THE PUKLEN INTRUSION, NUNARSSUIT, SW GREENLAND

A PRELIMINARY ACCOUNT OF A NEW GARDAR INTRUSION

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CONTENTS

Abstract.

The Puklen Intrusion is a small elongate complex situated in Nunarssuit, SW. Greenland. It was emplaced in Ketilidian basement, and cut off and hornfelsed Gardar dolerites. The four component members of the intrusion are augite syenite, quartz syenite, soda granite and granophyre, emplaced in that order. It seems that these components represent a differentiation sequence from augite syenite. This is of interest owing to the widespread occurrence of augite syenite (with fayalite) in the Gardar province of SW. Greenland.

I. INTRODUCTION

During the summers of 1957 and 1958 the author mapped the large island of Nunarssuit, SW. Greenland, on a scale of 1:20,000 for the Geological Survey of Greenland (Grønlands Geologiske Undersøgelse). In the second of these summers, while working mostly in the basement granite rocks of east Nunarssuit, he discovered a small intrusion, incorporating syenite and soda granite, of which no previous record existed[1]). This has been called the Puklen Intrusion, after the name given to a hill within it.

The geologist N.V. USSING visited the area in 1908 in the course of his travels in the Nunarssuit district. Although, as is clear from his diaries, Ussing climbed to the top of the highest point in this intrusion in order to take bearings on the Nunarssuit mountains for his topographic map, he did not realise that he had crossed from basement granite into a younger intrusion. His only geological observation from this traverse was that the summit of the hill was formed of »felsite«.

The only other geologist to have travelled extensively in this part of Greenland, prior to the recent activity by the Greenland Survey, was C. E. WEGMANN, However, there is no record of Wegmann having visited the Puklen area, nor does his map (WEGMANN, 1938) give any indication of an intrusion in this area.

The Puklen Intrusion is situated in the north-east part of Nunarssuit. The land here, unlike the outer coastal districts of Nunarssuit, is low-lying, and the highest point, not only in the intrusion but also in the area around, is the 160m. high hill Puklen. There being no Greenlandic names in the immediate vicinity, the author has given the name »Puklen« to this hump-shaped hill, which forms a landmark as one sails along Ikerasagssuaq between Bangs Havn and Takissut.

A large part of the Puklen intrusion lies under water. Most of the southern end is covered by a shallow inlet of the sea, and there are several lakes in the northern part. Over the rest the exposure is far from perfect, with boulders and vegetation, chiefly in the form of *Empe-*

[1]) It should be mentioned that, after a study of aerial photographs, A. BERTHELSEN in 1957 correctly predicted that an intrusive centre would be found around Puklen.

trum heath and fellfields, covering much of the ground, and lichen on outcrops obscures the nature of the rock.

The field work for this account was carried out in a little less than three days. In 1958 a day and a half was spent mapping the outer margin and contact features of the intrusion. The complex nature of the body was recognised then, and a few samples were collected. In 1959 the author returned to the complex, mapped the variations within it, and collected more specimens. While engaged in this work he was accompanied by E. SCHOU JENSEN and JENS APPEL, who acted as fields assistants in 1958 and '59 respectively .Thanks are due to these two for their cheerful companionship and help.

The author would like to thank the Board of GGU for permission to publish this report, and dr. phil. A. BERTHELSEN, who directed the field programme in this part of Greenland, for his encouragement and direction in the field. Facilities for laboratory work were provided by the Mineralogical Museum in Copenhagen.

II. REGIONAL SETTING

WEGMANN (1938) established the existence of two major periods in the geological history of SW. Greenland—the Ketilidian and Gardar periods. The basement rocks—schists, gneisses and granites—he defined as Ketilidian, while the flat-lying sandstones and lavas of the Igaliko district, together with the many dykes and intrusions which cut these and the basement he grouped as belonging to the Gardar period.

Recent work in SW. Greenland has made it clear that the post-Ketilidian, pre-Gardar history of the basement is more complex than WEGMANN had envisaged. Since the Ketilidian orogeny, two periods of intrusion of basic dykes, now amphibolites, were each followed by reactivation and recrystallisation of the granitic and gneissic basement.

