Ruby occurrences in the Fiskenæsset area, West Greenland

Peter W. Uitterdijk Appel

Open File Series 95/11

December 1995

GRØNLANDS GEOLOGISKE UNDERSØGELSE
Ujarassiortut Kalaallit Nunaanni Misissuisoqarfiat
GEOLOGICAL SURVEY OF GREENLAND

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CONTENTS

ABSTRACT

In the Fiskenæsset area, 150 km south of Nuuk, West Greenland, there are numerous ruby showings. They are mostly situated at the contact between a large anorthosite complex and supracrustal rocks, mainly amphibolites, where the rubies were formed during high grade metamorphism. The rubies are up to twenty centimetres long, and they occur in a complex mineral assemblage comprising such minerals as pargasite, sapphirine, kornerupine, red spinel and phlogopite.

Several of the ruby-bearing zones have been prospected in detail and the major ruby occurrences have been bulk sampled. So far about 50 metric tonnes of ruby-bearing material have been collected and shipped to Canada.

Most of the rubies recovered are heavily fractured, but less fractured rubies also occur. Some of these have produced attractive cabochons. A few of them, cut and polished into faceted stones, have an attractive pidgeon blood red colour.

There seems to be little possibility of finding rubies in placers in the Fiskenæsset area.

INTRODUCTION

Rubies of widely different qualities are found in the Fiskenæsset area, south of Nuuk, West Greenland (Fig. 1). The pale red varieties probably should be called corundum, but for convenience all red corundums are described in this report as rubies. They are part of a complex mineral association with more than 50 minerals, including sapphirine, pargasite, kornerupine, phlogopite and red spinel. Sapphirine was discovered at the village of Fiskenæsset in 1809 by K. L. Giesecke, who travelled extensively along the coast of Greenland, carrying out geological investigations and collecting minerals. Giesecke started as an opera singer and librettist. He wrote the text to Mozart opera Figaros Wedding and after his adventures in Greenland ended up as a professor of geology at the University of Edinburgh.

The sapphirine found by Giesecke was later investigated by N. V. Ussing (Bøggild, 1953). Sapphirine and ruby-bearing rocks are found as lenses and discontinuous layers situated at the intrusive contact between the Fiskenæsset anorthosite complex and the supracrustal rocks.

The rubies are up to tens of centimetres long and they vary in colour from pale red to deep pidgeon blood red. However, many of the rubies are heavily fractured. The rubies have been prospected in detail and bulk sampled by the company Platinomino A/S in the 1970's and 1980's. In 1995 Valhalla Mining Ltd, Virgin Island showed interest in the ruby-bearing zones.

LOGISTIC SETTING

The area containing rubies is situated about 150 km south of Nuuk, the capital of Greenland. The only inhabited place in the area is the village Fiskenæsset with a population of about 300. Fiskenæsset with a few shops and a small fish factory, has very

little infrastructure

The outer coast is generally ice free throughout the year, but the fiords are covered with ice which makes sailing with small vessels difficult during the winter.

GEOLOGICAL SETTING

A recent description of the geology of the area and an up-to-date litterature list has been presented by Kalsbeek & Garde (1989). The following description is only a brief account and the reader is referred to that paper for details.

The dominant rocks in the area are the Mid-Archaean quartzo-feldspatic Nûk gneisses, which have been derived from tonalites, granites and granodiorites. The gneisses have been deformed several times and repeatedly metamorphosed under amphibolite to granulite facies conditions. In the gneisses are abundant supracrustal enclaves ranging from a few metres to many kilometres in length and up to hundreds of metres in width. The supracrustal rocks comprise basic pillow lavas, basic intrusive rocks, acid volcanics and metasediments. The supracrustal rocks outcrop over the entire region that covers well over 45 000 km^2.

The Fiskenæsset complex is a layered anorthosite which intruded into supracrustal rocks. It has been described in detail by Myers (1985) and the chromite bands occurring throughout the complex have been described by Ghisler (1976). The complex has a total strike length of more than 200 km and an estimated thickness of about 400 m. The intrusive suite comprises gabbros, ultramafic rocks, leucogabbros and anorthosites. The plagioclase in the anorthosites is a anorthite.

The chromite occurs in chromitite bands composed of varying amounts of chromite, hornblende and plagioclase. The chromitite bands, which can be traced intermittently for hundreds of metres, are up to 7 m thick. Massive chromitites contain up to 57% chromite. Chromite concentrates have 33% Cr_2O_3, 34% FeO and

21% Al_2O_3 with a Cr/Fe ratio of 0.85:1 (Appel, 1992).

