Rånaundersøkelsene 1972

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1) BRUVANNSFELTET

2) BRUVANN - RÅNAOMRÅDET

3) SALTVIKFJELLOMRÅDET

NORGES GEOLOGISKE UNDERSØKELSE

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Saksbehandler	:	Geolog Rognvald Boyd
Ansvarshavende	:	Geolog Carl O. Mathiesen

Norges geologiske undersøkelse
Leiv Eirikssons vei 39
Postboks 3006, 7001 Trondheim
Tlf.: 075 20166

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INTRODUCTION

During the period 8.6.72 to 13.9.72 geological field work was carried out by the writer on the Råna mafic intrusive which lies on the south side of Ofotfjord about 20 kilometres south-west of Narvik. The investigation was part of a detailed examination and feasibility study of the nickel-copper ores of the intrusive, particularly those in the Bruvann area, carried out for Stavanger Staal A/S by Norges geologiske undersøkelse.

PREVIOUS WORK

The mass has been shown by Foslie (1921, 1922) to consist of a core of quartz norite with a perpheral zone of normal norite the latter containing apparently irregularly distributed slabs of ultramafic rock, mainly dunitic peridotite and enstatitic pyroxenite (hereafter called pyroxenite) but also with small amounts of troctolite and olivine norite. At several periods in this century drilling, geophysical and mapping investigations have been carried out in the area, the greatest activity having been on the peridotite of the Bruvann area which contains disseminations of pyrrhotite, pentlandite and chalcopyrite. A complete bibliography of those reports and maps from earlier investigations which are lodged in the NGU Bergarkiv has been prepared by Mr. Johan Gust and will not be repeated here.

AREA AND METHOD OF INVESTIGATION

The area occupied by the peripheral norite zone and adjacent gneisses between the northern slopes of Sepmolfjell in the west and Rødfjell (also called Tverfjell on some maps) in the east was mapped in some, if not uniform detail. The Bruvann area was mapped on a scale of 1:2000 (see Map 2) in addition to which the map incorporates information from over 10.000 metres of drilling carried out in the area between 1918 and 1971 and from drilling carried out in the summer of 1972 up to late September. The area between the northern slopes of Sepmolfjell and Råna bridge was mapped on a scale of 1:5000 (see Map 3) using maps prepared by Fjellanger Widerøe A/S as a basis (Økonomisk Kartverk serie); the 1:2000 map of

the immediate vicinity of Bruvann is an enlargement of part of one of these sheets. Between Råna bridge and Rødfjell apart from A.M.S. Sheet 1331 I on a scale of 1:50 000 use was made of aerial photographs at a scale of 1:34 000 - also obtained from Fjellanger Widerøe A/S, this area is shown as Map 4. Outside the areas specified above a brief reconnaissance was made of Sepmolfjell itself and of its western shoulder, Simlefjell.

The area shown coloured on Map 3 was also the subject of an electromagnetic survey under the charge of Per Singsaas, Geofysisk avdeling, NGU, and wherever possible, to facilitate correlation and in the interests of more accurate mapping, use was made of the grid laid out for the geophysical survey: this grid employs the same coordinate system as the Fjellanger Widerøe maps mentioned above. During the summer the writer was very ably assisted for periods of five weeks each by Bjørn Nilsen and Jørn Olsen, students at the Geologisk Institutt, NTH.

THE BRUVANN AREA

The Bruvann area (see Map 2) is dominated by an irregular body of dunitic peridotite up to 800 metres long (east - west) and 350 metres broad (north - south): the body has a northern contact which dips steeply to the south changing gradually from about 75 degrees on the surface to 45 degrees at a depth of about 100 metres, eventually becoming almost flat while the southern contact appears to have a more consistent dip of between 35 and 45 degrees to the south. The peridotite on the surface is seen to contain rounded blocks (up to 70 metres long) and embayments of pyroxenite and norite some of which have been proved by drilling to extend to some depth and to have a dip similar to that of the enclosing peridotite. The combination of good outcrop and drilling data at the eastern end of the peridotite mass suggests that it is terminated by two sets of arcuate shear zones, one set dipping to the north and one to the south (see Map 3): in several cases these shear zones contain discontinuous gneiss horizons. Horvath (1946) showed that the ore in this area is in a series of lenses of peridotite whose form and attitude suggests that they may be defined by these same shear zones - detailed study of drillcore obtained this season may prove the above suggestion. Disseminated sulphide does not occur throughout the surface exposure of peridotite in this area but its appearance and amount agree well with the drilling and electromagnetic indications which suggest that the footwall outcrops at

1460 - 1500 N between 2500 ϕ and 2800 ϕ and that the grade falls off to the east and west beyond these limits. Outside the area specified above moderately rich dissemination of sulphide occurs in peridotite near the northern margin of the body: its depth extent is not known with any accuracy.

