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Report on Geological Field work in the Region around Nasa and Bolna.

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Sammendrag

En gruppe med skifre og gneisser i omradet Nasa - Bolna pa Saltfjellet er kartlagt. Mineraliseringer av kvarts og kyanitt er av okonomisk interesse og grunnlag for undersokelser. Den stratigrafiske inndelinga er nederst grunn-granitt; deretter inhomogen gneiss; 'aluminium-sone~ med kvartsitter, glimmerskifre og kyanitt-bergarter; metasparagmitt. Fleire store kvartsitt-kropper danner kontinuerlig asrygg fra svenskegrensa til sor for Nasa. Spredte kropper av kyanitt. Se ogsa 522.230.011.

R E P O R T

on Geological Field Work in the Region around

NASA and BOLNA

July and August 1969

John Paul Platt

CONTENTS

Abbreviations.

m = metres
N = North, S = South, etc
qtz = quartz
musc.= muscovite
bi.= biotite

R e p o r t

on Geological Field Work around Bolan and Nasa

I. INTRODUCTION. Lying between the "Basement Granite" in the Nasa region and the Cambro-Silurin to the south are a group of schists and gneisses attribuded to the spragmite.

Within this group are two zones of economic interest, one containing bodies of pure crystalline quartz, and the other rocks rich in kyanite. These two zones were examined, mapped, and their relationships to the surrounding rocks elucidates as far as possible.

Samples were collected representing the lithologies present.

II. STRATIGRAPHY. The following, lithological units were distinguished, structurally lowest first:

A: "The Basement Granite". This is a coarsely crystalline rock of granitic apperance, containing some quartz, much biotite, and much pink and green felspar. Adjacent to the quartz zone, a strong foliation is developed, and the rock becomes a coarse augen gneiss. Sample N 3.

B: "The Quartz Zone". This zone is very varied in composition and thickness, but almost invariably includes graphite schist (sample nr.2). Also present may be biotite schist (sample N.23), often with accessory pyrite or calcite, green mica schists (particularly in the west, where the zone is very thick), muscovite psammites, showing flow folds isoclinal white banded quartzites, and locally, bodies of crystalline quartz. Around Nasa, there a local bodies of pyrrhotite-pyrite rock, underlying the quartz, locally with sphalerite and galena in small quantities (Samples N.21, N.24, N.15).

The development of the quartz does not seem to be related to tectonism or to be in any way predictable, but it is usually associated with the massive quartzites.

The rocks typically show violent folding and contortion and the thickness varies from zero to over 50 m. Locally, the unit appears to the repeated, a lower band of quartz and quartzities being found within the augen gneiss below the main quartz-graphite schist zone. This occurs in the east, towards the summit of Nasa, and in the west where the zone crosses Bolnabecken. The phenomenon may be simple thrusting, but is more probably, a complex result of the high degree of tectonism.

C: "The Irregular Gneiss". Above the Quartz Zone a unit of coarse gneiss is found, of very varied apperance. It is frequently an augengneiss indistinguishable from that below the quartz,and locally it is a granitic rock similar to the unfoliated "Basement" (Zone A). Other facies seen include: moderate graines biotite felspar gneiss (Sample N 7), gneiss with square 1 - 2 cms felspar porphyroblasts, and the "irregular gneiss" facies. The latter is a coarse imfoliated rock, the grains of which are highly irregular in shape, giving the rock a brecciated appearance. (Sample N 4).

The overall composition is similar to that of the "Basement", and west of Randalselven, where the qaurtz zone is locally absent, and is structurally independent of the spragmite, this unit must be mapped with the Basement.

West of Nasa, around Bolnabecken, and near the crest of Raufjellet, this unit includes bodies of amphibotite. These may be very thick, and the schistosity and lithological units are folded around them. (See Section 7, loc 31 in Field Notes, and Sample N. 27).

The "Irregular Gneiss" is usually internally folded, and it can only be said to be over 50 m thick.

UNIT D. Between the "Irregular Gneiss" and the Alumina Zone is a group of gneisses and schists of varied composition. The fine to moderate grainsize, absence of augen-texture, and the presence of green mica distinguishes these rocks from the irregular gneiss. Accessories include calcite and magnetite, the latter often in some quantity (Smaple N.20). A band of psammites, banded quarizities and graphite schists is locally developed at the base of the unit.

Strong, often isoclinal, folding is typical of the more competent rocks, the pelitic units showing microfolding. The zone is probably not more than 30 m thick at maximum development.

E: "The Alumina Zone" includes many rocks types: finegrained quartzites and psammites, quartz-muscovite and quartz-green mica schists, and kyanite rocks. All are rich in silica and alumina. The unit varies in thickness from 0 to 50 m approximately, and is liable to be very strongly conterted, the peletic rocks developing a secondary schistsity. The occurrence of the various lithologies within the zone is also higly variable. In character with this, the kyanite rock develops only locally, a detailed description of the outcrops is presented in section IV of this report.

The unit carries several interesting accesseries.s. Pyrite is common, and occurs as a major constituent in some of the schists, causing them to weather orange. Tourmaline has been found, and lazulite and pyrophyllite are present in the kyanite rocks.

F: "The Normal Sparagmite" is a somewhat monotonous group of psammites and semipelitte schists, with an average composition of an arkose. Biotite, muscovite and a green mica are commonly present, and accessories include an orange garnet, calcite, fluorspar (Sample N. 8), magnetite (Sample N.22), haematite, and occasionally galena. Pyrite is locally so abundant that distinct rusty zones are formed (Localities 47 and N. 18. Samples). Bands of Qtz-felspar bondins also occur, containing magnetite (Samples N. 16 and N. 18).

West of Randalselven the sparagmite overlying the alumina zone includes gneisses, often similar. To those of Unit D. Magnetite is common, and augen and pårphyroblastic textures are sometime developed (Sample N.19).

The thickness of rock between the Alumina Zone and the Cambro-Silurian is probably in excess of 1 000 m in Randalselven.

III Detailed Description of the QUARTZ ZONE.

The zone is described from the east: Nasa: FRom the Swedish border to loc. (39) on the south side of the summit of Nasa (167.741), the crystalline quartz forms a continuous ridge. No mapping was done east of loc. (39).

Loc. (39): Width of outcrop: > 100 m
Estimated thickness: ~ 20 m
Dip, south side: 40° S
north side: shallow but variable.

The quartz is pure, but contains occasional schist bands.

A little west, around loc. (36), the shallow variable dip is parallel to the hillside, and the quartz zone runs up towards the summit of Nasa. There are a number of quartz bands, from 0 to 5 m thick, but they are much mixed with schist. The large outcrop area contains little valuable quartz.

See notes for loc. (36, and (39), and structural section No 6.

Within the area mapped, the estimated outcrop area of uncontaminated quartz is about 100 000 sq. m. (Nasa).

Main Body. West from loc. (36), the quartz zone is repeated, (loc 25 a), but contains little crystalline quartz for 800 m. At loc. (25), a large outcrop of buckled, pure quartz appears, of unknow thickness.

Loc. (25): Outcrop Dimensions: NE-SW: ~300 m
NW-Se: ~150 m
Dip, SW side: ∠ 5°
NE side: ~30° SW

West from loc. (25), the quartz is continuously exposed in a prominent ridge.

Loc. (24), (16), (N.15):

Length: 100 m
Width: av. 60 m (locally 100 m)
Estimated thickness ~ 30 m
Dip: av. 50° SW

Estimated area of outcrop of Main Body: 100 000 sq m

Quartz Stream. 100 m west of the end of the Main Body, at the top of "Quartz Stream", is a poorly exposed body of quartz. (See loc. 101). Further down, in the stream, are a number of smaller bodies (loc. 8, 9 and 10).

Loc. (10). Length 500 m
Width av. 10 m
Dip ~ 40° SW

Loc (8) and (9).
Total summated length 120 m
Width av. 5 m
Thickness av. 3 m
Dip av. 40° SW

Estimated area of outcrop. Quartz Stream: 5 000 sq.m.

Bolnajavre Ridge. The quartz zone is not traceable for 1 km across Randalselven, but reappears in a direct line westwards at loc. (N.23). From there it widens considerably, farming a large, buckled near horizontal and very irregular outcrop on the ridge. The only significant outcrop of crystalline quartz is near loc. (N.24). See sketch map, p.32 of notes, and Sample N.24. Map reference (109,771).

Loc. (N.24): Outcrop Dimensions: N-S: 100 m
E-W: 50 m
Dip, Thickness and structure not discernible.

The quartz zone continuous approximately 500 m S.W. from loc. (N.21), then disappears.

Bolnabecken. 500 m further S.W. a thick zone of graphite schist and quartzite appears, and continnes three kilometres to the west, across Bolnabecken to Raufjellet. The zone there swings right round, and outcrops over a large area extending 2 kms N.W. to Raufjeldelven. No significant quantities of crystalline quartz were found.

Raufjellelven. Where the zone meets this stream a substantial body of quartz occurs. Much of this outcrop is and mixed with ore and schist: the quality is not as high as it is east of Bolna. However, a considerable body of quartz is present.

Loc. (57): (a): Length (SW-NE): 200 m
Width: 50 m
Thickness: 5 m
Dip: Shallow N.W.

This body is continuous east with:

(b): Length: 300 m
Width: av. 10 m
Theckness: 5 m
Dip: 30° NM

The quartz zone continnes east up the hill, the next quartz body being

(c): Length: 250 m
Width: av. 50 m
Thickness: ~5 m
Dip: variable N

After an exposure gap, another body outcrops:

(d): Length: 200 m
Width: av. 2 m
Dip: steep N

The zone cannot be traced further.

Raufjeldelven, outcrop area: 26 000 sq.m.

IV Detailed Description of the ALUMINA ZONE.

The zone will be described from the east:
Nasa. The alumina zone, containing hard quartzites and psammites, forms a prominent ridge south of Nasa. However. no kyanite rock was found, only occasional crystals being seen (loc 29).

The zone can be traced downhill to loc (37), (140,743), from there to loc (13) there is semi-continuous exposure of kyanite rock. Blue, white and grey varieties are present, all containing much kyanite and some containing qtz, muscovite, or pyrite. The band is strongly folded, dips are frequently near vertical, and there may be more than one band of kyanite rock distributed amongst qtz-musc. schists, etc.

Loc 13: Length: ~400 m in 650 m ground
Width: 1 m in the east, 15 m in the west
av. ~8 m
Outcrop Area: 3 000 sq.m.

Hill (884 m). The zone can be traced down the north side of the knoll (summit 884 m). Outcrop of kyanite rock is rare, but both pure kyanite rock and blue qtz-musc schist (Sample N 5) are present. See sketch Map, p.21 of notes, and loc. (41).

Loc. 41: Thickness of band: 10 - 50 cms.
Outcrop area: < 20 sq.-m.
Folding is intense.

Radio Hut. In this vicinity the kyanite forms a group of outcrops, whose scattered disposition and internal contortion suggest violent folding. Dips are frequently near vertical. See sketch map, p 9. of Notes, and loc. (20).

Loc. (20): Outcrop area summated: approx. 400 sq.m.

Bolnajavre Ridge. The alumina zone is not definitely traceable for 2 kms across Randalselven. On the rest of Bolnajavre ridge however, the zone is thin (< 10 m) but distinct. Occasional outcrops of kyanite rock were seen.

Loc (53): Outcrop area: 0.2 sq.m.

Loc (51): Outcrop area: 2.5 sq.m.

Loc. N.25: Thickness: 2 cms.
Length: 3 m

Bolnabecken. The alumina zone (~20 m wide) can be traced 500 m west from the stream (at N 25) to loc. (N.26). Here there is a substantical body of massive, grey, qtz-kyanite-musc.-pyrite rock, fairly rich in kyanite.

Loc. N. 26. Length (E-W): ~120 m
Thickness: av. 1½ m
Dip.: 20° S.E.