In Nunarssuit the basement consists predominantely of granite, migmatite and agmatitic amphibolite which were formed during the Ketilidian cycle. These are cut by various pre-Gardar amphibolite dykes. The earliest Gardar rocks here are dolerite dykes which belong to the regional swarms found throughout SW. Greenland south of Frederikshaab. In Nunarssuit there are three generations of these dykes. The oldest run east-west or ESE.: these are cut by rather scarce NNE. dykes which are succeeded in turn by large numbers of northeasterly dolerites. There are also a few quartz porphyries and trachytes which are younger than the dolerites.

Subsequent to the dyking the very large and important Nunarssuit igneous complex was formed (see fig. 1). This complex comprises six

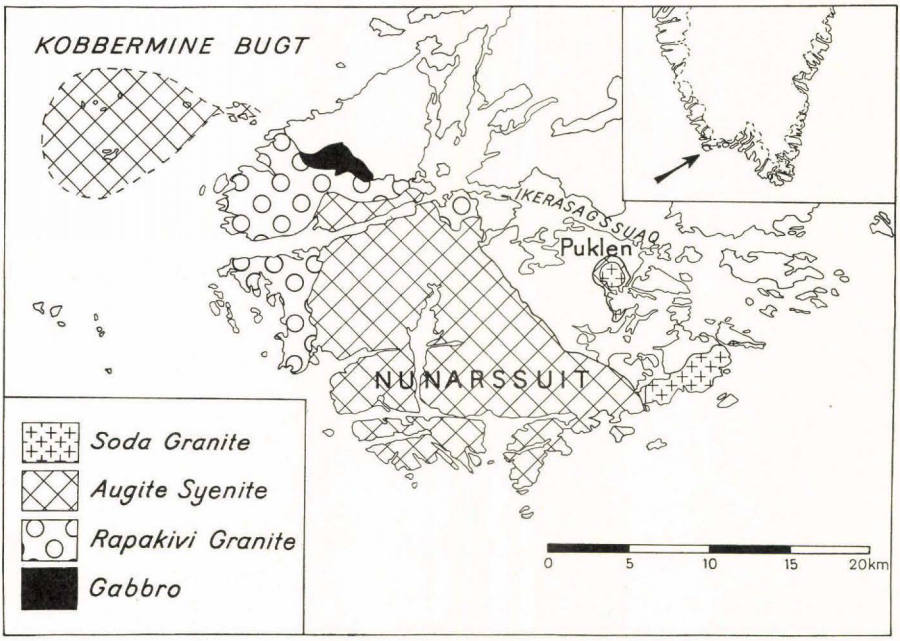

Fig. 1. Index map showing the position of the Puklen Intrusion in relation to the Nunarssuit complex.

major members.– a) gabbro, b) the Helene granite, a rapakivi-like granite carrying pyroxene, hornblende and occasionally a little fayalite, c) the Kitsigsut syenite, an augite-fayalite syenite usually without quartz, d) the Nunarssuit syenite, an augite-fayalite syenite with quartz, e) the biotite granite, f) the Malenefjeld granite, a soda granite containing Na-pyroxene, Na-amphibole and occasionally enigmatite. Although the Malenefjeld granite is not seen in contact with any other members of the main Nunarssuit intrusion, it is nevertheless regarded as a part of this complex

Throughout the coastal regions of SW. Greenland northwesterly (i. e., coast-parallel) dolerite dykes are found which cut all the Gardar rocks, including the Nunarssuit intrusion. These dykes are not displaced by any of the faults in the area. Since much of the faulting in SW. Greenland took place in the Gardar period, the late north-west dolerites are regarded as post-Gardar and possibly Tertiary in age.

The Puklen intrusion cuts off and has hornfelsed Gardar dolerites of the first and third generations. Its margin has been faulted. It is cut by the post-Gardar north-west dolerites. The intrusion is therefore of late Gardar age. Since the relations of the Puklen intrusion to the Gardar dolerites, faulting and post-Gardar dykes are the same as those of the big Nunarssuit complex, it is probable that these two intrusions are approximately contemporaneous.

III. EXTERNAL CONTACT RELATIONS

The Puklen complex is a comparatively small mass, being only four kilometres long by two kilometres wide; it is elongated in a north-south direction. Its consits of augite syenite, quartz syenite, soda granite and granophyre. The soda granite is entirely enclosed in a ring of quartz syenite, and thus never comes in contact with the country rocks.