The peridotite is quite variable in appearance on the surface, but to a large extent this is due to varying degrees of late or post magmatic alteration of primary silicates and weathering often in combination with deformation. In the southern part of this peridotite mass small amounts of plagioclase are present and to the south-east large pseudomorphs of orthopyroxene, normally consisting of uralitic amphibole, are particularly common. A second phenomenon seen in the south-eastern part of the peridotite appears at a distance to be a form of igneous banding but on closer examination proves to be a filling of fracture planes with a general east - west strike but a very variable dip. The bands are light grey in colour and appear to have resulted from the granulation and hydrothermal alteration of the peridotite with subsequent introduction of calcite. No good examples of primary igneous banding on the outcrop scale have been found in this area though in places it has been possible to measure the orientation of contacts or of bands of late magmatic amphibole; these readings tend to confirm that the peridotite dips to the south at about 45 degrees.

The other main body of peridotite exposed in the Bruvann area is a slab about 30 metres wide lying between 2350 ϕ and 2400 ϕ and striking at roughly 10 degrees east of north with a probable dip to the west of 45 degrees. The relationship of this band to the main body of peridotite is unexposed but electromagnetic information suggests that a weakened continuation of the main ore zone extends to the vicinity of this band and it appears likely that the two are connected or only just separated. The slab contains only weak sulphide disseminations.

Of the subsidiary peridotite bodies which outcrop on the Bruvann map only one, the small slab lying south of the main peridotite, is mineralised and that only in part. The peridotite mass which outcrops on the eastern margin of the sheet at 1600 N is mineralized to the north-east but only moderately. At no point in any of the above areas does the mineralization

show any obviously regular variation.

Pyroxenite occurs at several localities near Bruvann but is not of great extent at any of them. It forms a 'discordant' block to the north-east of the largest peridotite mass seeming to transgress the contact between the norite and the peridotite. This is easily explicable if, as suggested above, the contact is tectonic: the contact is nowhere exposed, but outcrops on either side of it show no sign of a transition, and one is strongly sheared. Two blocks of pyroxenite occur in the main peridotite, and one at least (that lying immediately east of 2800 Φ) shows a transition to peridotite which suggests that it is in place. Drilling carried out in 1971 has revealed bands of pyroxenite which may correspond to those on the surface. Scattered exposures of pyroxenite also occur in the western part of the Bruvann area. Generally the pyroxenite is unmineralized, but the block in the northeastern part of the map locally contains very fine disseminated sulphide which though probably mainly pyrrhotite includes a dark grey mineral with a purplish hue and a metallic lustre.

The remainder of the Bruvann 'arm' of the intrusion, comprising most of the mafic rock north, south and west of the peridotite is norite. In the latter two areas exposure is too sparse and irregular to permit the definition of variations in the norite though varieties containing olivine, biotite, or amphibole are exposed and also occur in drillcores. North of the peridotite it may be possible, on the basis of petrographic studies, to distinguish bands up to about 100 metres thick on the basis of their quartz content. The quartz is fine-grained and is not present in large amounts - less than 15%. In some outcrops the quartzose norite appears to intrude the normal type: they appear to strike NE - SW and to dip SE. Of equal interest is the presence within these units of quartz norite of two bands, both discontinuous, of granular norite with a deep red colour on weathered surfaces or fractures. They are to be seen clearly from a distance on the northern slopes of Arneshesten but are not easily accessible: they strike NE - SW and dip at about 40 degrees SE.