Ruby and ruby-sapphirine rocks are intimately associated with the anorthosite complex (Herd *et al.*, 1969). They are mostly found at the border between the anorthosite complex and amphibolites, but also frequently associated with sillimanite schists, calc-silicates and impure marbles. The sapphirine and ruby-bearing rocks are suggested to represent metamorphic reaction zones between high alumina anorthosites and alumina-rich metasediments and amphibolites (Herd, 1973; Herd *et al.*, 1969).

MINERALOGY OF THE RUBY-BEARING ROCKS

Rubies are found in several mineral associations of which the most common are:

1. Pargasite type, e.g. at Siggartartulik
2. Gedrite type, e.g. at Lower Angnertussoq
3. Phlogopite type, e.g. at Rubin Ø
4. Hornblende type, e.g. at 'Beer Mt'

The following description is partly a summary of Herd *et al.* (1969) combined with field work carried out by the company Platinomino (Geisler, 1976, 1979, 1980, 1981, 1982, 1983).

1. Pargasite type. This type consists of pargasite, ruby, sapphirine, ± plagioclase, ± cordierite, ± spinel, ± phlogopite. The grass green pargasite is medium to coarse grained and it locally makes up well over 60% of the rock. Pargasite-rich layers are interbanded with plagioclase phlogopite ± ruby layers or cordierite phlogopite ± ruby layers. Ruby is found as dark red grains up to a few centimetres long most of which are strongly fractured. The rubies are often rimmed by narrow zones of spinel and sapphirine. Sapphirine is often found as blue grains up to centimetres long (Fig. 2) in patches together with phlogopite. The pargasite type is well developed at Siggartartulik (see below) (Fig. 1 and 3).

2. Gedrite type. This type consists of gedrite, ruby, sapphirine, phlogopite, ± cordierite, ± spinel, and is well developed at lower Angnertussoq (see below) and at Fiskenæsset (Fig. 1 and 5). Coarse gedrite prisms up to 2 cm long form aggregates in a matrix of sapphirine, phlogopite and ruby. The rock has a slight foliation formed by parallel orientation of aggregates of gedrite prisms. Rubies are red and generally medium grained and fractured. Kornerupine is found as greenish to brownish crystals.

3. Phlogopite type as seen on Rubin Ø (Fig. 1 and 7) is a well-foliated rock with phlogopite, ruby, sapphirine, ± plagioclase, ± cordierite, ± spinel. Crystals of kornerupine in prismatic aggregates up to 0.2 mm in diameter occur in cordierite veinlets. The rubies are mostly a few millimetres in size and they have a deep pidgeon blood red colour. Frequently the rubies are unfractured; they are embedded in phlogopite which must have shielded the rubies during deformation.

4. Hornblende type. This type is found on Beer Mt.(Fig. 1). The rubies are in a hornblende-rich layer within leucogabbros and anorthosites. They range in size up to 20 cm and in colour from deep red to pale red. The grains larger than a few millimetres are always heavily fractured. The rubies are often rimmed by plagioclase and are found together with plagioclase, hornblende and mica.

RUBY SHOWINGS

The following description is based on Platinomino A/S exploration (Geisler, 1976, 1979, 1980, 1981, 1982 and 1983).

The Siggartulik showing, is the largest ruby showing found so far in the Fiskenæsset area and it was investigated in considerable detail by Platinomino. The showing also had the

largest amount of ruby-bearing rock and rubies are not heavily fractured. Figure 3 shows the main part of the showing, as well as the location of the test pits from which several bulk samples were collected. The typical ruby-bearing rock at Siggartartulik is a massive, green pargasite rock with centimetre-size rubies and patches of bright blue sapphirine together with minor amounts of phlogopite and feldspar. Apart from the bulk sampling carried out by Platinomino, blasting has been carried out by local inhabitants. The patchy nature of the ruby-bearing zones is clearly demonstrated on Figure 3.

Upper Angnertussoq has been mapped and bulk sampled by Platinomino, and Fig. 4 shows the easternmost showing. This consists of several small irregular patches of ruby-bearing rock. A typical ruby-bearing rock of this occurrence is gedrite-sapphirine and ruby.

Lower Angnertussoq is a small showing (Fig. 5) with rubies in three assemblages dominated respectively by pargasite, gedrite and phlogopite (Herd et al., 1969).

The Walton showing occurs at an altitude of well over 1000 m and is located far from the coast (Fig. 6). The showing is characterised by unusually large green kornerupine crystals and tiny bright red spinels, in a matrix of gedrite and pargasite. Bulk sampling has been carried out in the area by Platinomino.