At the southern end of the intrusion granophyre is in sharp contact with basement granite and Gardar dolerites. Locally this contact dips outwards, and there are a few veins and apophyses of granophyre which have been fed off the main mass.

South and south-west of the anchorage (see map, fig. 2) the augite syenite has a sharp contact against Ketilidian granite and the various amphibolitic enclaves within it. This contact dips outwards at angles as low as 40°. In one place it is displaced 200 m. on an ESE. sinistral fault. The syenite is finer at its margin than in the centre. Along the actual line of contact pyroxene (neutral with grass green borders), ore and zircon are concentrated in a thin zone about $^1/_2$ cm. across. In this the intercrystal borders are distinctly granulated. Where a dolerite dyke has been cut off by the syenite it has been hornfelsed. This has resulted in slight recrystallisation and the development of a little biotite in the dolerite; in hand specimen the hornfelsed rock is tougher and denser than normal.

Over the remainder of the exposed margin of the Puklen intrusion quartz syenite is in contact with the country rocks. This contact is comparatively easy to map on account of the contrast in outcrop form between the quartz syenite and the basement granite. The quartz syenite forms very smooth rounded outcrops, while the basement exposures are far more uneven and craggy. When investigated in detail, however, the contact is difficult or impossible to see over much of its course, especially in the north-west part of the intrusion. This is because the quartz syenite has strongly heated and even somewhat mobilised the country granite; the heated granite is not unlike marginal syenite in the field, and where it has been mobilised a slight mixing of syenite and granite is to be expected. Evidence for this is best sought along the north-easterly Gardar dolerite dyke which is cut by quartz syenite about a kilometre west of Puklen. As one approaches the syenite from south-west along this dyke, one passes from normal dolerite with a fine grained sharp contact against country granite, into hornfelsed dolerite. This is tough and compact, and is a distinct red-brown or sometimes pinkish-grey colour on the weathered surface. In thin slice the rock can be seen to have been completely recrystallised; the plagioclase grains have interlobate outlines and augite forms small round grains or larger crystals with sutured margins; biotite has also been developed. Near the syenite the

