DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 2014/72

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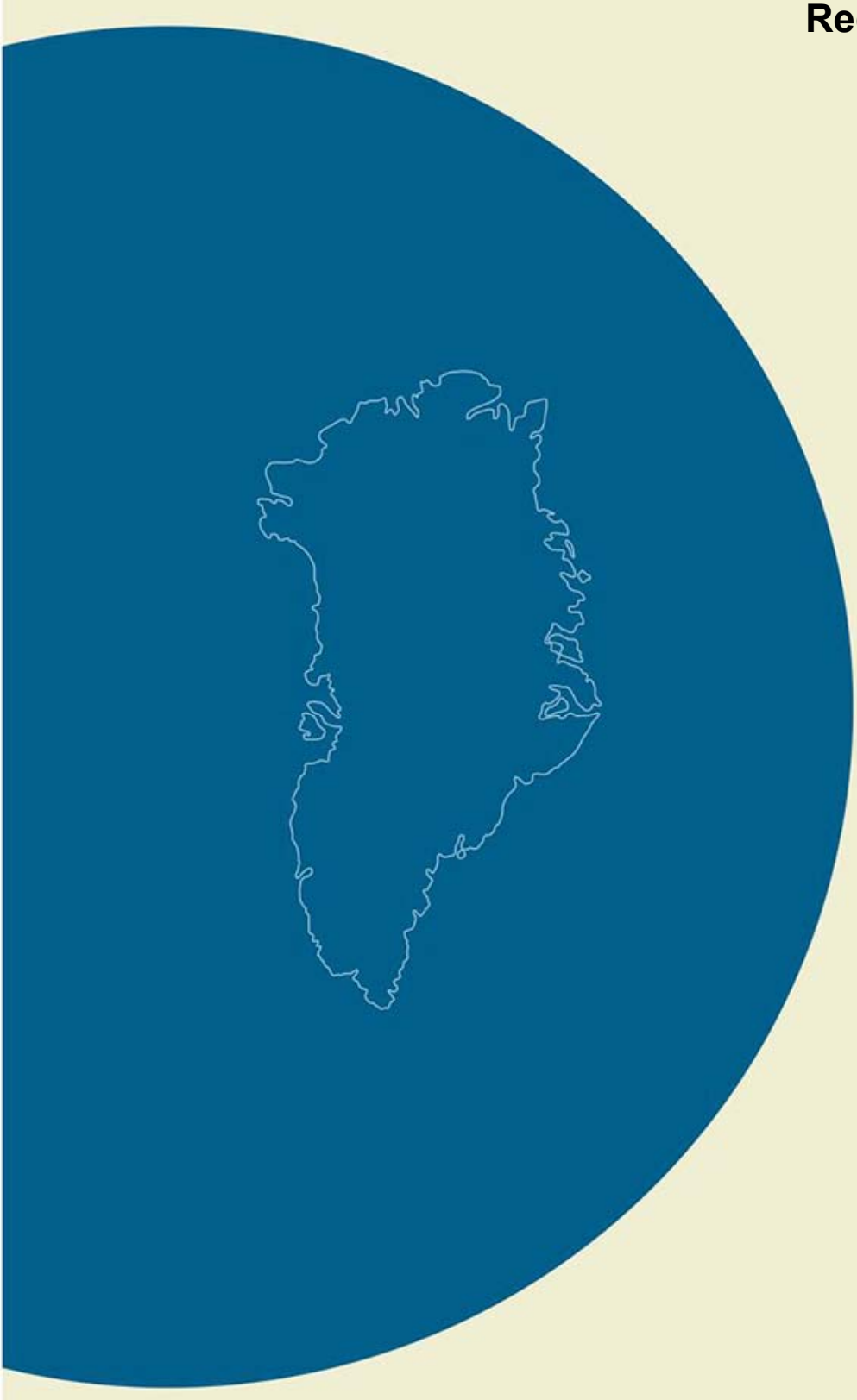
Peter W. U. Appel & Martin Ghisler



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

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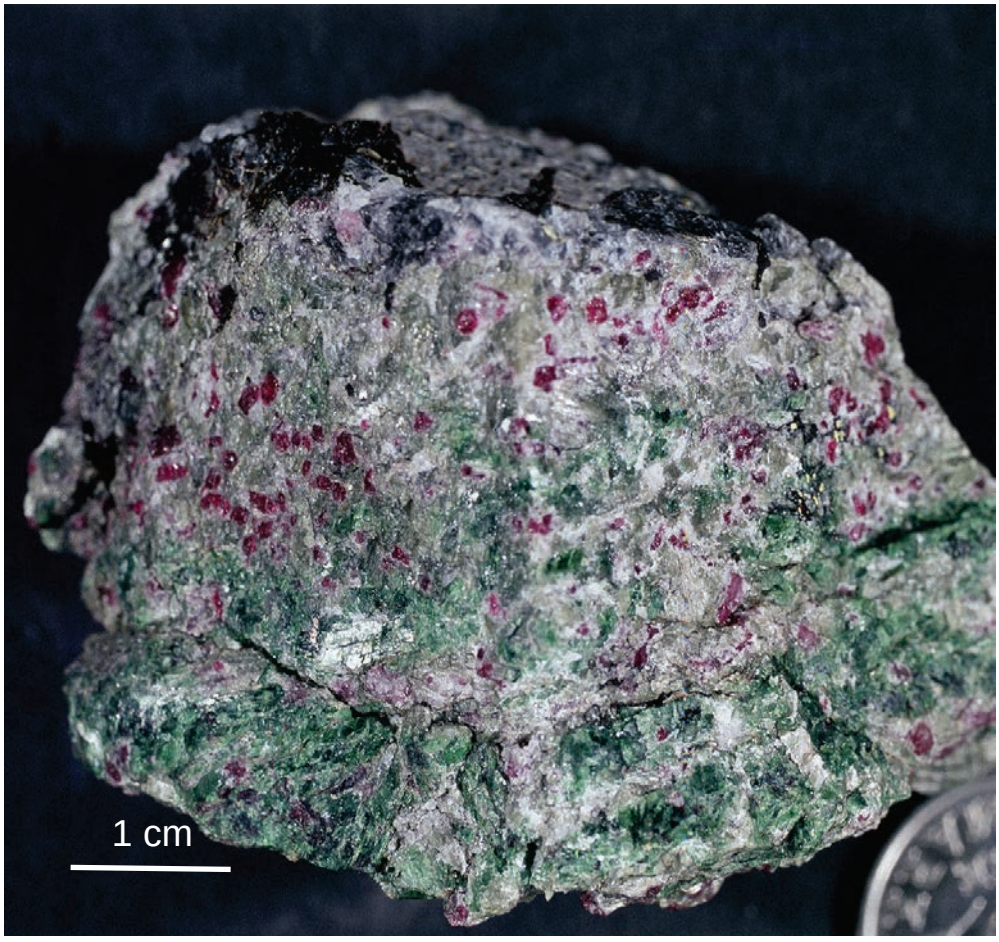


# Contents

# Summary

The Fiskenaesset anorthosite complex in the Archean block of West Greenland hosts many ruby/sapphirine occurrences. These occurrences furthermore contain other rare minerals such as kornerupine, gedrite, enstatite, cordierite, red spinel, pargasite and phlogopite. The report describes the geological setting of the ruby/sapphirine occurrences, mostly found in ultramafic layers and lenses along the contacts between anorthosite and amphibolite.

The report introduces a ruby/sapphirine portal at the web site of the Geological Survey of Denmark and Greenland (GEUS) with a short description of 28 localities comprising 87 occurrences. The portal gives access to a detailed inventory comprising literature references, geological maps, diaries and relinquished non-confidential company reports. The report presents an overview of the most common mineral parageneses, with special emphasis on the occurrences of ruby corundum and sapphirine.

A history of exploration is presented from the first collection of sapphirine in 1809, over the discovery of rubies in 1966, to the beginning commercial prospecting in the 1970'es and 1980'es, up to the recent activities by the Canadian company True North Gems Ltd. starting in 2004. The description and data base portal does not comprise the ruby localities found by True North Gems Ltd. due to confidentiality reasons.

One of the occurrences – Aappaluttoq – is by True North Gems Ltd. expected to contain enough rubies and pink sapphires of gem quality to form the basis for an industrial production. An open pit is prepared for exploitation planned to start in 2015.

In addition to the description of the Fiskenaesset localities the report in the Appendix contains a summary of six ruby/sapphirine localities from the Nuuk and Maniitsoq regions.

# Introduction

In the Fiskenaesset area south of Nuuk, rubies are fairly abundant. Rubies occur together with sapphirine as well as minerals such as kornerupine, pargasite, phlogopite, cordierite, gedrite, plagioclase and red spinel.

Scattered occurrences of rubies/sapphirine are found in the Nuuk region and further north near Maniitsoq. In the Appendix three localities from each area are described.

The first example of sapphirine mineral parageneses was discovered in Fiskenaesset village in 1809 by K. L. Giesecke (Fig. 1). He was originally an opera singer, and wrote the libretto to the Magic Flute by Mozart. Giesecke visited Johan Wolfgang von Goethe in Germany who taught him geology. He subsequently travelled to Copenhagen, where he convinced the Danish king to finance an expedition to Greenland. Giesecke travelled up and down the west coast of Greenland and made a large mineral collection. He discovered a light blue mineral which was named sapphirine. The type locality of sapphirine was in the harbour of Fiskenaesset. Giesecke subsequently became professor of Geology in Dublin.

In 1949 Henning Sørensen paid a short visit at Fiskenaesset and reported small patches with white to brown corundum from the sapphirine locality. The first new discoveries of sapphirine were made by Brian Windley (Geological Survey of Greenland) in 1964 in three locations in the Fiskenaesset area.

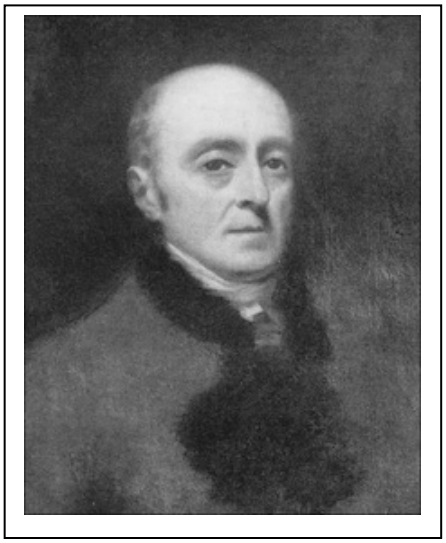


**Figure 1**. *K. L. Giesecke*

It took more than 150 years after Gieseckes expeditions before rubies were discovered in the Fiskenaesset area on the mountain of Annertussoq. In 1965 Martin Ghisler (Geological Survey of Greenland) found a loose block with a pink mineral which he back in Copenhagen identified as corundum. In 1966 Ghisler found the source locality of this block a few hundred metres uphill, containing sapphirine rocks with deep red rubies. Later he discovered small, transparent deep red rubies on a small island Rubin Ø (Fig.2).This was thus the first time that rubies were found in Greenland. This is in contrast to a non-documented statement by a group named: Fair Jewellery Action: "*For centuries, Inuits had scooped up rubies while they hunted or gathered berries".* (http://www.fairjewelry.org/the-politically-hot-greenland-ruby/).

In the early 1970's the Geological Survey of Greenland (since 1995 part of the Geological Survey of Denmark and Greenland (GEUS)) carried out systematic mapping of the Fiskenaesset area. During that period many new ruby and/or sapphirine showings were discovered.

Contemporaneously a Canadian company, Platinomino A/S, gained interest in the commercial side of the Fiskenaesset rubies. The company explored promising geological settings and found many new ruby/sapphirine occurrences. Platinomino carried out bulk sampling of some of the ruby showings and found gem quality rubies (Fig. 3). The company ceased operations in 1984. In 2004 True North Gems (TNG) obtained an exclusive exploration license covering the area hosting the most promising ruby showings. TNG explored the area and found several new occurrences.

This report presents an inventory of ruby and/or sapphirine localities comprising one or more of the following minerals: ruby/corundum, sapphirine, pargasite, phlogopite, cordierite, enstatite, gedrite, red spinel and kornerupine, discovered prior to the activities of TNG. In this report and in the inventory there is not distinguished between ruby and pink sapphire. All distinctly coloured stones are called rubies. The inventory is available on a Ruby/sapphirine Portal at:
http://data.geus.dk/geusmap/?mapname=greenland_ruby_sapphirine. Included in the inventory is a significant ruby-bearing zone north of Lake Qajartoriaq, which was discovered by GEUS in 2008. New ruby showings discovered by TNG are not described in the Ruby/sapphirine Portal because of confidentiality.

This report presents a short history of exploration of rubies, the geology of the ruby-bearing zones and a brief description of 28 ruby/sapphirine localities comprising 87 occurrences. Furthermore it gives an introduction how to access the Ruby/sapphirine Portal on the GEUS network.

**Figure 2**. *Ruby Island seen towards northeast, where the first Greenlandic rubies were found in 1966 (Photo: Line Ghisler).*

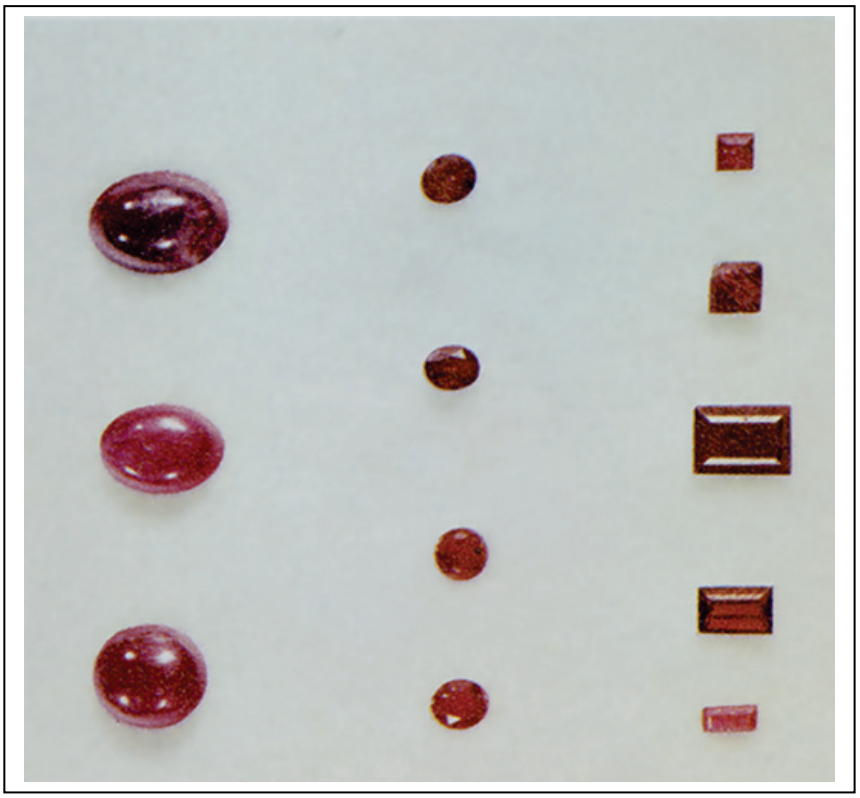
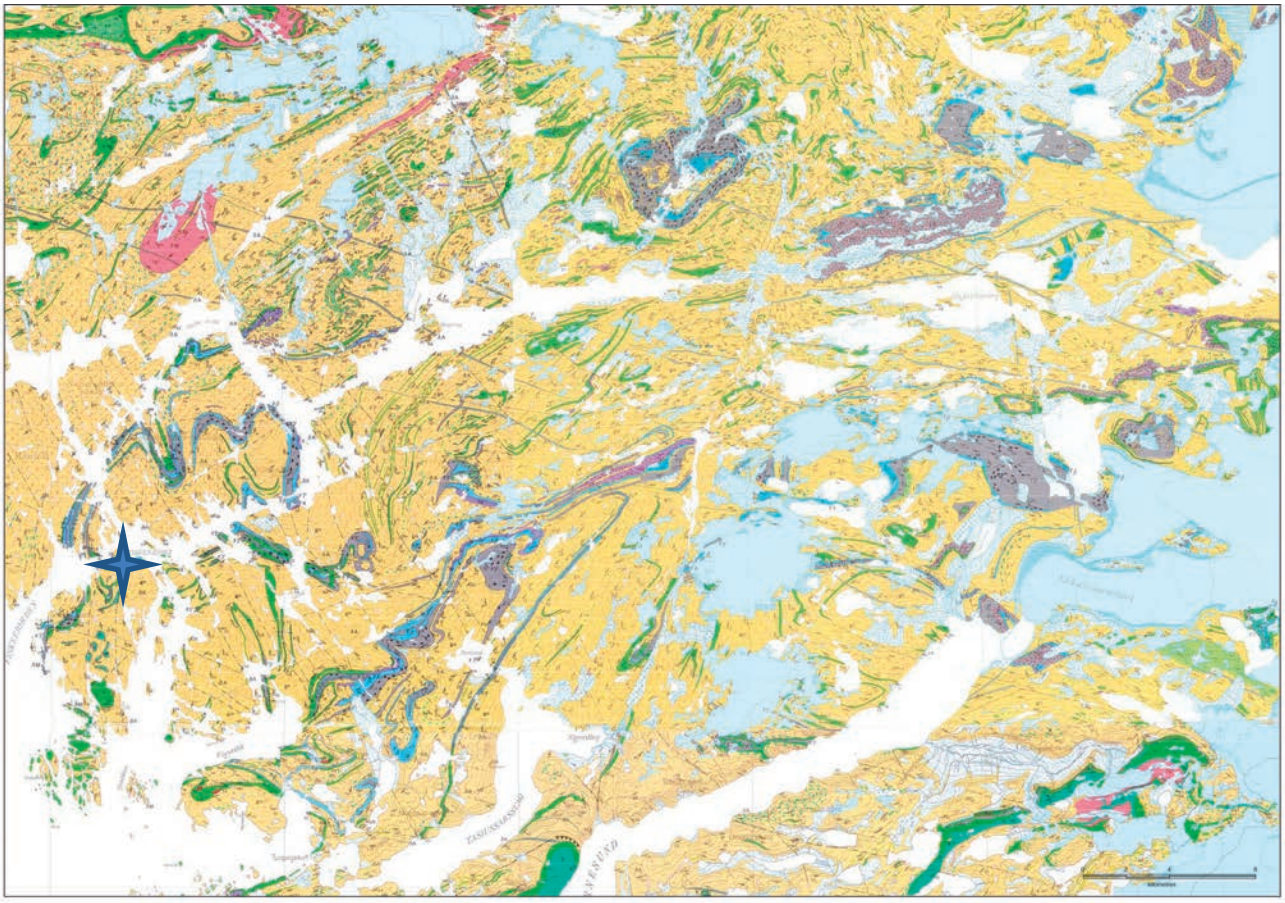


**Figure 3**. *Cabochon and facetted rubies from Siggartartulik collected and processed by Platinomino A/S. (Gübelin, 1979).*

# Geological setting

The ruby/sapphirine parageneses are intimately associated with the Archaean (~2970 Ma) Fiskenaesset stratiform anorthosite complex, which outcrops over a distance of more than 200 km. The anorthosite complex intruded in a sequence of amphibolites locally displaying pillow structures. The complex has been metamorphosed under amphibolite, locally up to granulite facies, conditions and has been repeatedly deformed (Myers 1985, Polat *et al*., 2009, 2010 and 2011). The complex has several chromitite horizons in different stratigraphic levels, but preferentially in the anorthosite unit (Ghisler, 1976).