ARNESHESTEN

This is taken to include the area forming a rough triangle between Bruvann, Råna bridge and Kringelvann. Within it (with the exception of what has aready been described) peridotite is found in two areas:

a) between 3200Φ and 4000Φ from 1500N to 2700N and

b) on the northern slopes of the mountain north of 3100N.

a) The clump of peridotite the edge of which appears on the Bruvann map has already been mentioned. It contains a weak dissemination of sulphide on its northern margin but not sufficient to register geophysically. The clump is terminated on its eastern margin by a shear zone in which a lens of garnetiferous gneiss has been emplaced. The shallow dip of this shear zone (28 degrees NW) suggests that this body has little depth extent. Five hundred metres to the north-east lie three bands of peridotite up to 550 metres in length: the westernmost may be folded on a N-S axis but its western limb and the other two bodies appear to dip at a shallow angle to the WNW. They are tectonically bounded at localities where the contact can be seen, but it is noticeable that the deformation affects the norite or pyroxenite rather than the peridotite. At its western margin the western band shows a curious in situ brecciation due to concentrations of uralitic amphibole along a fracture network which has been preferentially weathered. The central and eastern bands both contain relatively weak mineralization - insufficient to register electromagnetically.

To the east and south of these three bands lie a number of apparently isolated bands and blocks up to 200 metres long. Where their attitude is apparent they dip to the W or WNW with one exception in which case the dip is at a very shallow angle to the N. They are as a rule undeformed and unmineralized though not all of them have sufficient fresh rock exposed to be certain. One group lying north-east of the three longer bands is in relatively undeformed rock, and it is possible that they are connected at depth to each other and to the longer bands. The other group to the south-east occurs in strongly deformed norite, and its members are probably unconnected.

b) The area in question has much less exposure than that described above, and a high proportion of it is on steep slopes with scree covering lower parts and large boulders on more level terrain. The peridotite occurs in a series of bands, at least six in number, several of which are in places repeated in the 'succession' due to faulting. The bands generally appear to be vertical or to have a steep dip to the south, but there is evidence that this attitude may be the result of deformation: in two localities undeformed primary banding has been seen, one near the western contact and the other 700 metres south-west of Råna bridge, both of which suggest a more moderate dip towards the south-west. Fewer bands outcrop to the east,

but this may be a tectonic or an erosional feature rather than primary. Several bands including the most northerly are at least partially mineralized but not strongly: there are only weak electromagnetic anomalies in the area, and they do not all appear to correspond to exposed ultramafic bands. Preliminary analyses of samples from this area suggest that the mineralization is mainly pyrrhotitic (this applies equally to peridotite and to mineralized pyroxenite from this area). Of other characteristics it is noticeable that the northernmost band is relatively plagioclase rich and that the large uralite pseudomorphe common in other areas are rare here.

Pyroxenite is generally though not invariably associated with peridotite and as such is most common in peripheral areas of the mass. It does not, however, necessarily occur in bands with an orientation similar to that of the peridotite bands and may outcrop in apparently irregular forms. To some degree this may be due to a problem of definition: all ranges of types between pyroxenite and norite are to be found in the fresh undeformed state, and the difficulty is compounded by deformation which may result in strong mineral segregation frequently into almost monominerallic bands of pyroxene, plagioclase or amphibole. The pyroxenite is mineralized locally in a fashion similar to that found at Bruvann but also contains several narrow zones of limited extent of highly weathered rust matter: in their original state these may have been quite sulphide rich but even where they have been blasted (probably in every case before 1920) fresh samples cannot be found.

In the area described here norite generally retains its primary mineralogy, but in parts of the strongly deformed rocks south of Arneshesten it may be completely amphibolitized. Several discontinuous zones of reddish norite similar to those described earlier are found on Arneshesten and feature prominently on older maps of the area (e.g. Olsen, 1915). The norite contains patches which are both pegmatitic and amphibolitic: in one case a lens of this type, completely undeformed in outline and internally can be seen in a tectonically banded host norite cutting the numerous fine bands in the host abruptly. This would appear to suggest that deformation was in progress before complete solidification of the mass.

Dyke rocks of at least two major types are prominent on Arneshesten - trondhjemite which fills two sets of fractures, one at 10 degrees E of N , and the other at 50 degrees E of N, and a fine grained mafic rock, probably a biotite lamprophyre which in several places is seen to run N-S and to be almost vertical.

STRUCTURE OF THE ARNESHESTEN AREA

a) The gneisses and the form of the contact.