From here the alumina zone can be traced a further 300 m before it is obscured by drift.

Raufjellet 1. 1 km west of (N 26), at the bottom og a ridge running up towards Raufjellet, is a body of kyanite rock. (Lock 58). The band is locally 1 m thick, but it is strongly folded with other schist types, and it is difficult to estimate the quantity of kyanite rock present.

Loc 58. Area of outcrop, approx 3 000 sq.m.

Raufjellet 2. Towards the top of the ridge, ~800 m west of loc (58), the alumina zone outcrops over a large area, being broadly folded with the clips nearly parallel to the hillside. In the southerly limb a broad syncline, plunging S.E.:

Loc (56),a:	Length (NW-SE):	200 m
	Width:	15 - 30 m
	Thickness, estimated:	12 m
	Dip, at N.W. end	50° N.E.
	at S.E. end	shallow, buckled
(b):	Length:	100 m
	Width:	av. 3 m

V. Note on the STRUCTURE.

It would appear that the alumina zone and the sparagmite do not follow the quartz zone round to Raufjellelven. I.e: the anticline effecting the quartz does not affect the units above. It may be that the latter outcrop north outside the area mapped, but gneiss outcrops above the quartz zone for a least 1 km to the north of loc (54).

Thus it is possible that the alumina zone is part of the sparagmite, whereas the Irregular Gneiss and the Quartz zone arw integral parts of the Basement. The apparent parallrlism of the zones in the Nasa region may be a result og the tectionism.

If any discordance is present, it is probably at the base of zone D.

J. P. Platt

15. august 1969.

LIST OF SAMPLES

N 1: Moderate-grained bi-musc. s.p.s.
N 2: Graphite schist
N 3: Basement Granite
N 4: Irregular Coarse-grained gneiss
N 5: Blue qtz-musc. schist. From loc. (41)
N 6: Musc. s.p.s.
N 7: Flaggy moderate-grained bi-felspar gneiss
N 8: Fine-grained bi-musc. s.p.s. with fluorspar
N 9: Fine-moderate grained bi-musc. s.p.s. with accessories
N 10: Orange-weathering fine-grained bi. psammite
N 11: Flaggy white-weathering fine-grained bi. psammite
N 12: Massive white-weathering fine-moderate grained bi.psammite
N 13: Green-mica pelitic schist
N 14: Biotite-felspar pelitic schist
N 15: Pyrrhotite
N 16: Three samples: (Crystalline Quartz + Mica + ore x 2
(Green-mica Schist + Pyrite
N 17: Coarse grained bi. felspar schist
N 18: Three samples: (Qtz-musc.-pyrite schist, orange weathering x 2
(Crystalline quartz + felspar + mica + ore
N 19: Augen-gneiss with large felspar
N 20: Massive microfolded green-mica-biotote-felspar gneiss with magnetite
N 21: Quartzite
N 22: Bi-psammite with garnet and magnetite
N 23: Biotite schist + pyrite
N 24: Quartz
N 25: Orange-weathering qtz-musc-pyrite schist x 3
N 26: Qtz-musc-kyanite-pyrite rock
N 27: Amphibolite

STRUCTURAL SECTIONS

Drown across the Quartz and Alunina zones around Nasa.

The letters marking the ends of the sections are marked on the 1: 10 000 map.

Colour coding as for the map.

The sections are not designed to indicate more than was observed on the ground.

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on Geological Field Work in the Region around

NASA and BOLNA

July and August 1969

John Paul Platt

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The thickness of rock between the Alumina Zone and the Cambro-Silurian is probably in excess of 1 000 m in Randalselven.

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The zone is described from the east: Nasa: FRom the Swedish border to loc. (39) on the south side of the summit of Nasa (167.741), the crystalline quartz forms a continuous ridge. No mapping was done east of loc. (39).

Loc. (39): Width of outcrop: >100 m
Estimated thickness: ~ 20 m
Dip, south side: 40° S
north side: shallow but variable.

The quartz is pure, but contains occasional schist bands.

A little west, around loc. (36), the shallow variable dip is parallel to the hillside, and the quartz zone runs up towards the summit of Nasa. There are a number of quartz bands, from 0 to 5 m thick, but they are much mixed with schist. The large outcrop area contains little valuable quartz.

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Within the area mapped, the estimated outcrop area of uncontaminated quartz is about 100 000 sq. m. (Nasa).

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Loc. (25): Outcrop Dimensions: NE-SW: ~ 300 m
NW-SE: ~150 m
Dip, SW side: < 5°
Dip, SW side: ~ 30° SW
NE side:

West from loc. (25), the quartz is continuously exposed in a prominent ridge.

Loc. (24), (16), (N.15):

Length:		100 m
Width:	av.	60 m (locally 100 m)
Estimated thickness		~30 m
Dip:	av.	50° SW

Estimated area of outcrop of Main Body: 100 000 sq m

Quartz Stream. 100 m west of the end of the Main Body, at the top of "Quartz Stream", is a poorly exposed body of quartz. (See loc. 101). Further down, in the stream, are a number of smaller bodies (loc. 8, 9 and 10).

Loc. (10). Length 500 m
Width av. 10 m
Dip ~40° SW

Loc (8) and (9).

Total summated length		120 m
Width	av.	5 m
Thickness	av.	3 m
Dip	av.	40° SW

Estimated area of outcrop. Quartz Stream: 5 000 sq.m.

Bolnajavre Ridge. The quartz zone is not traceable for 1 km across Randalselven, but reappears in a direct line westwards at loc. (N.23). From there it widens considerably, farming a large, buckled near horizontal and very irregular outcrop on the ridge. The only significant outcrop of crystalline quartz is near loc. (N.24). See sketch map, p.32 of notes, and Sample N.24. Map reference (109,771).

Loc. (N.24): Outcrop Dimensions: N-S: 100 m
E-W: 50 m
Dip, Thickness and structure not discernible.

The quartz zone continuous approximately 500 m S.W. from loc. (N.21), then disappears.

Bolnabecken. 500 m further S.W. a thick zone of graphite schist and quartzite appears, and continnes three kilometres to the west, across Bolnabecken to Raufjellet. The zone there swings right round, and outcrops over a large area extending 2 kms N.W. to Raufjeldelven. No significant quantities of crystalline quartz were found.

Raufjeldelven. Where the zone meets this stream a substantial body of quartz occurs. Much of this outcrop is and mixed with ore and schist: the quality is not as high as it is east of Bolna. However, a considerable body of quartz is present.

Loc. (57): (a):	Length (SW-NE):		200 m
	Width:		50 m
	Thickness:		5 m
	Dip:		Shallow N.W.

This body is continuous east with:

(b):	Length:		300 m
	Width:	av.	10 m
	Theckness:		5 m
	Dip:		30° NW

The quartz zone continnes east up the hill, the next quartz body being

(c):	Length:		250 m
	Width:	av.	50 m
	Thickness:		5 m
	Dip:	variable	N

After an exposure gap, another body outcrops:

(d):	Length:		200 m
	Width:	av.	2 m
	Dip:	steep	N

The zone cannot be traced further.

Raufjeldelven, outcrop area: 26 000 sq.m.

IV Detailed Description of the ALUMINA ZONE.

The zone will be described from the east:

Nasa. The alumina zone, containing hard quartzites and psammites, forms a prominent ridge south of Nasa. However, no kyanite rock was found, only occasional crystals being seen (loc 29).

The zone can be traced downhill to loc (37), (140,743), from there to loc (13) there is semi-continuous exposure of kyanite rock. Blue, white and grey varieties are present, all containing much kyanite and some containing qtz, muscovite, or pyrite. The band is strongly folded, dips are frequently near vertical, and there may be more than one band of kyanite rock distributed amongst qtz-musc. schists, etc.

Loc 13: Length: ~400 m in 650 m ground
Width: 1 m in the east, 15 m in the west
av. ~ 8 m
Outcrop Area: 3 000 sq.m.

Hill (884 m). The zone can be traced down the north side of the knoll (summit 884 m). Outcrop of kyanite rock is rare, but both pure kyanite rock and blue qtz-musc schist (Sample N 5) are present. See sketch Map, p.21 of notes, and loc. (41).

Loc. 41: Thickness of band: 10 - 50 cms.
Outcrop area: < 20 sq.-m.
Folding is intense.

Radio Hut. In this vicinity the kyanite forms a group of outcrops, whose scattered disposition and internal contortion suggest violent folding. Dips are frequently near vertical. See sketch map, p 9. of Notes, and loc. (20).

Loc. (20): Outcrop area summated: approx. 400 sq.m.

Bolnajavre Ridge. The alumina zone is not definitely traceable for 2 kms across Randalselven. On the rest of Bolnajavre ridge however, the zone is thin (< 10 m) but distinct. Occasional outcrops of kyanite rock were seen.

Loc (53): Outcrop area: 0.2 sq.m.

Loc (51): Outcrop area: 2.5 sq.m.

Loc. N.25: Thickness: 2 cms.
Length: 3 m

Bolnabecken. The alumina zone (20 m wide) can be traced 500 m west from the stream (at N 25) to loc. (N.26). Here there is a substantical body of massive, grey, qtz-kyanite-musc.-pyrite rock, fairly rich in kyanite.

Loc. N. 26. Length (E-W): ~120 m
Thickness: av. 1½ m
Dip.: 20° S.E.

From here the alumina zone can be traced a further 300 m before it is obsured by drift.

Raufjellet 1. 1 km west of (N 26), at the bottom og a ridge running up towards Raufjellet, is a body of kyanite rock. (Lock 58). The band is locally 1 m thick, but it is strongly folded with other schist types, and it is difficult to estimate the quantity of kyanite rock present.

Loc 58. Area of outcrop, approx 3 000 sq.m.

Raufjellet 2. Towards the top of the ridge, ~800 m west of loc (58), the alumina zone outcrops over a large area, being broadly folded with the clips nearly parallel to the hillside. In the southerly limb a broad syncline, plunging S.E.:

Loc (56),a:	Length (NW-SE):	200 m
	Width:	15 - 30 m
	Thickness, estimated:	12 m
	Dip, at N.W. end	50° N.E.
	at S.E. end	shallow, buckled
(b):	Length:	100 m
	Width:	av. 3 m

V. Note on the STRUCTURE.

It would appear that the alumina zone and the sparagmite do not follow the quartz zone round to Raufjellelven. I.e: the anticline effecting the quartz does not affect the units above. It may be that the latter outcrop north outside the area mapped, but gneiss outcrops above the quartz zone for a least 1 km to the north of loc (54).

Thus it is possible that the alumina zone is part of the sparagmite, whereas the Irregular Gneiss and the Quartz zone arw integral parts of the Basement. The apparent parallrlism of the zones in the Nasa region may be a result og the tectionism.

If any discordance is present, it is probably at the base of zone D.

J. P. Platt

15. august 1969.

LIST OF SAMPLES

N 1: Moderate-grained bi-musc. s.p.s.
N 2: Graphite schist
N 3: Basement Granite
N 4: Irregular Coarse-grained gneiss
N 5: Blue qtz-musc. schist. From loc. (41)
N 6: Musc. s.p.s.
N 7: Flaggy moderate-grained bi-felspar gneiss
N 8: Fine-grained bi-musc. s.p.s. with fluorspar
N 9: Fine-moderate grained bi-musc. s.p.s. with accessories
N 10: Orange-weathering fine-grained bi. psammite
N 11: Flaggy white-weathering fine-grained bi. psammite
N 12: Massive white-weathering fine-moderate grained bi.psammite
N 13: Green-mica pelitic schist
N 14: Biotite-felspar pelitic schist
N 15: Pyrrhotite
N 16: Three samples: (Crystalline Quartz + Mica + ore x 2
(Green-mica Schist + Pyrite
N 17: Coarse grained bi. felspar schist
N 18: Three samples: (Qtz-musc.-pyrite schist, orange weathering x 2
(Crystalline quartz + felspar + mica + ore
N 19: Augen-gneiss with large felspar
N 20: Massive microfolded green-mica-biotote-felspar gneiss with magnetite
N 21: Quartzite
N 22: Bi-psammite with garnet and magnetite
N 23: Biotite schist + pyrite
N 24: Quartz
N 25: Orange-weathering qtz-musc-pyrite schist x 3
N 26: Qtz-musc-kyanite-pyrite rock
N 27: Amphibolite

STRUCTURAL SECTIONS

Drown across the Quartz and Alunina zones around Nasa.