Geology of the Fiskenaesset area. Grey: anorthosite, blue: gabbro anorthosite, green: amphibolite, pink: granite, yellow: gneisses. Star shows position of Fiskenaesset village. Scale is 8 km.

The ruby/sapphirine parageneses are mostly found in ultramafic lenses at the border between the anorthosite complex and amphibolites (Herd *et al*. 1969), but are locally also found at the contacts between amphibolites and sillimanite schists, calc-silicates and impure marbles. The parageneses is suggested to represent metamorphic reaction zones between high alumina anorthosites and alumina-rich amphibolites and metasediments (Herd, 1973).

The anorthosite complex stands out on aerial photographs (Fig.4) and is thus easy to locate. The reason is that the anorthosites weather so fast to a rubbly surface that vegetation has difficulties getting solid ground for their root systems. Prospective areas hosting ruby/sapphirine parageneses are therefore easy to trace along strike.

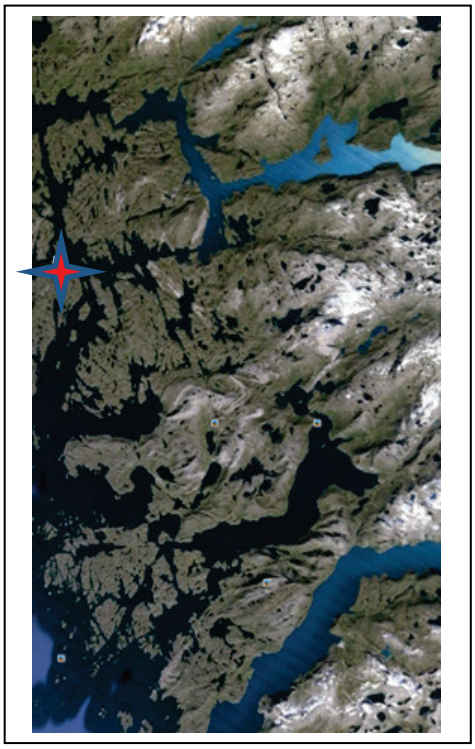


**Figure 4.** *Image from Google Earth over Fiskenaesset ( ). Note the light grey outcropping bands of anorthosite complex. High altitudes covered with snow*

# Mineralogy of the ruby/sapphirine-bearing rocks

Sapphirine and rubies occur in many different mineral assemblages. The sapphirine-bearing rocks have been divided into four types by Herd et al. (1969) and Herd (1972), depending on which of the ferromagnesian minerals, enstatite, pargasite, gedrite, phlogopite is prevalent or characteristic. The mineral name pargasite is used in this report for the very important and common green hornblende in accordance with Herd (1972). The composition of the hornblende occurring in the ruby/sapphirine rocks range from pargasite over Mg-hornblende, tschermakitic hornblende to tschermakite.

The four types of sapphirine – bearing rocks are:

A. Enstatite type, located e. g in Fiskenaesset harbour
B. Pargasite type, located e.g. at Siggartartulik
C. Gedrite type, located e.g. at Lower Annertussoq
D. Phlogopite type, located e.g. on Ruby Island

The descriptions are based on Herd *et al*. (1969), Herd (1972) combined with field observations by Platinomino (Geisler, 1971, 1972, 1973, 1977, 1980, 1981).

*Enstatite type.* The main minerals are sapphirine, enstatite, spinel and phlogopite. Sapphirine occurs in an enstatite-rich spinel-layered matrix, exhibiting a sequence of mutual intergrowth textures with respect to enstatite. The coarsest prismatic enstatite crystals are in the spinel-free zones. In hand specimen the texture shows rosette-like, very coarse (up to 4 cm) enstatite-sapphirine intergrowth. Corundum is rare.

*Pargasite type.* The main minerals are sapphirine, pargasite, spinel, phlogopite, corundum± plagioclase ± cordierite. The often grass green-coloured pargasite is medium to coarse grained and it locally makes up over 60% of the rock. Pargasite-rich layers are interbanded with plagioclase, phlogopite ± ruby layers or with cordierite, phlogopite ± ruby layers. Ruby is found as dark red grains up to a few centimetres most of which are strongly fractured. The rubies are often rimmed by narrow zones of spinel and sapphirine.

*Gedrite type*. This type consists of sapphirine, gedrite, corundum, phlogopite, ± cordierite, ± spinel, ± plagioclase , ± pargasite. Coarse gedrite prisms up to 2 cm long form aggregates in a matrix of sapphirine, phlogopite and ruby. Gedrite type has often a slight foliation formed by parallel orientation of aggregates of gedrite prisms. Kornerupine occurs as greenish to brownish crystals. Rubies are red and generally medium grained.

*Phlogopite type.* This type is a well foliated rock consisting of sapphirine , phlogopite, corundum , ± plagioclase, ± cordierite, ± spinel. Crystals of kornerupine in prismatic aggregates occur. The rubies are mostly a few millimetres in size and are deep red (pigeon blood) coloured.

Besides in sapphirine-bearing rocks ruby corundum also occurs in a number of non-sapphirine bearing assemblages.

The main mineral combinations are:

- corundum – pargasite – plagioclase – cordierite,
- corundum – gedrite – plagioclase ± cordierite ± phlogopite,
- corundum – phlogopite – plagioclase – cordierite.

The mineral assemblages thus correspond to rock types B, C, and D above, but without sapphirine.

# Exploration history

The occurrences of rubies in the Fiskenaesset area are closely related to the occurrences of sapphirine. The history of exploration of the rubies accordingly begins with the discovery of sapphirine at Fiskenaesset harbour in 1809 (Giesecke, 1910). About 150 years later several new sapphirine occurrences were found in 1964 during a reconnaissance mapping program by the Geological Survey of Greenland (GGU) (Windley 1964).

The first rubies were found by GGU in the summer of 1966 (Ghisler,1966, Herd et al. 1969) during a systematic investigation of the chromite deposits of the Fiskenaesset anorthosite complex. Small grains of red corundum were found in a sapphirine-rich layer at Upper Annertussoq. Deep red, transparent rubies were, however, first found on a small island in the brackish lake Tasiussa at the head of Tasiussarssuaq fjord. The island had no official name and was unofficially by Ghisler called Rubin Ø (Ruby Island). The rubies - embedded in a phlogopite-rich rock - are very small; 1-2 mm. GGU asked a jeweller in Copenhagen, Ove Dragsted, to investigate a sample from this locality. He concluded that the colour of the rubies were of gem quality, but were two small for cutting and polishing.

In the seventies GGU carried out a detailed mapping programme of the Fiskenaesset area. As a result, a large number of sapphirine showings, with and without rubies were discovered.

In the 1970's and early 1980's Greenland rubies attracted commercial interest. Detailed exploration for rubies was conducted by Platinomino A/S for Fiscanex Ltd. from 1969 to 1983. The prospecting activities of Platinomino A/S are reported in a series of now non-confidential reports which are available from GEUS. Following the initial prospecting for rubies in 1970 to 1974 Platinomino A/S collected 9933 kg of ruby-bearing material in the Siggartartulik area in 1976. In 1979 the company carried out prospecting in some of the promising zones where anorthosites border supracrustal amphibolites, and additional 1360 kg of loose ruby-bearing rock was collected at Siggartartulik. In 1980 Platinomino A/S carried out detailed mapping and bulk sampling at Qaqqatsiaq, Upper Annertussoq South, Kigutilik and Siggartartulik East, where a total of 32 tonnes of material was collected.

In 1981 Platinomino A/S processed 1360 kg ruby bearing-material collected in 1979 at Siggartartulik (Geisler, 1982). This yielded a ruby concentrate weighing 72.3 kg. The concentrate was screened into four fractions each of which was examined as to proportion of clean

ruby (deep pink to red corundum essentially free of matrix) and dirty ruby (containing 30% or more attached matrix).

Table 1. Concentrates of ruby processed from 1360 kg ruby-bearing material

| Size Fraction (mm) | Clean Ruby (%) | Dirty Ruby (%) | White corundum (%) | Sapphirine (%) | Ilmenite (%) |
|---|---|---|---|---|---|
| + 4.75 | 30 | 53 | 12 | 4 | 1 |
| -4.75 to +2 | 49 | 17 | 14 | 19 | 1 |
| -2 to + 1 | 54 | 10 | 12 | 23 | 1 |
| -1 | 55 | 12 | 14 | 18 | 1 |
| Average | 47 | 23 | 13 | 16 | 1 |

Geisler (1982).

In the coarsest fraction about one percent of the +4.75 mm fraction proved to be translucent. Most of the rubies appeared to contain numerous cracks as well as some dark inclusions (Geisler, 1982).

Based on Platinomino's work Geisler (1983) concluded:

*The +4.75 mm size fraction of ruby recovered from samples collected in 1979 was beneficiated to yield 108.78 carats of visually selected best cutting material. Eight pieces of this ranging to 4 carats were cut into four stones and four cabochons. Although all suffered from imperfections and chipping, they nevertheless displayed a remarkably good colour occasionally equal to the best Burmese variety. The four faceted stones ranged from 0.10 to 1.51 carats and disclosed cutting losses of 52 to 90 percent*.

In 1980 GGU undertook a pilot project by processing 50 kg of ruby-bearing material obtained from Platinomino A/S (Demina *et al*., 1980). Different types of crushing were applied such as jaw crushing and hydraulic crushing. Chemical decomposition with hydrofluoric acid was tested. No promising results were obtained.

Jensen (1980) carried out investigations on the rubies from Fiskenæsset area. Jensen brought rubies to mineral dealers in Idar-Oberstein, Germany. One dealer selected two and another company one stone for cutting and polishing cabochons. During cutting and polish-

ing the stones were reduced between 40 and 60%, and the final cabochons weighed 2 carat, 2 ¾ carat, and 1 ¾ carat. The two companies found the Greenlandic rubies comparable with rubies from Kenya and Tanzania. In the mid-eighties Platinomino A/S ceased working in Greenland.

In 2004 True North Gems Inc. from Canada obtained an exclusive exploration licence and commenced prospecting and bulk sampling. The company continued prospecting and processing for several years, and found numerous new ruby-bearing localities. Since 2007 the main efforts were concentrated on the Aappaluttoq deposit. In March 2014 the company and the Greenland Government signed and exploitation license for this deposit. For further information website: www.truenorthgems.com

In 2008 GEUS (Geological Survey of Denmark and Greenland) found a new, significant zone of ruby-bearing rocks north of the lake Qajartoriaq, 2.5 km east of the Qaqqatsiaq occurrence (Kalvig & Keulen, 2011).

# Mineral licenses in Greenland

Mineral licenses in Greenland comprise personal small scale licenses to local residents as well as licenses to companies. There are several types of licenses and this is only a brief overview. Details on terms, rules, laws and guidelines relevant for mineral prospecting, exploration and exploitation in Greenland can be found at www.govmin.gl.

Persons who are permanent residents of and fully liable to pay tax in Greenland are allowed to collect minerals without using any tools in areas not covered by licenses with exclusive rights. Excepted are diamonds, rubies, sapphires, emeralds, chrysoberyl and opal.

**Small scale mining licenses** can be granted to permanent residents, who have been fully liable to pay tax in Greenland for the recent 5 years. There are two types of small scale licenses:

- Small scale license to mineral exploration and exploitation with exclusive rights to an area of 1 square kilometer. Duration up to 3 years with the possibility of extension.
- Small scale license (non-exclusive) to mineral exploration and exploitation by use of non-mechanical tools within one of the four Greenlandic municipalities. Duration 3 years.

**Exploration license (exclusive).** An exploration license covers all mineral resources except hydrocarbons and radioactive elements. A minimum annual spending for exploration is required, depending on the size of the area. First license period is 5 years, with the possibility of extension.

**Exploitation license (exclusive).** If the licensee has found and delineated commercially viable deposits which the licensee intends to exploit and provided the terms of the exploration license have been complied with, the licensee is entitled to be granted an exploitation license. An exploitation license terminates when exploitation activities are discontinued and the closure is completed, but the total period cannot exceed 50 years.

**Special exploration license (exclusive)** is granted for large areas in North and East Greenland and covers all mineral resources except hydrocarbons and radioactive elements. A minimum annual spending for exploration is required, depending on the size of

the area. The license period is 3 years and the licensee is entitled to be granted, upon application, an exploration license on normal terms for the license area, wholly or partly.

**Prospecting non-exclusive license.** A prospecting license covers all mineral resources except hydrocarbons and radioactive elements. The license is not valid in areas covered by exclusive licenses. The licensee is not obligated to spend exploration expenses. The license period is 5 years, but after expiry a new prospecting license may be applied for and granted.

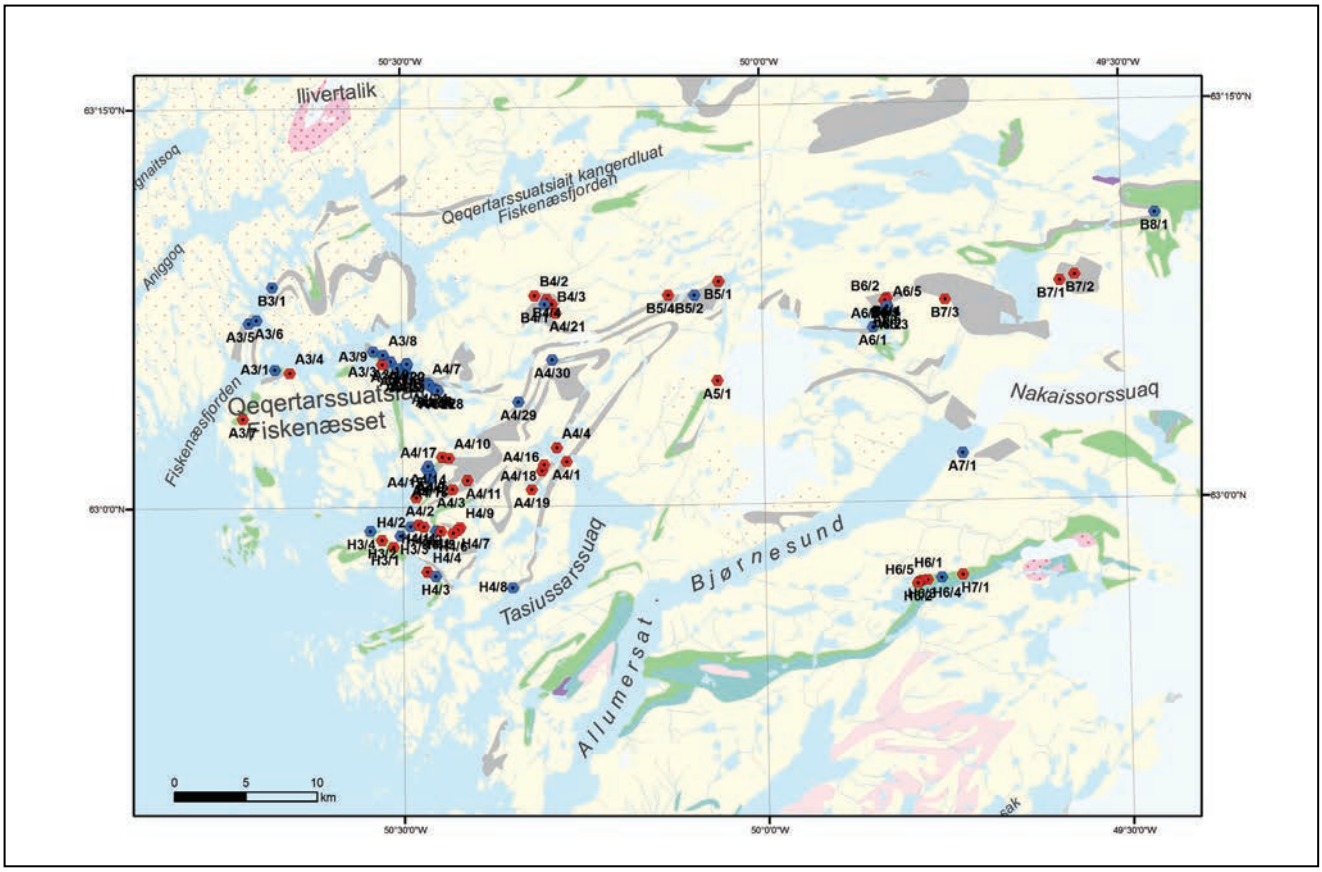
**Scientific work related to mineral resources** including geological surveys is permitted only according to licenses granted by the Mineral License and Safety Authority. Applicants for scientific work must forward an application form and insurance statement to the Mineral License and Safety Authority.

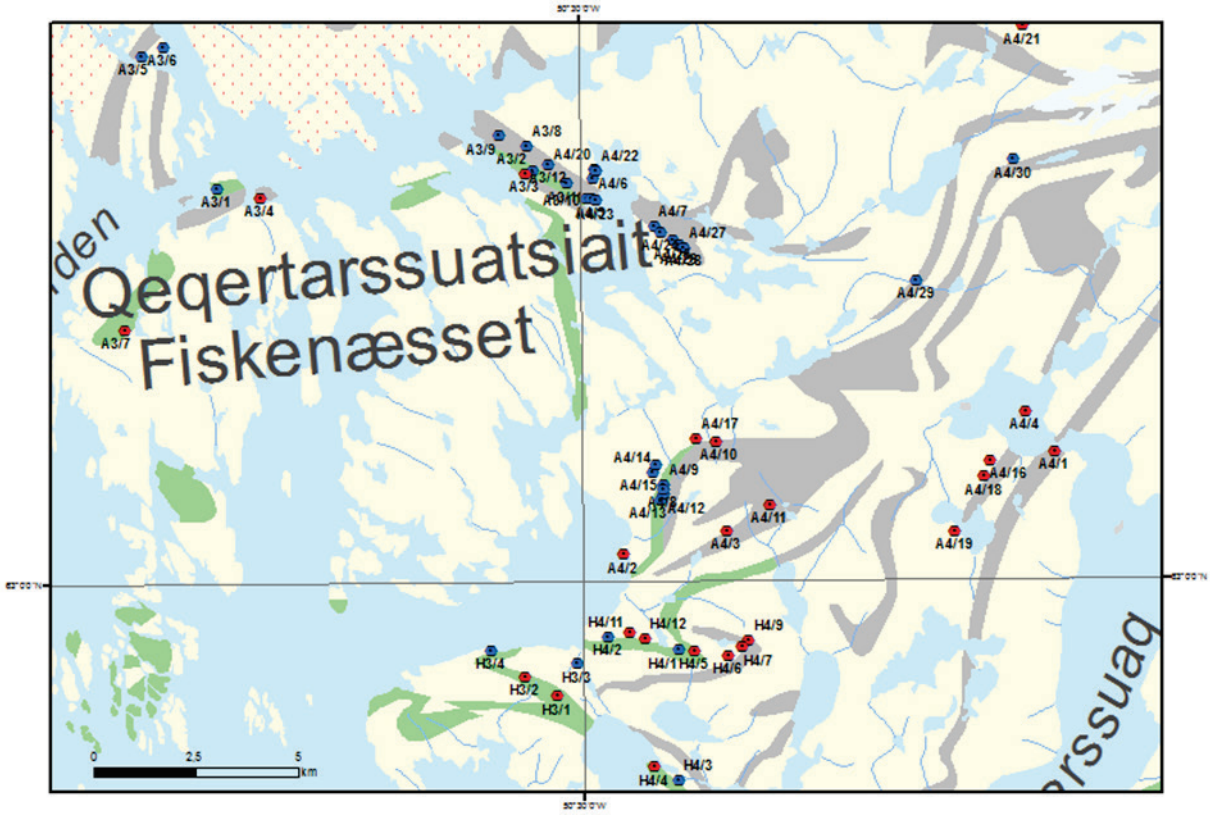
**Tourists and other visitors** are allowed to collect mineral samples, but cannot exploit or export these unless they obtain a permission.