The outer contact of the mass from Arneselven to Råna bridge has a superficial simplicity in that over most of its length it appears to be parallel to the cleavage of the gneisses and to dip at moderate to steep angles away from the mass. There is locally e.g. between Arneselven and Arneshesten, evidence from both core and outcrop that within 100 metres of the contact the dip steepens from between 30 and 70 to 80 degrees or more on the contact, but elsewhere the situation is less clear. If one can, however, assume that the contact is generally concordant there are three exceptional areas where it dips inwards towards the centre of the mass at a steep angle: these are on each side of and between the two lobes which project northwards from the main mass west of Råna (see map 3). It is unlikely to be a coincidence that the anomalous dip occurs where the contact appears to be pinched.

At some points e.g. on the stretch parallel to Arneselven, and in drill-cores through the contact south of the road to Bruvann the contact is seen to be sheared, the deformation affecting several metres of rock at least on both sides of the contact. On the other hand on the northern slope of Arneshesten a coarse, almost structureless garnet gneiss can be seen within three metres of normal norite there being no indication that either has been in the vicinity of a syn- or post-intrusive deformation zone. There are also points on Arneshesten and on Saltvikfjell (Flood, 1963) at which shear zones turn the cleavage of the gneisses into an attitude normal to the contact without the latter showing any marked deviation.

The outer contact of the mass from Arneselven to Sepmolfjell is in some ways much more complex than that described above: in effect it outlines a tongue of gneiss over 1,5 kilometres long which projects into

the intrusive towards the NE. At almost all points in the vicinity of this contact, especially NE of Bruvann both the norite and the gneiss have been strongly sheared parallel to the contact at a relatively late stage in the history of the area. To the SW degree of deformation on the contact is much weaker and of more local extent. The broader part of the tongue contains a series of open folds with axes between 245 and 290 degrees, and a plunge of about 30 degrees in those directions: elsewhere in the area folds of this type can be seen to refold at least one, possibly two sets of isoclinal folds. The form of the contact is parallel to the outline of the major pair in the group of open folds which suggests three possible origins for these folds: a) the process of intrusion itself folded the immediate country rocks, b) the later deformation mentioned in the next paragraph folded the norite and the country rock or c) intrusion was a relatively passive process along the line of pre-existing folds. Subsequent description shows b) to be the most likely of the three.

The rocks within the intrusion are also considerably deformed. The peridotite shows the least effect, the most obvious one, generally seen in drill core rather than in outcrop, being the presence of discrete zones in which the whole rock is replaced by medium to coarse-grained zones, strongly sheared, of tale, chlorite, anthophyllite and uralite in various combinations: elsewhere the rock is cut by very fine-grained dark sheared zones seen frequently in drillcores whose mineralogy is as yet unknown. None of these is very wide, and most of the peridotite outcropping appears to be undeformed in hand specimen. The norite and more locally the pyroxenite show much more intense deformation and over quite large areas show irregular plastic flow-banding with many if not all of the characteristic noted elsewhere by Thayer (1960), Oosterom (1963) and Hooper (1971). The banding is on a fine scale with extreme compositional contrast between bands: the bands also tend to be sharply bounded on both sides and to be quite discontinuous. The rock is in effect a flaser norite. Over large areas, especially north of the gneiss tongue, no hydrous minerals are present in this rock type, but amphibolitic sheared rocks are present south of the gneiss tongue. Drag folds with wavelengths ranging from one centimetre up to several metres affect the sheared norite and correspond with structures in the gneiss tongue both suggesting movement to the south-east.

On a larger scale the whole area of mafic rock between Bruvann and Råna is separated from the rest of the mass by a series of arcuate shear zones. These dip steeply to the north-west at high altitudes with shallover dips lower down and at various points along their length contain tectonically emplaced lenses of gneiss. These include calc-silicate gneiss with graphitic bands, garnet biotite gneiss, a variety of migmatitic and contaminated gneisses and a breccia containing fragments of hornfels and norite in a leucocratic matrix (a similar rock at Sulitjelma is described by Mason, 1971). Deformation in the norite tends to be parallel to these zones. Further north there is evidence for the existence of two sets of shear zones, one set striking north-south and one east-west. They appear as strong linear elements on aerial photographs and topographic maps and on that basis could be either shear zones/faults or joints but where exposed there is evidence of strong deformation in one case over a zone only about a metre wide. A shear zone of this type can be seen in one outcrop (at 4200 ϕ 3750 N) to strike N-S and to cut along a sharp boundary norite with tectonic banding which has an E-W strike without deviation of the latter close to the shear. The east-west set of shear zones has been exploited to a greater extent by forces of erosion, and its members tend to be unexposed: to this degree their presence on Map 3 is interpretative. The apparent displacements of peridotite bands along these shears are small and suggest that the major stress axis had a NW-SE orientation. Later in the sequence of events two sets of joints without associated deformation opened out - one at roughly 10 and one at 50 - 60 degrees E of N. These are filled by trondhjemite pegmatite.

