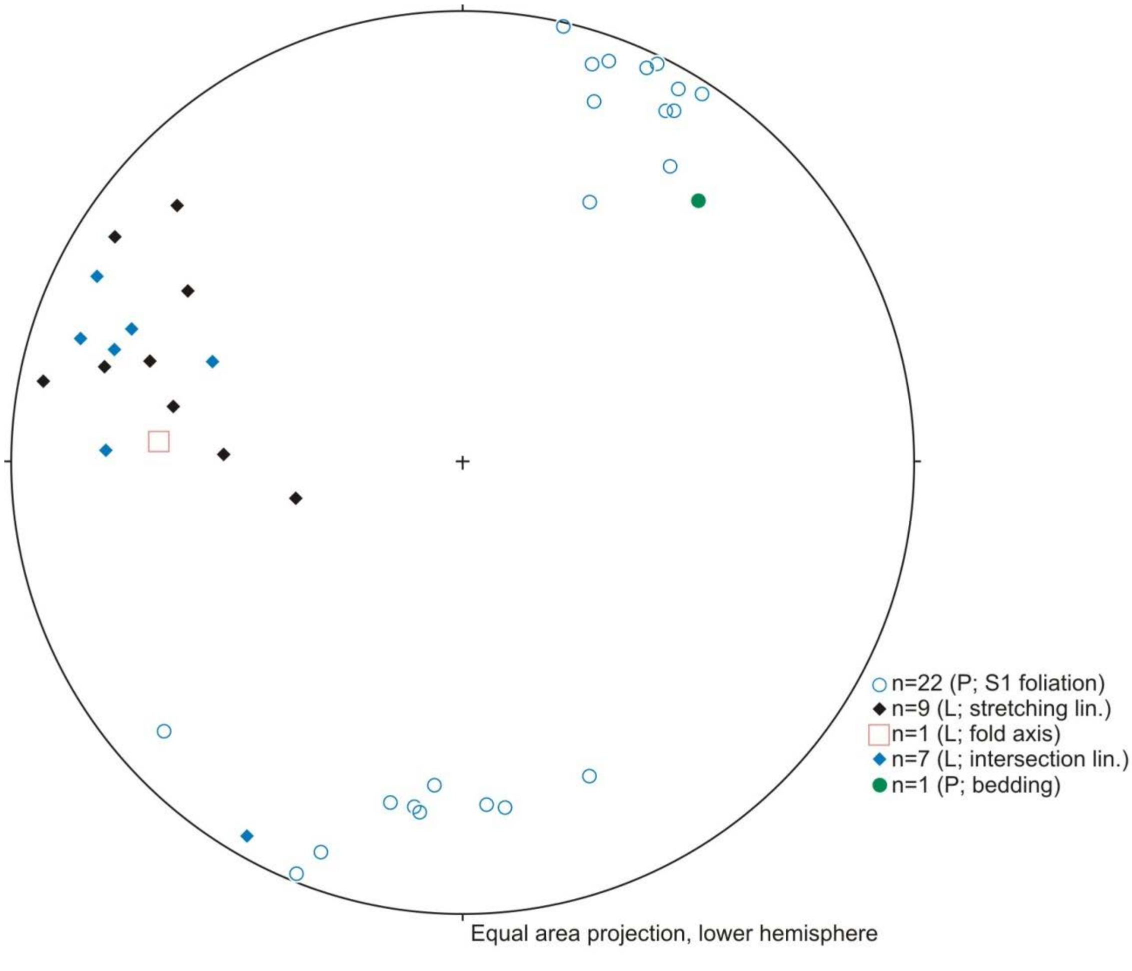

Figure 15. *Stereographic projection of structural data collected at camp 7.*

The structural inventory of the camp 7 area is very similar to that of the camp 5 area (Fig. 15). The dominant foliation (here termed S_1) strikes W/NW to E/SE, and dips mainly at steep angles to the N/NE and S/SW (Fig. 15). The associated mineral stretching lineation plunges at low angles to the W/NW, parallel to the fold axes and intersection lineations of close to tight F_2 folds. Shear sense indicators, such as S-C fabrics and sigma clasts, point to an oblique-sinistral to oblique dextral sense of shear.