The letters marking the ends of the sections are marked on the 1: 10 000 map.

Colour coding as for the map.

The sections are not designed to indicate more than was observed on the ground.

FIELD NOTES

Taken while mapping in the region

around

BOLNA AND NASA

July and August 1969

J. P. Platt

I 22nd July - 30th July. Pages 1 - 14

042.004

BOLNA 22. July

1) In stream 800 m south of radio hut, near two small lakes. Fine-grained banded semipelitic schists (almost gneisses). Very massive. Some rusty-weathering grains.
Sligth flexuring 80/225
70/228
90/240

2) In stream 600 m south of radio hut, 300 m east of (1). Massive pale semipelites continne to stream. Then Fine-moderate grained biotite schists, sometimes very dark. All massive.
75/234

Rusty weathering grains, flecks of pyrite and iron ores, calcite grains 2-5 mms diam.
Some fine augen texture, and microfolding. Previous "S" has distinctive outcrop on glaciated surfaces.

North side of stream : rock paler : schistosity irregular, grainsize variable. Flecks of galena and band of purple mineral (fluorspar) along the schistosity. (Specimen N 8)

Rocks contain muscovite: not seen at loc (1). Ptygmatic quartz veins.

3) 100 m north of (2), over stream, fine-grained pale bi-musc, semipelitic schist. Coarser than that at (1). Local flecks of haematite.

4) 200 m north of (3) Scarce outcrop. Musc semipelites (in place) dipping east.

5) On hill (758) 200 m south of radio hut. Coarse-grained musc.-bi. semipelitic schists, and qtz-musc. schists strongly microfolded and very irregular dip. Generally N.E. 45/045

6) 100 m north of 5), over hill (758). Fine grained qtz-musc.-pyrite schists. 80/050.

7) In stream 400 m east of radio hut. Coarse bi. gneiss with good schistosity and occasional augen texture. Also qtz, felspar
70/030.

8) In next stream north, 200 m N.E. of 7).
Crystalline quartz. Not seen further west, down stream. Some ironstaining, but the quartz is fairly pure.
Dip: 55/216
Joints: 60/015
45/026
85/312

Just downstream (structurally below quartz) rusty weathering graphitic schist, and with im pure, fine-grained quartzite. North of stream, irregular coarse grained augen gneiss.

Immediately below quartz, massive jointed fine-grained bi.-musc. semipelitic schist, conformable with quartz. 40/230.

Qtz-body as seen: 30 m long (east-west), maximum 5 m thick. Above and south of quartz, banded fine-grained semipelites, then fine-grained augen gneiss. Buckled, but dip generally south-west.
85/238.
45/220.

Upstream, pale semipelitic and psammitic schist exposed below quartz, then coarse augengneiss.

100 m upstream, no quartz. Sequence seen:

	Foliated gneiss	
	Massive psammites	.5 m
up	Graphite schist	0.5 m
	Banded quartzite	2 m
	Grap	3 m
	Coarse augen gneiss.	

Schists continne upstream, dip steep south or vertical, strike undulating.

9) 400 m upstream form (8), 1 km east of radio hut. Crystalline quartz body 40 m long, 2-3 m thick, lying directly on augen gneiss, no graphitic schist. Massive fine-grained bi.semipelites above, then calcareous fine-grained bi. schists.

100 m further upstream, qtz body 50 m x 3 m. Rests conformably above 1 m massive bi.semipelite, then coarse augéngneiss
35/190.

10) 400 m upstream (east) of (9), just south of stream. Very coarse irregular biotite gneiss with pink felspar. Poorly developed and inconsistent schistosity. Highly contorted qtz-bi. gneisses in stream. Below about

1 m x 10 m schist heavely veined with quartz. Coarse augen gneiss below.

Irregular gneiss continuous south to next stream.

11) In stream 800 m upstream from (7), 300 m south of (10). Coarse irregular bi.-gneiss with some augen texture. Strongly folded schistosity

All vertical. Overall E-W strike.

30 m south-east, banded and contarted bi.-musc. gneiss, nearly horizontal.
200 m downstream, imfoliated gneiss in stream. 50 m further: 70/200.

12) Abandoned. See locality (41).

13) Just west of hill (934 m), 1.6 km east of radio hut. Massive white and pale-blue qtz-kyanite-musc. rock. Some very rich kyanite rock. Also small pure crystalline quartz bodies, and patches of coarsely crystalline radiating pyrophylite. Schistosity near vertical, but contorted 85/035.

Continnes sparadically 200 m to east.

BOLNA 23. July

14) Quartz stream. North bank, 300 m east of (9).
Coarse irregular augengneiss with poor schistosity.

Further northeast, schistosity decreases, grainsize increases: grades into coarse granite gneiss: felspar, biotite a little quartz. Lithology continnes north to lake, east up stream on north side. Moderate grained augen gneiss. Foliation approx horizontal, flexured about E-W axes on 10 m scale 15/266.

Small bondin (2 x 1 m) of crystalline quartz in augengneiss. Further up, in stream bed, 5 - 10 cm quartz vein with nodules of galena ~5 cms diam.

15) 1 km southeast of lake (858 m), 1-3 kms upstream from (14). 50 m south of stream lower contact of large quartz body. No exposure below, but much ore in boulders and at base of quartz. Qtz-pyrrhotite-pyrite rock. Sample N 15.

400 m east, at west end of lake, schistosity in semipelitic schists below quartz: 45/226
in quartz: 45/236
Quartz apparently concordant.
Thickness of quartz, which forms prominent ridge, difficult to estimate. Possibly 50 m.

Moraine filled decression on south side, but patches of schist adere to the quartz indicating steep southerly dip.

16) 200 m south of (15), across channel. Coarse augengneiss 55/222. Lying above, massive, very hard felspathic amphibolite lacking visible foliation.

50 m west down ridge augengneiss lies under amphibolite with a shallow dip 10/130

16a) 200 m southwest of (16). After exposure gap, banded felspathic amphibolite with strong schistosity and much meso-folding. Banded quartzite within gabbro ∿ 10 cms thick

Plunge of fold axis: 55/238
10/160

Walked across hill (884) See locality (41)

17) 200 m west of hill (884 m), on south side og ridge. Qtz-musc schists, weathering organge. Nearly vertical, striking N-S. Estwards, pass into buckled beds.

Steep limb 75/216
1 m scala buckles Also 80/058
overturned.

100 m south: pale fine grained musc.-bi. semipelitic schist. South across buckled schists with overall southerly dip. Some moderate grainsize muscovite schists and biotite schists in band. Some fine-grained augen texture.

18) 600 m south of (17). Isolated exposure of fine grained bi. semipelitic and psammitic schists. Some quartzites. Lithology like that of (1).

50/228

BOLNA 24. July

19) 800 m west of (1), 1-2 kms southwest of radio hut, between two streams. Very massive fine grained bi. semipelitic schists, or gneiss. Looks like fine grained granite gneiss. 45/214.

20) Radio hut on hill (749). Scattered outcrops of strongly folded qtz-muscovite schists (orange weathering) and qtz-kyanite rock. Scattered pyrite in both types.

Kyanite rock white or pale blue, litle weathering. Kyanite visible on surface as 1 - 5 mm grains. More competent than surrounding schists, forms metre scale folds, approximately all in vertical plane.

See scale drawing of outcrops, next sheet.

100 m north of hut, contorted green mica schists, approx vertical.

Sketch map of kyanite outcrops around radio hut on hill [749 m].

Scale approx: 1 cm = 6 m.

45° 055 →

: KYANITE

: Qtz-musc Schist.

21) 1 km north of radio hut, 300 m north of quartz stream. Isolated outcrop of massive poorly foliated irregular coarse crystalline rock. Green and pink felspar, much biotite, a litle quartz.

400 m west, by quartz stream, well foliated mafic gneiss (felspar + biotite). Vertical, strike 308.

22) Just north of bridge over Randalselven on west bank. Fine grained massive bi. semipelites and psammites. Dip fairly constant 20/138. Flaggy apperance.
100 m upstream a few metres down section, 1/2 m band of pale bi. psammite with minute red garnets and numerous flecks of magnetite. Sample N 22. Dip as before.

150 m further, some lithology. 50/208.

Wet weather.

BOLNA 25. July

23) Stream south of quartz stream. 800 m east of (11), 1 -8 kms east of radio hut. Irregular coarse grained biotitic gneiss. 75/028.

Northeast contact of gabbro with gneiss traced. Contact irregular, veins into gneiss. Intrusive relations: rotation of gneiss blocks. Also qtz-felspar veins in gabbro. ("Gabbro": always felspathic amphibolite and epidote amphibolite: fairly coarse grained).

Gneiss near gabbro vertical, dip rapidly shallows away from it: 45/246.

Across channel with no exposure to quartz:

24) South side of qtz ridge, 500 m east of (16). Flakes of fine-grained biotite semipelitic schist attached to quartz. 50/252.
Width of qtz body at this point ~100 m on the ground.
North side. Contact conformable 30/242.
Below a few metres of biotite psammitic gneiss, then coarse augen-gneiss.

25) On quartz, near marsh and lake 300 m south of (24). Quartz layer turns horizontal, and the outcrop forms a lobe to the south.
Thin patches of schist on surface. Dip < 5° to south.
Eastwards: 20/190
Then augen gneiss appears to east. End of quartz body. Eastwards, thin band of contorted graphitic and other schists, dipping to S-E., between the gneisses. Band runs eastwards in gully.

26) Abandoned. See locality (36).

27) Across marsh 200 m west of (25). Coarse augen gneiss. 50/310.

28) S.E. side of Gabbro. 200 m east of hill (1055 m), 100 m west of (27). Coarse augen gneiss. 85/340.
Gneiss folded round gabbro, dips beneath it. But dips always steepen towards it. No Continuous exposure on south side.

Graphite schist, contorted, 50 m east of (28). Gabbro tongues in augen gneiss, all vertical, 200 m south of (28).
400 m southeast of (28), microfolded mica semipelitic schists and musc. psammites in contact with augen gneiss.
Vertical. Strike ~ 300.

29) 100 m northwest of hill (1068 m), 3 - 2 kms southeast of radio hut. Long ridge formed of orange weathering muscovite schists, and some very clean banded quartzites 1 - 5 m thick. A litle kyanite seen, but rocks largely quartz. Rocks mainly vertical, but folded. Overall strike ~ 300. On north side, steep S-W dips.

30) In boulder filled gully, 200 m SW of (28).
Schistz (in place ?). 45/105.

31) West side of gabbro. 200 m west of hill (1055 m) foliated ampibolite, vertical, in conformable contact with augen gneiss.
Strike 044.
Gneiss streaked, locally thrust and contorted. Becomes increasing schistose westwards. Then 5 m graphite schist, and then green mica schists, all vertical, contorted.
Very sharp fold about N-S axis bungs sequence into horizontal. In crags 100 m south of stream, near horizontal graphite schists seen above augen gneiss. Dip gentle southwards.

Sequence seen:

Green mica schist		
Graphite schist	5 m	
Biotite schist	3-5 m	
Quartzite	0.5 m	
Schistose augen gneiss		50 m
Coarse augen gneiss		
Gabbro		

500 m west, 200 m south of stream and loc (23) contorted graphite schist, dipping gently south, overlain by microfolded green mica schists.