Three parts of the evidence above: a) the form of drag folds in the norite and the gneiss tongue, b) the stress axis suggested by the shears in the northern part of the mass and c) the geometric relationship of the larger arcuate shears to the body as a whole suggest that the part of the mass between Bruvann and Råna was thrust upwards towards the SE when the norite was almost solid. In view of this the Arneshesten 'block' has probably a more limited depth extent than adjacent parts of the main mass. The direction of thrust movements postulated is in agreement with that suggested by Gustavson (1972) and Olesen (1971) for the latest stage of Caledonian deformation in Ofoten and southern Troms and thus would appear to reflect regional forces.

THE OCCURRENCE OF SULPHIDES IN THE ARNESHESTEN AREA

The main aims of the investigation are to assess the geology with a view to: a) locating nickel bearing ore and b) explaining its origin. The first aim can to a large extent be met by field work while the second requires the aid of laboratory techniques.

At present it would appear that ore as opposed to mineralization is unlikely to be found in rocks other than peridotite: to date evidence suggests that in pyroxenite and even more so in norite mineralization is of much more restricted extent and forms a smaller proportion of the rock as a whole: it also appears to contain a higher proportion of pyrrhotite and chalcopyrite than that found in peridotite. The problem does not however end there because as most earlier investigators have noted peridotite occurs both with and without ore. Field evidence shows that the host rock type occurs in bands with a total thickness of up to 150 metres and that the ore forms roughly conformable units within the major bands but not necessarily at a key locality such as the main contact of the mass, the lower contact of a thick peridotite unit or the lowest of a sequence of separate peridotite bands. Though the peridotite is commonly sheared along discrete planes there is no evidence to suggest that this is associated with remobilization of sulphides on a large scale at the present stage of the investigation (though small veins of massive sulphide can in some cores be seen to cut deformation zones in peridotite), or that the mineralization follows any well defined structure (a conclusion also reached by Flood, 1963). Some sections across peridotite bodies show an increase in the proportion of sulphides to one of the margins, and this can also be seen in several cores, but only a detailed study of the cores will give confirmation.

SALTVIKFJELL AREA

During the period 3.7.72 to 8.7.72 a preliminary survey was carried out in the Saltvikfjell area from the slope above Rånbogen in the west to Rødfjell in the east: later two days were spent in Rånbogen itself. The main purpose was to erect cairns on claims already made and to observe and claim other areas of potential economic interest. A geological sketch map was produced on the basis of aerial photographs and is shown as Map 4.

Apart from reports and publications by Foslie detailed field work has been carried out in the Saltvikfjell area by Flood, 1963 whose report includes a map on a scale of 1:2000 attention being mainly focussed on the contact and the gneisses: the present work is in some degree complementary in that it was directed towards the peridotites.

Peridotite occurs in a broken zone over the whole length of the contact examined, but the largest units are found on the steep north-west facing slope of Rånkjeipen. In this area there are three zones of peridotite: the lower two are almost continous from the edge of Råndalen in the west to the northern contact, but the highest is merely a series of clumps in line with the lower two zones. All three zones contain disseminated sulphides in part and may include quite rich ore at least in the lowest zone. The lower two zones appear to the writer to dip steeply to the south: the highest may have a much shallower dip to the east though it is possible that this is an impression given by preferential weathering along joints in that orientation. Foslie's interpretation suggests a dip to the N for these peridotites at an angle parallel to the contact which in this case would also be close to the slope of the topography. The writer's opinion that this is unlikely is to some extent reinforced by Flood's observation that towards Rånbogen the gneiss dips towards the south, the reverse of what appears on Foslie's sections. On the eastern contact at Rødfjell peridotite occurs as a weakly mineralized cap on top of the mountain: the unit appears to dip at a shallow angle to the west, an observation again supported by Flood's measurements on the foliation of the gneisses a short distance further east. No indication was seen in either of these areas that the peridotite masses were not in place relative to their immediate surroundings - unlike several on Arneshesten. Of perhaps more academic interest is the presence in Rånbogen close to the outer contact, of a vein of sulphide about a metre wide with a very high proprotion of pyrrhotite: poor exposure in the area does not permit any estimate of the extent of this vein.