4. Reconnaissance stops

4.1 Reco day 1

The first day of reconnaissance work was carried out on July 21 2014 together with JKOL and ABJ (team 1), and focused on the contact relationships between the Ammassalik Intrusive Complex and the Kuummiut Terrane in the south-western part of the Kuummiut Terrane, in an area east of Sermilik Fjord (Fig. 1). The gneiss there is composed of quartz, plagioclase, hornblende, garnet, and K-feldspar. It is rich in garnet in the south and shows an oblique-reverse sinistral shear sense, consistent with the moderately westerly plunging mineral stretching lineations. Towards the north, the gneiss becomes less garnet-rich and more ultramylonitic, indicating increasing strain intensities during retrogression. Amphibolitic relicts within this northern gneiss are hence dominated by hornblende and plagioclase. Garnet reappears further north as small grains that are always associated to leucosomes. The various gneiss units are commonly intruded by pegmatite, which locally forms relatively thin (<20 cm) conjugate vein sets.

4.2 Reco day 2

On July 23 2014, we joined Leon Bagas (LBA) – School of Earth and Environment, University of Western Australia, Australia and Nanna Rosing-Schow (NRS) – University of Copenhagen, Denmark (team 3), as well as Bo Møller Stensgaard (BMST) – GEUS, on a reco day in the Auppaluttoq area west of the Sermilik Fjord.

Our first stop was at a sheared diorite with small leucosome veinlets and a hornblende-plagioclase-quartz-garnet assemblage. Garnet in the diorite is always associated with the leucosomes, indicating a peritectic origin. The S_1 foliation in the diorite dips at low angles to the S, and contains a well-developed mineral stretching lineation that plunges at low angles to the SE. The diorite is crosscut by a moderately easterly dipping pegmatite dyke with a mineral assemblage of quartz, K-feldspar, garnet, biotite, and plagioclase.

At next, we examined a contact between massive and weakly foliated amphibolite and layered TTG gneiss to the south of the last locality. The amphibolite mainly consists of hornblende, plagioclase, and quartz, and locally contains garnet, which is mostly replaced by plagioclase. Boulders of aluminous gneiss in the vicinity of the contact contain sillimanite and kyanite. The S_1 foliation dips at moderate angles to the S. An oblique S_2 foliation crosscuts the S_1 foliation and the pegmatite dyke, and dips at moderate angles to the SSW.

The last stop was at another amphibolite/gneiss contact. The gneiss here, however, is quite rusty and strongly foliated with a mineral assemblage of garnet, biotite, plagioclase, and quartz. The amphibolite schist has a mineral assemblage of hornblende, plagioclase, quartz, and garnet, and is interlayered with graphite schist. The foliation dips at moderate angles to the S, and the associated mineral stretching lineation plunges at low angles to the W. Shear sense indicators in the graphite schist point to an oblique reverse sinistral sense of shear.

4.3 Reco day 3

During the third day of reconnaissance work on July 30 2014, we were accompanied by VIVH and MADP (team 6), as well as BMST. This reco day focused on some rusty gneiss and retrogressed eclogite localities around and near our campsite 2 (Fig. 1), with the observations for the rusty gneiss localities given in chapter 3.2.
Some 5 km to the west of camp 2 (Fig. 1), we examined a sequence of highly-weathered garnet amphibolite, in which some layers preserve relict eclogite-facies mineral assemblages and well-developed, coarse-grained reaction textures between garnet and clinopyroxene (Fig. 16).