Rubin Ø is a very small island crossed by a belt of anorthosite, ultramafics and amphibolite (Fig. 7), it exposes a variety of ruby-bearing rocks. One of the most abundant types is a banded, somewhat schistose, rock with minute deep red rubies in a sapphirine, phlogopite matrix.

The Fiskenæsset ruby-bearing zone is a very small showing, but is of historic importance because it is the type locality for sapphirine. Rubies occur as small grains in a gedrite-dominated type as well as a phlogopite dominated type.

'Beer Mt.', situated close to the Inland Ice, is a ruby showing within the anorthosite complex. A gabbroic layer in anorthosite contains scattered rubies over a width of a few metres and a strike length of some tens of metres. The rubies are rimmed with plagioclase and mica in a hornblende matrix. The rubies are up to 20 cm long and a few centimetres across. No unfractured rubies have been found.

Outside the Fiskenæsset area few ruby occurrences have been found. In the Maniitsoq area, about 300 km north of Fiskenæsset, two ruby showings have been encountered in a mineral paragenesis resembling the types found in the Fiskenæsset area (Herd et al., 1969). Two smaller occurrences are also known in the Godthåbsfjord area, about 150 km north of Fiskenæsset (Herd et al., 1969), while ruby has been identified in a pargasite matrix in a boulder in the Isukasia area to the north at the edge of the Inland Ice between Nuuk and Maniitsoq.

EXPLORATION ACTIVITIES

The prospecting activities of Platinomino A/S are reported in a series of reports which can be ordered on microfiche or as photocopies from Copenhagen. Following the initial prospecting 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 1360 kg of loose ruby-bearing rock was collected at Siggartartulik. The ruby showings found by Platinomino are shown in Fig. 8.

In 1980 Platinomino A/S carried out detailed mapping and bulk sampling at several localities, such as the Walton showing, Upper Angnertussoq and the Siggartartulik area where 35 tonnes of material were collected.

In 1981 Platinomino A/S processed 1360 kg ruby-bearing material collected in 1979 in 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 gives the results.

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

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).

ECONOMIC POTENTIAL

Most of the rubies found in the Fiskenæsset area are strongly fractured, but occasionally weakly to unfractured stones are found. Unfortunately most of these are small.

A total close to 50 metric tonnes of ruby-bearing material has been collected by Platinomino A/S. The company processed several rubies and some of the better quality rubies were cut and polished. The following is taken from a company report (Geisler, 1983):

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 in weight were cut into four faceted 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 ruby-bearing material obtained from Platinomino A/S (Demina *et al.*, 1980). The sample consisted of two types of material with two types of mineral assemblages. A pargasite, feldspar, phlogopite ruby rock and a biotite, feldspar ruby rock. Different types of jaw-crushing, hydraulic crushing as well as chemical decomposition with hydrofluoric acid was tested. Crushed specimens were subjected to magnetic separation, tumbling and gravity separation. It was concluded that hydraulic crushing was a good first step. Chemical composition was found to be costly and could only be recommended for specimens with visible high quality rubies. Gravity separation of the crushed material is efficient but costly. Magnetic separation was only efficient in the fine grain size fraction.

Jensen (1980) also carried out investigations on the rubies from the Fiskenæsset area. The rubies were brought to Idar-Oberstein and shown to a couple of mineral dealers. One Idar-Oberstein company selected two and another company one stone for cutting and polishing cabochons. During cutting and polishing 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. Three small cabochons cut and polished in Idar-Oberstein are shown in Fig. 9, the cabochons weigh 0.5, 0.45 and 0.15 carat.

Rubies from the Siggartartulik showing are also described by Gübelin (1979) who depicts cabochons and faceted rubies in a photograph. The photograph has no scale but it reveals at least that the rubies possess an attractive deep red colour. Gübelin (1979) analysed the Cr content of the rubies and found light coloured varieties to have 0.27% and dark coloured 3% Cr. It is not stated in Gübelin article whether the analytical value is

Cr or Cr_2O_3. The density of the rubies has been measured to 4.05 g/cm^3. Gübelin (1979) states that the quality of the Greenlandic rubies is comparable with rubies from Thailand and Tanzania, but notes that most rubies have too much fracturing to produce cut and polished stones.

SUMMARY AND CONCLUSION

The ruby potential of the Fiskenæsset area has been investigated in some detail. Some of the zones between the anorthosite and supracrustal rocks have been prospected and detailed mapping and bulk sampling of several occurrences have been carried out. However, very little work has been done on the bulk samples. The work carried out so far indicates that most rubies are fractured but that some non- or weakly fractured rubies do occur, although admittedly most of them are quite small. Attractive cabochons have been prepared but so far only few faceted stones have been made.