Several observations not directly related to peridotite or sulphides but of interest were made in the Saltvikfjell area. Foslie (1921) describes the leucocratic veins common in the mass as "confined to the norite field": both Flood and the writer have observed that they are common in

the gneisses also - more so on Saltvikfjell than near Bruvann. In the gneisses these veins are generally conformable, if not also sheared and boudinaged unlike those normally found within the mass which tend to maintain their orientation over some considerable distance. Immediately west of Rødfjell however, complexly folded acid veins can be seen within the norite which at least locally extends the period of deformation in relation to the period of crystallization of the mass even if Foslie's contention that the veins are differentiates of the basic magma is not accepted. In the same area the quartz norite/norite transition occurs in or close to a zone of tectonism and blocks of the latter can be seen as it were floating in the more leucocratic type: the reverse relationship was not seen (as it can be between norite and pyroxenite on Arneshesten where bodies of each occur in the other and all transitions are also found). A third observation occurs in relation to recent geochemical work (Krog, 1973) which shows the existence of a strong nickel anomaly in sediment at the mouth of the stream flowing from Råntindvann. Elsewhere in the mass such anomalies can be securely correlated with bodies of peridotite without exception. There are no recorded occurrences of peridotite in the area which drains into Råntindvann; the whole area is in fact mapped as quartz norite in which no peridotite bodies have been found to date in any part of the intrusion.

SEPMOLFJELL

On the north side of the mountain peridotite was observed at several localities which suggest the existence of a narrow band - possibly two, in this area. At one locality, on Simlefjell, it is mineralized. From the top of Sepmolfjell there is a clear view of the peridotite masses on Kvanåkertind to the S and on Tverfjell to the SE; each has a surface area comparable to that of the Bruvann peridotite if not greater. The mass on Kvanåkertind would appear from a distance to be solid peridotite unlike that on Tverfjell which contains bands of another rock type.

CONCLUSIONS BASED ON FIELD WORK

On the basis of present knowledge the peridotites between the top of Arneshesten and Råna bridge do not merit further attention from an economic point of view. Geological and geophysical work both suggest only weak mineralization while the peridotites, that apart, occur in

smaller units and are more complex structurally than those at Bruvann.

The peridotite bands on Saltvikfjell and Rånkjeipen are more promising so far as they are known and further mapping on the scale carried out west of Råna (1:5000) would appear to be justified possibly in conjunction with an electromagnetic survery on the N slope of Rånkjeipen in so far as the terrain allows this.

Despite the considerable attention focussed on the Råna mass during this century little is known of the two major peridotite bodies on the southern contact (both mapped as being actually in contact with the gneiss which is not normal elsewhere in the mass). They merit a much closer examination.

A further report will deal with the petrography, chemistry and petrogenesis of the area mapped, on the basis of laboratory work now in progress - hence the absence of any discussion of these topics at present.

The writer wishes to thank Carl Olaf Mathiesen and Per Singsaas for their help in discussing the problems of the area and in many other ways.

Trondheim, april 1973

Rognvald Boyd

Rognvald Boyd
geolog

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OFOTFJORD

STORFJELLET
BALLANGEN
RÅNA
RØSÅSEN
SKJOMNES-
FJELLET
HAMMERFJELLET
RÅNKJEIPEN
SKJOMEN
SKJOMVANN
EITERDALEN
SEPMOLFJELLET
BØRSVANN
ISVANN
SØRSKJOMEN
FROSTISEN
KJELVANN
N

TEGNFORKLARING

- SKJOMENGRANITT
- KVARTSNORITT OG DIORITT
- NORITT
- 0 OLIVINBERGARTER
- AMFIBOLITT OG HORNBLENDEGABBRO
- TRONDHJEMITT
- GRANODIORITT
- GLIMMERSKIFER
- GLIMMERSKIFERKONTAKTMETM / MED GRANITTINTRUSJONER
- KALKGLIMMERSKIFER
- KALKMARMOR
- LØSAVLEIRINGER

- SKURINGSSTRIPER
- STRANDLINJE
- FOLDINGSAKSE (HORISONTAL)
- STRØK OG FALL
- STEINBRUDD
- KOBBER OG SVOVELKIS
- NIKKEL

STAVANGER STAAL A/S

RÅNAUNDERSØKELSENE 1972

GEOLOGI, RÅNAMASSIVET, (ETTER S. FOSLIE)

RÅNA / BALLANGEN OG ANKENES

NORGES GEOLOGISKE UNDERSØKELSE
TRONDHEIM

MÅLESTOKK 1:100 000	MÅLT		
	TEGN		
	TRAC. T.J.S.	JAN. – 73	
	KFR.		