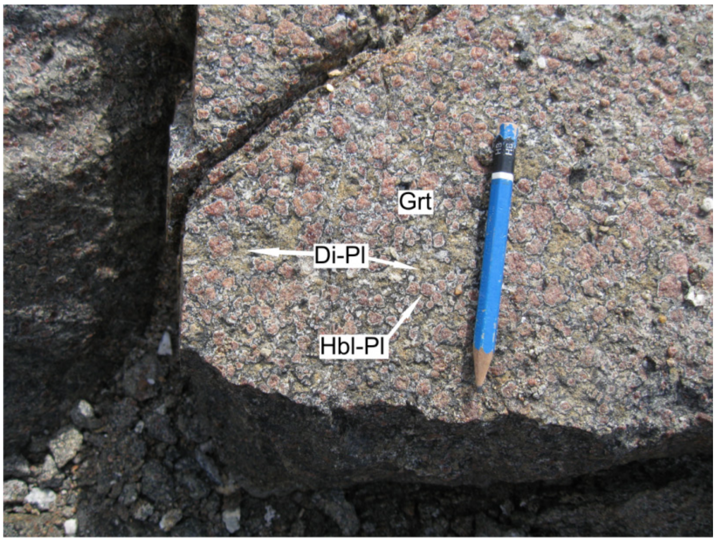

Figure 16. *Field photograph of mineral reactions textures in a mafic supracrustal rock (retrogressed eclogite) collected on Reco day 3.*

Garnet in this mafic supracrustal rock is rimmed by coronitic plagioclase, and clinopyroxene has been partially replaced by hornblende. The amphibolite and retrogressed eclogite are intruded by up to 5 m thick pegmatite dykes. The foliation in the amphibolite and surrounding TTG gneiss dips at moderate to steep angles to the N and S, and the associated mineral stretching lineation plunges at moderate values to the W. A second foliation is developed in the pegmatite dyke, and dips at moderate values to the W.

Our next stop was at a ca. 200x300 m large ultramafic boudin at the northern end of the fjord to the east of the last locality (Fig. 1). This body, which is not shown in the geological maps, mainly consists of tremolite, magnetite, olivine, and orthopyroxene, and was too magnetic for structural readings. Towards the contact with the surrounding gneiss, the rock is more mafic in composition and contains garnet and clinopyroxene.

5. References

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Appendix A – List of localities (from aFieldwork[1])

Locality ID	Locality Name	Date	Latitude	Longitude
	Camp 1 (15.07-17.07.2014)			
1	Camp 1	16.07.2014	66.4143692	-38.1832291
2	Diorite gneiss	16.07.2014	66.4154169	-38.1829386
3	Grt[2]-amphibolite	16.07.2014	66.4159667	-38.1820439
4	TTG gneiss	16.07.2014	66.4164828	-38.1805751
5	Grt-Bt rock	16.07.2014	66.4176359	-38.1797003
6	Grt-Bt-Pl-Qz gneiss	16.07.2014	66.4182904	-38.1765059
7	Ol-Hbl-Pl-Opx schist	16.07.2014	66.419087	-38.1780403
8	Grt-Pl-Qz-Hbl gneiss	16.07.2014	66.4197229	-38.1762198
9	Folded gneiss	16.07.2014	66.4207007	-38.1763812
10	Sheared amphibolite	16.07.2014	66.4213525	-38.1797777
11	Grt-amphibolite	16.07.2014	66.4207449	-38.1809773
12	TTG gneiss 2	17.07.2014	66.4197963	-38.1822434
13	Grt-amphibolite	17.07.2014	66.4306376	-38.1833079
14	Grt-amphibolite	17.07.2014	66.431567	-38.1828318
15	Grt-amphibolite/gneiss contact	17.07.2014	66.4321467	-38.1870393
16	Pyroxenite	17.07.2014	66.4319722	-38.1923289
17	Grt-rich layer in amphibolite	17.07.2014	66.4295463	-38.1977401
	Camp 2 (18.07-22.07.2014)			
18	Camp 2	18.07.2014	65.9731367	-37.9927371
19	Basic boudin next to camp	18.07.2014	65.9733745	-37.9942623
20	Garnet and kyanite	18.07.2014	65.9730386	-37.9980445
21	Garnet with bright stripes	18.07.2014	65.9733414	-37.9984331
22	Eclogite gravel	18.07.2014	65.9734869	-37.9957144
23	Trondhjemite gneiss	19.07.2014	65.9724519	-37.9996722
24	Grt-amphibolite with relict eclogitic assemblages	19.07.2014	65.9738418	-38.0047792
25	Grt-amphibolite	19.07.2014	65.9735006	-38.0093765
26	Weathered amphibolite with eclogitic relicts	19.07.2014	65.9734668	-38.0102148
27	TTG gneiss	19.07.2014	65.9719638	-37.990133
28	Weathered amphibolite	19.07.2014	65.9725571	-37.9889499
29	Green orthoamphibole schist	19.07.2014	65.9725559	-37.9876542
30	Grt-Am rich schist	19.07.2014	65.9725044	-37.9853406
31	Green lens in TTG gneiss	20.07.2014	65.9720104	-38.0075451
32	Grt-amphibolite with eclogitic relicts	20.07.2014	65.9694852	-38.0075268
33	Retrogressed eclogite	20.07.2014	65.9698572	-38.0073142
34	Banded amphibolite	20.07.2014	65.9628507	-38.0104586
	Reco 1 (21.07.2014)			
35	Gneiss at reco	21.07.2014	65.7846899	-37.8707219