BOLNA 27. July

32) By small stream, 400 m east of Randalselven, 600 m S-E of Bolna Station. Fine grained bi. s.p.s. (semi-pelitic schist).
50/224
Isolated exposure. Ground much covered by drift and forest.

33) 400 m east of Randalselven, 600 m east of Bolna Station. Fine-moderate grained bi.-musc. s.p.s.
Gently buckled beds. 25/190

No further exposure up to quartz stream. In stream, 400 m north of radio hut, coarse irregular biotitic gneiss 30/046

Up quartz stream, mapping in outcrops. See localittes (8), (9) and (10).

Above locality (10), no exposure for 200 m. Then varied schists in stream 40/176
100 m upstream, quartz body appeare, thickens from 0 - 10 m in 30 m. Northern margin observed, but quartz continuous uphill with hardened, contorted graphite schists and black calcareous biotite schists on southern margin, then augen gneiss above 50/186.
700 m above (10), over 50 m ground exposure of sediments above quartz.
Quartz irregular and much contaminated by sediment. On southern margin, fills tension gashes in contorted schist.

Qtz body apparently not quite connected with body forming main ridge.

25 a) Eastern end of quartz ridge: 400 m N.E. of loc (25). Small qtz body (25 m x 2 m), apparently within "basement" augen gneiss, below main, quartz horizon. Augen gneiss above and below: all dip south
25/192
50 m along strike, east, another small body, mainly veined agein gneiss.
Series of veined patches connect this eastwards with another body, (15 m x 1 m), with psammitic schist above and below.
This passes into 2 - 3 m quartzite + psammites in tight buckle fold.
Thins to nothing eastwards.

35) 400 m west of summit (1213 m). Augen gneiss with intercalated bands of psammite. 25/342.

Quartz and contorted schist, all buckled, lie south and structurally above, dipping generally south down hillside. Several discontinuous 1 m quartz bands.

36) Quartz band passing into white banded quartzite. East of small pond, 400 m south of (35), 700 m S.W. of summit 25/226.
Quartz irregular and of varied thickness: 1 - 3 m.

Sketch section:

50 m east, NE-SW gully exposes augen gneiss right up the hill.

100 m west, on east side of pond:

100 m further west, on the west side of pond:

BOLNA 28. July

37) S.E. end of big kyanite body, 600 m S-E og (13). Thin band of contorted kyanite ~ 1 m. Massive quartzites and qtz-musc. Schists associated 85/230.

Om ridge, around hill (1038 m), very strongly contorted qtz-musc. schists.

Around loc. (29) qtz-musc. schists and quartzites. On north side, on the ridge, green mica schists.

Much qtz veining. Small patches of fluorspar in qtz.

No kyanite seen.

38) On north side of ridge, 500 m S-E of hill (1068 m). Psammites and semipelites dip under yellow weathering contorted muscovite schist.

On top of ridge, quartzites and qtz-musc. schists strongly contorted. General appearance of vertical dip, strike 300.

Flow folds in psammites: 10 cm scale.

39) No exposure in gully to north. Hillside across gully, 1 km east of hill (1068 m), 900 m S.W. of summit (1213 m), quartz, buckled dipping steeply down hill. Black biotite schists above, also schists and banded quartzite within it 40/220.

Quartz body as a whole ~ 20 m thick
500 m NW, augen gneiss. 30/200
Calcareous black biotite schists associated with quartz.

Thin band of graphitic schists running east from (25) not traceable into schists associated with (36) and (39) 50 m exposure gap.

No exposure between loc (25 a) and the lake north of the quartz ridge, along strike.

Between lakes, near horizontal augen gneiss. On north side of quarts body, hardened and brecciated schist mingled with quartz.

On south side of western lake, nearly 1 m of coarse breccia cemented by quartz.

BOLNA 29. July.

Revisited loc (20)
Revisited loc (5) (6). Mainly qtz-muscovite schists, at (5), two 10 cms bands of harder qtz-musc. rock irregularly developed. One isolated 2 x 1 m outcrop of kyanite rock S-E of (5). A little north, some 50 cm quartzites, strongly folded.
Overall strike to NW.

Knoll (763 m) above loc (5), bi. s.p.s. either side of microfolded qtz-musc. schist.

41) Hill (884 m), and around. See sketch map.

(a) Moderate grained bi.-musc. s.p.s. Much microfolded, and contorted. Dip generally near vertical, strike about 325.
Also 70/068.

(b) Orange weathering qtz-pyrite-musc. schists. Strong development of two schistosities very confusing.

(c) Sample locality N 5. At bottom of crag, fairly dark moderate grained bi. s.p.s. Considerable microfolding 30/196
Massive s.p.s. no microfolding, just above 40/196.
Then strongly contorted qtz-musc. schist with 10 cm band of blue weathering kyanite rock. Strongly folded on 10 sm scale.
Fold axis plunges 20/122.
Outcrop passes out of hill westwards. Eastwards, passes into band including 1/2 m of blue qtz-musc. rock. Specimen N.S.
Also, pyritous, quartzites, and rusty coarse-grained muscovite schists.

5 m length of kyanite outcrop.

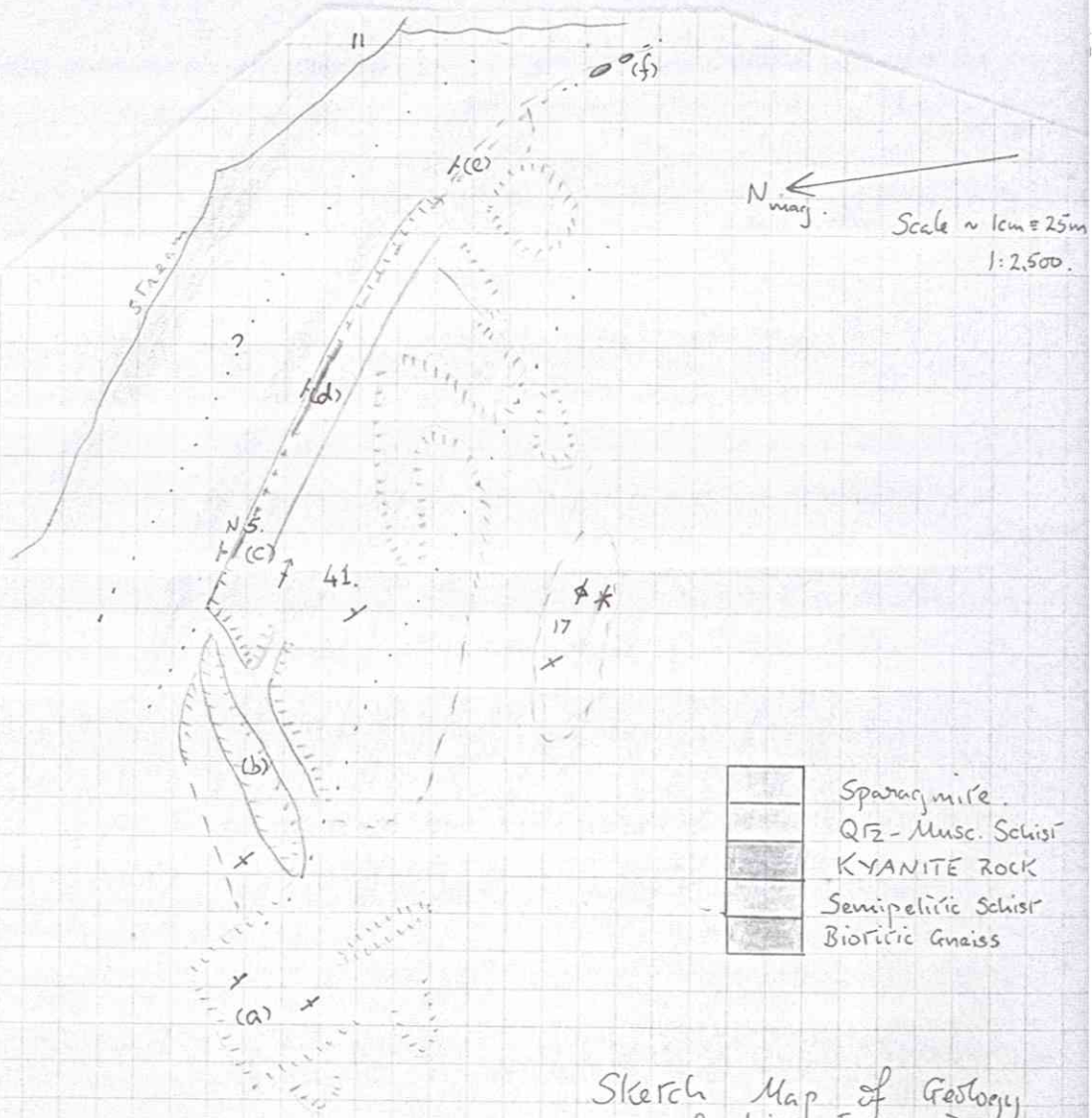
Sketch section:

On top, red orange qtz-musc schist: 65/058.

(d) Kyanite rock reappears: 20 cms thick, but deffuse margins.
Gently dipping: uphill, gradual transition into contorted beds:

(e) Bi-musc. s.p.s. 60/218
On summit, gently dipping qtz-pyrite-musc. schist.

(f) Kyanite body. Outcrop about 15 m x 1/2 m. Not continuous.



Sketch Map of Geology around hill [884 m].

Locality (13) Revisited.

To north, by small stream, very foliated gneiss, and moderate grained bi.-musc. s.p.s. with rusty weathering grains, all nearly horizontal.

Kyanite body about 15 m thick. Vertical on north side. South side 30/196.

Eatwards, across gully, vertical. contorted psammites and s.p.s. with rusty cavities. Just uphill, green mica s.p.s. horizontal. Increase in grainsize and foliation uphill.

Revisited loc 31.
Revisited loc 16 a.

700 m NW of radio hut, but 11th power pole down: contorted qtz-musc. schist. No kyanite seen. 50 m south, over stream and power line, moderate grained bi.-musc. s.p.s.

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75/234

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Some fine augen texture, and microfolding. Previous "S" has distinctive outcrop on glaciated surfaces.

North side of stream : rock paler : schistosity irregular, grainsize variable. Flecks of galena and band of purple mineral (fluorspar) along the schistosity. (Specimen N 8)

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85/238.
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	Foliated gneiss	? m
	Massive psammites	0.5 m
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	Grap	3 m
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All vertical. Overall E-W strike.

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Plunge of fold axis: 55/238
10/160

Walked across hill (884) See locality (41)

17) 200 m west of hill (884 m), on south side og ridge. Qtz-musc schists, weathering organge. Nearly vertical, striking N-S. Estwards, pass into buckled beds.

Steep limb 75/216
1 m scala buckles Also 80/058 overturned.

100 m south: pale fine grained musc.-bi. semipelitic schist. South across buckled schists with overall southerly dip. Some moderate grainsize muscovite schists and biotite schists in band. Some fine-grained augen texture.

18) 600 m south of (17). Isolated exposure of fine grained bi. semipelitic and psammitic schists. Some quartzites. Lithology like that of (1).

50/228

BOLNA 24. July

19) 800 m west of (1), 1-2 kms southwest of radio hut, between two streams. Very massive fine grained bi. semipelitic schists, or gneiss. Looks like fine grained granite gneiss. 45/214.

20) Radio hut on hill (749). Scattered outcrops of strongly folded qtz-muscovite schists (orange weathering) and qtz-kyanite rock. Scattered pyrite in both types.

Kyanite rock white or pale blue, litle weathering. Kyanite visible on surface as 1 - 5 mm grains. More competent than surrounding schists, forms metre scale folds, approximately all in vertical plane.

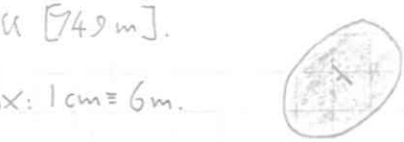
See scale drawing of outcrops, next sheet.