# Description of localities in the Fiskenaesset area

The position of the ruby/sapphirine occurrences is shown below. Sapphirine occurrences without rubies (48) are marked with blue, ruby/sapphirine occurrences (39) with red. Shaded grey shows major anorthosite bodies.

The coordinates given are not measured in the field. They are calculated from locality positions plotted on 1:20.000 geological field maps. The accuracy is estimated to be not better than 100 m in both north-south and east-west directions.






## 1. Akunnaq/Lichtenfels

Coordinates:
A3/7: -50,71986933 63,05604719

1 km east of the abandoned Moravian mission settlement Lichtenfels (in German “light rock) occur two small sapphirine localities 450 m apart from each other. The southernmost occurrence is a 20 m wide and 4 m thick lens at the eastern contact between anorthosite and amphibolite. The mineral parageneses is sapphirine, tremolite, pargasite, biotite and plagioclase. Pink corundum and red rubies occur in a 1 m tick zone, of which the lower two thirds is a well-banded ruby-pargasite-plagioclase rock (Fig.5).

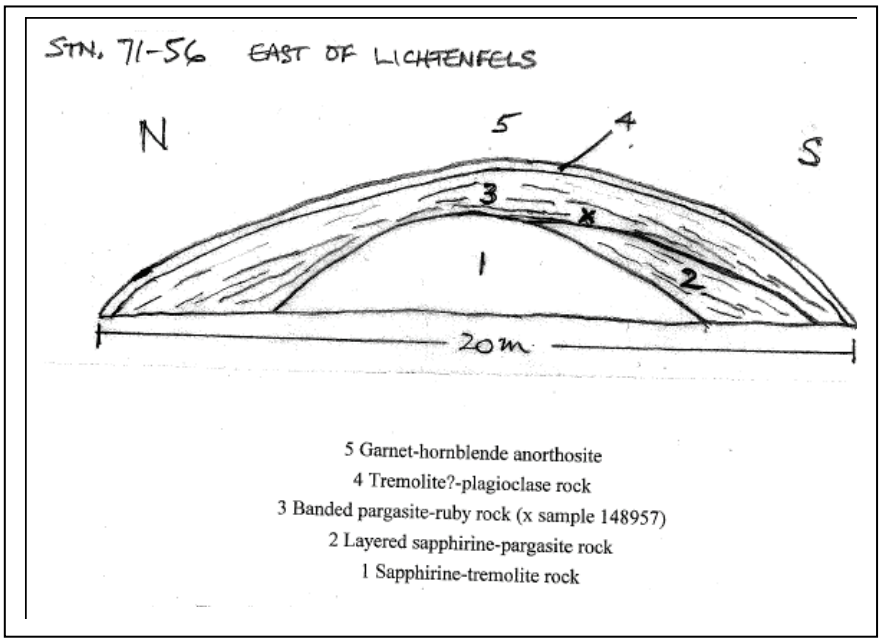



**Figure 5.** *Geology of the Akunnaq ruby/sapphirine occurrence. Tomas Frisch, pers. com. (2014).*

## 2. Qeqertarssuatsiaat/Fiskenaesset

Coordinates:
A3/1: -50,67540318 63,08692353

A3/4: -50,65470978 63,08473955

The sapphirine locality at Qeqertarssuatsiaat lies at the southern margin of the settlement. It is the type locality for sapphirine and probably also for kornerupine. The sapphirine rocks occur within an ultramafic lens of peridotite and pyroxenite between anorthosite to the west and amphibolite to the east (Fig.6). The exposure of sapphirine-bearing rocks reaches 40 m northwards from the coastline of the southern harbour, where the width is some 30 m. The southernmost part of the exposure is water covered at high tide level (Fig. 7).

All main four types of sapphirine parageneses are present at this locality. Detailed maps of the distribution of rock types are given at Figs.8 and 9. Pink corundum occurs together with blue spinel in a coarse grained hornblendite close to the coastline at the eastern end of the exposure, and minor amounts of corundum are observed in several samples under the microscope.

At the western end of the island Qassartoq east of Qeqertarssuatsiaat is found a small lens 1 m x 15 cm with rubies in a cordierite-phlogopite-plagioclase rock and in a sapphirine-phlogopite rock.

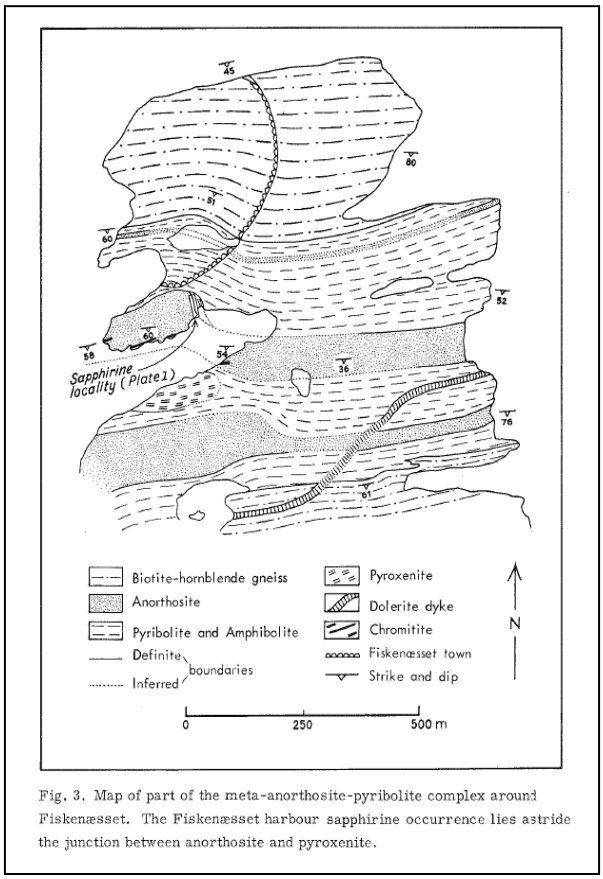



Fig. 3. Map of part of the meta-anorthosite-pyribolite complex around Fiskenæsset. The Fiskenæsset harbour sapphirine occurrence lies astride the junction between anorthosite and pyroxenite.

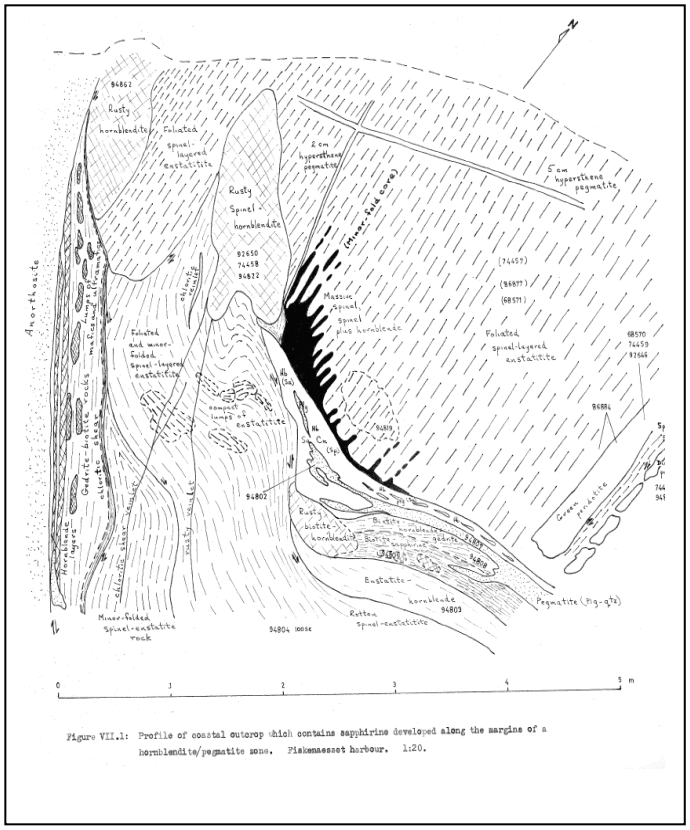



Figure VII.1: Profile of coastal outcrop which contains sapphirine developed along the margins of a hornblendite/pegmatite zone. Fiskenaesset harbour. 1:20.

**Figures 6 and 8**. *Showing location and details of the sapphirine locality in Fiskenaesset harbour (Herd et al., 1969; Herd, 1972).*

**Figure 7.** *Exposure of the Fiskenaesset harbour locality.*

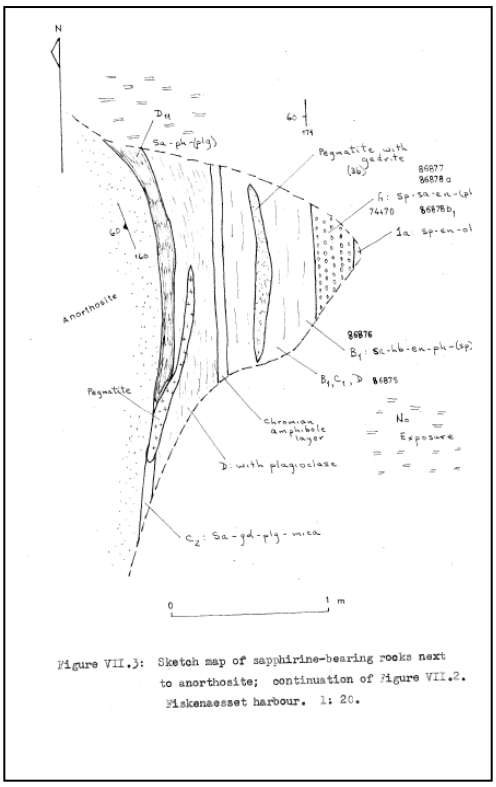



Figure VII.3: Sketch map of sapphirine-bearing rocks next to anorthosite; continuation of Figure VII.2. Fiskenaesset harbour. 1: 20.

**Figure 9.** *Sketch map of sapphirine-bearing rocks next to anorthosite. Fiskenaesset Harbour. Herd (1972).*

## 3. Nunaqarfinguaq

Coordinates:

| | |
|---|---|
| A3/5: -50,71129849 | 63,11587385 |
| A3/6: -50,70071581 | 63,11801234 |
| B3/1: -50,67863504 | 63,13875967 |

Three small occurrences of sapphirine-bearing rocks are found some 5 km NW of Fiskenaesset. Two on a small island Nunaqarfinguaq 600 m apart from each other and one 3 km to NE on the west coast of the island Qeqertarssuatsiaq. The latter occurrence is 10 m long and 4 m wide sandwiched between anorthosite and amphibolite (Fig.10). Sapphirine parageneses are developed as gedrite type and phlogopite type with cordierite as a distinct component. Only little corundum is found, no rubies.

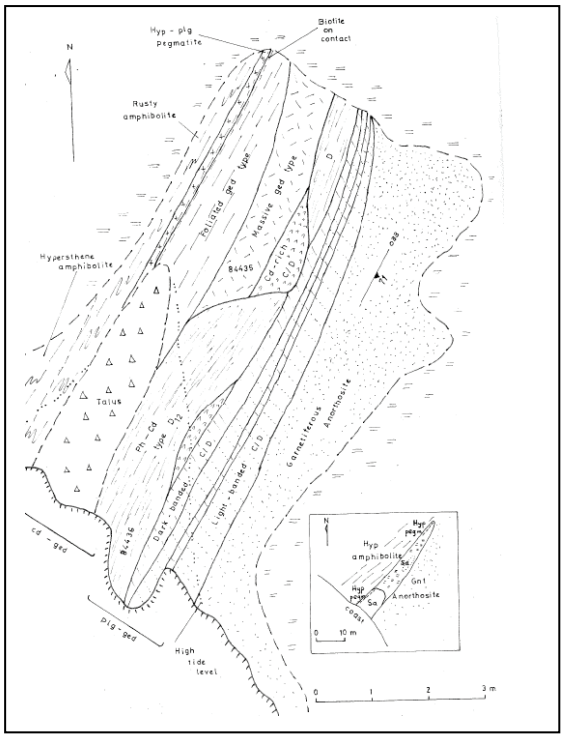



**Figure 10**. *Geological map showing a sapphirine occurrence on the island of Qeqertarssuatsiaq. Herd (1972).*

## 4. Sungaasa Nuaat

Coordinates:

| | |
|---|---|
| A3/2: -50,5228907 | 63,09037372 |
| A3/3: -50,52689035 | 63,08982193 |
| A3/8: -50,52542194 | 63,09575155 |
| A3/9: -50,53935452 | 63,09811478 |
| A3/10: -50,49692958 | 63,08440595 |
| A3/11: -50,50635229 | 63,08754765 |
| A3/12: -50,51538412 | 63,09181776 |
| A4/5: -50,49458901 | 63,08416044 |
| A4/6: -50,49368113 | 63,08870428 |
| A4/20: -50,49311588 | 63,09059358 |
| A4/22: -50,49238325 | 63,09036816 |
| A4/23: -50,49253696 | 63,08377707 |


**Figure 11**. *Ruby/sapphirine occurrences at Sungaasa Nuaat after Gormsen (1971). Green: anorthosite; grey: amphibolite; yellow: gneiss, black: dolerite.*

This flat area 8 km east of Qeqertarssuatsiaat reaching maximum altitudes of 100 metres are build-up of repeated layers of anorthosite and amphibolite. Along the contacts occur frequently small lenses of ultramafics, of which many contain sapphirine-bearing rocks. 12 occurrences are found (Fig. 11). One locality (A3/11) represents a number of ultramafic lenses along a strike length of 350 m.

All types of sapphirine mineral assemblages can be found. Pink and grey spinel occurs, and large accessory zircon was observed at one occurrence. Ruby is only reported from one occurrence (A3/3).

## 5. Taseq East

Coordinates:
A4/7: -50,46474442 63,07812561

A4/24: -50,46111202 63,07676641

A4/25: -50,45571946 63,07494008

A4/26: -50,45234017 63,07389915

A4/27: -50,4502322 63,07349226

A4/28: -50,45002044 63,0734479

East of the brackish inland lake Taseq 10 km east of Qeqertarssuatsiaat is exposed a double folded anorthosite-amphibolite sequence with a horizontal east-west trending axes (Fig.12). At the southern limb along the contact between the main anorthosite layer and the amphibolite south of it ultramafic lenses contain 5 occurrences of sapphirine rock over a strike length of 1 km. The westernmost lens is 19 m long and 4 m wide and rich in sapphirine belonging to the phlogopite type. Mineral parageneses found comprise sapphirine, phlogopite, gedrite, hornblende, biotite, plagioclase, spinel and corundum. No rubies**.**

**Figure 12**. *Anorthosite synform (white) with intercalated amphibolite (dark) viewed towards east.*

## 6. Pikiniq

Coordinates:
B4/1: -50,3010373 63,12691757

B4/2: -50,31509973 63,13229925

B4/3: -50,29108525 63,12678123

B4/4: -50,29774371 63,13000814

A4/21: -50,2861133 63,12130229

A fold structure of anorthosite-amphibolite 600 m across at an altitude around 600 m 5 km NNW of Qagsse Mountain contains 4 sapphirine occurrences. They all are situated in ultramafic rocks at contacts between anorthosite and amphibolite. The southern limb of the fold at the shore of Lake 560 shows a small occurrence with sapphirine, cordierite and gedrite, but no corundum.

At the westernmost point of the northern limb of the fold occurs a 10 m thick zone with sapphirine, phlogopite, cordierite and corundum, sometimes showing ruby colour.

Between localities B4/3 and B4/4 scattered rubies occur in rocks consisting of sapphirine, cordierite, gedrite, phlogopite and corundum. Fine-grained red spinel with green chrome pargasite and corundum occur in an olivine-rich rock.

At the nose of a disconnected fold core 860 m SE of B4/1 was found an ultramafic lens at the contact between anorthosite and amphibolite (A4/21). Pink corundum up to 2.5 cm occurs in a 15 cm thick pargasite-rich layer 5 m long.

## 7. Tuk

Coordinates:
B5/1: -50,05997283 63,14015188

B5/2: -50,09353067 63,13154199

12,5 km NE of Qagsse Mountain at an altitude of 790 m, 350 m west of lake 621 and west of the Iterdlaq fault two ruby-bearing pegmatoid bodies 20 m long and up to 50 cm thick occur along the contact between an ultramafic lens and amphibolite. Idiomorfic grains or aggregates of ruby corundum up to 20 cm occur in a matrix of plagioclase, cordierite, phlogopite, sillimanite and kyanite. Nearby are found rocks with sapphirine and gedrite.

1700 m to the SW in the contact between an ultramafic lens and pegmatite is developed a phlogopite-rich zone with sapphirine or cordierite, gedrite and pargasite, no corundum.

## 8. Ivnaarssuunguaq

Coordinates:
B5/4: -50,12979992 63,13187722

8,5 km NE of Qagsse Mountain at the southeast corner of lake 605 at an altitude of 660 m outcrops a 100 m wide anorthosite. The rock suite comprises a 20 m thick spinel-layered ultramafic, garnet-bearing anorthosites, leucogabbro and a 6-10 m amphibolite. A mineralogically complex locality with a more than 1 m thick korneruppine-rich lens as the most prominent feature.

The mineral parageneses comprise cordierite, gedrite, sapphirine, chromian pargasite, red spinel, phlogopite, plagioclase and ruby corundum. Kornerupine occurs as white radiating columnar crystal aggregates within which individual prisms may reach 50 cm in length and 1-2 cm across.

## 9. Iterdlaq fault

Coordinates:
A5/1: -50,06262007 63,07784031

15 km south of the head of Fiskenaesfjorden on the east side of the Iterdlaq fault close to the glacier the anorthosite complex is exposed. Sapphirine-ruby rocks occur in a peridotite between anorthosite and amphibolite in two places. Sapphirine paragenesis of gedrite and phlogopite types contains cordierite. The southern occurrence is relatively poor in sapphirine, but contains brown spinel. Pink corundum and rubies up to 6 mm are exposed in a 50 m long and 7 m wide zone.

## 10. Qaqqatsiaq (“Waltons showing”)

Coordinates:
A6/1: -49,84643771 63,10991066

A6/2: -49,82649259 63,11951192

A6/3: -49,82718535 63,11960382

A6/4: -49,82893197 63,12107226

A6/5: -49,825948 63,12302024

A6/6: -49,82645236 63,12304247

B6/1: -49,82957995 63,12647126

B6/2: -49,82939537 63,12673695

B6/3: -49,82920699 63,12703258

B6/4: -49,82679888 63,12806002

An anorthosite/amphibolite fold structure 8 km NW from the head of Bjørnesund SE of the 1440 m Qaqqatsiaq peak contains a great number of complex mineral occurrences of sapphirine, kornerupine and other rare minerals at elevations between 840 m and 1190 m over a strike length of 3 km. The occurrences are found in 16 ultramafic lenses developed along folded anorthosite/amphibolite contacts (Fig. 13), of which ten have an occurrence number.