36	Darker gneiss with two lineations	21.07.2014	65.7865528	-37.8697936
37	Anorthosite, leucogabbro	21.07.2014	65.7863942	-37.7870473
38	Gneiss	21.07.2014	65.7860352	-37.78898
	Camp 2 (continued)			
39	Retrogressed eclogite	21.07.2014	65.9812112	-37.9964542
41	Gneiss	21.07.2014	65.9783968	-38.0032856
42	Rusty gneiss	21.07.2014	65.9744279	-37.9983094
43	Gneiss southeast	22.07.2014	65.9686137	-37.986601
44	Gneiss further south with fold axis	22.07.2014	65.9671351	-37.9859184
45	Ultramafite	22.07.2014	65.9631661	-37.9832736
46	Intrusive plutonic body	22.07.2014	65.962582	-37.9827871
47	Garnet 2	22.07.2014	65.9600077	-37.98125
48	Garnet 3	22.07.2014	65.9573893	-37.981391
49	Gneiss above garnet	22.07.2014	65.955281	-37.9894707
50	Fold axis in gneiss	22.07.2014	65.964689	-37.9950668
51	Garnet 4	22.07.2014	65.9680474	-37.9979684
52	Garnet 5	22.07.2014	65.9720899	-37.9948328
	Reco 2 (23.07.2014)			
53	Reco 2 stop 1	23.07.2014	66.1428578	-37.9921478
54	Reco 2 stop 2	23.07.2014	66.1092147	-37.9703311
55	Reco 2 stop 3 graphite locality	23.07.2014	66.0879704	-38.0452815
	Camp 3 (23.07-26.07.2014)			
56	Camp 3	23.07.2014	65.8299301	-36.820587
57	Rusty gneiss east of lake	24.07.2014	65.8338188	-36.8210995
58	Gneiss	24.07.2014	65.8347846	-36.8243015
59	Gneiss above second lake	24.07.2014	65.8384297	-36.8452227
60	Amphibolite boudin	24.07.2014	65.8387032	-36.8466636
61	Gneiss with amphibolite boudin	24.07.2014	65.8390373	-36.848823
62	Retrogressed eclogite	24.07.2014	65.8386818	-36.8483786
63	Amphibolite with many veins	24.07.2014	65.8409785	-36.853023
64	Gneiss next to boudins	24.07.2014	65.8418087	-36.856116
65	Retrogressed eclogite	24.07.2014	65.8408408	-36.8564342
66	Boulder with amphibolite schist containing eclogitic boudins	24.07.2014	65.8395705	-36.8569557
67	Gneiss north of camp	24.07.2014	65.8364129	-36.8367181
68	Lens in gneiss	25.07.2014	65.8251824	-36.8224606
69	Gneiss and amphibolite	25.07.2014	65.8234792	-36.8298863
70	Gneiss and amphibolite 2	25.07.2014	65.8201519	-36.8312214
71	Gneiss on southeastern ridge of Blokken	25.07.2014	65.8146143	-36.8357427
72	Grt-amphibolite next to Ky-Grt schist	25.07.2014	65.8155549	-36.8393393
73	Gneiss next to river	25.07.2014	65.8159743	-36.8585064