100 m north of hut, contorted green mica schists, approx vertical.

9

Sketch map of kyanite outcrops around radio hut on hill [749 m].

Scale approx: 1 cm ≡ 6 m.



: KYANITE

: Qtz-musc Schist.

21) 1 km north of radio hut, 300 m north of quartz stream. Isolated outcrop of massive poorly foliated irregular coarse crystalline rock. Green and pink felspar, much biotite, a litle quartz.

400 m west, by quartz stream, well foliated mafic gneiss (felspar + biotite). Vertical, strike 308.

22) Just north of bridge over Randalselven on west bank. Fine grained massive bi. semipelites and psammites. Dip fairly constant 20/138. Flaggy apperance.
100 m upstream a few metres down section, 1/2 m band of pale bi. psammite with minute red garnets and numerous flecks of magnetite. Sample N 22. Dip as before.

150 m further, some lithology. 50/208.

Wet weather.

BOLNA 25. July

23) Stream south of quartz stream. 800 m east of (11), 1 -8 kms east of radio hut. Irregular coarse grained biotitic gneiss. 75/028.

Northeast contact of gabbro with gneiss traced. Contact irregular, veins into gneiss. Intrusive relations: rotation of gneiss blocks. Also qtz-felspar veins in gabbro. ("Gabbro": always felspathic amphibolite and epidote amphibolite: fairly coarse grained).

Gneiss near gabbro vertical, dip rapidly shallows away from it: 45/246.

Across channel with no exposure to quartz:

24) South side of qtz ridge, 500 m east of (16). Flakes of fine-grained biotite semipelitic schist attached to quartz. 50/252.
Width of qtz body at this point ~100 m on the ground.
North side. Contact conformable 30/242.
Below a few metres of biotite psammitic gneiss, then coarse augen-gneiss.

25) On quartz, near marsh and lake 300 m south of (24). Quartz layer turns horizontal, and the outcrop forms a lobe to the south. Thin patches of schist on surface. Dip $< 5^{\circ}$ to south. 20/190
Eastwards:
Then augen gneiss appears to east. End of quartz body. Eastwards, thin band of contorted graphitic and other schists, dipping to S-E., between the gneisses. Band runs eastwards in gully.

26) Abandoned. See locality (36).

27) Across marsh 200 m west of (25). Coarse augen gneiss. 50/310.

28) S.E. side of Gabbro. 200 m east of hill (1055 m), 100 m west of (27). Coarse augen gneiss. 85/340.
Gneiss folded round gabbro, dips beneath it. But dips always steepen towards it. No Continuous exposure on south side.

Graphite schist, contorted, 50 m east of (28). Gabbro tongues in augen gneiss, all vertical, 200 m south of (28).
400 m southeast of (28), microfolded mica semipelitic schists and musc. psammites in contact with augen gneiss.
Vertical. Strike ~ 300.

29) 100 m northwest of hill (1068 m), 3 - 2 kms southeast of radio hut. Long ridge formed of orange weathering muscovite schists, and some very clean banded quartzites 1 - 5 m thick. A litle kyanite seen, but rocks largely quartz. Rocks mainly vertical, but folded. Overall strike ~ 300. On north side, steep S-W dips.

30) In boulder filled gully, 200 m SW of (28).
Schists (in place ?). 45/105.

31) West side of gabbro. 200 m west of hill (1055 m) foliated ampibolite, vertical, in conformable contact with augen gneiss.
Strike 044.
Gneiss streaked, locally thrust and contorted. Becomes increasing schistose westwards. Then 5 m graphite schist, and then green mica schists, all vertical, contorted.
Very sharp fold about N-S axis bungs sequence into horizontal. In crags 100 m south of stream, near horizontal graphite schists seen above augen gneiss. Dip gentle southwards.

Sequence seen:

Green mica schist	
Graphite schist	5 m
Biotite schist	3-5 m
Quartzite	0.5 m
Schistose augen gneiss / Coarse augen gneiss	50 m
Gabbro	

500 m west, 200 m south of stream and loc (23) contorted graphite schist, dipping gently south, overlain by microfolded green mica schists.

BOLNA 27. July

32) By small stream, 400 m east of Randalselven, 600 m S-E of Bolna Station. Fine grained bi. s.p.s. (semi-pelitic schist).
50/224
Isolated exposure. Ground much covered by drift and forest.

33) 400 m east of Randalselven, 600 m east of Bolna Station. Fine-moderate grained bi.-musc. s.p.s.
Gently buckled beds. 25/190

No further exposure up to quartz stream. In stream, 400 m north of radio hut, coarse irregular biotitic gneiss 30/046

Up quartz stream, mapping in outcrops. See localittes (8), (9) and (10).

Above locality (10), no exposure for 200 m. Then varied schists in stream 40/176
100 m upstream, quartz body appeare, thickens from 0 - 10 m in 30 m. Northern margin observed, but quartz continuous uphill with hardened, contorted graphite schists and black calcareous biotite schists on southern margin, then augen gneiss above 50/186.
700 m above (10), over 50 m ground exposure of sediments above quartz.
Quartz irregular and much contaminated by sediment. On southern margin, fills tension gashes in contorted schist.

Qtz body apparently not quite connected with body forming main ridge.

25 a) Eastern end of quartz ridge: 400 m N.E. of loc (25). Small qtz body (25 m x 2 m), apparently within "basement" augen gneiss, below main quartz horizon. Augen gneiss above and below: all dip south
25/192
50 m along strike, east, another small body, mainly veined agein gneiss.
Series of veined patches connect this eastwards with another body, (15 m x 1 m), with psammitic schist above and below.
This passes into 2 - 3 m quartzite + psammites in tight buckle fold.
Thins to nothing eastwards.

35) 400 m west of summit (1213 m). Augen gneiss with intercalated bands of psammite. 25/342.

Quartz and contorted schist, all buckled, lie south and structurally above, dipping generally south down hillside. Several discontinuous 1 m quartz bands.

36) Quartz band passing into white banded quartzite. East of small pond, 400 m south of (35), 700 m S.W. of summit 25/226. Quartz irregular and of varied thickness: 1 - 3 m.

Sketch section:

50 m east, NE-SW gully exposes augen gneiss right up the hill.

100 m west, on east side of pond:

100 m further west, on the west side of pond:

BOLNA 28. July

37) S.E. end of big kyanite body, 600 m S-E og (13). Thin band of contorted kyanite : ~ 1 m. Massive quartzites and qtz-musc. Schists associated 85/230.

On ridge, around hill (1038 m), very strongly contorted qtz-musc. schists.

Around loc. (29) qtz-musc. schists and quartzites. On north side, on the ridge, green mica schists.

Much qtz veining. Small patches of fluorspar in qtz.

No kyanite seen.

38) On north side of ridge, 500 m S-E of hill (1068 m). Psammites and semipelites dip under yellow weathering contorted muscovite schist.

On top of ridge, quartzites and qtz-musc. schists strongly contorted. General appearance of vertical dip, strike 300.

Flow folds in psammites: 10 cm scale.

39) No exposure in gully to north. Hillside across gully, 1 km east of hill (1068 m), 900 m S.W. of summit (1213 m), quartz, buckled dipping steeply down hill. Black biotite schists above, also schists and banded quartzite within it 40/220.

Quartz body as a whole ~ 20 m thick
500 m NW, augen gneiss. 30/200
Calcareous black biotite schists associated with quartz.

Thin band of graphitic schists running east from (25) not traceable into schists associated with (36) and (39) 50 m exposure gap.

No exposure between loc (25 a) and the lake north of the quartz ridge, along strike.

Between lakes, near horizontal augen gneiss. On north side of quarts body, hardened and brecciated schist mingled with quartz.

On south side of western lake, nearly 1 m of coarse breccia cemented by quartz.

BOLNA 29. July.

Revisited loc (20)
Revisited loc (5) (6). Mainly qtz-muscovite schists, at (5), two 10 cms bands of harder qtz-musc. rock irregularly developed. One isolated 2 x 1 m outcrop of kyanite rock S-E of (5). A little north, some 50 cm quartzites, strongly folded.
Overall strike to NW.

Knoll (763 m) above loc (5), bi. s.p.s. either side of microfolded qtz-musc. schist.

41) Hill (884 m), and around. See sketch map.

(a) Moderate grained bi.-musc. s.p.s. Much microfolded, and contorted. Dip generally near vertical, strike about 325.
Also 70/068.

(b) Orange weathering qtz-pyrite-musc. schists. Strong development of two schistosities very confusing.

(c) Sample locality N 5. At bottom of crag, fairly dark moderate grained bi. s.p.s. Considerable microfolding 30/196
Massive s.p.s. no microfolding, just above 40/196.
Then strongly contorted qtz-musc. schist with 10 cm band of blue weathering kyanite rock. Strongly folded on 10 cm scale.
Fold axis plunges 20/122.
Outcrop passes out of hill westwards. Eastwards, passes into band including 1/2 m of blue qtz-musc. rock. Specimen N.S.
Also, pyritous, quartzites, and rusty coarse-grained muscovite schists.

5 m length of kyanite outcrop.

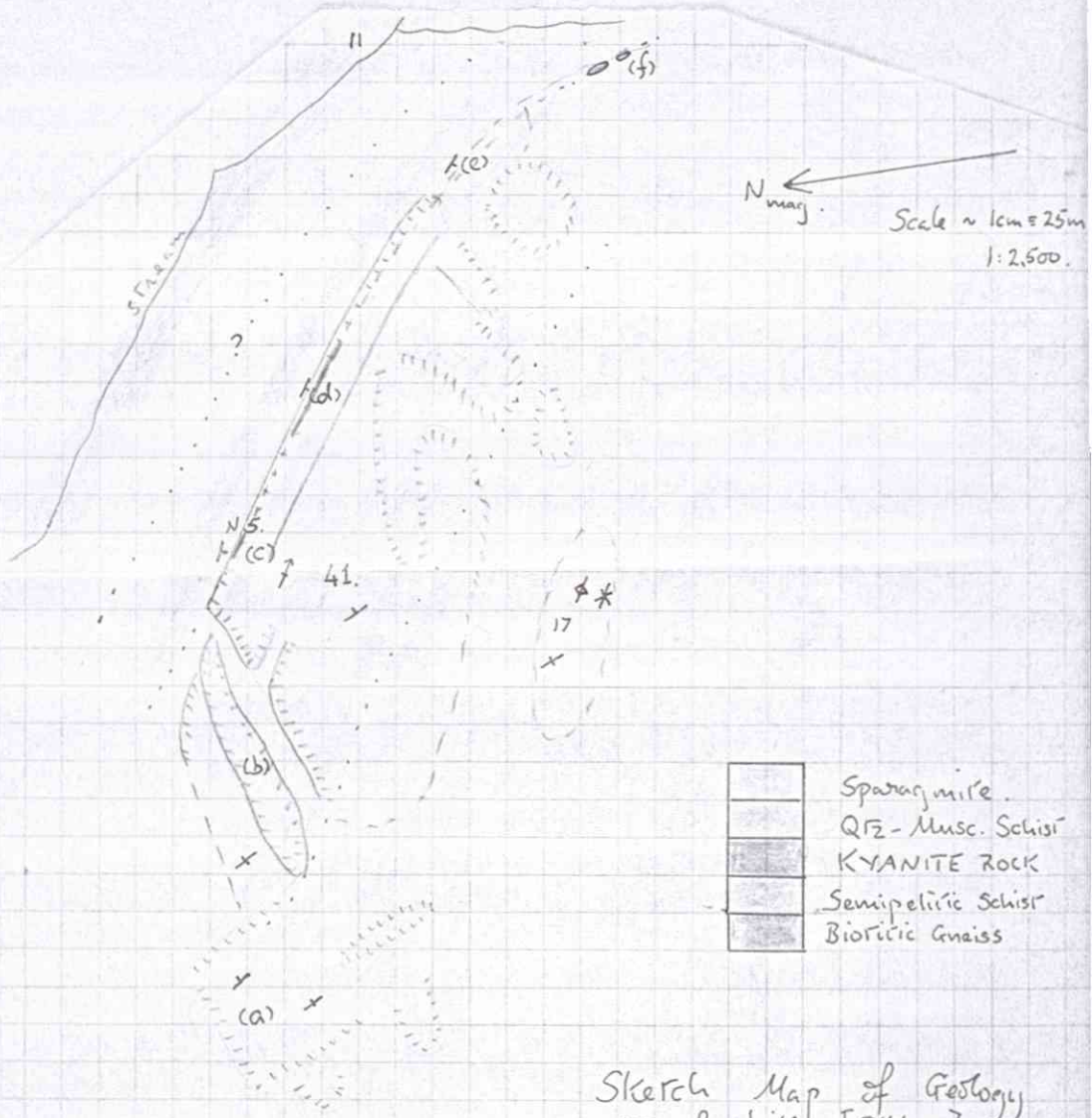
Sketch section:

On top, red orange qtz-musc schist: 65/058.