SE NGU RAPPORT NR. 515 C

TEGNING NR	KARTBLAD (AMS)
1120 A – 01	1331 I

P-200 P-210 P-220 P-230 P-240 P-250 P-260 P-270 P-280 P-290 P-300 P-310 P-320

1800 1700 1600 1500 1400 1300 1200 1100 1000

2000 2100 2200 2300 2400 2500 2600 2700 2800 2900 3000 3100 3200

Arneselven

325 350 375 400 425 450 475 500 525 550 575 600 625

Bruvann
421,3

N

TEGNFORKLARING:

- P PERIDOTITT
- Py PYROKSENITT
- N NORITT
- G GNEIS
- Ks KALKSILIKATBERGART
- BLOTNING
- G/Py KONTAKT (OBSERVERT)
- Ks/P KONTAKT (TILNÆRMET)
- Py/N KONTAKT (ANTATT)

FORANDRING 26. AUG. 1975:
BERGARTENE ER NÅ ANGITT VED BOKSTAVER (P, Py, N, G, Ks)
ISTEDET FOR TALL (8, 23, 21, 4, 11)

STAVANGER STAAL A/S

RÅNAUNDERSØKELSENE 1972

GEOLOGI

BRUVANNOMRÅDET, RÅNA

NORGES GEOLOGISKE UNDERSØKELSE
TRONDHEIM

MÅLESTOKK: 1:2000	OBS. R.B.	JUN./AUG.-72	
	TEGN. R.B.	OKT. 1972	
	TRAC. T.J.S.	MARS 1973	
	KFR. R.Berg	APRIL 1973	
TEGNING NR. 1120A – 02		KARTBLAD NR. 1331 I	

OFOTFJORD

Koordinatbetegneiser for det økonomiske kartverk

TEGNFORKLARING:

- P — PERIDOTITT
- Py — PYROKSENITT
- N — NORITT
- G — GNEIS
- Ks — KALKSILIKATBERGART
- KONTAKT (OBSERVERT)
- KONTAKT (TILNÆRMET)
- KONTAKT (ANTATT)
- FOLIASJON
- FOLIASJON (VERTIKAL)
- FOLIASJON (HORISONTAL)
- PRIMÆR BÅNDING
- FORKASTNING / MARKERT SKJÆRSONE
- DISSEMINERT KIS