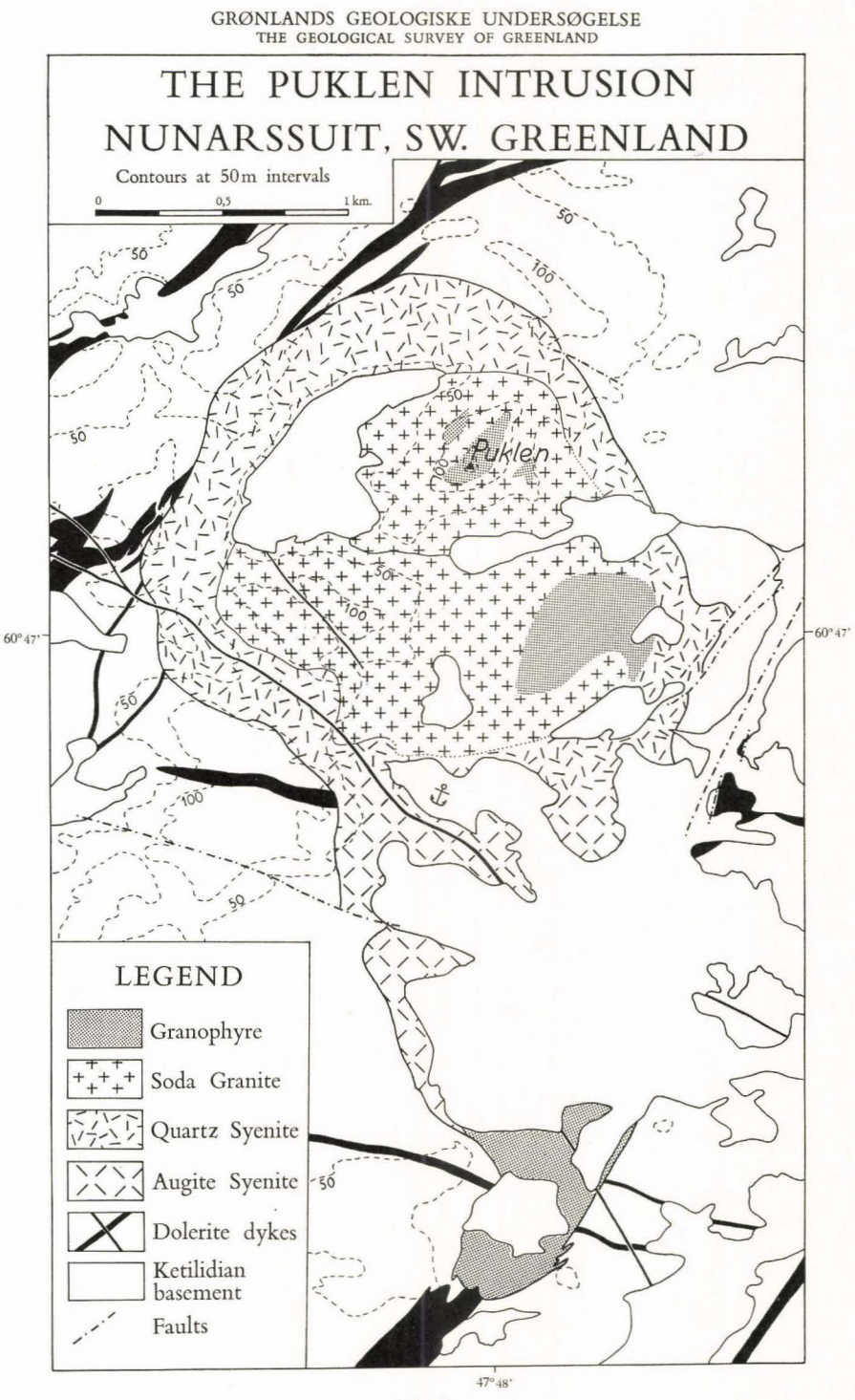
GRØNLANDS GEOLOGISKE UNDERSØGELSE
THE GEOLOGICAL SURVEY OF GREENLAND
THE PUKLEN INTRUSION
NUNARSSUIT, SW. GREENLAND
Contours at 50m intervals
0
0,5
1 km.
Puklen
60°47'
47°48'
LEGEND
Granophyre
Soda Granite
Quartz Syenite
Augite Syenite
Dolerite dykes
Ketilidian basement
Faults

Fig. 2.

hornfelsed dolerite forms large isolated lenticular bodies in the granite, as far as can be seen in the poorly exposed ground. Although some of the north-east dykes are rather irregular, no others have been seen which break up into lenses in this manner, and the behaviour of this dyke is regarded as the result of disruption of the dolerite in granite which has been rendered plastic by the quartz syenite.

It is in the north-east continuation of this dyke that unequivocal evidence for activation of the country granite can be found. Near the syenite contact the dyke, which has a hornfelsed appearance, is veined by thin quartzo-felspathic veins and stringers which are fed from the country granite. However, the dyke-like form of the body has been preserved, and these hornfelsed and veined rocks may be traced north-east away from the syenite contact into a normal unmetamorphosed Gardar dolerite with chilled margins against granite. The presence of quartzo-felspathic veins in the Gardar dyke in the proximity of the syenite can only be attributed to the action of the syenite on the granite, Some of the quartzo-felspathic material of the granite was mobilised by the heat from the syenite, and was able to migrate and vein the dolerite dykes.

It is interesting to note that whereas the augite syenite has a sharp contact against the basement granite, the quartz syenite, which might be expected to have formed from a lower temperature magma, has had a stronger effect on the rocks. Presumably a heat supply to the quartz syenite magma was maintained for a sufficiently long period to allow the host rocks to become very hot.