74	Gneiss next to whirlpool	25.07.2014	65.8122639	-36.8498237
75	Gneiss with two foliations	25.07.2014	65.8127294	-36.8484661
76	Amphibolite east of camp	26.07.2014	65.8297171	-36.811809
77	Grt-amphibolite further south	26.07.2014	65.8298889	-36.8087335
78	Folded pegmatite next to gneiss and mafic rock	26.07.2014	65.8301101	-36.8057039
79	Basic dyke	26.07.2014	65.8291137	-36.8014487
80	Gravel sample and sample depot	26.07.2014	65.8284472	-36.7979007
81	Amphibolite southeast of sample depot	26.07.2014	65.827711	-36.7934204
82	Retrogressed eclogite	26.07.2014	65.8277115	-36.7925239
83	Amphibolite southeast of camp	26.07.2014	65.8299382	-36.8066318
	Camp 4 (27.07-29.07.2014)			
84	Camp 4	27.07.2014	65.9269585	-37.2392755
85	Rusty amphibolite	27.07.2014	65.9316094	-37.2251759
86	Metasediment boulders	27.07.2014	65.9335338	-37.2103312
87	Rusty rock at river	27.07.2014	65.9269476	-37.2237561
88	Orthogneiss	28.07.2014	65.9390583	-37.186814
89	Thrust	28.07.2014	65.9535348	-37.1877429
90	Metasediment	28.07.2014	65.9533648	-37.1907216
91	Gneiss	28.07.2014	65.9527994	-37.1909666
92	Metasediment 2	28.07.2014	65.9524238	-37.1920559
93	Folded gneiss	28.07.2014	65.9521198	-37.1924814
94	Grt-amphibolite	28.07.2014	65.951022	-37.196586
95	Eclogitic gravel below dyke	28.07.2014	65.9474612	-37.1974457
96	Basic dyke in gneiss	29.07.2014	65.9383653	-37.3181214
97	Gneiss and diorite	29.07.2014	65.9393586	-37.3202546
98	Gneiss with two foliations	29.07.2014	65.9399869	-37.3179609
99	Retrogressed eclogite	29.07.2014	65.9402906	-37.3175326
100	Gneiss	29.07.2014	65.9422329	-37.322893
101	Folded gneiss	29.07.2014	65.9445591	-37.3228576
102	Gneiss with cleavages	29.07.2014	65.9462256	-37.3219136
103	Gneiss near rivers	29.07.2014	65.950238	-37.3047406
	Reco 3 (30.07.2014)			
105	Reco 3 stop 1 Grt-amphibolite	30.07.2014	66.1650454	-37.4959128
106	Retrogressed eclogite	30.07.2014	65.9799691	-38.1081672
107	Reco 3 stop 2	30.07.2014	65.9807571	-38.1085326
	Camp 5 (30.07-01.08.2014)			
104	Camp 5/joint camp with team 6	30.07.2014	65.9981805	-38.0684711
108	Gneiss near water spot	31.07.2014	66.1644091	-37.4734786
109	Rusty gneiss	31.07.2014	66.1638346	-37.4397718
110	Amphibolite	31.07.2014	66.1631799	-37.4325998
111	Orthogneiss and amphibolite	31.07.2014	66.1602743	-37.415424