One consideration is whether placer deposits with rubies could be found. However, it seems only remotely possible to find economic placers since little superficial material is preserved; any accumulations have been removed by glaciers during the last hundred thousand years or so.

A positive feature is that most of the ruby occurrences found so far are in close proximity to the sea and thus fairly easy accessible. It is possible that the ruby occurrences could be worked on a small-scale basis by the local population.

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LEGEND FOR DETAILED MAPS OF RUBY SHOWING

The maps and the legend are compiled from various Platinomino company reports listed in the references.

1	Amphibolite gneiss
2a	Pargasite
2b	Gedrite-sapphirine ± phlogopite
2c	Biotite-schist
2d	Phlogopite-schist
3	Anorthosite
3a	Anorthosite
3b	Chromitite
4	Feldspar pegmatite
4a	Feldspar pegmatite
4b	Biotite feldspar pegmatite
	White to pink corundum
	Ruby
G	Garnet
S	Spinel
C	Cordierite
K	Kornerupine
	Boundary of outcrop area
	Geological boundary; defined, approximate
	Strike and dip of schistosity
	Test pit

Fig. 1. Map of the Fiskenæsset area showing the anorthosite complex and the amphibolites. 3: Siggartartulik; 4: Upper Angnertussoq; 5: Lower Angnertussoq; 6: Walton showing; 7: Rubin Ø; 8: 'Beer Mt.'

Fig. 2. Ruby-pargasite rock. The blue mineral is sapphirine. This is a cut and polished specimen from Siggartartulik measuring about 18 cm by 32 cm.