Viewed as a whole, the northern margin of the Puklen intrusion is roughly circular in form. The only deviation from this is in the east near the NNE. sea channel. In this part the contact has been influenced by NNE. faults. One such fault (or crush belt) runs along the channel. The rocks on either side are shattered and crushed, and the dolerite in the island on the east side has been displaced and sheared by faults. Two smaller parallel dextral faults west of this displace the syenite contact slightly. The country rocks in this area are veined by many fine quartz syenite dykes and sheets. These are often xenolithic, and the xenoliths may not be of the same rock as the walls; for example, a fine quartz syenite vein in dolerite contains granite inclusions, and visa versa. The quartz syenite veins have not been sheared to the same extent as the country rocks. This, together with the fact that only here does the syenite send out veins into the country rock, indicates that the faults existed prior to the emplacement of the intrusion. Naturally the syenite only fed a complex network of veins, sheets and dykes into the country rocks where these had previously been brecciated and shattered. Slight rejuvenation of two of the faults resulted in displacement of the syenite contact. It should be noted that here the quartz syenite has a sharp contact against the older rocks.

IV. THE COMPONENTS OF THE INTRUSION AND THEIR RELATIONS

The Puklen Intrusion has four components–augite syenite, quartz syenite, soda granite and granophyre, emplaced in that order. Within each of these there is considerable variation, and a variant of one member may be almost indistinguishable from a variant of another. Nevertheless it was possible to distinguish four different components in the field and map their distribution. The same four components were separated after a microscopic examination of the thin slices.

The fact that the augite syenite, quartz syenite and soda granite each has a characteristic outcrop form and colour enabled the author to appreciate the varied and composite nature of the intrusion within a few hours of arriving in the locality, and furthermore greatly facilitated the mapping, especially as sharp contacts between different members are lacking over much of the complex. The granophyre, which gives rise to the same sort of outcrop as the soda granite, could be distinguished in the field by its finer grain size.

a) The augite syenite. –This syenite is found in the southern part of the complex. Its outcrop is rather limited as much is covered by an inlet of the sea. The total area occupied by augite syenite (including that under water) is probably about two square kilometres.

The augite syenite forms fairly bold smooth outcrops which weather to a brown, red brown or yellowish brown colour. The rock is typically moderately coarse, but it is somewhat inhomogeneous with regard to grain size and texture though not to composition. Within the normal coarse rock there are patches of very much coarser almost pegmatitic syenite in which the felspars exceed 2 cms. across. At the centre of some of the pegmatitic knots there are small cavities. In places the syenite may be finer, and porphyritic texture, with plagioclase phenocrysts up to a centimetre long, is developed locally, especially around the anchorage. Here also the syenite has been quite intensively veined by sheets of fine grained granite. The sheets may enclose blocks of augite syenite, and in one instance a xenolith of the basement granite was seen in a granite vein.

In thin section the augite syenite is seen to be composed of potash felspar (80–85 %), plagioclase (2–4 %), augite (6–8 %), hornblende (3–7 %) and fayalite (1–3 %): the percentages are based on modal analyses. The usual accessories are ore, apatite and biotite. A little zircon has been found in one slide, together with a deep red pleochroic mineral which is suspected to be enigmatite. Very scanty quartz was seen in another rock. The over-all texture is hypidimorphic-xenomorphic gra-

nular. Augite, fayalite and potash felspar were the first minerals to crystallise: hornblende and replacive plagioclase formed later.

The potash felspar is for the most part perthitic, the perthite being of the vein or vermiform type. The perthitic textures may be seen as easily under ordinary light as with crossed nicols, because the K felspar is slightly cloudy while the exsolved albitic plagioclase is clear. Albite has replaced the K felspar on its borders and in patches in some of the specimens. Plagioclase cores to K felspar grains have occasionally been observed. The 2–4% plagioclase referred to in the previous paragraph is original albite-oligoclase.

Pyroxene forms subhedral grains up to 2mm. across. These are pale pinkish brown in the centre but have green and sometimes weakly pleochroic borders which may partially or completely surround the grain. 2 V determinations gave 55° for the centres and 61° for the green margins. The hornblende occurs independently or is built onto pyroxene. Its pleochroism is X: light brown, Y: greenish brown, Z: dark olive or bluish green. Few fresh fayalite crystals were seen, as in most cases this mineral has altered to reddish iddingsite and iron ore. V was determined on a few grains as 24°, indicating a fayalitic composition. The little biotite present occurs associated with the other coloured minerals; it may be red brown or greenish brown in the maximum absorption position.