112	Rusty gneiss on way back	31.07.2014	66.1636684	-37.4329752
113	Rusty gneiss 3	31.07.2014	66.1635318	-37.4348591
114	Gneiss with weathered out mineral	31.07.2014	66.1648091	-37.4547365
115	Carbonate	31.07.2014	66.1646451	-37.4624584
116	Gneiss north of camp	01.08.2014	66.168042	-37.488465
117	Gneiss further north	01.08.2014	66.1724615	-37.486114
118	Gneiss	01.08.2014	66.1678865	-37.4794225
119	Gneiss 4	01.08.2014	66.1690005	-37.4674542
120	Break spot	01.08.2014	66.171153	-37.4520787
121	Gneiss with two foliations	01.08.2014	66.1706219	-37.4523836
122	Gneiss near lunch spot	01.08.2014	66.1685971	-37.455742
123	Gneiss with S-C structures	01.08.2014	66.1665723	-37.4586377
124	Carbonate bounded by two gneiss units and pegmatite	01.08.2014	66.1664312	-37.4585168
125	Carbonate with weathered out top	01.08.2014	66.1651396	-37.4578064
126	Rust zone	01.08.2014	66.1648544	-37.4532315
	Camp 6 (02.08-05.08.2014)			
127	Camp 6	02.08.2014	66.2050494	-37.140727
128	Ultramafite	02.08.2014	66.2137728	-37.1430236
129	Dyke	02.08.2014	66.2162702	-37.1484911
130	Between two glaciers before the metasediment	02.08.2014	66.2195582	-37.1563205
131	Grt-amphibolite	02.08.2014	66.2193483	-37.1659689
132	Double folded gneiss	02.08.2014	66.2171659	-37.1634799
133	Garnet pyroxene rock	03.08.2014	66.2214444	-37.1584455
134	Lunch stop day 2	03.08.2014	66.217112	-37.1396243
135	Rusty gneiss	03.08.2014	66.2171433	-37.1335244
136	Gneiss	03.08.2014	66.2176171	-37.1280966
137	Amphibolite	03.08.2014	66.2193786	-37.1242063
138	Orthogneiss	03.08.2014	66.2187147	-37.1238404
139	Ultramafite east of camp	04.08.2014	66.2066656	-37.1299225
140	Felsic lens between ultramafite	04.08.2014	66.2067835	-37.1285035
141	Grt gneiss	04.08.2014	66.2067287	-37.1265549
142	Grt-amphibolite	04.08.2014	66.2078166	-37.1264735
143	Grt-amphibolite with pegmatite containing blue mineral	04.08.2014	66.2088878	-37.1202985
144	On top of glacier rim	04.08.2014	66.2092236	-37.1162027
145	Folded gneiss	04.08.2014	66.2095215	-37.1172124
146	At rim of fjord next to granulite	05.08.2014	66.3056872	-37.0867153
	Camp 7 (05.08-07.08.2014)			
147	Camp 7	05.08.2014	65.6659843	-37.1008245
148	Garnet gneiss	06.08.2014	65.6742014	-37.1051587
149	Sheared gneiss	06.08.2014	65.6756164	-37.1094523

150	Dunite	06.08.2014	65.6764765	-37.1078638
151	Contact between gneiss and ultramafic pod	06.08.2014	65.6802787	-37.1084682
152	Gneiss with garnet	06.08.2014	65.6830581	-37.1061793
153	Gneiss at last lake before fjord	06.08.2014	65.6887744	-37.1006139
154	Gneiss on other side of lake	06.08.2014	65.6859316	-37.1019297
155	Grt-rich gneiss	06.08.2014	65.684064	-37.1002263
156	Gneiss near waterfall	06.08.2014	65.682667	-37.0976758
157	Ultramafic rock near fjord	07.08.2014	65.6761789	-37.1120971
158	Gneiss in high valley	07.08.2014	65.6922155	-37.1023848
159	Lunch stop at lake	07.08.2014	65.6925565	-37.1259017
160	Gneiss near western end of valley	07.08.2014	65.6918768	-37.1443086
161	Gneiss 2	07.08.2014	65.6920331	-37.1432878
162	Dunite	07.08.2014	65.6916845	-37.1389492

[1] Official sample collector: Annika Dziggel (ADZ); [2] Mineral abbreviations after Whitney and Evans (2010).

Appendix B – List of samples (from aFieldwork[1])

Sample Nr.	Locality ID	Description	Purpose
566201	3	Grt[2]-amphibolite	Mineralogy
566202	5	Garnetite schist	Mineralogy
566203	8	Grt-Hbl-Pl-Qz gneiss	Mineralogy
566204	11	Sheared amphibolite	Mineralogy
566205	13	Cpx-rich layer	Mineralogy
566206	13	Grt-amphibolite	Mineralogy
566207	13	Grt-amphibolite	Mineralogy
566208	14	Grt-amphibolite	Mineralogy
566209	16	Pyroxenite	Mineralogy
566210	17	Layered amphibolite	Mineralogy
566211	21	Garbenschiefer ultramafite	Mineralogy
566212	20	Kyanite	Mineralogy
566213	20	Garnet	Mineralogy
566214	20	Grt-bearing gneiss	Mineralogy
566215	20	Grt-bearing gneiss	Mineralogy
566216	22	Eclogitic gravel	Mineralogy
566217	22	Eclogitic gravel	Mineralogy
566218	22	Eclogitic gravel	Mineralogy
566219	22	Pegmatite next to gravel	Mineralogy
566220	19	Basic boudin with eclogitic patches	Mineralogy
566221	19	Basic boudin with eclogitic patches	Mineralogy
566222	24	Amphibolite with retrogressed eclogite	Mineralogy
566223	24	Pink amphibolite	Mineralogy
566224	25	Grt-amphibolite	Mineralogy
566225	26	Weathered Grt-amphibolite	Mineralogy
566226	26	Grt-amphibolite with green mineral	Mineralogy
566227	28	Weathered Grt-amphibolite with pyroxene	Mineralogy
566228	28	Weathered Grt-amphibolite	Mineralogy
566229	28	Garnet with inclusions	Mineralogy
566230	29	Green orthoamphibole-rich schist	Mineralogy
566231	30	Red-green Grt- and Am-rich schist	Mineralogy
566232	30	Red-green Grt- and Am-rich schist	Mineralogy
566233	30	Red-green Grt- and Am-rich schist	Mineralogy
566234	20	Pegmatite with blue mineral	Mineralogy
566235	31	Green boudin surrounded by gneiss	Mineralogy
566236	32	Amphibolite with retrogressed eclogite	Mineralogy
566237	33	Retrogressed eclogite	Mineralogy
566238	33	Retrogressed eclogite	Mineralogy
566239	33	Retrogressed eclogite	Mineralogy
566240	39	Zebra-striped retrogressed eclogite	Mineralogy
566241	46	Diorite	Mineralogy