Rare minerals known from elsewhere in the Fiskenaesset complex occur in multiple combinations and textures and in large crystals. Most exotic are coarse crystals of variably coloured (e.g. deep green) kornerupine (Fig.14), coarse grained blue sapphirine, assemblages of red spinel and green chromian pargasite as well as rose quartz and tourmaline in cross-cutting pegmatites. Rubies and pink corundum are reported from the 4 northernmost localities only (B6/1 to B6/4).

Various combinations of the following minerals are found: Olivine, plagioclase, pargasite, enstatite, gedrite, phlogopite, sapphirine, kornerupine, red and blue spinel, pink and ruby corundum, sillimanite.

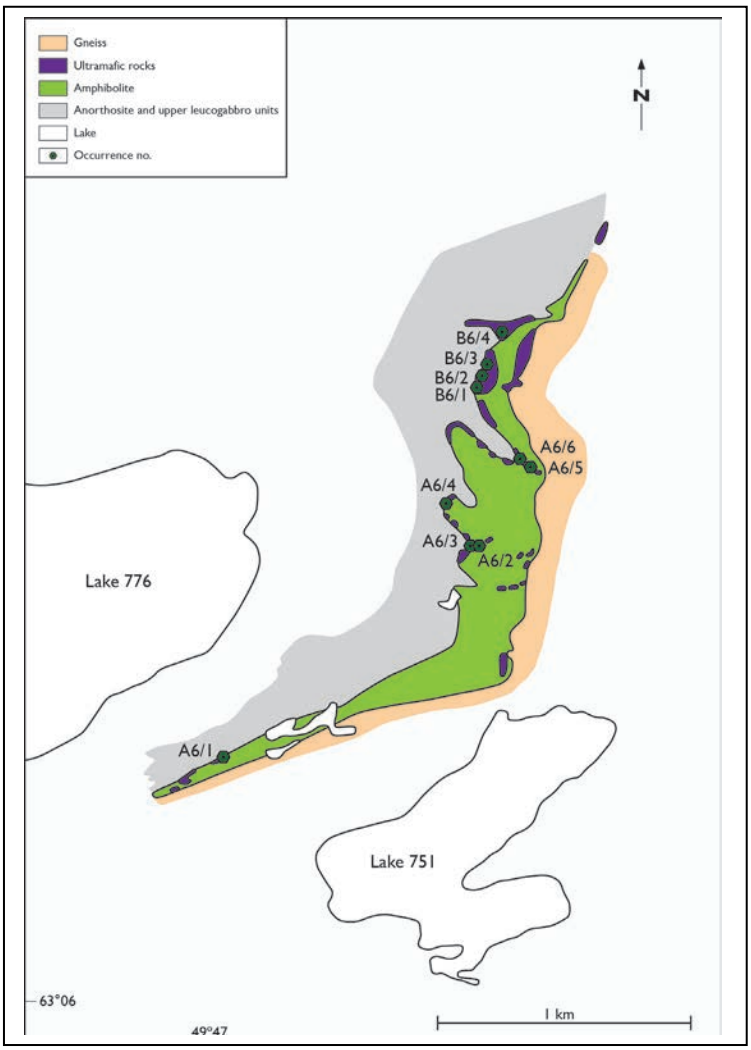



**Figure 13**. *Ruby/sapphirine occurrences at Qaqqatsiaq after Friend (1974).*

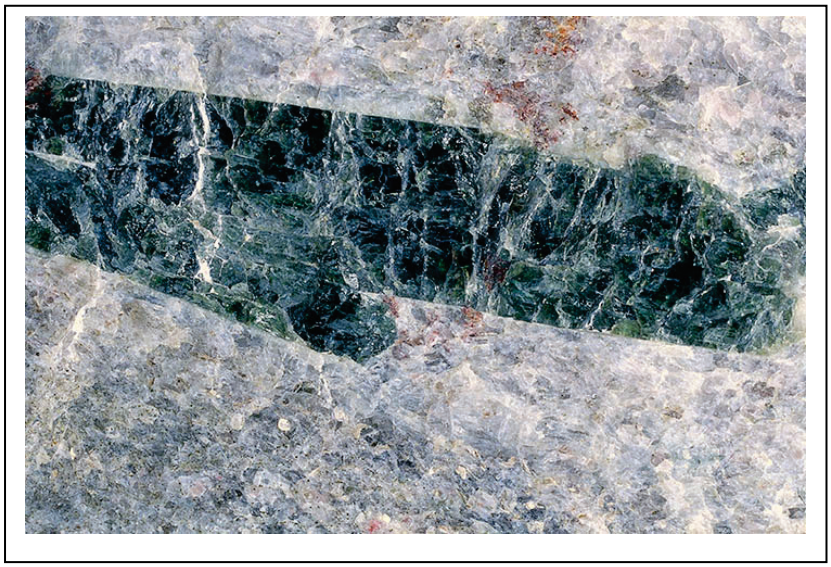


**Figure 14.** *Green kornerupine crystal 5 cm long from Qaqqatsiaq. Photo Johnsen (2000).*

## 11. Marradlugtup qava

Coordinates:
A7/1: -49,72519918 63,0302968

A small sapphirine occurrence was found in the innermost part of Bjørnesund in the southern amphibolite limb of the Marradlugtup anorthosite complex. The sapphirine rock is found within layered ultramafics immediately above the 40 m raised beach 80 m south of the coast line.

The sapphirine occurs in hornblendite (pargasite type) accompanied by green spinel and plagioclase, under the microscope with minor corundum (no rubies).

## 12. Qaqqat Akulerit West (“Beer Mountain”)

Coordinates:
B7/1: -49,58675772 63,13755488

B7/2: -49,56597375 63,14098993

At the top of the plateau (Fig. 15) at an altitude of 1000 m east of the lake 600 in the south western part of the Qaqqat Akulerit area are found significant occurrences of ruby corundum in a gabbro layer of the anorthosite complex. Over a distance of 1 km in an east-west direction 3 occurrences of rubies are separated by each other by snow fields and overburden.

The westernmost occurrence consists of a 10 x 20 m area of ruby-bearing rocks. Ruby corundum occurs in poikiloblasts and masses up to 8 cm across (Fig. 16), surrounded by plagioclase. The colour varies from pink to lilac to deep pink or red. The crystals are usually fractured and seldom translucent. An exceptional feature of this occurrence is the sporadic presence of sapphirine.

The two easternmost showings are about 3 m wide, consisting mostly entirely of hornblende and plagioclase with rubies confined to the lower 1 m. Mineral assemblages are plagioclase-rich with only little phlogopite, gedrite and spinel.

**Figure 15**. *Photo of Qaqqat Akulerit ("Beer Mountain").*

**Figure 16**. *Polished surface of mega crystals of rubies from "Beer Mountain". Sample size 15x17 cm.*

## 13. Qaqqat Akulerit East

Coordinates:
B8/1: -49,45299583 63,17867395

At an altitude of ca. 1500 m in the middle of a moraine, there is exposed a fold core of gabbro, ultramafics and garnet amphibolite. Within the gabbros occur 2 cm thin layers with sapphirine, spinel and corundum (no rubies).

## 14. Kangaarsuk

Coordinates:
H3/1: -50,51254941 62,97552877

H3/2: -50,52869248 62,97981474

H3/3: -50,50280188 62,98253439

H3/4: -50,54465291 62,98555858

On the peninsula Kangaarsuk south of Kigutilik bay occur four small sapphirine occurrences at the contacts between amphibolite and anorthosite. Small rubies are found at two localities in the inner part of the peninsula. Sapphirine and rubies are mainly associated with pargasite, phlogopite and plagioclase.

No rubies are reported from the two occurrences at the north coast of the peninsula, where the sapphirine mineral parageneses at H3/3 occurs at the margin of an ultramafic body at the anorthosite-amphibolite contact.

## 15. Lakseelv

Coordinates:
H4/3: -50,45496061 62,95687395

H4/4: -50,46645361 62,95984641

On the south side of a narrow bay facing the fjord Kangerdluarssunguaq two small sapphirine occurrences are found at the anorthosite/amphibolite contact, the easternmost containing small rubies. The accompanying minerals are pargasite, enstatite, gedrite and phlogopite.

## 16. Tasiussarssuaq

Coordinates:
H4/8: -50,34856528 62,94947236

Close to the shore on the north side of the Tasiusarsuaq fjord a small sapphirine locality was found. No further information.

## 17. Kigutilik

Coordinates:
H4/2: -50,48860598 62,98839375

H4/11: -50,47755118 62,98921585

H4/12: -50,47075084 62,98795757

From the south eastern corner of the Kigutilik bay eastwards 600 m along the anorthosite-amphibolite layers three occurrences of sapphirine/ruby-bearing rocks are found. Layers and lenses 5 – 22 m long and 1 - 3 m thick are dominated by phlogopite and pargasite respectively. Pink to deep red corundum grains 3 - 5 mm across are reported from the two eastern occurrences.

## 18. Siggartartulik West

Coordinates:
H4/1: -50,45392482 62,98540605

H4/5: -50,44717944 62,98522106

In the center of Siggartartulik area at altiudes 150 - 200 m two sapphirine occurrences are found.

At locality H4/1 a strongly pegmatised anorthosite contains inclusions of up to 6 m long sapphirine-bearing rocks of pargasite type with phlogopite, enstatite, plagioclase, cordierite, spinel and corundum (no rubies reported).

The eastern H4/5 sapphirine locality is reported to contain rubies. No further information.

## 19. Siggartartulik East

Coordinates:
H4/6: -50,43033027 62,98404273

H4/7: -50,42401062 62,98589601

H4/9: -50,42054886 62,9873638

At elevations about 400 m numerous exposures of sapphirine- and ruby-bearing rocks are found along the southern contact of anorthosite to amphibolite. The zone is 250 m long and 20 m wide. The eastern 175 m are shown in Fig.17.

The typical ruby-bearing rocks occur in lenticular zones with massive green pargasite with up to centimeter sized rubies (Fig.18). Phlogopite, plagioclase and sapphirine occur as common constituents in varying amounts.

Sapphirine occurs often in blue radiating aggregates, but also as rims on corundum. Cordierit, spinel, gedrite and kornerupine are associated minerals.


**Figure 17.** *175 m long section of the Siggartulik ruby zone (Geisler, 1979).*


**Figure 18.** *Rubies in green pargasite and grey phlogopite. Size of sample 17x10 cm.*

See section: Examples of descriptive sheets of ruby/sapphirine occurrences.

This locality was long regarded as the most promising occurrence for commercial source of rubies, but is since passed by the ruby zone 6 km to the NE.

## 20. Lower Annertussoq

Coordinates:
A4/2: -50,48088221 63,00634921

A promontory in Kigutilik bay SW of Annertussoq mountain consists of intensely folded anorthosite and amphibolite rocks (Fig. 19). At a mutual contact 150 m from the coast is exposed a sapphirine-ruby- bearing lens some 25 m x 5 m.

Sapphirine types B, C, and D are represented. On the margin of anorthosite and metagabbro occur rocks rich in sapphirine, gedrite, cordierite, plagioclase, corundum and phlogopite. In the centre of the outcrop is an up to 1 m thick plagioclase-rich layer with hornblende, phlogopite, gedrite, sapphirine, chromian spinel and rubies over a strike length of 10 m.

An extension to NW for another 10 m contains blue-grey kornerupine in a biotite-cordierite rock, and sillimanite with pink corundum in a biotite-plagioclase rock.

Another sapphirine outcrop is found 100 m to the NE, and right at the coast 250 m to the west is found a 50 cm inclusion in amphibolite consisting of a sillimanite, plagioclase, biotite rock with minor sapphirine and corundum.

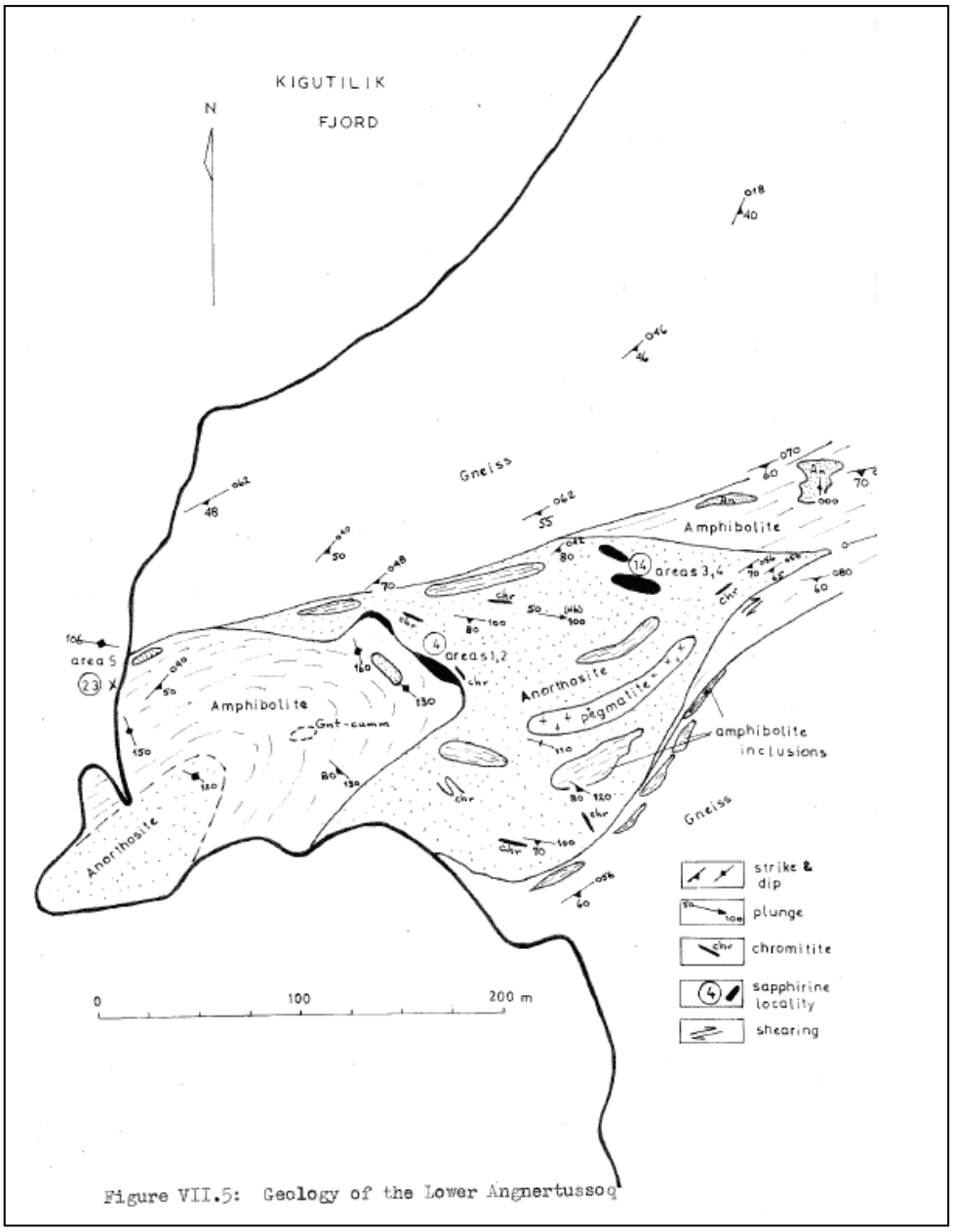



**Figure 19.** *Geological sketch map of Lower Annertussoq locality (Herd, 1972).*

## 21. Upper Annertussoq South

Coordinates:
A4/3: -50,43076632 63,01140589

A4/11: -50,40979752 63,01696276

A significant zone of sapphirine- and ruby- bearing rocks is exposed over 1 km on the south east slope of the Annertussoq mountain on both sides of the long valley running north from the lake Eqaluit tasé.

On the west side of the valley at an altitude of 390 m ultramafic rocks occur close to the southern contact of the anorthosite horizon. The sapphirine-ruby bearing rocks, which reach a maximum thickness of 14 m, are sandwiched between a 3 m wide amphibolite layer to the north and a 1-2 m thick chromite horizon in anorthosite to the south. The zone can be followed for more than 300 m (Figs. 20 and 21). Here the first loose block of pale corundum was found in 1965, and the first ruby corundum occurrence found in 1966.

Mineral paragenesis of gedrite type, phlogopite type and pargasite type are represented associated with kornerupine and cordierite. Small but deep red ruby grains are found in sapphirine, and pale pink corundum crystals up to 3 cm occur.

On the east side of the valley sapphirine – ruby rocks several metres wide are exposed over a strike length of 3 – 400 m in the same stratigraphic position as on the west side of the valley. Sapphirine and rubies are associated with pargasite, gedrite, phlogopite, cordierite and spinel. Corundum is also found in anorthosite close to the sapphirine rocks.

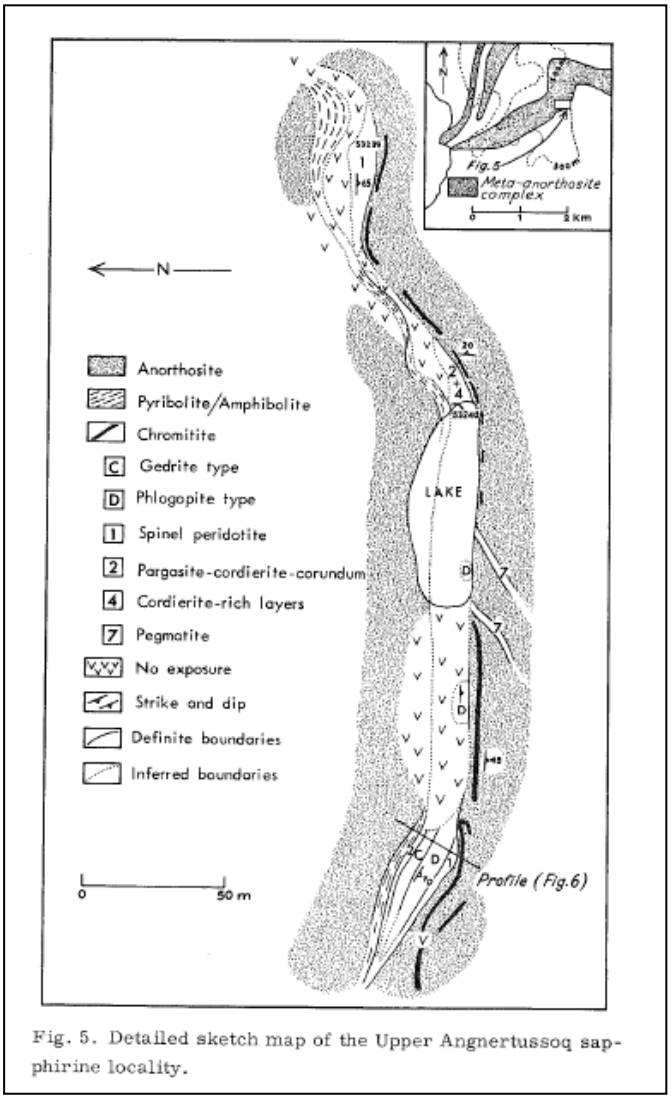



Fig. 5. Detailed sketch map of the Upper Angnertussoq sapphirine locality.