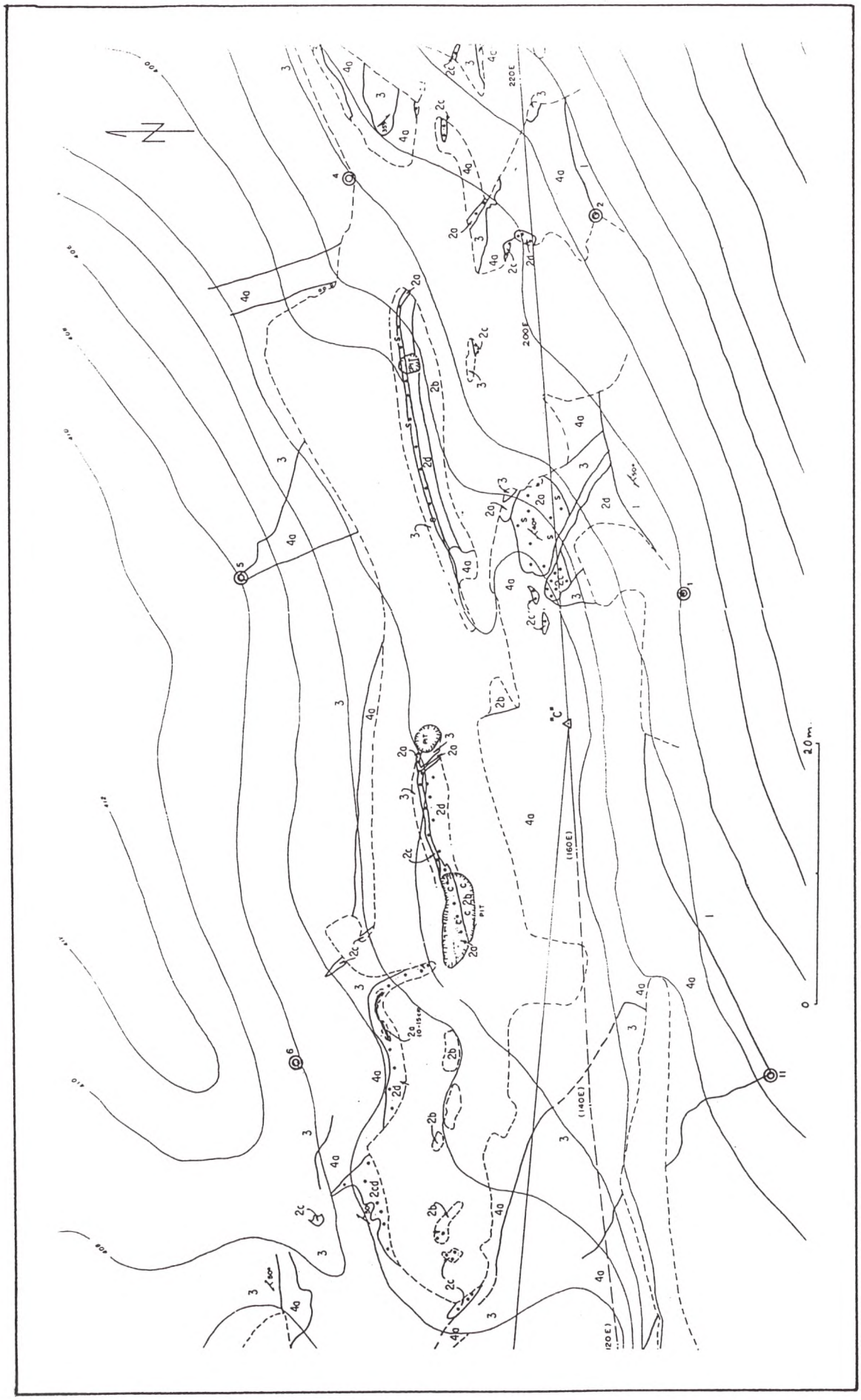

Fig. 3. Detailed map of the Siggartartulik ruby zone.

Fig. 4. Detailed map of the upper Angnertussoq ruby zone.

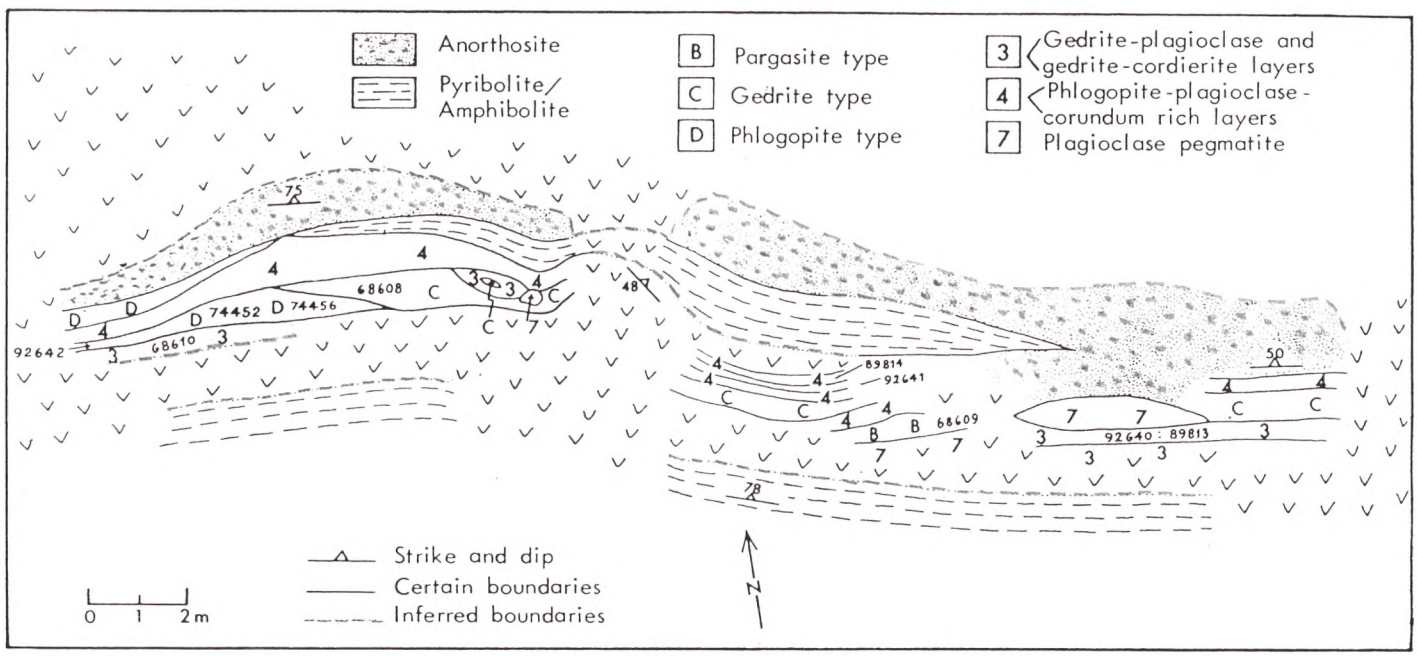

Fig. 5. Detailed map of the upper Angnertussoq ruby zone.