All the specimens of the augite syenite collected from the northern part of its outcrop, in the neighbourhood of the anchorage inlet, show some effect of reworking or contact alteration by the later members of the complex. In one slice the augite has partially recrystallised and formed symplectic grains. The hornblende has altered in a more notable way, and has a fine mottled appearance due its being peppered with very small grains of ore and altering in patches to green pyroxene. Fine granular green pyroxene has also developed on the margins of hornblendes. These alterations were clearly accompanied by an exchange reaction with the adjacent K felspar grains. These are normally dusty but have water-clear borders against the mottled hornblendes.

The only porphyritic syenite sliced shows more marked contact alteration. The phenocrysts are of untwinned albite oligoclase with slight development of vein antiperthite. There are also a few augite and fayalite crystals which are larger than the average grains of the matrix. The matrix comprises the same minerals as the normal augite syenite, but the texture is secondary. The potash felspar, together with a little plagioclase, forms completely anhedral interlocking grains .4–.6 mm. across. Pyroxene occurs as very small and abundant blebs or »droplets« which are scattered freely through the felspars. The plagioclase phenocrysts seem to have a sharp outline against the matrix, but on closer examination it is evident that the phenocryst is in optic continuity with

some of the adjoining »matrix« felspar. The former outline of the phenocryst is marked by the line where the small augite inclusions cease abruptly. The phenocryst has grown into the matrix during the hornfelsing.

b) The quartz syenite. –No contact was seen between this and the augite syenite. Although the difference between the two rocks types is not great, it is sufficient to distinguish them in the field and their distribution can therefore be mapped. Since the outcrop of the quartz syenite cross-cuts that of the augite syenite, it is taken to be the younger rock: however, as there are no contacts between the two the age difference is probably small.

The outcrop of the quartz syenite forms a virtually complete ring around the granitic rocks in the northern part of the Puklen intrusion. Over most of the ring, from the anchorage around the north-west part of the complex to the north shore of the long lake south-east of Puklen, the rock is very homogeneous. This homogeneous quartz syenite weathers to very smooth rounded outcrops of brownish colour and disintegrates into a brown gravel. Similar smooth exfoliation domes are typical of much of the Nunarssuit syenite terrain. In the east, north-east of the anchorage, the character of the rock changes somewhat and the outcrops are bolder, less rounded and reddish or pinkish in colour.

The typical homogeneous quartz syenite of the ring is a medium-coarse rock, the real colour of which was never seen on account of the depth of weathering; the freshest specimens obtained are light brown. Quartz is easily visible to the naked eye as it forms fairly large grains, 2–3mm. across, which are scattered rather sparsely through the rock.

In the east, where the quartz syenite is less homogeneous, it is characterised by abundant coarse patches and pegmatitic knots, especially near the contact. At the centre of such a knot, which may be up to 50 cms. wide, there is usually a cavity lined by a few large quartz crystals. The felspar and ferromagnesian grains around the centre are up to 3 cms. across, but the grain size diminishes gradually towards the outer part of these coarse patches into the normal medium-coarse rock.

In one place on the shore near the north-east sea channel, a streaky banding is developed in the quartz syenite near its outer contact and running parallel to it. This is due to the concentration of augite (and to some extent ore) in wisps and lenses up to a metre long. It is evident that these minerals are the primary precipitates.

The constituent minerals of the quartz syenite are the same as those in the augite syenite, but their proportions and properties are somewhat different. Quartz is always present, but its percentage is difficult to ascertain from thin slices on account of the scattered distribution of much of it in large grains: the remainder is interstitial. The former pre-

sence of olivine can be inferred from the aggregates of ore, iddingsite and sometimes blue sodic amphibole (?riebeckite) seen in some specimens. The pyroxene and amphibole of the quartz syenite seem a little more sodic than those of the augite syenite. The green rims to the pale brown augite grains are quite often pleochroic, and whole crystals of pleochroic grass green pyroxene (aegirine augite) characterise some slices. The amphibole shows a bluer colour parallel to its cleavage, especially on the margins. Furthermore really blue amphibole in very small acicular crystals is found in sheaves sprouting off the sodic hornblendes or isolated in the felspar.

Ore, biotite, apatite and zircon have been found as accessories. The biotite varies a little in colour and habit, occurring as red brown or brownish green flakes or in aggregates.