**Figure 20.** *Detailed sketch map of the Upper Annertussoq South ruby/sapphirine-bearing rocks (Herd et al. 1969).*

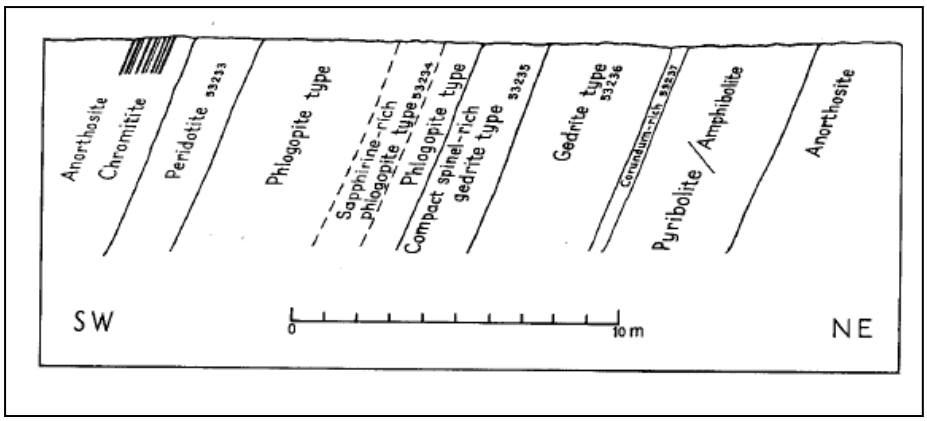



**Figure 21.** *Profile across same horizon (Herd et al., 1969).*

## 22. Upper Annertussoq North

Coordinates:

| | |
|---|---|
| A4/8: -50,46090526 | 63,02055626 |
| A4/9: -50,46075863 | 63,02160069 |
| A4/12: -50,46105056 | 63,01944454 |
| A4/13: -50,46215968 | 63,01812086 |
| A4/14: -50,46427319 | 63,02606472 |
| A4/15: -50,46609894 | 63,02436605 |
| A4/17: -50,44491299 | 63,03169343 |
| A4/10: -50,43534801 | 63,03095645 |

A geological map (Fig.22) shows the ruby/sapphirine occurrences of Upper Annertussoq North. At an altitude of 400 m at the west slope of the Annertussoq mountain four small sapphirine occurrences are found (Nos. 7, 8, 11, 12). Sapphirine is associated with phlogopite, gedrite, enstatite, green spinel and hornblende. No rubies are found, but corundum was observed under the microscope. The sapphirine occurrences are situated within an area of 200 x 200 m (Tupek area). 3 of the occurrences are at the contact between amphibolite and anorthosite to the east. One ultramafic lens 10 m across is close to the contact to gneiss to the west. In the centre of the area is a prominent pegmatite 2 m wide in amphibolite. A geological map of occurrence No. 7, which has most abundant sapphirine, is given at Fig. 23.

400 m to the NNW there is a narrow valley (Sumpetdal/Swampy Valley) with several ultramafic bodies a few metres across along anorthosite/amphibolite contacts (Nos. 14, 22). One of these has a sapphirine layer less than 50 cm thick with enstatite, spinel, pargasite and gedrite (No. 22).


Green: amphibolite
Grey: anorthosite
Blue: Gabbro
Red and yellow: Gneiss

No. 7 = A4/8; No. 8 = A4/9; No. 12 = A4/12; No. 11 = A4/13; Nos. 14 and 22 = A4/15; Nos. 23, 24, 25 = A4/14; Nos. 26, 27 = A4/17.

**Figure 22.** *Position of the ruby/sapphirine occurrences at Upper Annertussoq North (geology after Windley, 1972).*

300 to 600 m north of Sumpetdal is found three sapphirine occurrences in small ultramafic lenses (Nos. 23, 24, 25): gedrite-sapphirine type rock with minor phlogopite, pargasite and spinel.

One km towards NE at the nose of the isoclinal folded anorthosite is a ruby/sapphirine occurrence of an unusual appearance, associated with marble (No. 26). Specialities of this occurrence are abundance of chromite, ruby-chromite rock, solid red corundum rock, skye blue sapphirine crystals, and white kornerupine in radiating prisms with a spinifex type texture.

500 m towards SE at the northern contact of the main chromite-layered anorthosite are several outcrops of B, C, D type sapphirine assemblages with corundum and cordierite (No. 27).

Six hundred metres east of locality No.26 red corundums occur along the northern contact of the main amphibolite in a three m thick zone traceable for 200 m (A4/10). The mineral assemblage consists of phlogopite, sapphirine, kornerupine, corundum in recrystallized anorthosite.

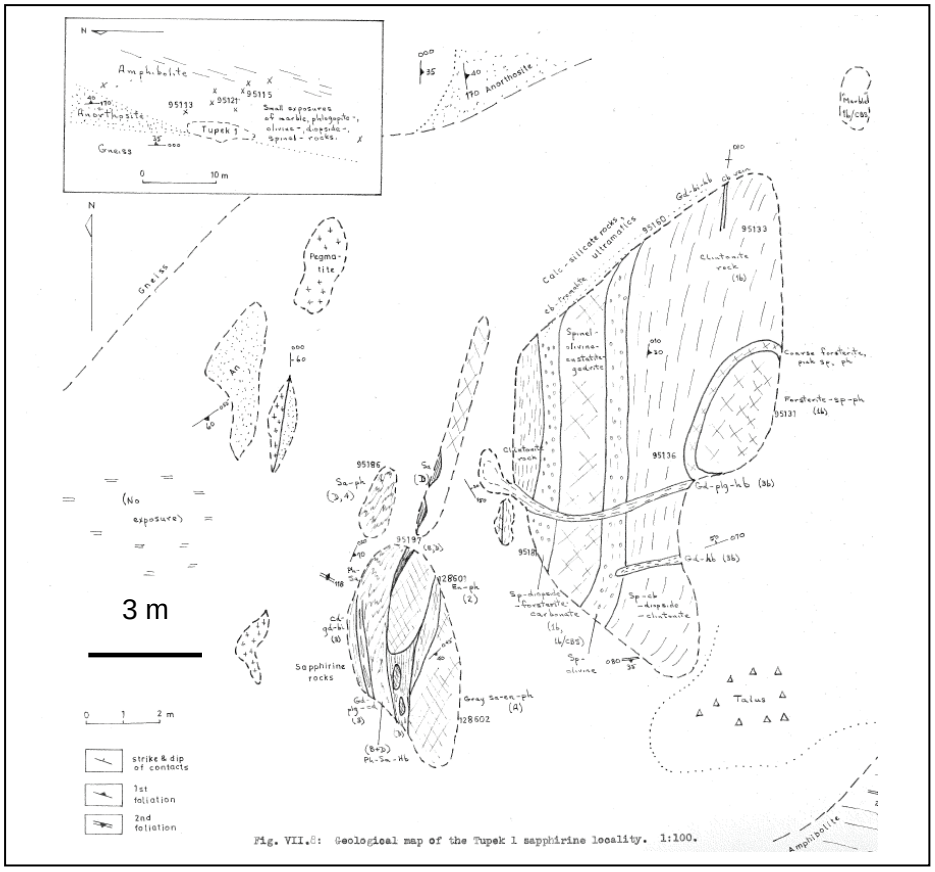



Fig. VII.8: Geological map of the Tupek 1 sapphirine locality. 1:100.

**Figure 23.** *Geological map of occurrence A4/8 (Herd, 1972).*

## 23. Puilassut qava

Coordinates:
A4/16: -50,30376812 63,0262552

A4/18: -50,30702345 63,0227915

A4/19: -50,32127531 63,01096716

South of Tasiussa the anorthosite horizon from Ruby Island continues 3 km southwards. The horizon is 100 m wide and consists of alternating narrow layers and lens of anorthosite, amphibolite and gneiss.

Intermittently occur lenses up to 0.2m x 7 m of sapphirine-ruby bearing rocks. Mineral parageneses are mostly of pargasite and phlogopite types with sapphirine, spinel and corundum. Pale to deep red rubies 1 mm to 8 mm in size were reported.

The southernmost occurrence A4/19 corresponds to True North Gems locality Aappaluttoq.

## 24. Ruby Island

Coordinates:
A4/4 -50,28628791 63,03704349

Rubies from the small island (Fig. 2) in the middle of the Tasiussa inlet at the head of the Tasisarsuaq fjord are only a few millimetres, but deep red and translucent, and thus were the first to attract the interest of gemmologists. They occur in a phlogopite rich rock at the northern end of the island. The sapphirine- and ruby- bearing zone up to 8 m wide and 100 m long is situated between garnet-rich anorthosite and amphibolite (Fig.24).

A large variety of sapphirine and ruby –bearing rocks occur comprising phlogopite, gedrite, enstatite, pargasite, plagioclase, cordierite, red spinel and kornerupine. The latter shows spectacular development of grey-blue to yellow-grey crystal prisms and radiating aggregates up to 20 cm long.

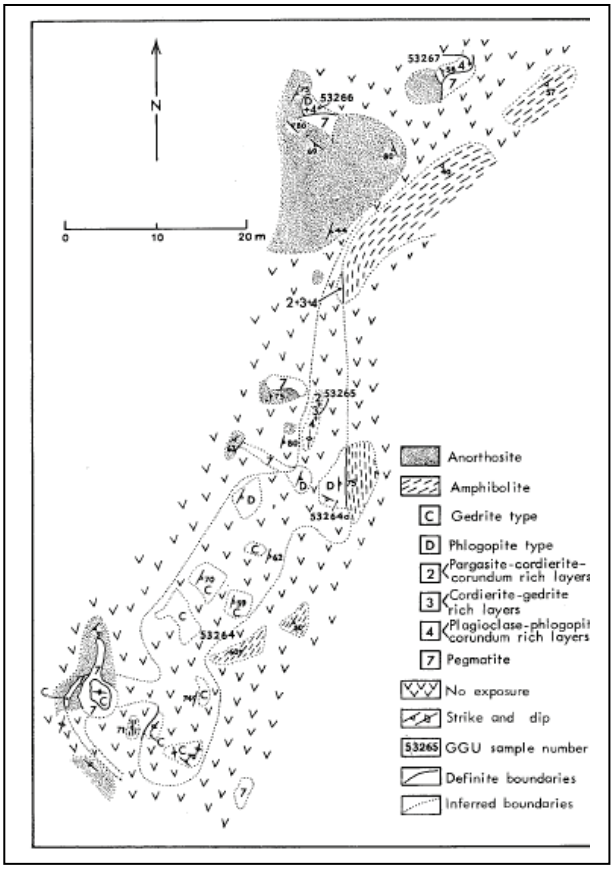



**Figure 24.** *Sketch map of the Rubin Ø ruby/sapphirine locality (Herd et al., 1969).*

## 25. Sarfaq Tasiussa

Coordinates:
A4/1: -50,2728968 63,02827874

At the head of Tasiussarssuaq fjord at the exit of the Tasiusa bay, on the south side of the Sarfaq sapphirine is found in a small lens of a garnet-rich rock. The lens occurs in a mafic

layer of the anorthosite. This unusual garnet-sapphirine mineral association further contains gedrite, spinel, phlogopite and corundum. Pale blue kornerupine has been found in this rock.

## 26. Qagsse

Coordinates:
A4/29: -50,33881764 63,06584888

A4/30: -50,29109128 63,09204425

1.4 km north west and 4.7 km south west of Qagsse mountain are found two sapphirine occurrences along gabbro anorthosite contacts against ultramafics and amphibolite respectively. Sapphirine occurs in lenses with a maximum length 75 m and thicknesses of 2 to 5 m in a phlogopite-rich schist with gedrite and korneruppine. No rubies.

See section: Example of descriptive sheets of ruby/sapphirine occurrences (A4/29).

## 27. Qororssuaq

Coordinates:
H6/1: -49,75713673 62,95233662

H6/2: -49,79032686 62,9488818

H6/3: -49,78499268 62,95046756

H6/4: -49,77713005 62,95101394

H6/5: -49,78872988 62,94978946

H7/1: -49,72804553 62,95397625

Located about 11 km south of the head of Bjørnesund at an altitude of 900 m ultramafic lenses along both the northern and southern contacts between anorthosite and amphibolite contain sapphirine-ruby rocks (Figure 25). The zone can be traced intermittently along the western 5 km of the anorthosite complex.

The mineral paragenesis A and C (enstatite and gedrite types) are represented. They include sapphirine, enstatite, gedrite, anthophyllite, phlogopite, spinel, kornerupine and rutile. Pink and ruby corundum occurs in the zone as finegrained layers and masses, but occasionally with crystals up to 4 mm in size.

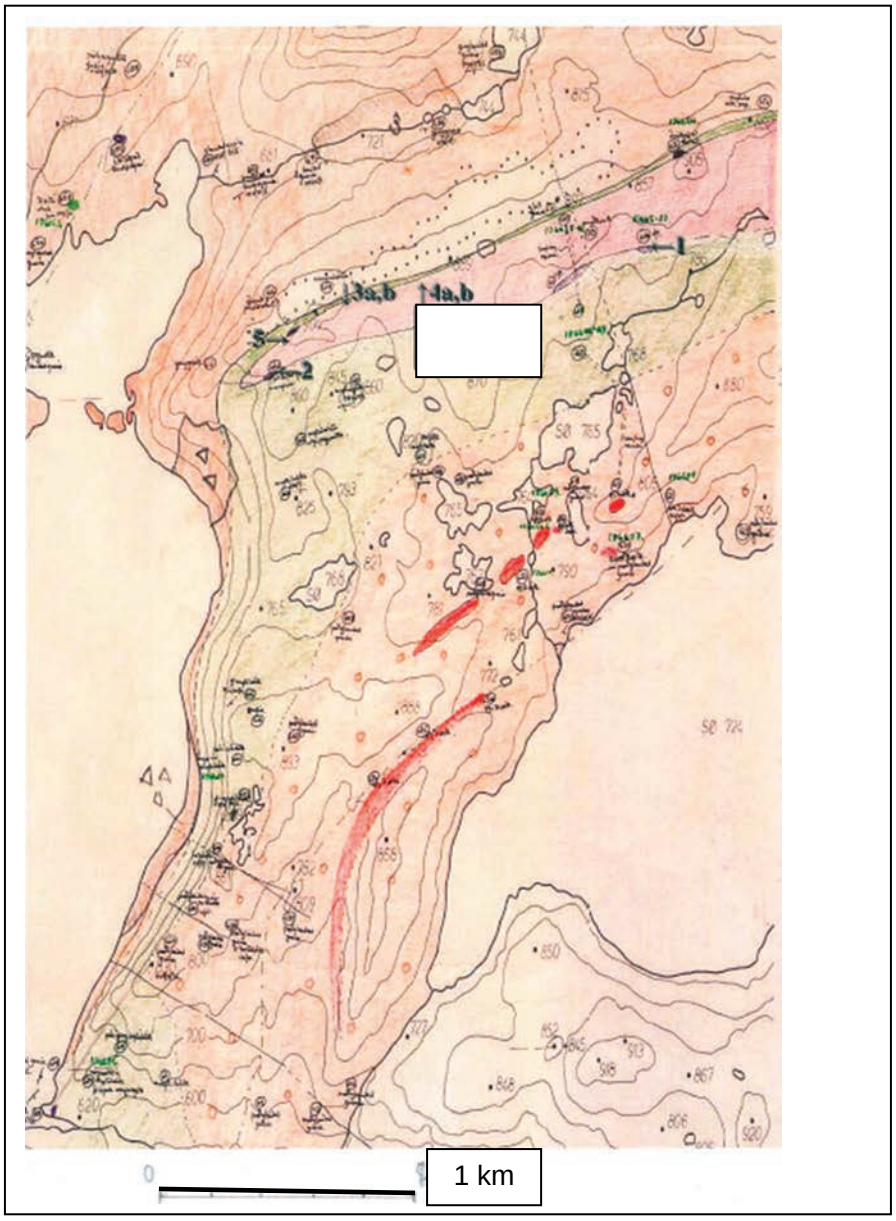



**Figure 25.** *Geological map of the Qororssuaq localities after Williams (1970, 73). Pink: anorthosite, green: amphibolite, orange: gneiss, red: pegmatite. Localities: 1=H6/1, 2=H6/2, 3a,b=H6/3, 4a,b=H6/4, 5=H6/5.*

## 28. Qajartoriaq

Coordinates:
B7/3: -49,74599453 63,12672534

7 km north of the north end of Lake Qajartoriaq 5 km north of the head of Bjoernesund a great number of ruby/sapphirine-bearing exposures occur over a distance of 1.5 km at alti-

tudes between 800 and 1000 meters. The zone is aligned along the contact of the upper gabbro unit at the western side of a 3 km wide anorthosite. 34 locality-sites are registered.

The sapphirine/ruby-bearing ultramafic lenses vary in length from a few to more than 20 m with thicknesses from 0.3 m to several meters.

The mineral parageneses are dominated by phlogopite- and pargasite-rich rocks associated with sapphirine, plagioclase and gedrite. The mineralogy has not been studied yet. Rubies up to 5 mm in size are often deep red and may show good transparency.

# Examples of descriptive sheets on ruby/sapphirine occurrences

There are altogether 87 ruby/sapphirine occurrences described in the Fiskenaesset area. The information from the different occurrences varies from merely geographical coordinates and name of finder to detailed mineralogical and exploratory information. From Nuuk and Maniitsoq regions there are described 6 ruby/sapphirine localities.

Below are descriptive sheets from the Fiskenaesset area on two occurrences, one with scarce information and another which has a wealth of information.

**Description of the ruby/sapphirine localities in the Fiskenæsset (Qeqertarsuatsiaat) region of southern West Greenland**

**Occurrence Number(s):** A4/29

**Co-ordinates:**

-50,33881764 63,06584888

**Name(s):** Qagsse

**Discovered by:** Platinomino A/S 1980

**Description(s):**

At the Eastern contact between a 60 m wide gabbro anorthosite and a 20 m wide amphibolite occurs a 2 metres thick layer of phlogopite, gedrite, sapphirine, kornerupine schist traceable for 50 m. No rubies.

**References:**

Geisler, R. A. 1981

**Description of the ruby/sapphirine localities in the Fiskenæsset (Qeqertarsuatsiaat) region of southern West Greenland**

**Occurrence Number(s):** H4/6

**Co-ordinates:**

-50,43033027 62,98404273

**Name(s):** Siggartulik East

**Discovered by:** Chris Pulvertaft 1970 (GGU)

**Description:**

One of the largest ruby-bearing zones found in the Fiskenæsset area. It was long regarded as the most promising showing for commercial source of rubies, now passed by the ruby zone East of Siggartulik. The typical ruby-bearing rock is a massive green pargasite rock with centimetre sized rubies and patches of bright blue sapphirine together with minor amounts of phlogopite and feldspar. Platinomino carried out bulk sampling in 1980. When the company gave up the concession the ruby showings were sampled by unknown people using dynamite.