N

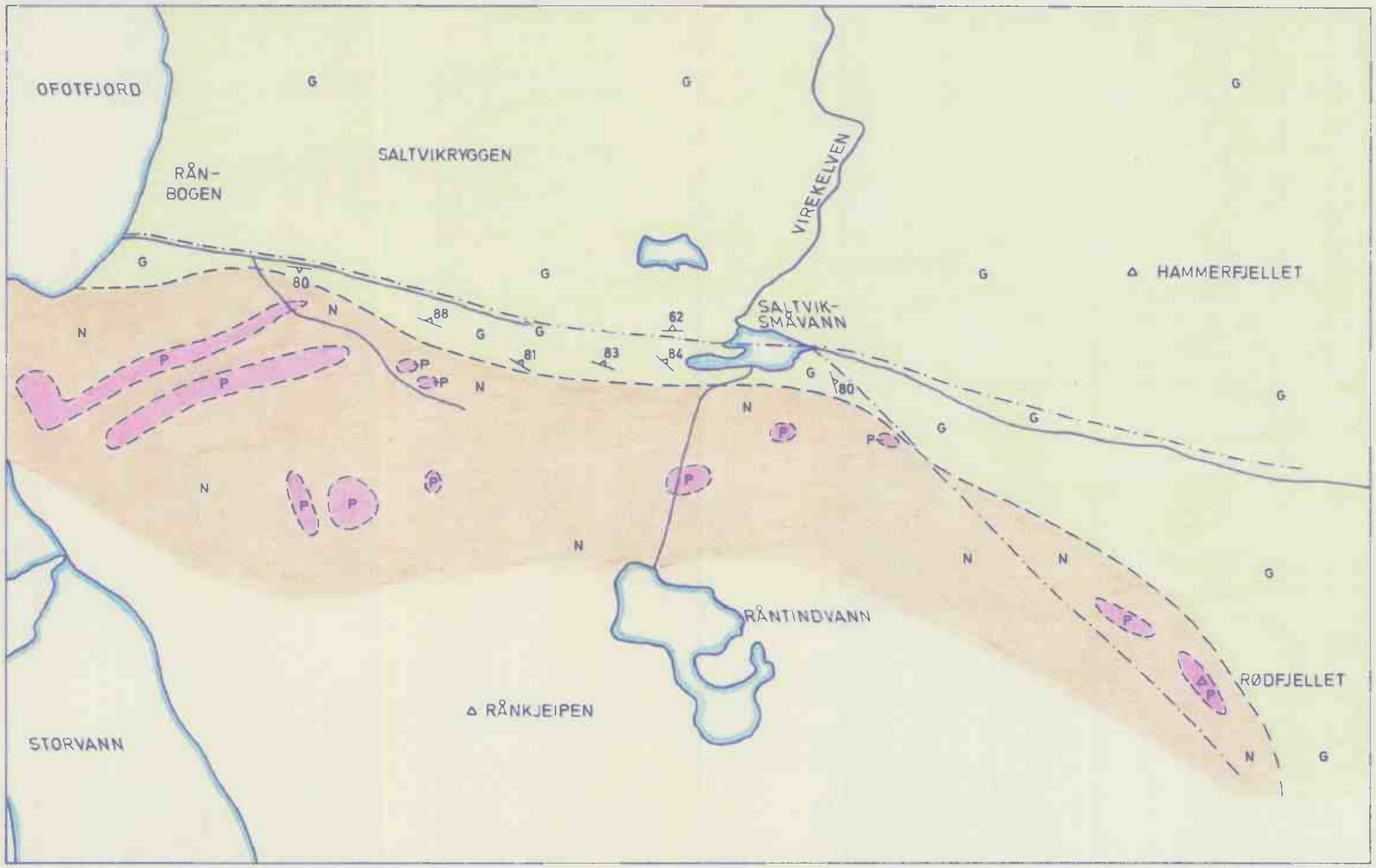
FORANDRING 1. SEPT. 1975:
BERGARTENE ER NÅ ANGITT VED BOKSTAVER (P, Py, N, G, Ks)
ISTEDET FOR TALL (8, 23, 21, 4, 11)

STAVANGER STAAL A/S
RÅNAUNDERSØKELSENE 1972
GEOLOGI
BRUVANN-RÅNA / BALLANGEN

NORGES GEOLOGISKE UNDERSØKELSE
TRONDHEIM

MÅLESTOKK 1:10 000	OBS. R.B.	AUG. 1972
	TEGN. R.B.	NOV. 1972
	TRAC. T.J.S.	NOV. 1972
	KFR R. Boyd	MARS 1973

TEGNING NR.	KARTBLAD NR.
1120 A-03	1331 I



etter Fjellanger Widerøe A/S flybilder dekn. 3042

TEGNFORKLARING:

P	PERIDOTITT	P / N	KONTAKT (TILNÆRMET)
N	NORITT	G / N	SKJÆRSONE
G	GNEIS	61	FOLIASJON

FORANDRING 19. AUG. 1975:
BERGARTENE ER NÅ ANGITT VED BOKSTAVER (P,N,G)
ISTEDET FOR TALL (8,21,4)

0 1km 2km

STAVANGER STAAL A/S

RÅNAUNDERSØKELSENE 1972

GEOLOGI, SALTVIKFJELLOMRÅDET

RÅNA / BALLANGEN OG ANKENES

NORGES GEOLOGISKE UNDERSØKELSE
TRONDHEIM

MÅLESTOKK ca. 1:34 000	OBS. R.B.	JULI 1972
	TEGN. R.B.	JAN. 1973
	TRAC. T.J.S.	JAN. 1973
	KFR. R Bryhni	JAN. 1973

TEGNING NR.	KARTBLAD NR.
1120 A-04	1331 I