(d) Kyanite rock reappears: 20 cms thick, but deffuse margins.
Gently dipping: uphill, gradual transition into contorted beds:

(e) Bi-musc. s.p.s. 60/218
On summit, gently dipping qtz-pyrite-musc. schist.

(f) Kyanite body. Outcrop about 15 m x 1/2 m. Not continuous.



Sketch Map of Geology around hill [884 m].

Locality (13) Revisited.

To north, by small stream, very foliated gneiss, and moderate grained bi.-musc. s.p.s. with rusty weathering grains, all nearly horizontal.

Kyanite body about 15 m thick. Vertical on north side. South side 30/196.

Eatwards, across gully, vertical. contorted psammites and s.p.s. with rusty cavities. Just uphill, green mica s.p.s. horizontal. Increase in grainsize and foliation uphill.

Revisited loc 31.
Revisited loc 16 a.

700 m NW of radio hut, but 11th power pole down: contorted qtz-musc. schist. No kyanite seen. 50 m south, over stream and power line, moderate grained bi.-musc. s.p.s.

FIELD NOTES: BOLNA and NASA

J.P. Platt.

Pages 15 - 25

31. July - 11. August

042.005

BOLNA 31. July

East bank of Randalselven: working upstream from bridge. Lithology changes from fine grained bi.s.p.s. and psammitic schist to moderate-coarse grained bi.-musc. s.p.s. and psammites a little above loc (N 22).

N 1) 300 m upstream from bridge: end of exposure in stream. Moderate grained bi.-musc. s.p.s. with ore. Heavily weathered. Gentle flexuring. 50/150. Sample.

42) 500 m up from bridge, opposite generator. Isolated exposure of fine grained bi.- musc.- s.p.s. 60/210.
No further exposure on east bank until quartz stream.

N 2) Gorge of quartz stream 350 m east of Randalselven. Steeply dipping graphite schists with small quartz bodies. >6 m s.p.s. above. Sample 70/217.
Upstream, above and south of graphite schists, schistose irregular gneiss and augen gneiss. North, finer grained, microfolded, schistose gneiss directly overlies locally folded graphite schist. Graphite schist followed up hill, north of stream, gneiss to the south, and foliated musc. augen-gneiss to the north.

N 3) 150 m north of quartz stream, 250 m east of (N 2). Unfoliated "Granite". Qtz-felspar-biotite rock: biotite in large aggregates, possibly pseudomorping, amphibole. "Basement": structurally below graphite schist: passer up into augen gneiss. Sample.

N 4) Quartz stream, 200 m S.E. of (N 2). Coarse-grained irregular gneiss. Rough foliation. 40/072.
Sample.
5 cms bands of schist in gneiss parallel to foliation. Downstream, easterly dip steepens, passes trough vertical to steep westerly overlying graphite schist.

43) Gully east of and parallel to Randalselven. 200 m S.E. of Randalselven, 400 m west of (N 2). Coarse biotite schists and moderate-coarse grained bi.-musc. s.p.s. 85/040.

N 6) By stream, 350 m S.E. of Randalselven, 650 m south of quartz stream. Gentle anticline in musc. psammites and s.p.s. Some contortion and qtz veining. Sample.

N 7. West bank of Randalselven, 450 m N.E. of Bolna Station. Flaggy moderate grained biotite felspar gneiss. Some coarse layers with augen texture. Gentle irregular buckles. Sample 25/063.
North, coarse felspathic augen-gneiss (in place ?), then varied moderate grained bi. s.p.s. and bi.- musc.-pelitic schists.
300 m north of (N 7), coarse bi.-felspar varied augen-gneiss.

BOLNA 2nd August

Visitors.

N 9) Hillside. 1 - 6 kms S.E. of radio hut, 300 m south of (13). Fine-moderate grained bi.-musc. s.p.s. Somewhat microfolded. Much green mica, muscovite, also calcite, ore graines, and rusty cavities.
Sample.
Dip constant. 30° to S.
Pass up into fine grained flaggy bi. s.p.s. and gneisses.

N 10) 150 m south of (N 9). Fine grained bi. psammite. Weathered pale orange. Sample.
Dip as before.

N 11) 150 m S.E. of (N 10). Fine-grained bi. psammite with iregularly distributed 1-2 mm quartz grains. Very flaggy. White weathering.
Sample. 10° to S.E.

Traverse S.E. over much similar rock all dipping 10 -20° to south.

N 12) 500 m S.E. of (N 11). Fine moderate grained massive bi.-psammite. White weathering.
Sample. 20° to S.

N 13) 600 m south of (N 12). Moderate grained massive green-mica. s.p.s., weathering white. Passes south into green-mica pelitic schist. Sample 30° to S.W.

Traverse south over green-mica schists. Dip steepens steadily to about 70° S.W.

N14) 250 m north of hill (939 m). 2 - 7 km. S.E. of radio hut.
250 m S.W. of (N 13).
15 m band og steeply dipping bi.felspar pelitic schist.
Sample.
Then s.p.s. with biotite schist bands. Near summit, another 15 m biotite rock: much harder and more massive than previous one.
Summit: near vertical crinkled qtz-green mica schist. Strike N-S.

BOLNA 3rd August

44) West side of Randalselven valley. In Bolnabecken 500 m S.W. of Bolna Station, 50 m west of railway.
Fine-grained bi.psammite and moderate-grained green-mica. s.p.s.
Gentle buckled. 20/184.
Stream roughly parallel to strike, but cuts down section a little.
Upstream, 1 m band of bi. schist, some moderate grained musc.-bi. s.p.s., and much fine-grained biotite psammite.
Traverse south from bend in stream. Much fine-grained bi.psammite moderate grained g.m. s.p.s. (green-mica semi-pelitic schist). Occasional bands rich in green mica or biotite. Very occasional minute (1/4 mm) garnets, and one isolated garnet aggregate (2 cms diam) seen.
Dips all shallow southerly.

N 16) 500 m S.W. of Bolnabecken, 1 - 3 kms west of Bolna Station. g.m. s.p.s. 15/176.
In stream 10 m south, band of contorted crystalline quartz and green mica, 20 cms thick. Ore particles, and green and red staining.
2 Samples.
Just above, green-mica schist with scattered pyrite. Sample.

Traverse south. Other small quartz veins seen with rims of chloritized biotite.

N 17) 500 m south of (N 16). Coarse-grained felspathic schist. 2 - 3 mm felspars, some biotite. Pale yellow weathering. Sample. 30/216.
100 m south, g.m.s.p.s. with scattered 1 mm garnets 50/216.
Many 5 cms qtz-felspar-calcite veins, parallel to schistosity.

45) 600 m south of (N 17). Fine-grained bi.psammite. Some mod-coarse bi-pelitic schist. Dip vertical. Strike 304.

300 m further south, Cambro-Silurian graphite schists. Dip gentle south.

Bulk of rock: bi.-psammite or g.m.s.p.s.
G.M.S.: 1/2 m green mica schist bands developing second schistosity.
Pyritous bands: 1/2 m bands of qtz-musc-pyrite schists weathering orange. Sample x 2.
Lower band causes very rusty water in ponds near stream.
Qtz-bands: Impersistent 5 cms bondinaged bands of quartz, felspar and ore scattered in massive mica. Sample. 30/186.
300 m north of stream, mod-grained qtz-bi-felspar gneiss. Some augen-texture. Dip as before. 10-20 m thick. 1 - 2 m normal sparagmite below.

N 19) 300 m north of (N 18½. Augen-gneiss with scattered 1 - 2 cms rounded felspars. Conglomeratic.
Appearance. Sample. Irregular contact with overlying schists.
More bi. s.p.s. further north.

N 21) See sketch map, next page.
Sequence seen:

	Very coarse augen-gneiss	
	Psammites and biotite schists:	2 m
up ↑	isoclinally folded	
	Graphite schist	~ 5 m
	Psammitic schist	~10 m
	Banded quartzite	3-5 m
	Coarse augen-gneiss	

Much contortion: sheet-dip shallow 27/218.

46) Top of ridge. 600 m north of Bolnabecken, 1-2 kms N.W. of Bolna Station. Orange weathering qtz-musc. and qtz-green mica schists. Also fine-grained s.p.s. and thin quartzites. Buckled. Overlie mod.-grained gneiss. 25/152.

West up ridge, gneiss. Dip locally steep. In stream 300 m north, moderate grained gneiss. Vertical - Strike 130.

BOLNA 4th August

47) 200 m north of Bolnabecken, 450 m west of Bolna Station. Fine-grained bi.psammite. 30/188.

6 rustu weathering pyritous bands, 1/2 m - 1 m thick, visible over 200 m traverse north from (47). Some bands with muscovite or green mica. Intervening rock normal sparagmite (bi.psammite and s.p.s.).

400 m further traverse north. All normal sparagmite dipping south.

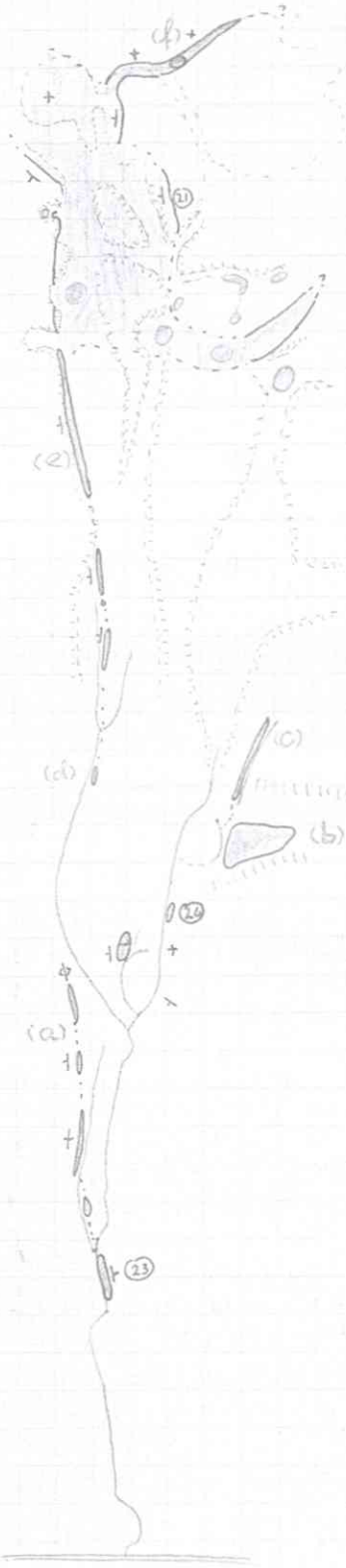
48) 700 m north of (47). Fine-moderate grained s.p.s. microfolded, rests sharply and conformably on moderate grained qtz-felspar-bi. gneiss. (2-3 mms felspar). ~2 m mafic gneiss rests on 10 - 20 cms crystalline quartz, then contorted bi. quartzite. 40/194. Across 30 m gully, pale green-mica. s.p.s. On ridge to north, moderate grained g.m.s.p.s. Some contortion, quartz veining, steep d. ps.
No high alumina zone seen.