**References:**

Geisler, R. A., 1971

Geisler, R. A., 1972

Geisler, R. A., 1973

Geisler, R. A., 1977

Geisler, R. A., 1980

Geisler, R. A., 1981

Geisler, R. A. 1982

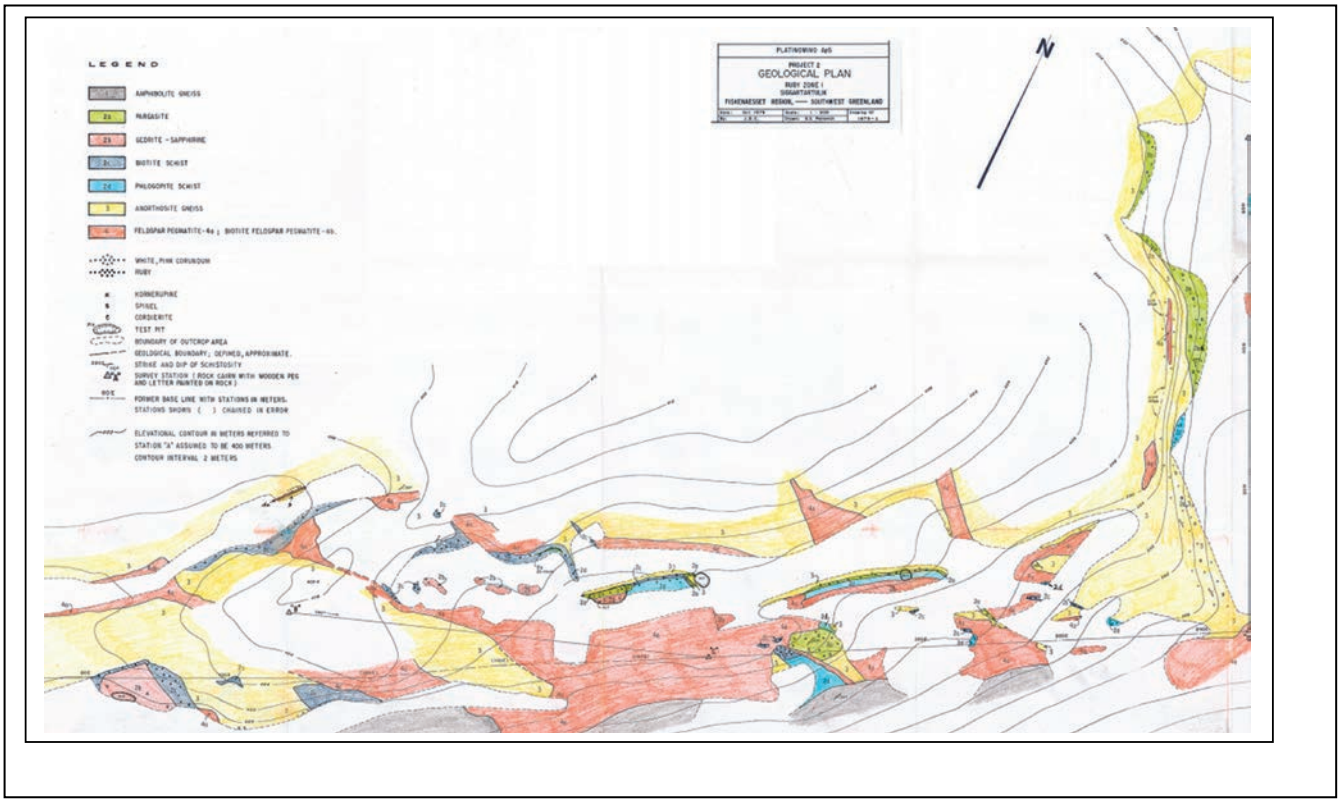
Geisler, R. A., 1983

Herd, R. K., 1970

Herd, R. K., 1972

Herd, R. K., Windley, B. F. & Ghisler, M., 1969

*Typical ruby sample from Siggartartulik. Coarse ruby crystals in a matrix dominated by green pargasite, dark phlogopite and bluish sapphirine. Sample is about 30 cm long.*



# Acknowledgments

Collecting all relevant data from the ruby- and sapphirine-bearing occurrences in the Fiskenaesset area for an inventory in the GEUS database was initiated in collaboration between the Mineral Resources Administration (MRA) of the Home Rule Government and GEUS in 2006. The project received financial support from MRA in 2006-07.

The most comprehensive mineralogical study on the sapphirine and associated mineral parageneses to date is still the work done by R.K Herd (1972). Herd assisted the project in 2006 and 2007 by identifying relevant information for the inventory from unpublished diaries, field notes and Ph.D. and M.Sc. theses from geologists taking part in the GGU activities 1964 – 1974 and from released data in reports from the Canadian company Platinomino A/S. Herd localized the majority of the occurrences treated in this report on 1:20.000 geological maps and delivered descriptions for the inventory for a significant part of the localities.

Mette Svane Jørgensen is responsible for the digitalization of localities and together with Marianne B. Wiese the design of the access to the inventory. Information on the Lichtenfels, Nunaqarfinguaq and Qassartoq occurrences near Fiskenaesset are provided by Tomas Frisch. Information on the GEUS – discovered locality in 2008 Qajartoriaq is given by Per Kalvig,

Karsten Secher provided information on the Kapisillit locality in the Nuuk region and the Kangerdluarssuk locality in the Maniitsoq region. Jeroen van Gool contributed with the information on the Storø occurrences in the Nuuk region. Majken D. Poulsen has given helpful comments to a late draft of the report. Robin-Mary Bell assisted with correction of the English text. Benny M. Schack, Peter Warna-Moors, Jakob Lautrup and Susanne Rømer and Susanne Veng Christensen are acknowledged for their assistance with the illustrations and arranging the text in the report.

# References and relevant literature

(Diaries, field notes and company reports with a GEUS No. are accessible at the Ruby/sapphirine Portal

http://data.geus.dk/geusmap/?mapname=greenland_ruby_sapphirine).


Appel, P. W. U., 1995: Ruby occurrences in the Fiskenæsset area, West Greenland. Grønlands geol. Unders. Open file Ser. 95/11, 26 pp.

Appel, P.W.U., 2001. Diary. In GEUS archives.

Appel, C. C., Appel, P. W. U. & Rollinson, H. R., 2002: Complex chromite textures reveal the history of an early Archaean layered ultramafic body in West Greenland. Miner. Mag. 66, 1029-1041.

Bøggild, O. B., 1953: The mineralogy of Greenland. Meddr. Grønland 149, (3) 442 pp.

Chadwick, B. & Crewe, M. A., 1986: Chromite in the Early Archaean Akilia association (Ca. 3800 M. Y.) Ivisartoq region, inner Godthåbsfjord, Southern West Greenland. Econ. Geol. 81, 184-191.

Coggon, J. A., Luguet, A., Nowell, G. E. & Appel, P.W.U., 2013: Hadean mantle melting recorded in Southwest Greenland Chromite $^{186}$Os signatures. Nature Geoscience. Doi: 10. 1038/ngeo p. 1911 only.

Demina, A., Cooke, H. R. & Frederiksen, J., 1980: On the separation of red corundum (RC) found in the Fiskenaesset region. Internal report Grønlands geol. Unders. 4pp.

Friend, C.R.L., 1974: Diary, GEUS No. 22861. 80 pp.

Friend, C.R.L., 1982: Al-Cr substitution in peraluminous sapphirines from the Bjoernesund area, Fiskenaesset region, Southern West Greenland. Min. Mag. 46, 323-328.

Friend, C.R.L. & Hughes, D.J., 1977: Archaean aluminous ultrabasic rocks with primary igneous textures from the Fiskenaesset region, Southern West Greenland. Earth Planet. Sci. Lett. 26, 157-167.

Friend, C.R.L. & Hughes, J., 1981: Chromium-rich sapphirine from the Bjoernesund area, Southern West Greenland and its bearing on the conditions of crystallisation of the Fiskenaesset anorthosite complex. Rapp. Grønlands geol. Unders. 105, 41-44.

Garde, A. A. & Marker, M., 1988: Corundum crystals with blue-red colour zoning near Kangerdluarssuk, Sukkertoppen district, West Greenland. Rapport Grønlands geol. Unders. 140, 46-49.

Geisler, R. A., 1970: Investigations to June 15, 1970 on the Platinomino A/S concession Fiskenaesset, Greenland. 7 pp. GEUS No. 20002.

Geisler, R. A., 1971: Investigations on the Platinomino A/S concession Fiskenaesset, Greenland during the year ending June 15, 1971. 6 pp. GEUS No. 20001.

Geisler. R. A., 1972. Investigations on the Platinomino A/S Fiskenæsset concession, and the West coast of Greenland (Renzy Mines limited prospecting permit) during the year ending June 15, 1972. 8 pp. GEUS No. 20011.

Geisler, R. A., 1973: Investigations on the Platinomino A/S Fiskenæsset concession, Greenland during the year ended June 15, 1973. 4 pp. GEUS No. 20004.

Geisler, R. A., 1977: Investigations on the Platinomino Aps. Exploration concession, Fiskenaesset, Greenland during the period June 16 1976 to December 31, 1976. 6 pp. GEUS No. 20040.

Geisler, R. A., 1980: Investigations on the Platinomino Aps Exploration concession, Fiskenaesset region southwest Greenland during the year ending December 1979, 11 pp. GEUS No. 20009.

Geisler R. A., 1981: Investigations on the Platinomino Aps Exploration concession, Fiskenaesset region southwest Greenland during the year ending December 1980. 11 pp. GEUS No. 20007.

Geisler R. A., 1982: Investigations on the Platinomino Aps Exploration concession, Fiskenaesset region southwest Greenland during the year ending December 1981. 9 pp. GEUS No. 20008.

Geisler R. A., 1983: Investigations on the Platinomino Aps Exploration concession, Fiskenaesset region southwest Greenland during the year ending December 1983. 11 pp. GEUS No. 20014.

Ghisler, M. 1965. Dagbog. 47 pp. GEUS Nos. 22899/ 22900.

Ghisler, M. 1966: Dagbog 36 pp. GEUS Nos. 22899/22905.

Ghisler, M., 1976: The geology, mineralogy and geochemistry of the pre-orogenic Archaean stratiform chromite deposits at Fiskenæsset, West Greenland. In Borchert, H. (ed.) Monograph Series on Mineral Deposits, 14, 156 pp. Berlin. Gebr. Borntraeger.

Giesecke, K. L. 1910. Karl Ludvig Gieseckes mineralogishes Reisejournal über Grönland 1806-1813. Meddr. Grønland, 35, 529 pp.

Gormsen, K. 1971. En geologisk undersøgelse af det chromitførende Fiskenæsset kompleks omkring Taseq, Vestgrønland. 99 pp. M. Sc. Thesis, University of Copenhagen. GEUS archives.

Grew, E. S., Herd, R. K., & Marquez, N. 1987: Boron-bearing minerals from Fiskenaesset West Greenland – a reexamination of specimens from the type locality. Min. Mag. 51, 695-708.

Gübelin, E. J., 1979: Fiskenässet-Rubin Vorkommen auf Grönland. Lapis, 4, (3), 19-26.

Herd, R. K., 1970. Daybook 1970. 53 pp. GEUS archives.

Herd, R. K., 1972. The petrology of the Sapphirine-bearing and associated rocks of the Fiskenaesset complex, West Greenland. 608 pp.Ph. D. Thesis University of London. GEUS archives.

Herd, R. K., 1973: Sapphirine and kornerupine occurrences within the Fiskenæsset complex. Rapp. Grønlands geol. Unders. 51, 65-71.

Herd, R. K., Windley, B. F. & Ghisler, M., 1969: The mode of occurrence and petrogenesis of the sapphirine-bearing and associated rocks of West Greenland. Rapp. Grønlands geol. Unders., 24, 44 pp.

Higgins, J. B., Riebbe, P. H. & Herd, R. K., 1979: Sapphirine I. Crystal Chemical Contributions. Contr. Miner. Petrol. 68, 349-356.

Hutt, D., 1971. Field notes 1971. 55 pp. GEUS No. 23013.

Hutt, D., 1972. Field notes 1972. 14 pp. GEUS No. 23012.

Jensen, Aa., 1980: Vurdering af udnyttelsesmulighederne for de grønlandske rubinforekomster. Internal report Grønlands geol. Unders. 6 pp.

Johnsen, O., 2000: Mineralernes verden. 439 pp. Gads Forlag.

Kalsbeek, F. & Garde A., A., 1989: Geological map of Greenland 1:500.000 Frederikshåb Isblink – Søndre Strømfjord Sheet 2., Descriptive text. Copenhagen. Grønlands geol. Unders. 36 pp.

Kalvig, P. & Frei, D., 2010: Testing the use of geochemical characteristics of corundum from Greenland as a tool for geographical typing. Danmarks og Grønlands Geologiske Undersøgelse. 2010/68. 36 pp.

Kalvig, P. & Keulen, N., 2011: Aktiviteter i rubin projektet 2011 – samarbejdsprojekt med Råstofdirektoratet. Danmarks og Grønlands Geologiske Undersøgelse Rapport 2011/138, 41 pp.

Keulen, N. & Kalvig, P., 2013: Report on the activities in the ruby project 2012. Danmarks og Grønlands Geologiske Undersøgelse, Rapport 2013/9, 24 pp.

Ljungdal, B., 2005: Mineral guide. Grønlandske smykkesten. 81 pp. Grønlands Stenklub.

Ljungdal, B., 2008: Mineral guide. Det ældste grundfjeld. 117 pp. Grønlands Stenklub.

Myers, J.S., 1974: Field diary. 48 pp, GEUS No. 23198.

Myers, J. S., 1985: Stratigraphy and structure of the Fiskenæsset Complex, southern West Greenland. Bull. Grønlands geol. Unders. 150, 72 pp.

Petersen, O. V., 1979: Korneruppin, en anden ædelsten fra Grønland. Dansk Gemmologisk Selskab, Jubilæumsskrift, 17-22.

Petersen, O.V. & Secher, K., 1985: Grönland, Mineralien, Geologie, Geschichte, Magma 6/84, 83 pp.

Pedersen, O.V. & Secher, K., 1993: The minerals of Greenland, Mineralogical Record 24/2, 1-65.

Polat, A., Appel, P.W.U., Fryer, B. J., Windley, B. F., Freu, R., Samson, E. M. & Huang, H., 2009: Trace element systematics of the Neoarchean Fiskenæsset anorthosite complex and associated meta-volcanic rocks, SW Greenland: Evidence for a magmatic arc origin. Precam. Res. 175, 87-115.

Polat, A., Frei, R., Scherstén, A. and Appel, P. W. U., 2010: New age (ca. 2970 Ma), mantle source composition and geodynamic constraints on the Archean Fiskenæsset anorthosite complex, SW Greenland. Chem. Geol. 277, 1-20.

Polat, A., Fryer, B. J., Appel, P. W. U., Kalvig, P., Kerrich, R., Dilek, Y. & Yang, Z., 2011: Geochemistry of anorthositic differentiated sills in the Archean (~2970 Ma) Fiskenæsset Complex, SW Greenland: Implications for parental magma compositions, geodynamic setting, and secular heat flow in arcs. Lithos 123, 50-72.

Pulvertaft, T.C.R., 1970: Day books (handwritten), GEUS archives.

Ramberg, H. ,1948: On sapphirine-bearing rocks in the vicinity of Sukkertoppen (West Greenland). Meddr. Grønland, 142, 5. 31 pp.

Rivalenti, G. 1970., Field notes. 69 pp. GEUS No. 23321.

Rivalenti, G. 1971., Field notes. 66 pp. GEUS No. 23320.

Rivalenti, G. 1974., A ruby corundum pegmatoid in an area near Fiskenässet, south-west Greenland. Boll. Soc.Geol. It. 93, 23-32.4ff.

Secher, K. & Appel, P., 2007: Gemstones of Greenland. Geology and Ore 7, 4-7.

Secher, K., Petersen, O. V. & Johnsen, O., 2006: En verden af mineraler i Grønland. GEUS.171 pp.

Stromeyer, F., 1819: Göttingsche Gelehrte Anzeigen 3. 1993-2000.

Sørensen, H., 1953: The ultrabasic rocks of Tovqussaq, West Greenland. Meddr. Grønland, 136,4, 9 pp.

Sørensen, H., 1955: On sapphirine from West Greenland. Meddr. Grønland, 137,1, 6-10.

Walton, B. J., 1971: Field notes. 72 pp. GEUS No. 23546.

Walton, B. J., 1973: Field notes. 87 pp. GEUS No. 23545.

Walton, B. J., 1973: The structure and stratigraphy in the area North of Bjoernesund, near Fiskenaesset. Rapp. Grønlands geol. Unders. 51, 60-65.

Willan, R.. C. R., 2005. Field notes, 10 pp. GEUS archives.

Williams, H. R., 1970: Field notes summer season 1970. 35 pp. GEUS No. 23573.

Williams, H. R., 1971: Field notes. 43 pp. GEUS no., 23572.

Williams, H. R., 1973: The geology of an area to the northeast of Bjoernesund, near Fiskenaesset, West Greenland. Ph. D. Thesis University of Exeter. 290 pp. GEUS archives,.

Windley, B. F., 1964: Diary. 37 pp. GEUS No. 23564,

Windley, B. F., 1970: Diary. 54 pp.  GEUS No. 23591,.

Windley, B. F., 1972: Daybook. 61 pp. GEUS No. 23590,

Windley, B. F., Herd. R. K. & Bowden, A. A., 1973: The Fiskenaesset Complex, West Greenland. Part I. Bull. Grønlands geol. Unders. 106. 80 pp.

Windley, B. F. & Smith, J. V., 1974: The Fiskenaesset Complex, West Greenland. Part II, Bull. Grønlands geol. Unders, 108. 54 pp.

# Appendix: Description of ruby/sapphirine localities in the Nuuk and Maniitsoq regions

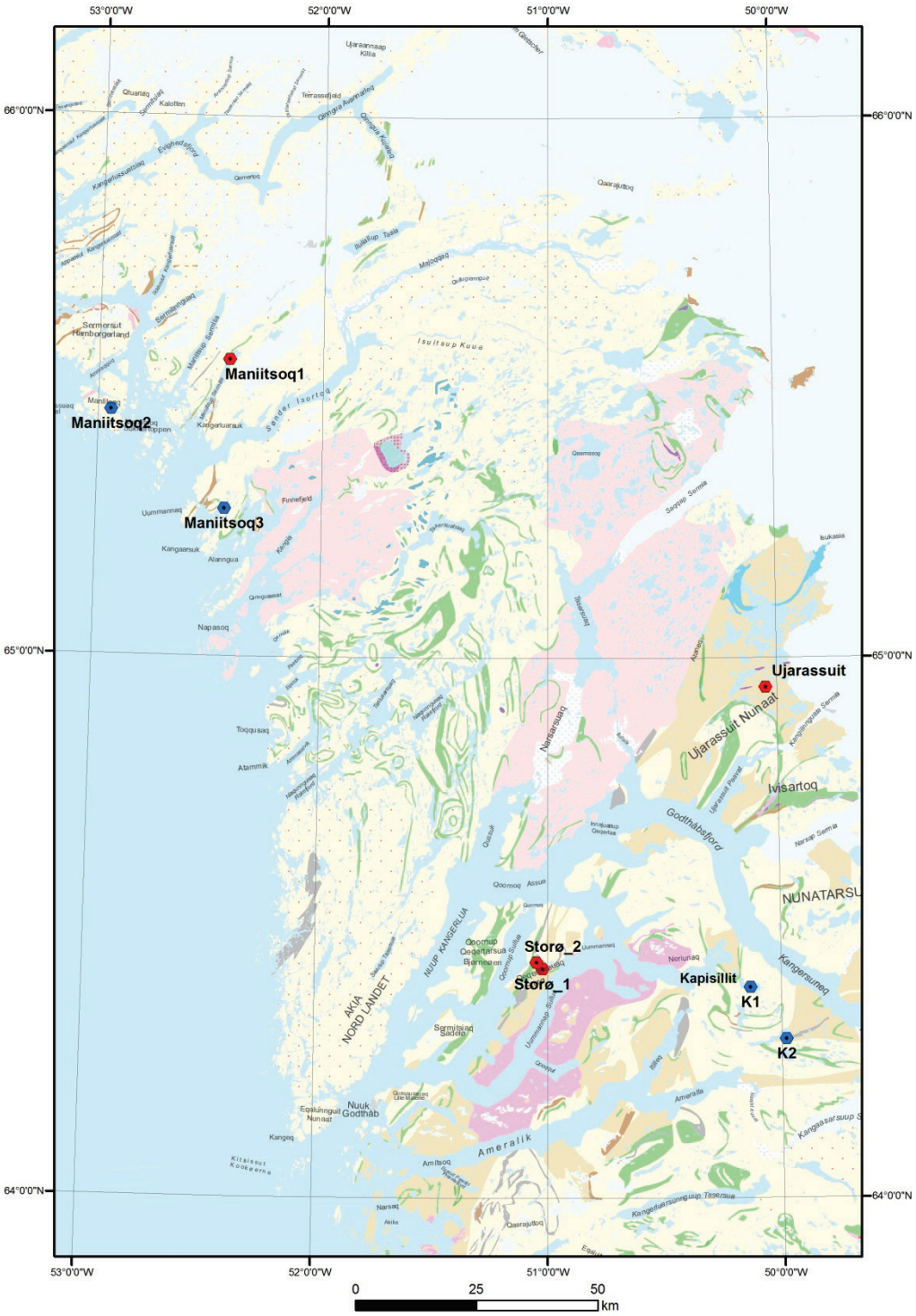
Scattered ruby/sapphirine localities north of Fiskenaesset have been found, some are closely associated with anorthosites others are not. A description and locations of those occurrences are included in this report because they can act as guides to discovery of further ruby/sapphirine occurrences north of the Fiskenaesset area, thus increasing the possibility of finding further ruby occurrences in West Greenland. The locations can be seen on the map below. Red dots indicate ruby corundum in the occurrences. Blue dots indicate sapphirine, but no ruby observed in the occurrences.