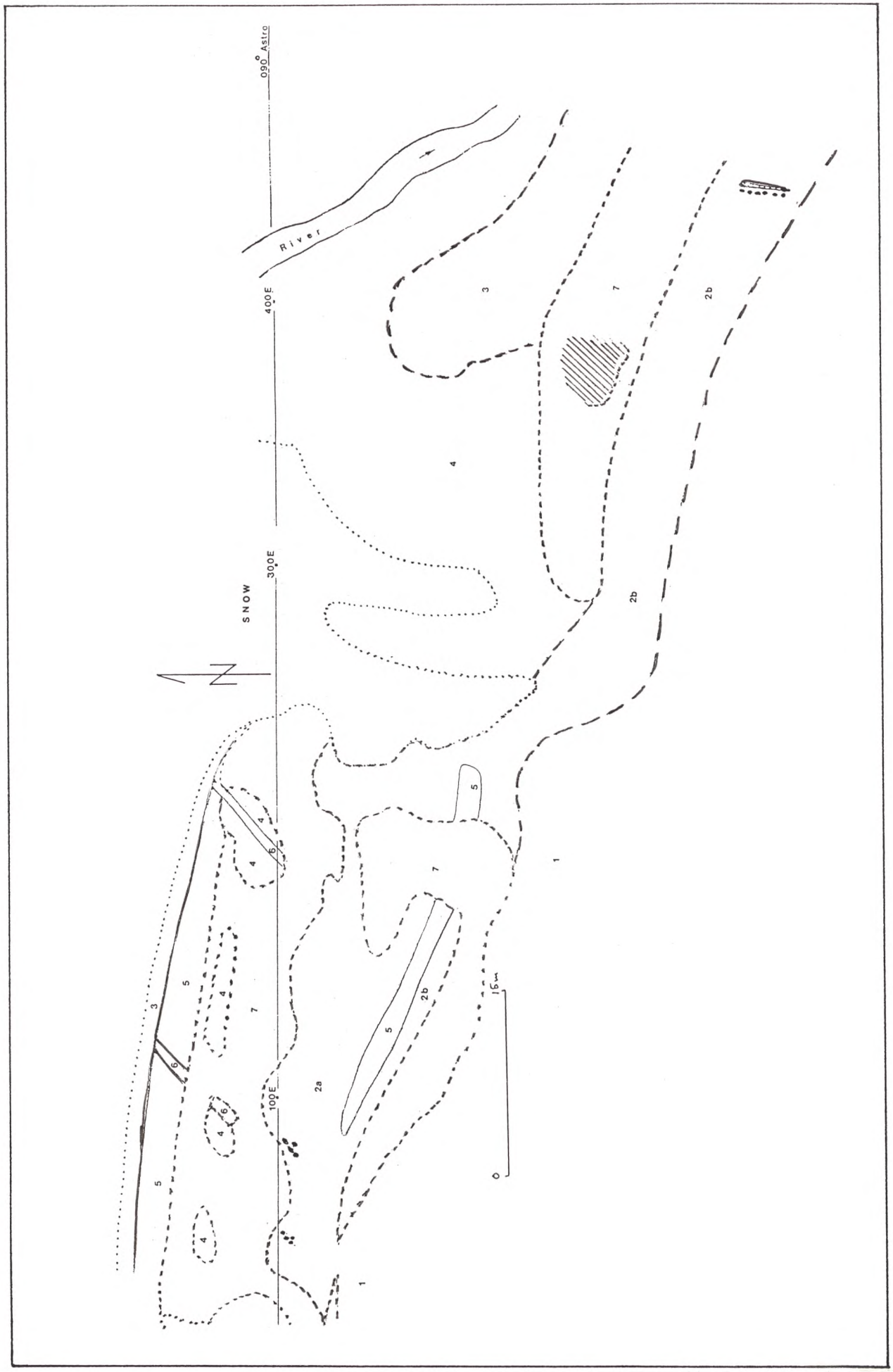

Fig. 6. Detailed map of the Walton ruby zone.