N 20) 200 m N.W. of (48), 1 km N.W. of Bolna Station. Massive microfolded moderate grained green-mica biotite felspar gneiss. Scattered 1-2 mms grains of magnetite. Sample. 20/140.
Very varied lithologies, to north and south, gneiss, biotite schist, bi. s.p.s., g.m.s.p.s. Much contortion, qtz veining. Dips shallow, generally S.E.

49) 50 m north of stream, 200 m north of (N 20). Microfolded moderate grained qtz-bi.-felspar gneiss. Irregularly sized augen of felspar. 40/186.
Rest sharply, conformably, on 2 m graphitic schist. Microfolded augen-gneiss beneath: becoming coarser down-section to north. Graphite schist traceable for 200 m west.

Traverse north: Coarse, sometimes flaggy, augen gneiss. Low southerly dips. Marked lineation, probably formed by outcrop of a vertical cleavage. Thin, 5 cms, quartzite band seen.
Dip of schistosity: 15°/234.
Lineation plunges 5°/178.

SKETCH MAP
for
localities
N.21, N.23, N.24.



N. Mag.

Scale : approx.
1 : 10,000.

: lake
: stream
: gully
: schists and quartzite
: crystalline quartz.
Not coloured : Augen gneiss.

BOLNA 5th August

Railway cutting 300 m N.E. of Bolna Station. Moderate grained green-mica gneiss.

N 23) In stream 400 m N.W. of railway, 1.1 kms north of Bolna Station. Coarse biotite augengneiss. 80/044.
Just upstream, 1/2 km band of black biotite schist with pyrite within augengneiss. Sample. 60/236.
20 m upstream: 3 m of schist and black quartzites.

Outcrop continnes sporadically up gully to south of main stream. (See diagram, page 20).
1/2 - 3 m schist. No crystalline quartz. Augen gneiss either side.
Schist outcrops may not be latterally continuous. Dip vertical or steep N.E.

a) 300 m N.W. of (N.23), two outcrops seen with gentle southerly dips: out of line. Structure may be:

Middle limb exposed at (N 23).
Just N.W. antivlinal fold nose runs into hill.

N 24) In northerly branch of stream, 500 m. N.N.W. of (N 23). Two small bodies of crystalline quartz (10 m x 3 m and 20 m x 3 m) associated with schists. Gneiss nearly dips gently south or is horizontal. Sample of quartz.

b) 100 m north, body of crystalline quartz, about 100 m x 50 m on the ground. Structure not discernible, but dips probably shallow. Some associated quartzite and graphite schist. Augen gneiss to west and north. (See diagram page 20).

c) Going north-west from (b), line of quartz bodies mixed/schist : with ~ 2 m thick. About 100 m long. Then disappears. Traverse north over augen-gneiss to Bolnajavre.

d) By southern branch of stream. Graphite schist. Quartz body 10 x 2 m.

e) N.W. up gully. Semicontinuous 1 - 2 m band of graphite schist. Isoclinally folded psammites. Dip gently south under augen gneiss.

BOLNA WED. 6th August

N 21) Revisited. See diagram, page 20.

f) Band of massive quartzite and graphite schist, 1 - 2 m thick, near, horizontal. 15 m x 1.5 m body of crystalline quartz in band.
Outcrop fades out northwards.

50) Small pond in stream. 400 m N.E. of Bolnabecken, 2 - 3 kms N.W. of Bolna Station. Outcrop of graphitic and biotite schist, + quartzite and psammites, thickens rapidly from nothing westwards. 40/202.
Meets Bolnabecken 600 m west at sharp bend in stream. Gabbro above, on south side.
Several metres of white-weathering psammite beneath (north)of graphite schist. Then augengneiss.

51) 400 m east of Bolnabecken, 600 m S.E. of (50). 5 m band of quartz-musc. schists and quartzites. 5 x 1/2 m body of kyanite rock. Bi.psammites above, fine-moderate grained bi.-g.m. gneiss, with rusty weathering cavities below.
Augen gneiss 70 m north. 47/206.

BOLNA 7th August.

52) Bolna railway cutting 150 m N.E. of Bolna Station. Massive psammites and moderate grained g.m. gneisses. 60/216.

N.W. of Bolna in stream 200 m east of (48), ~1/2 m. Clean white quartzite, between biotite schists. No kyanite seen. Irregular augen gneiss to north, green mica gneiss to south.
Dip steep south.
Semicontinuous outcrop upstream.
100 m north of (N 20), same zone includes g.m. s.p.s., white weathering s.p.s. orange-weathering qtz-g.m.-pyrite schist. Not convincingly rich in alumina.
To south: moderate-grained v. massive g.m. gneiss, and very massive pale bi.-musc. s.p.s. with ptygmatic qtz veins, and contartion, microfolding.
Band of orange-weathering schist runs west of (N 20).

53) 500 m west of (N 20), 400 m east of (51). 150 m east of large pond at head of gully. Crags of very massive moderate-grained bi.-g.m.s.p.s. overlook lake. Just south, above, band of qtz-musc. schists etc. 1 m x 20 cms body of kyanite rock. No appreciable contortion. 35/196.
Aluminous zone continuous past (51) to Bolnabecken.

N 25) Bolnabecken, 400 m west of (51). Aluminous band, wisth of outcrop on ground: 50 m.

Band includes 1 - 2 cm band of coarse-grained blue kyanite. Impersistent.

Sequence seen:

Mod.grained bi.-g.m.s.p.s.
" " g.m.s.p.s.
Orange-weathering qtz-musc.-pyrite schist. Sample x3.
Mod. grained g.m.s.p.s.
Orange qtz-musc.-pyrite schist
up ↑ Fine-grained musc. s.p.s.
Quartz-musc. schist
Kyanite band
Quartzite
Qtz-g.m. schist
Microfolded g.m. magnetite schist, rusty cavities
Fine-grained bi. gneiss
Mod.grained bi.gneiss with square 2-3 mm felspars.

Traverse further S.E. downstream, g.m.s.p.s. and bi.-felspar. gneiss rich in magnetite.
Upstream: Variable gneiss, including very biotite-rich gneiss. Then coarse irregular augen-gneiss.

Zone followed west from stream. Strongly contorted qtz-musc. schist in 20 cms bands, parallel to regonial schistosity. Also 1/2 m fine-grained massive quartzites. No kyanite. Some crystalline qtz-felspar bodies.

N 26) 600 m west of (N 25). Straight along strike. Hard, orange-weathering, qtz-kyanite-muscovite-pyrite rock. Locally very rich in kyanite. Thickens from 0 - 1½ m in 25 m continuous outcrop. Then sporadic outcrop of 1 - 2 m thick kyanite rock over next 100 m. Partly obscured by drift. Sample. 20/158.
Moderate-grained bi.-g.m.s.p.s. with rusty cavities above.

N 27) 300 m north of (N 26). Amphibolite. Sample. 35/168.
Augengneiss above.

BOLNA 9th August

Traverse to connect qtz-graphite schist zone between localities (N 21) and (50°). Outcrop sparse: distinct gap present.

Graphite schist and quartzites around Bolnabecken scarched for quartz.
No significant quantities present.

West of Bolnabecken, massive white quartzites below the graphite schist separate from the latter, forming a separate unit within the augengneiss.

Further west, augen gneiss seen, gabbro above.
50 m no exposure between. 20°/126

54) In stream, 1-5 kms west of graphite schist outcrop in Bolnabecken, 2-1 kms west of loc (50). Folded graphite schist and associated biotite schist, green mica schist. Substantial outcrop of folded schists in this area, but no quartz seen. anticline: (25/106 (55/234

Upstream buckled augen-gneiss.
Quartz body, 20 m x 2 m in anticlinal axis in stream.
Traverse south of buckled and contorted gneiss. Much isoclinal folding. Sheet dip nearly parallel to hillside. Slovly up section.

55) On ridge, 700 m south of (54).
Alumina zone. Sequence similar to that seen further east:

up ↑ Qtz-musc-schist + qtzites
Fine-grained pale psammites
Green-mica gneiss.

No kyanite seen. Much contortion: Tight metre-scale folds. Second schistosity in fold cores.

Ridge runs west up towards Raufjellet. 500 m west, on north side of ridge, at bottom, large area of rusty weathering muscovite schists. Near horizontal. Above south onto ridge, flow-folded massive white psammites. On ridge, qtz-musc. schists.

56) West end of alumina-zone ridge, 600 m west of (55). Massive kyanite rock. 50/050.
Very rich in blue kyanite: 0.3 - 1.0 cms length. Zone 15 m wide on ground.
Continuous exposure south for 60 m. Then zone widens: Kyanite band buckled, locally near horizontal. Some obscuration by drift. Traced for a further 150 m into gully. Bands of blue, white and grey kyanite rock seen. All rich in kyanite.

Further 100 m long zone continnes line on other side of gully. Band much narrower: 3-5 m maximum. Thins southwards.

Zone not traceable north from (56), but many very large boulders of blue kyanite rock on hillside.

BOLNA 10th August

Traverse west, south of alumina zone, to elucidate structure.

At sharp bend in Bolnabecken, 200 m south of loc (N 25). Bi.psammite overlying moderate-grained bi-felspar gneiss. 25/222.

200 m south of (N 26). Fine-grained bi.psammite. 25/178.
500 m west: moderate-grained g.m. s.p.s. 20/156.

Shallow dips, nearly parallel to hillside. Outcrop trend variable.

400 m west, by stream: first fold observed.
Steep limb: 65/052.
Dip undulates 15/104.

N.W. to loc (56) observing two mayor synclines in hard musc. psammites with small orange garnets.

Further examination and mapping around localities (56) and (54).
Large body of amphibolite observed towards top of Raufjellet ridge. To N.W.: thick graphite schists beneath. Then augen gneiss.

Traverse north to valley bottom, mapping augen-gneiss and graphite schist. Valley heavily covered by drift.

57) In stream, near head of Raufjellelven. 3-4 kms north west (along valley bottom) from (N 25). Large body of cavernous crystalline quartz and rusted ore mixed with schist. Augen-gneiss below (S.E.), graphite schist above. Zone probably connects southwards with graphite, around loc (54). To N.E. zone runs up hillside.
Near lake in stream: graphite schist 30/346.
5 m thickness of quartz visible.
N.E.of lake, quartz purer, less mixed with schist, less cavernous.
Quartz band 3-5 m thick runs 300 m N.E. from lake. Then no exposure.
200 m N.E. uphill, in direct line, 3-5 m thick band of quartz with shallow dip forms wide outcrop. Some schist and coarsely crystalline potash felspar, but much pure massive quartz.
150 m long zone beyond with schists and some 1 m x 20 cms bodies of pure crystalline dolomite. Then 200 m long body of cavernous rusty quartz runs east. Thickness variable: 1/2 - 3 m.
Augen-gneiss above and below. Then zone disappears.

Small outcrop of horizontal graphite schist found 400 m south.

BOLNA 11th August

Traverse north past Bolnajavre. Augen gneiss. N-W on hill above quartz, loc (57). Augen gneiss. West across stream, to north of loc (57). Augen gneiss.
South east along valley, bottom, to west of streams and lakes, past loc (57). Graphite schists and psammites outcrop for 1 km S.E. of (57). Then swings SW. Augen gneiss below, S.E.

58) On ridge of alumina zone, 200 m east of loc (55). Wide outcrop of contorted quartz, quartzites, qtz-musc schist, and kyanite rock. 1-2 m thick very folded band of kyanite. Sheet dip gentle south. Green mica gneisses above and below. Zone about 100 m long, disappears east and west.