566242	47	Rusty colored Grt-gneiss	Mineralogy
566243	47	Ultramafic rock	Mineralogy
566244	51	Grt-gneiss with sillimanite	Mineralogy
566245	52	Grt-gneiss	Mineralogy
566246	52	Grt-gneiss	Mineralogy
566247	20	Grt-bearing gneiss	Mineralogy
566248	62	Retrogressed eclogite, fine-grained	Mineralogy
566249	62	Retrogressed eclogite, unsheared	Mineralogy
566250	62	Retrogressed eclogite	Mineralogy
566251	65	Retrogressed eclogite	Mineralogy
566252	66	Eclogitic boudin	Mineralogy
566253	66	Eclogitic boudin	Mineralogy
566254	72	Ky-Grt schist	Mineralogy
566255	72	Grt-amphibolite	Mineralogy
566256	76	Grt-amphibolite	Mineralogy
566257	77	Grt-amphibolite	Mineralogy
566258	77	Grt-amphibolite	Mineralogy
566259	79	Retrogressed eclogite	Mineralogy
566260	79	Retrogressed eclogite	Mineralogy
566261	80	Eclogitic gravel	Mineralogy
566262	81	Retrogressed eclogite	Mineralogy
566263	82	Retrogressed eclogite	Mineralogy
566264	83	Amphibolite lense	Mineralogy
566265	86	Grt-Ky-Bt-Qz schist	Mineralogy
566266	87	River outcrop with rusty gneiss	Geochemistry
566267	90	Grt-Ky gneiss	Mineralogy
566268	92	Grt-Ky gneiss	Mineralogy
566269	95	Eclogitic gravel	Mineralogy
566270	95	Eclogitic gravel	Mineralogy
566271	95	Eclogitic gravel	Mineralogy
566272	97	Diorite	Mineralogy
566273	99	Grt-pyroxenite	Mineralogy
566274	102	Granite	Mineralogy
566275	106	Retrogressed eclogite	Mineralogy
566276	106	Retrogressed eclogite	Mineralogy
566277	106	Retrogressed eclogite	Mineralogy
566278	106	Retrogressed eclogite	Mineralogy
566279	107	Eclogite	Mineralogy
566280	107	Eclogite	Mineralogy
566281	107	Magnetite-rich rock	Mineralogy
566282	107	Magnetite-rich rock	Mineralogy
566283	107	Eclogite	Mineralogy
566284	124	Siderite-rich rock	Mineralogy