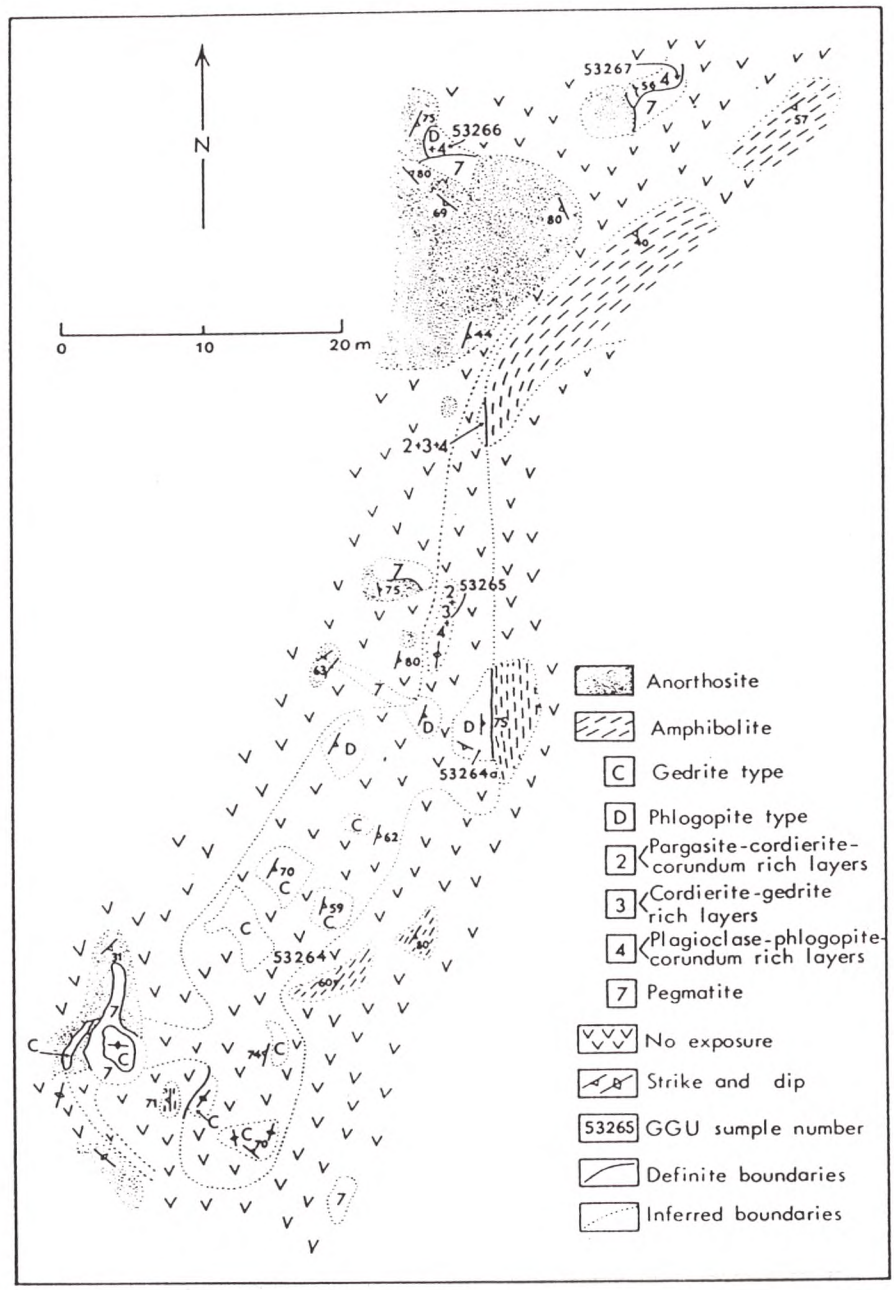

Fig. 7. Detailed map of the Rubin Ø ruby zone.

Thematic map 94/2-404

MINERAL OCCURRENCES: Ruby
Paamiut - Buksefjorden

Compiled by Peter W. Uitterdijk Appel

LEGEND

HOST ROCK
- Metamorphic
- Volcanic
- Igneous
- Sedimentary
- Unknown

GENETIC ENVIRONMENT
- Magmatic
- Volcanogenic
- Igneous
- Sedimentary
- Syngenetic
- Epigentic
- Hydrothermal
- Metamophic
- Unknown

MORPHOLOGY
- Stratiform
- Stratabound
- Lenticular
- Massive
- Disseminated
- Vein
- Pipe
- Stockwork
- Other

RESOURCE
- Fe, V, Ti, Mn, Cr
- PGE, Au
- Mo, W, Sn, Hg, Sb, Bi
- Pb, Zn, Ag
- Gemstone, indust. mineral
- Cu, Ni, Co
- U, Th, Zr Nb, REE

MINERALOGY
- Sulphide
- Native element
- Gemstone
- Silicate
- Other
- Oxide
- Sulphate
- Phosphate Carbonate Indust. min.

DATA SOURCE

The Greenland mineral occurrence database :(GREENMIN).

The data have been compiled from Survey reports, industry mineral assessment reports and published and unpublished research data.

All localities represent mineral occurrences observed on surface, in drill holes or mine workings.

SYMBOL SIZE

ECONOMIC IMPORTANCE
- Mine
- Prospect
- Showing

EXAMPLE

Pb 24/13

Disseminated lead sulphide(s) of hydrothermal origin hosted by volcanic rock(s). More detailed information available from the Greenland mineral occurrence database, occurrence ID: 24/13. Underlining indicates the presence of several occurrence IDs on the same site.