The less homogeneous quartz syenite with pegmatitic knots is clearly more sodic. Albite is quite plentiful, both as original grains and replacive in the potash felspar. The amphibole is pleochroic from brownish green to grey blue and deep blue green, and the pyroxene from yellowish green to strong grass green. In addition to the normal accessories, the rock contains minute fungus-like radial aggregates of a light brown mineral with fairly strong birefringence and straight extinction; this is believed to be elpidite with associated epididymite. In every respect this rock is very similiar to a very local late phase of the Nunarssuit syenite found in the extreme south-east of the island.

c) The soda granite. –A round boss of soda granite, 1.6 km. in diameter, is completely enclosed in quartz syenite in the northern part of the intrusion. Fine granite veins in the augite syenite around the anchorage show that the granite is younger than the augite syenite, and the position of the soda granite within the quartz syenite indicates that it is also younger than this.

The soda granite–quartz syenite contact is readily mappable in the north-west (see map, fig. 2), chiefly because the two rocks give rise to very different terraines. The soda granite country is rather rough and boulder-strewn, and the outcrops are broken and somewhat angular, while the quartz syenite forms rounded brown outcrops disintegrating to gravel. A sharp contact between the two rock types has been seen north-west of the anchorage and again north-east of Puklen. There is nothing notable about this contact: neither rock develops a marginal facies against the other. North-west of the anchorage it dips outwards at a fairly low angle locally, but north-east of Puklen it is vertical.

In the east, north-east of the anchorage, there is a considerable convergence in the appearance, texture and composition of the soda granite and the quartz syenite. No contact could be mapped here, and

indeed none exists. The relations of the two are further confused by the later granophyre, which itself approaches the soda granite in appearance here. Two factors probably have contributed to this convergence: i) original variation in the quartz syenite, which was more granitic in the east than in the west and north-west, ii) the condition of the quartz syenite at the time of emplacement of the granite; it may have been plastic or mobile in the east but completely solidified in the north-west.

The typical soda granite is a medium or medium-coarse rock consisting of felspar (62–63 %), quartz (32 %), aegirine (3–5 %), and sodic amphibole (1–2.5 %). Zircon, biotite, apatite and ore have been found in minute quantities as accessories. The main minerals seem to have formed at more or less the same time: there is no obvious sequence of crystallisation to be read from the textures. The potash felspar is microperthitic, the perthitic textures being of a fine vermiform type. Late albite has replaced potash felspar, in some grains almost completely, and there are sometimes indications that there are two generations of deuteric albite. The quartz is anhedral, but much of it forms roughly equidimensional grains. The pyroxene is taken to be aegirine on account of its green colour, pleochroism (yellowish or brownish green to almost emerald green), high relief and very high birefringence. The pleochroism of the sodic amphibole is from yellowish or brownish grey to blue grey and deep indigo. These latter two minerals are usually closely associated and may be intergrown, but there is no consistent pattern of intergrowth indicating that one is earlier or later than the other.

d) The granophyre. –Small areas of granophyre occur in the Puklen intrusion around the summit of Puklen, north-east of the anchorage and in the extreme south of the complex. In addition to these areas there are many veins of granophyre cutting the soda granite which are too small to represent on the map. For the most part the granophyre is a fine grained rock–much finer than the granite–and it characteristically forms splintery outcrops which are brick red in colour. The small bodies and veins have sharp contacts against the soda granite. The southern mass, which grades from granophyre into a medium grained rock like the soda granite, cross-cuts the augite syenite.

The granophyre is for the most part mineralogically identical to the soda granite. Modal analyses on typical slices showed felspar 62–64 %, quartz 30–35 %, sodic pyroxene 1–4 % and soda amphibole 1.5 %. Traces of biotite, zircon, and ore are also present. The bulk of the felspar is rather turbid potash felspar with vermiform or ragged vein microperthite. Some of the quartz forms rounded or embayed grains up to .7 mm. across, but most is in micropegmatitic intergrowth with potash felspar.

Albite as an original constituent is rather more abundant in two of the slides than in the soda granite. Up to 1.5% biotite, showing X: straw, Y and Z: reddish brown, also occurs in two slices.