Nuuk region:

1. Kapisillit
2. Storø
3. Ujarassuit

Maniitsoq region:

1. Kangerdluarssuk (Maniitsoq 1)
2. Maniitsoq (Maniitsoq 2)
3. Tasiussaq (Maniitsoq 3)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52°0'0"W
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64°0'0"N
Maniitsoq1
Maniitsoq2
Maniitsoq3
Ujarassuit
Storø_2
Storø_1
Kapisillit
K1
K2
Ujarassuit Nunaat
Ivisartoq
Godthåbsfjord
NUNATARSU
Kangersuneq
Ameralik
Nuuk
Godthåb
AKIA
NORD LANDET
Isuitsup Kuua
Sermersut
Hamborgerland
Kangaarsuk
Napasoq
Atammik
Toqqusaq
Qoornoq Assua
Kangaasarsuup S
0
25
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km

**Description of the ruby/ sapphirine localities in the Nuuk region**

**Locality Number:** **1**

**Co-ordinates:** K1: -50,13 W 64,39 N (Exact position unknown)
K2: -49,98005964 W 64,29465337 N

**Name(s):** Kapisillit
Auvaitsersarfik
Avisisarfik
Avatsissarfik

**Discovered by:** Giesecke 1810

**Description:**

In 1810 Giesecke discovered sapphirine and corundum at a locality named Auvaitsersarfik some 10 km SE of Kapisillit (K1). Bøggild gave a brief description in 1953. Irregularly formed grains of faintly reddish corundum up to several cm in size occur in a mixture of gedrite, sapphirine, black spinel and mica (phlogopite). The sapphirine occurs as individual grains a few mm in length, but often also as rims around gedrite.

In 2006 bluish grey corundums were discovered as part of Ujarassiorit (local mineral hunting competition) 20 km SE of Kapisillit (K2). The corundums occur in 1 to 3 cm size well developed flat crystals associated with red garnet.

Recently occurrences of corundum in the innermost part of the Ameralik Fjord some 20 km SW of Kapisillit are reported by a local mineral hunter (Ilannguaq Olsen, personal communication).

A loose boulder of hornblendite with sapphirine and corundum found near Qorqut some 40 km SW of Kapisillit was described by Sørensen (1955). The mineral assemblage comprise hornblende, plagioclase, anthophyllite, green spinel, sapphirine, corundum, chlorite, muscovite and clinozoisite.

**References**.

Giesecke, K. L., 1910
Bøggild, O. B., 1953
Ramberg, H., 1948
Herd,R.K., Windley, B.F. & Ghisler, M., 1969

**Description of the ruby/ sapphirine localities in the Nuuk region**

| | |
|---|---|
| **Locality Number:** | 2 |
| **Co-ordinates:** | Area 1: -51,02058 W, 64,4257 N |
| | Area 2: -51,04711 W, 64,437499 N |
| **Name(s):** | Storø |
| **Discovered by:** | Jeroen van Gool ( Nunaminerals) 2004 |

**Description(s):**

Two locations in the Aappalaartoq area, Storø.

Area 1. Rubies occur in a mica schist within an ultramafic lens 10 by 35 m. The rubies with a size of 1 to 5 mm are mostly rimmed with sillimanite. The rubies are red with a strong violet tinge.

Area 2. Rubies also occur in biotite schists at a contact to an ultramafic rock. One of the ruby-bearing zones is about one metre wide and the other slightly less than 2 metres wide. The zones can possibly be traced for about 50 metres. Rubies make up around 20% of the rock. Many of the rubies are sub-to euhedral and many are up to 1 cm in diameter. The biggest ruby crystal found was 3.5 cm across and 7.5 cm long.

**Reference:** Jeroen van Gool: pers. com. 2014

Rubies up to one centimetre across in area 2

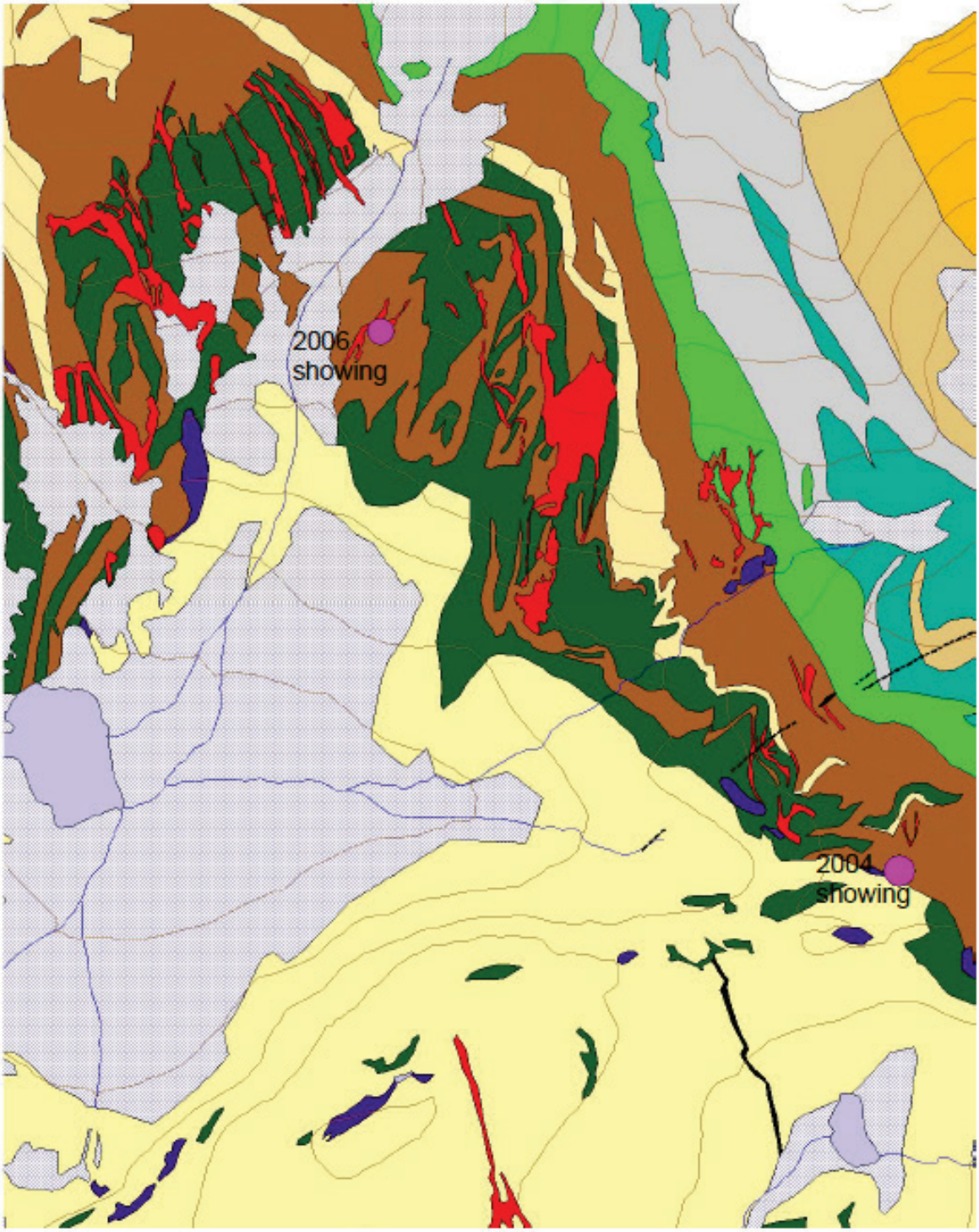



Fig 1. Geological map of the area southeast of Aappalaartoq with the two ruby showings marked with pink circles. Note that the ultramafic rock at the 2006 showing is not indicated in the map.

Mapped by van Gool

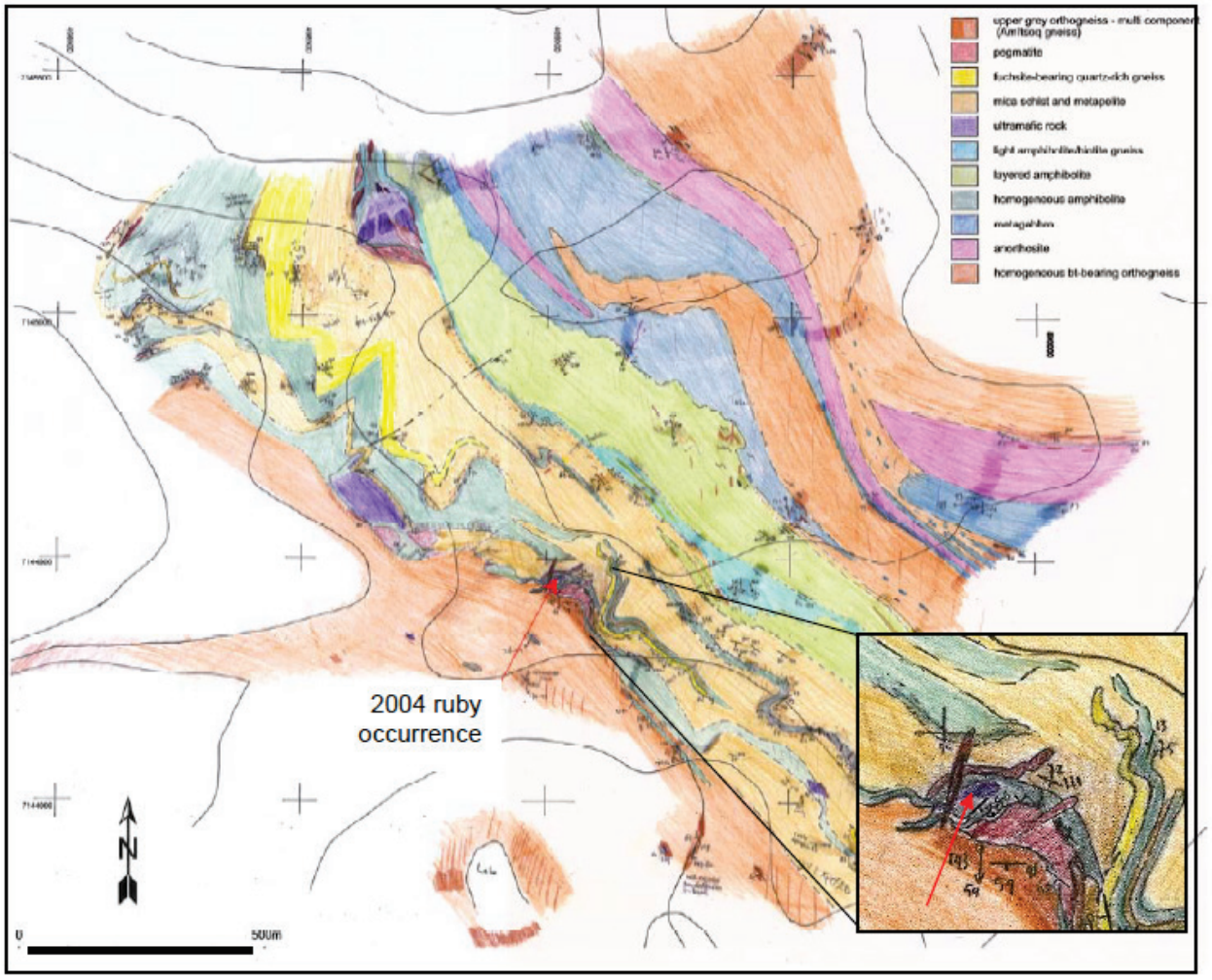



Fig 2. Detailed geological map of the area sout-east of Aappalaartoq, showing the location of the 2004 ruby occurrence. Map by van Gool 2004.


7.5 cm long ruby corundum crystal from the 2006 discovery

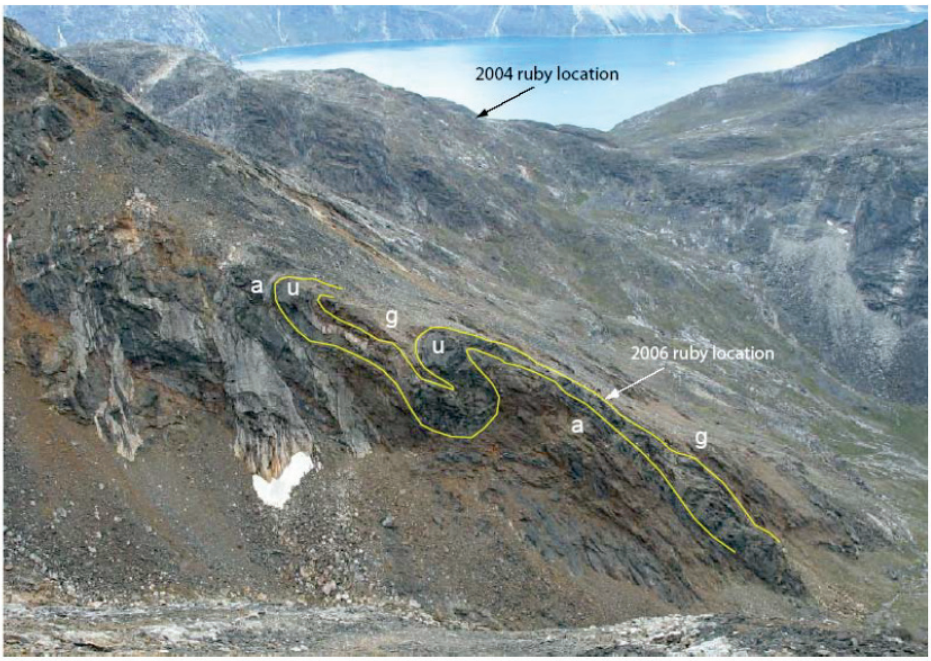



Fig. 4. Locality of 2006 ruby showing on the Aappalaartoq east ridge and the folded ultramafic body along which the rubies occur. a = amphibolite, g = garnet-sillimanite-biotite gneiss, u = ultramafic rock. In the background is also the 2004 locality. View towards the east.

**Description of ruby/sapphirine localities in the Nuuk region**

| | |
|---|---|
| **Locality Number:** | 3 |
| **Co-ordinates:** | -50,047216 W, 64,945831 N |
| **Name(s):** | Ujarassuit Nunaat |
| **Discovered by:** | Peter W. U. Appel (GEUS) 2000 |

**Description:** The rubies occur in a small ultramafic chromite-banded intrusion discovered by Chadwick in 1986. The dimension of the preserved parts of the intrusion is in the order of a few hundred metres long and around 50 m thick. The ultramafic body has a well preserved magmatic banding with chromite bands indicating facing directions. The lower part of the intrusion is dominated by dunites giving way up to harzburgites. At the top of the intrusion is an about one metre thick gabbro anorthosite with scattered deep red rubies up to a few centimetres in size. Adjoining minerals are feldspar and green hornblende

**References:**

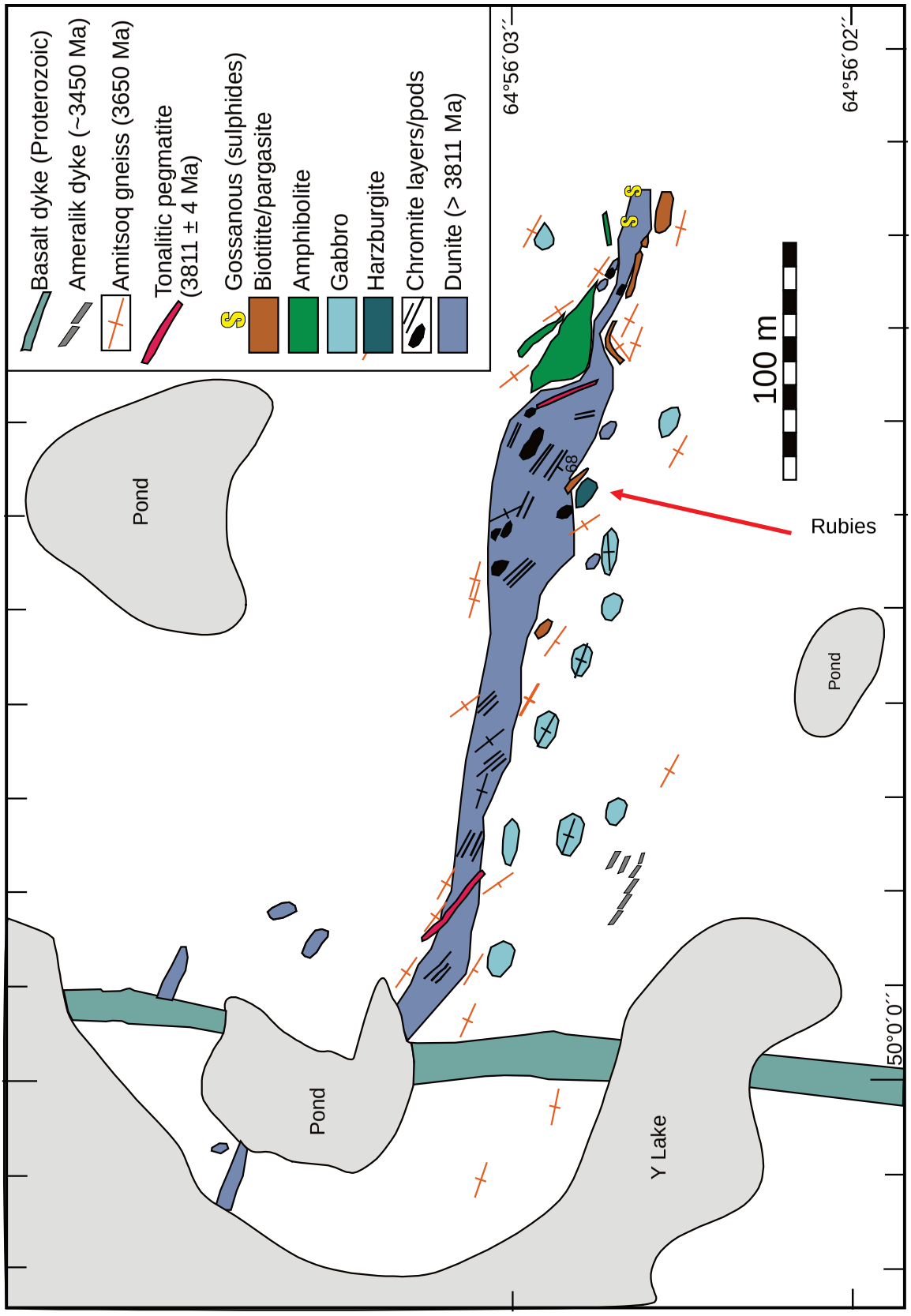
Appel, P. W. U. 2001 Field diary. GEUS archives.