Projection: Lambert conformal conic
Standard parallel: 66° 30' 00" N
Scale factor: 0.99700
Ellipsoid: Clarke 1866
Datum: Qornoq
Scale: 1:1 000 000

Ice margins and coast lines digitized from 1:250 000 topographic maps.
Permission No: KMS A.200/87

Released: 01-DEC-94

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The Geological Survey of Greenland
Øster Voldgade 10 DK-1350 København K Danmark

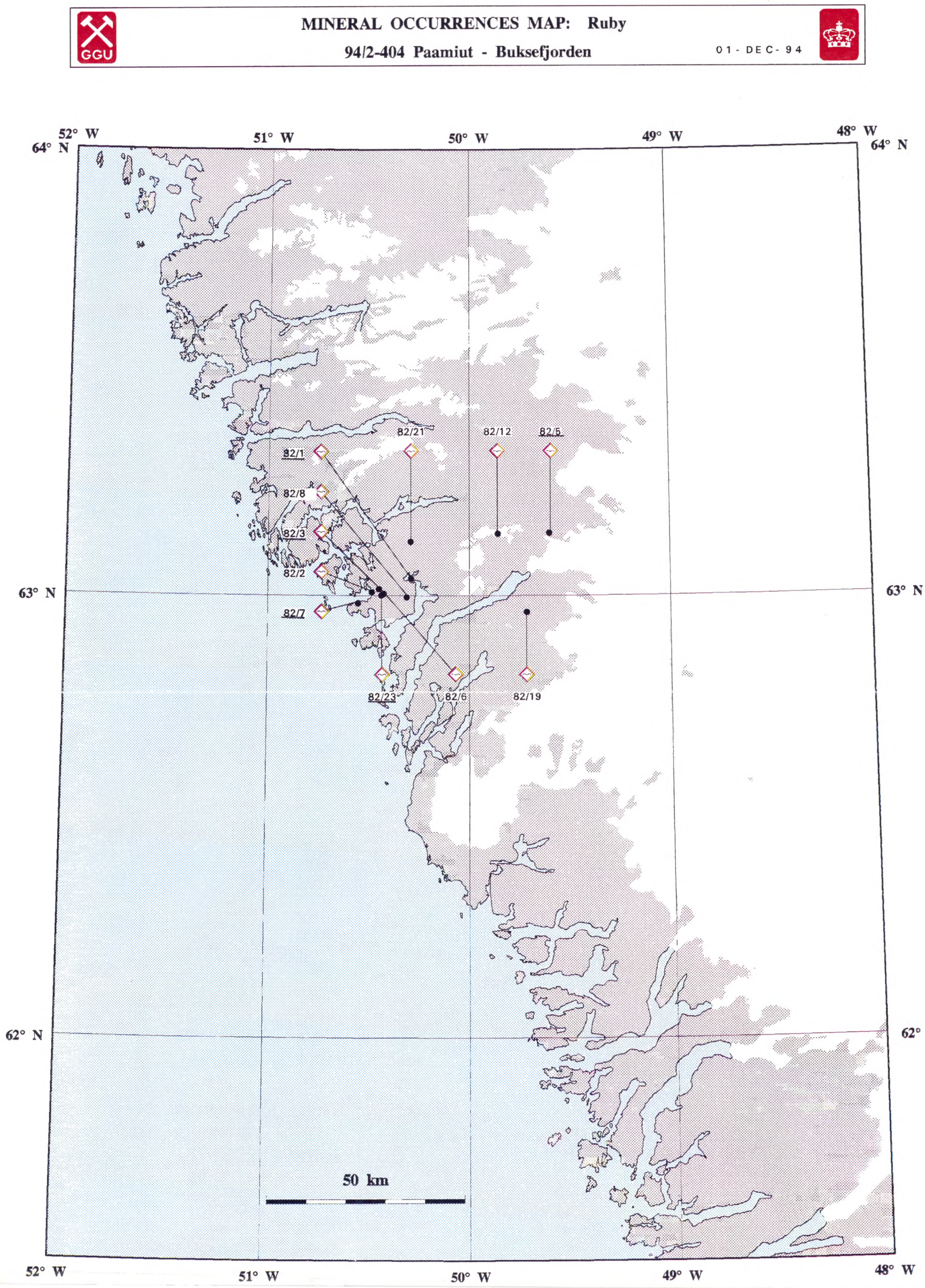

Fig. 8. Map of the Frederikshåb-Fiskenæsset area showing the distribution of ruby-bearing rocks.

Fig. 9. Ruby cabochons weighing 0.50 carat, 0.45 carat and 0.15 carat respectively.

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