The granophyre outcropping in the southern end of the complex passes, in the small peninsula, into a medium grained granite in which micro-pegmatitic texture is almost lacking. The most notable feature of this rock is the presence of enigmatite in more than accessory proportions. This mineral, easily recognisable on account of its cleavage, colour, pleochroism and large extinction angle, occurs independently or intergrown with the green strongly sodic pyroxene (aegirine). The amphibole, also a sodic variety, is either intergrown or associated with the aegirine, or in the form of very small acicular crystals scattered through the potash felspar and in sheaves sprouting into quartz grains.

V. DISCUSSION AND COMPARISONS

The very short time which could be given to the study of the Puklen intrusion in the field, and the paucity of the material collected do not permit any far-reaching petrogenetic conclusions and comparisons to be drawn. The object in writing the present account was to record the existence of a small previously unknown Gardar intrusion so that a more complete picture of the Gardar province in SW. Greenland can be obtained. However, even from the scanty data available certain points of general interest stand out and some comment seems justified.

The close association of the four rock types, augite syenite, quartz syenite, soda granite and granophyre, in space is very obvious from the map. Their association in time is equally evident in view of the scarcity of sharp contacts and lack of chilled margins between them. The order of emplacement of the four is that in which they are listed above. It seems reasonable to conclude, therefore, that the four components, augite syenite, quartz syenite, soda granite, and granophyre and their variants represent a differentiation sequence from an augite syenite or similar magma.

The Gardar intrusive centres in SW. Greenland are characterised by often large and usually homogeneous masses of augite syenite, hence the Puklen Intrusion is of general interest as it indicates a possible trend in the differentiation of such a magma. The Kûngnât complex, recently described in detail by UPTON (1960), consists in the main of augite-fayalite syenites. In the Narssaq area to the east USSING (1912) recorded augite syenite from the margin of the Ilímaussaq and Igaliko intrusions. GGU geologists working in this area have recently brought to light more

extensive areas of augite syenite. J. W. STEWART has found that much of the area marked as nordmarkite by USSING in his map of the Narssaq area consits in fact of augite-fayalite syenite. The nordmarkite described by USSING is not unlike the quartz syenite of the Puklen intrusion. B. G. J. UPTON's work on Tugtutôq has shown that augite syenite occupies the centre of one of the giant composite dykes on that island. Nearer Nunarssuit D. BRIDGWATER has observed very thick north-easterly dykes of augite syenite nearer the Inland Ice.

The most pertinent comparisons of the Puklen intrusion can be made with the nearby Nunarssuit complex, with which the author is familiar from his own work in Nunarssuit and that of W. T. HARRY in Alángorssuaq. The augite syenite of the Puklen intrusion may be compared with the Kitsigsut and Nunarssuit syenites of the bigger complex. But for the almost complete lack of quartz, the Puklen augite syenite recalls the Nunarssuit syenite more than the Kitsigsut syenite. The typical quartz syenite has no counterpart in the Nunarssuit complex, but the variety found in the east of the Puklen intrusion resembles closely a very locally developed late phase of the Nunarssuit syenite in southeast Nunarssuit. The soda granite of Puklen is like the Malenefjeld granite, and a very close parallel to the only slightly micropegmatitic, enigmatite-bearing granophyre in the south of the Puklen mass occurs in the Malenefjeld granite where there is a little granophyric texture and enigmatite intergrown with aegirine-augite.

The similarity between the Puklen granitic types and those of Malenefjeld is of special interest because so far the author has only been able to infer from limited evidence that the Malenefjeld granite is a member of the Nunarssuit complex. This inferrence is more justified now that rocks almost identical to the Malenefjeld granite have been observed in the Puklen intrusion very closely associated with and seemingly derived from an augite syenite resembling the Nunarssuit syenite.

The Puklen intrusion lacks any form of late-stage pegmatitic veins and in this respect contrasts with the Nunarssuit complex. Banding and lamination of the kind developed in many of the Gardar intrusions is not found in that at Puklen.

At present the most extensive and best developed granophyres known in the Gardar province in SW. Greenland are those of the Puklen intrusion. Granophyric texture is sometimes seen in the alkali granites of the Narssaq area, and E. BONDESEN has found thin fine grained granophyre dykes on Tôrnârsuk, some way north of Nunarssuit. Otherwise granophyre is rare in this region of Greenland.

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