Appel, C. C., Appel, P. W. U. and Rollinson, H. R. 2002: Complex chromite textures reveal the history of an early Archaean layered ultramafic body in West Greenland. Miner. Mag. 66, 1029.1041

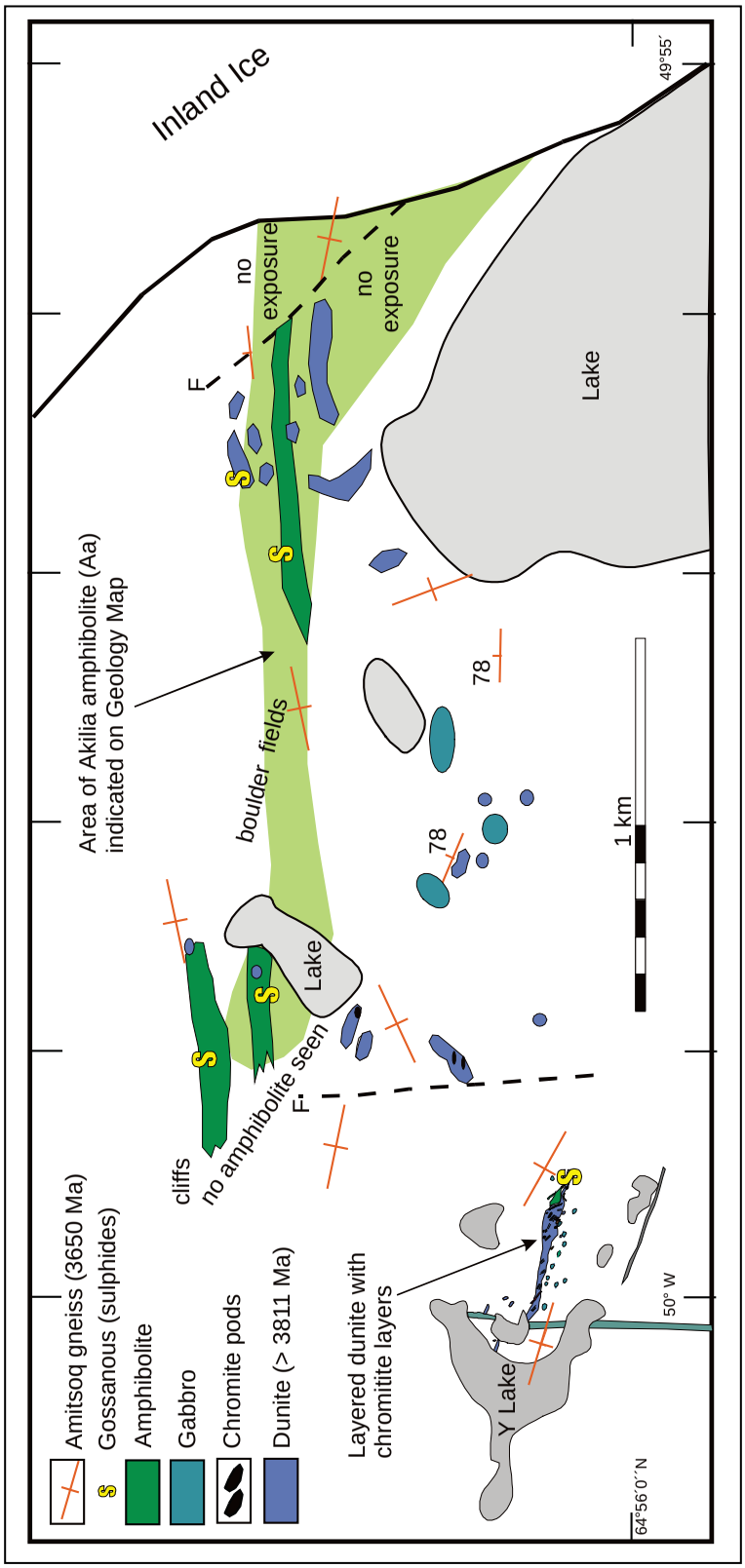
Chadwick, B. & Crewe, M. A. 1986: Chromite in the Early Archaean Akilia association (Ca. 3800 M. Y.) Ivisartoq region, inner Godthåbsfjord, Southern West Greenland. Econ. Geol. 81, 184.191.

Coggon, J. A., Luguet, A., Nowell, G. E. & Appel, P.W.U. 2013: Hadean mantle melting recorded in Southwest Greenland Chromite $^{186}$Os signatures. Nature Geoscience. Doi: 10. 1038/ngeo 1911 Willan, R. C. R. 2005. Field notes, 10 pp. GEUS archives.

Gabbro anorthosite with an abundance of rubies (Scale 10 cm)




Willan R. C. R. 2005




Willan R. C. R. 2005

**Description of the ruby/ sapphirine localities in the Maniitsoq region**

**Locality Number:** 1
**Co-ordinates:** -52,257249 W, 65,342327 N
**Name(s):** Kangerdluarssuk
**Discovered by:** Jan Allaart (GGU) 1983
**Description: by Karsten Secher, GEUS**

The locality is situated at the head of the fjord Kangerdluarssuk in altitude of 110–130 m a.s.l. The corundum occurrence is located in the basement gneisses along the margins of an ultrabasic lens within a sequence of supracrustal amphibolite and metasediments. The ultrabasic lens is elongated in the NE-SW strike with the size of app. 50 x 100 m.

The ultrabasic rock is an olivine rich peridotite (field description) which along the margins has reacted to form as corundum bearing biotite-kyanite-garnet schist. The corundum crystals are sub to euhedral, barrel shaped and often with both terminations developed and apparently following the strike in the foliation plane. The schist locally grades into a corundum schist, up to 1 m and extending up to 20 m along strike, where a majority of the potential gems material are found.

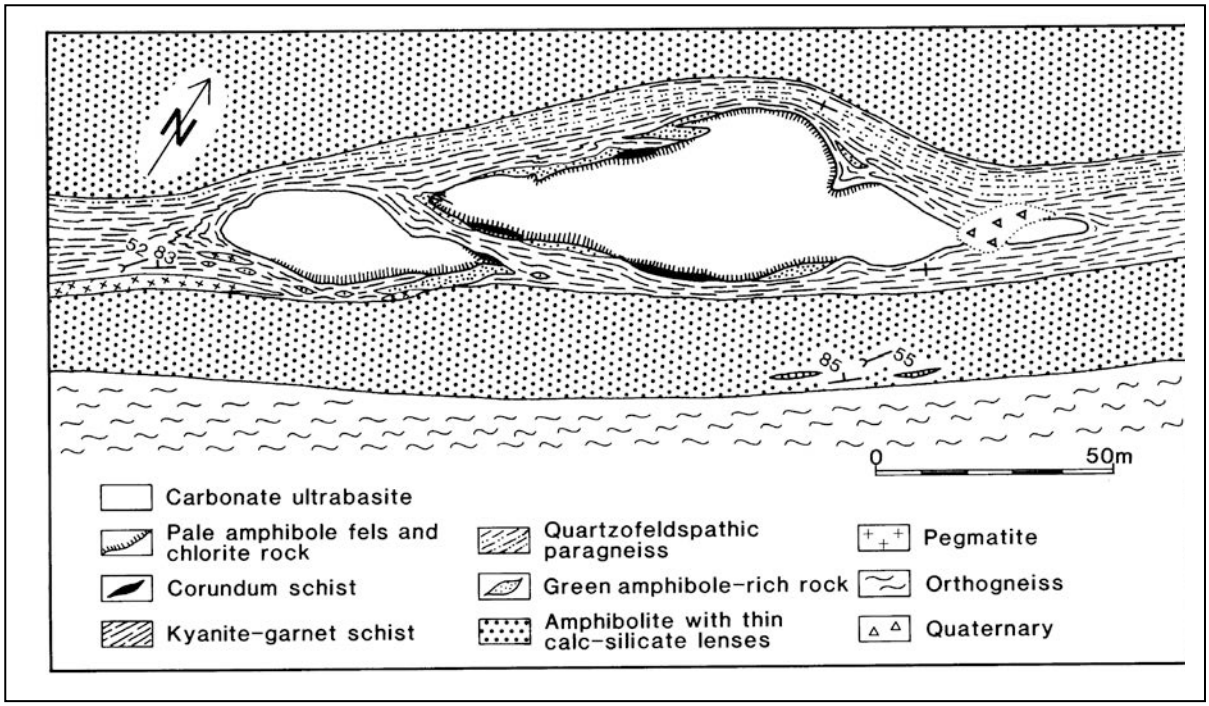
The corundum is generally characterised by its pink to ruby read colour, somehow variable from lens to lens and now and then developed with a bluish grey core, resulting in a concentric coloured crystal observed perpendicular to the c-axis. Smaller crystals are coloured red throughout. The size of the crystals is normally 2-5 cm but can reach 15 cm or more in length. One single crystal of 6 x 15 cm collected 1983 by the author has the weight of 1.085 kg and with light ruby red colour, is now on display at the Geological Museum in Copenhagen. The crystal surfaces are uneven from impressions of adjacent minerals (mica) and with only a weak adamantine luster.

The area has not been prospected for other ultramaficlenses as potential carriers of corundum. However, the regional mapping has only located the described lense and kyanite rich schists are reported from several localities along the fjord, and accordingly the potential of finding more corundum bearing lenses are obvious.

**References**.

Garde, A. & Marker, M. (1988): Corundum crystals with blue-read colour zoning near Kangerdluarssuk, Sukkertoppen district, West Greenland, Rapport GGU 140, 46-49.
Petersen, O.V. & Secher, K. (1985): Grönland, Mineralien, Geologie, Geschichte, Magma 6/84, 83 pp.

Petersen, O.V. & Secher, K. (1993): The minerals of Greenland, Mineralogical record 24/2, 1-65.




Garde & Marker (1988)

**Description of ruby/sapphirine localities in the Maniitsoq region**

**Locality Number:** 2

**Coordinates:** -52,94147553 65,45281772

**Name:** Maniitsoq

**Discovered by:** Hans Ramberg (GGU) 1946

**Description:**

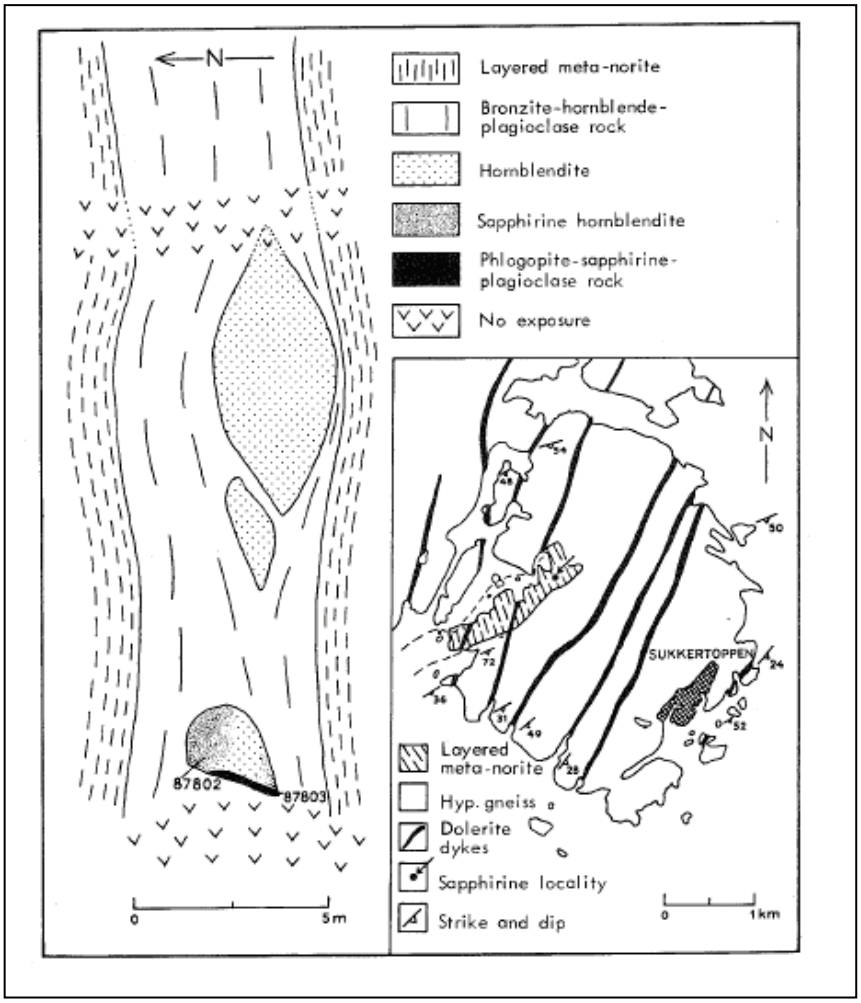
In the first summer expedition of the new-born GGU Arne Noe-Nyggard and Hans Ramberg in 1946 during a geological reconnaissance collected some samples in the vicinity of Maniitsoq (earlier Sukkertoppen), which back in Copenhagen appeared to contain sapphirine. In 1967 Richard Herd tried to find the locality mentioned by Ramberg to ly 3-4 km north of Maniitsoq, but without success. He found – however - a large body of meta-norite containing lenses up to 30 m across of hornblendite 2 km northwest of the settlement. He assumed it to be the same area from where Rambergs samples came.

The sapphirine-bearing rocks occur in a small hornblendite lens 2 m across (See below). According to Ramberg the mineral assemblages comprise “emerald” green hornblende, plagioclase, bronzite, dark green spinel, phlogopite, sapphirine and olivine in varying relative amounts. Herd reports the same minerals in his samples, which under the microscope in addition contained small amounts of corundum.

**References:**

Ramberg, H., (1948)

Herd,R.K., Windley,B.F & Ghisler,M., (1969)




Sketch map showing the main features and location of the Maniitsoq (Sukkertoppen) sapphirine occurrence (Herd et al., 1969).

**Description of ruby/sapphirine localities in the Maniitsoq region**

**Locality Number:** 3

**Coordinates** -52,42832144 65,27314485

**Name:** Tasiussaq

**Discovered by:** Henning Sørensen (GGU) 1949

**Description:**

This locality is situated in the innermost part of the bay Tasissuaq 28 km SE of Maniitsoq. The sapphirine occurrence was found and described by H. Sørensen in 1951 in an unpublished dissertation at the University of Copenhagen. Richard Herd revisited the locality in 1967, but no sapphirine was left of the little amount originally found. Herd made a sketch map of the area and indicated the probable location of the sapphirine-corundum bearing rocks (see below).

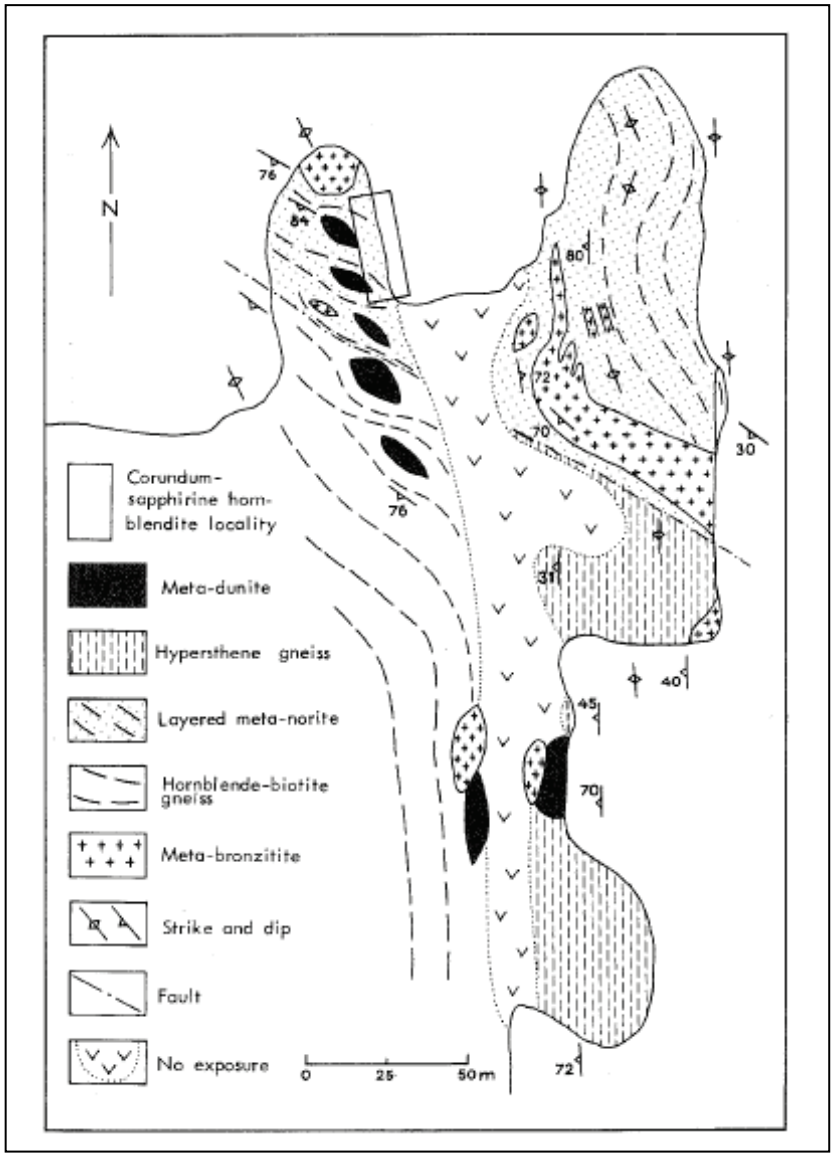
In a hornblende-biotite gneiss environment are found layers and lenses of meta-norite, bronzitite, dunite and peridotite up to 500 m across. Sapphirine occurs in green hornblendite in meta-norite. It forms small patches with plagioclase (anorthite), biotite, spinel and mostly colourless corundum. Up to 2 cm big grains of red corundum were, however, in a few cases observed embedded in a matrix of plagioclase and biotite. Sapphirine may occur along the margins of corundum.

**References:**

Sørensen, H., 1953

Sørensen, H., 1955

Herd, R.K., Windley, B.W. & Ghisler, M., 1969




Sketch map of the Tasiussaq area showing the probable location of the sapphirine - bearing rocks. (Herd et al.,1969).