566285	124	Rust zone	Mineralogy
566286	124	Laminated quartz	Mineralogy
566287	124	Green carbonate	Mineralogy
566288	126	Rust zone	Mineralogy
566289	113	Sillimanite schist	Mineralogy
566290	131	Grt-amphibolite	Mineralogy
566291	131	Grt-amphibolite with pyroxene	Mineralogy
566292	131	Pyroxene-Grt rock	Mineralogy
566293	133	Grt-amphibolite with pyroxene	Mineralogy
566294	136	Rusty gneiss	Mineralogy
566295	136	Rusty gneiss	Mineralogy
566296	137	Amphibolite sequence within metasediments	Mineralogy
566297	141	Grt-gneiss	Mineralogy
566298	142	Mylonitic amphibolite	Mineralogy
566299	143	Pegmatite	Geochronology
566301	143	Mineral sample, Carbonate boudin	Mineralogy
566302	146	Granulite	Mineralogy
566303	146	Granulite	Mineralogy
566304	146	Granulite	Mineralogy
566305	148	Garnet gneiss	Mineralogy
566306	150	Amphibolite at contact to dunite	Mineralogy
566307	151	Ultramafite	Mineralogy
566308	153	Gabbroic lens in gneiss	Mineralogy
566309	153	Ultramafic body in gneiss	Mineralogy
566310	155	Grt-Sill gneiss	Mineralogy
566311	161	Fine-grained Grt-Sill gneiss	Mineralogy
566312	161	Grt-Sill gneiss	Mineralogy
566313	162	Dunite	Mineralogy

[1] Official sample collector: Annika Dziggel (ADZ); [2] Mineral abbreviations after Whitney and Evans (2010).

Appendix C – 2018 Lithos paper (abstract)

Lithos 296–299 (2018) 212–232

Contents lists available at ScienceDirect

Lithos

journal homepage: www.elsevier.com/locate/lithos

Mineral textural evolution and PT-path of relict eclogite-facies rocks in the Paleoproterozoic Nagssugtoqidian Orogen, South-East Greenland

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ARTICLE INFO

Article history:
Received 29 June 2017
Accepted 7 November 2017
Available online 11 November 2017

Keywords:
Eclogite
Nagssugtoqidian Orogen
Paleoproterozoic
Pseudosection modelling
Symplectites

ABSTRACT

The Nagssugtoqidian Orogen in South-East Greenland is a deeply eroded, Paleoproterozoic collision orogen. It consists of a variety of Archean and Paleoproterozoic rocks, most notably TTG gneiss, a variety of supracrustal rocks and basic dykes. This study aims at providing new insight into the geodynamic processes and subduction depth of this orogen by investigating the metamorphic evolution of garnet pyroxenite, retrogressed eclogite and amphibolite-facies rocks that are exposed within the Kuummiut Terrane of the Nagssugtoqidian Orogen. The garnet-pyroxenite has a dominant mineral assemblage of garnet, orthopyroxene, clinopyroxene and hornblende, while garnet-amphibolite and garnet-kyanite schist are made up of garnet, hornblende, plagioclase and quartz, and garnet, kyanite, biotite and quartz, respectively. Relicts of, and pseudomorphs after, eclogite-facies mineral assemblages are frequently found within basic metavolcanic rocks and Paleoproterozoic discordant basic dykes. In the retrogressed eclogite, the retrograde mineral reactions ceased prior to completion, resulting in the formation of two domains. A clinopyroxene domain consists of diopside-plagioclase symplectites, which are interpreted to have grown at the expense of omphacite. The symplectites are surrounded and partly replaced by hornblende and plagioclase. Omphacite (X_{Jd} 25–42) is preserved in a Na-rich sample, where it occurs in the core of large clinopyroxene and as inclusion in garnet and hornblende. In a garnet domain, garnet is variably replaced by an inner corona of plagioclase and an outer corona of amphibole +/− orthopyroxene and clinopyroxene. The degree of retrogression as well as the type of the retrograde assemblage in both domains appears to be dependent on fluid activity. Large garnet grains preserve Ca-rich cores, interpreted as prograde in origin, while Mg-rich garnet rims formed during eclogite-facies metamorphism and later re-equilibration. Pseudosection modelling combined with conventional geothermobarometry reveals a clockwise PT-evolution, involving eclogite-facies conditions of 17–19 kbar and 740–810 °C, followed by near-isothermal decompression to medium-pressure granulite-facies conditions (13.8–15.4 kbar, 760–880 °C) and subsequent decompression with minor cooling to high-pressure amphibolite-facies grades (8.8–10.9 kbar, 660–840 °C). These data show that rocks of the Kuummiut Terrane were exhumed from 70 to about 30 km into the mid- and lower crust. The PT-path implies that exhumation initially was rapid and tectonically-controlled.