J.P. Platt

14.8.1969

FIELD NOTES: BOLNA and NASA

J.P. Platt.

Pages 15 - 25

31. July - 11. August

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BOLNA 31. July

East bank of Randalselven: working upstream from bridge. Lithology changes from fine grained bi.s.p.s. and psammitic schist to moderate-coarse grained bi.-musc. s.p.s. and psammites a little above loc (N 22).

N 1) 300 m upstream from bridge: end of exposure in stream. Moderate grained bi.-musc. s.p.s. with ore. Heavily weathered. Gentle flexuring. 50/150. Sample.

42) 500 m up from bridge, opposite generator. Isolated exposure of fine grained bi.- musc.- s.p.s. 60/210.
No further exposure on east bank until quartz stream.

N 2) Gorge of quartz stream 350 m east of Randalselven. Steeply dipping graphite schists with small quartz bodies. >6 m s.p.s. above. Sample 70/217.
Upstream, above and south of graphite schists, schistose irregular gneiss and augen gneiss. North, finer grained, microfolded, swhistose gneiss directly overlies locally folded graphite schist. Graphite schist followed up hill, north of stream, gneiss to the south, and foliated musc. augen-gneiss to the north.

N 3) 150 m north of quartz stream, 250 m east of (N 2). Unfoliated "Granite". Qtz-felspar-biotite rock: biotite in large aggregates, possibly pseudomorping, amphibole. "Basement": structurally below graphite schist: passer up into augen gneiss. Sample.

N 4) Quartz stream, 200 m S.E. of (N 2). Coarse-grained irregular gneiss. Rough foliation. 40/072.
Sample.
5 cms bands of schist in gneiss parallel to foliation. Downstream, easterly dip steepens, passes trough vertical to steep westerly overlying graphite schist.

43) Gully east of and parallel to Randalselven. 200 m S.E. of Randalselven, 400 m west of (N 2). Coarse biotite schists and moderate-coarse grained bi.-musc. s.p.s. 85/040.

N 6) By stream, 350 m S.E. of Randalselven, 650 m south of quartz stream. Gentle anticline in musc. psammites and s.p.s. Some contortion and qtz veining. Sample.

N 7. West bank of Randalselven, 450 m N.E. of Bolna Station. Flaggy moderate grained biotite felspar gneiss. Some coarse layers with augen texture. Gentle irregular buckles. Sample 25/063.
North, coarse felspathic augen-gneiss (in place ?), then varied moderate grained bi. s.p.s. and bi.- musc.-pelitic schists.
300 m north of (N 7), coarse bi.-felspar varied augen-gneiss.

BOLNA 2nd August

Visitors.

N 9) Hillside. 1 - 6 kms S.E. of radio hut, 300 m south of (13). Fine-moderate grained bi.-musc. s.p.s. Somewhat microfolded. Much green mica, muscovite, also calcite, ore graines, and rusty cavities.
Sample.
Dip constant. 30° to S.
Pass up into fine grained flaggy bi. s.p.s. and gneisses.

N 10) 150 m south of (N 9). Fine grained bi. psammite. Weathered pale orange. Sample.
Dip as before.

N 11) 150 m S.E. of (N 10). Fine-grained bi. psammite with iregularly distributed 1-2 mm quartz grains. Very flaggy. White weathering.
Sample. 10° to S.E.

Traverse S.E. over much similar rock all dipping 10 -20° to south.

N 12) 500 m S.E. of (N 11). Fine moderate grained massive bi.-psammite. White weathering.
Sample. 20° to S.

N 13) 600 m south of (N 12). Moderate grained massive green-mica. s.p.s., weathering white. Passes south into green-mica pelitic schist. Sample 30° to S.W.

Traverse south over green-mica schists. Dip steepens steadily to about 70° S.W.

N14) 250 m north of hill (939 m). 2 - 7 km. S.E. of radio hut.
250 m S.W. of (N 13).
15 m band og steeply dipping bi.felspar pelitic schist.
Sample.
Then s.p.s. with biotite schist bands. Near summit, another 15 m biotite rock: much harder and more massive than previous one.
Summit: near vertical crinkled qtz-green mica schist. Strike N-S.

BOLNA 3rd August

44) West side of Randalselven valley. In Bolnabecken 500 m S.W. of Bolna Station, 50 m west of railway.
Fine-grained bi.psammite and moderate-grained green-mica. s.p.s.
Gentle buckled. 20/184.
Stream roughly parallel to strike, but cuts down section a little.
Upstream, 1 m band of bi. schist, some moderate grained musc.-bi. s.p.s., and much fine-grained biotite psammite.
Traverse south from bend in stream. Much fine-grained bi.psammite moderate grained g.m. s.p.s. (green-mica semi-pelitic schist).
Occasional bands rich in green mica or biotite. Very occasional minute (1/4 mm) garnets, and one isolated garnet aggregate (2 cms diam) seen.
Dips all shallow southerly.

N 16) 500 m S.W. of Bolnabecken, 1 - 3 kms west of Bolna Station. g.m. s.p.s. 15/176.
In stream 10 m south, band of contorted crystalline quartz and green mica, 20 cms thick. Ore particles, and green and red staining.
2 Samples.
Just above, green-mica schist with scattered pyrite. Sample.

Traverse south. Other small quartz veins seen with rims of chloritized biotite.

N 17) 500 m south of (N 16). Coarse-grained felspathic schist. 2 - 3 mm felspars, some biotite. Pale yellow weathering. Sample. 30/216.
100 m south, g.m.s.p.s. with scattered 1 mm garnets 50/216.
Many 5 cms qtz-felspar-calcite veins, parallel to schistosity.

45) 600 m south of (N 17). Fine-grained bi.psammite. Some mod-coarse bi-pelitic schist. Dip vertical. Strike 304.

300 m further south, Cambro-Silurian graphite schists. Dip gentle south.

Bulk of rock: bi.-psammite or g.m.s.p.s.
G.M.S.: 1/2 m green mica schist bands developing second schistosity.
Pyritous bands: 1/2 m bands of qtz-musc-pyrite schists weathering orange. Sample x 2.
Lower band causes very rusty water in ponds near stream.
Qtz-bands: Impersistent 5 cms bondinaged bands of quartz, felspar and ore scattered in massive mica. Sample. 30/186.
300 m north of stream, mod-grained qtz-bi-felspar gneiss. Some augen-texture. Dip as before. 10-20 m thick. 1 - 2 m normal sparagmite below.

N 19) 300 m north of (N 18½. Augen-gneiss with scattered 1 - 2 cms rounded felspars. Conglomeratic.
Appearance. Sample. Irregular contact with overlying schists.
More bi. s.p.s. further north.

N 21) See sketch map, next page.
Sequence seen:

	Very coarse augen-gneiss	
	Psammites and biotite schists: isoclinally folded	2 m
up ↑	Graphite schist	~ 5 m
	Psammitic schist	~10 m
	Banded quartzite	3-5 m
	Coarse augen-gneiss	

Much contortion: sheet-dip shallow 27/218.

46) Top of ridge. 600 m north of Bolnabecken, 1-2 kms N.W. of Bolna Station. Orange weathering qtz-musc. and qtz-green mica schists. Also fine-grained s.p.s. and thin quartzites. Buckled. Overlie mod.-grained gneiss. 25/152.

West up ridge, gneiss. Dip locally steep. In stream 300 m north, moderate grained gneiss. Vertical - Strike 130.

BOLNA 4th August

47) 200 m north of Bolnabecken, 450 m west of Bolna Station. Fine-grained bi.psammite. 30/188.

6 rustu weathering pyritous bands, 1/2 m - 1 m thick, visible over 200 m traverse north from (47). Some bands with muscovite or green mica. Intervening rock normal sparagmite (bi.psammite and s.p.s.).

400 m further traverse north. All normal sparagmite dipping south.

48) 700 m north of (47). Fine-moderate grained s.p.s. microfolded, rests sharply and conformably on moderate grained qtz-felspar-bi. gneiss. (2-3 mms felspar). ~ 2 m mafic gneiss rests on 10 - 20 cms crystalline quartz, then contorted bi. quartzite. 40/194.
Across 30 m gully, pale green-mica. s.p.s. On ridge to north, moderate grained g.m.s.p.s. Some contortion, quartz veining, steep d. ps.
No high alumina zone seen.

N 20) 200 m N.W. of (48), 1 km N.W. of Bolna Station. Massive microfolded moderate grained green-mica biotite felspar gneiss. Scattered 1-2 mms grains of magnetite. Sample. 20/140.
Very varied lithologies, to north and south, gneiss, biotite schist, bi. s.p.s., g.m.s.p.s. Much contortion, qtz veining. Dips shallow, generally S.E.

49) 50 m north of stream, 200 m north of (N 20). Microfolded moderate grained qtz-bi.-felspar gneiss. Irregularly sized augen of felspar. 40/186.
Rest sharply, conformably, on 2 m graphitic schist. Microfolded augen-gneiss beneath: becoming coarser down-section to north. Graphite schist traceable for 200 m west.

Traverse north: Coarse, sometimes flaggy, augen gneiss. Low southerly dips. Marked lineation, probably formed by outcrop of a vertical cleavage. Thin, 5 cms, quartzite band seen.
Dip of schistosity: 15°/234.
Lineation plunges 5°/178.

SKETCH MAP
for
localities
N.21, N.23, N.24.

N. Mag.

Scale : approx.
1 : 10,000.

: lake
: stream
: gully
: schist and quartzite
: crystalline quartz
Not coloured : Augen gneiss.

BOLNA 5th August

Railway cutting 300 m N.E. of Bolna Station. Moderate grained green-mica gneiss.

N 23) In stream 400 m N.W. of railway, 1.1 kms north of Bolna Station. Coarse biotite augengneiss. 80/044.
Just upstream, 1/2 km band of black biotite schist with pyrite within augengneiss. Sample. 60/236.
20 m upstream: 3 m of schist and black quartzites.

Outcrop continnes sporadically up gully to south of main stream. (See diagram, page 20).
1/2 - 3 m schist. No crystalline quartz. Augen gneiss either side.
Schist outcrops may not be latterally continuous. Dip vertical or steep N.E.

a) 300 m N.W. of (N.23), two outcrops seen with gentle southerly dips: out of line. Structure may be:

Middle limb exposed at (N 23).
Just N.W. antivlinal fold nose runs into hill.

N 24) In northerly branch of stream, 500 m. N.N.W. of (N 23). Two small bodies of crystalline quartz (10 m x 3 m and 20 m x 3 m) associated with schists. Gneiss nearly dips gently south or is horizontal. Sample of quartz.

b) 100 m north, body of crystalline quartz, about 100 m x 50 m on the ground. Structure not discernible, but dips probably shallow. Some associated quartzite and graphite schist. Augen gneiss to west and north. (See diagram page 20).

c) Going north-west from (b), line of quartz bodies mixed with schist : ~ 2 m thick. About 100 m long. Then disappears. Traverse north over augen-gneiss to Bolnajavre.

d) By southern branch of stream. Graphite schist. Quartz body 10 x 2 m.

e) N.W. up gully. Semicontinuous 1 - 2 m band of graphite schist. Isoclinally folded psammites. Dip gently south under augen gneiss.

BOLNA WED. 6th August

N 21) Revisited. See diagram, page 20.

f) Band of massive quartzite and graphite schist, 1 - 2 m thick, near, horizontal. 15 m x 1.5 m body of crystalline quartz in band.
Outcrop fades out northwards.

50) Small pond in stream. 400 m N.E. of Bolnabecken, 2 - 3 kms N.W. of Bolna Station. Outcrop of graphitic and biotite schist, + quartzite and psammites, thickens rapidly from nothing westwards. 40/202.
Meets Bolnabecken 600 m west at sharp bend in stream. Gabbro above, on south side.
Several metres of white-weathering psammite beneath (north)of graphite schist. Then augengneiss.

51) 400 m east of Bolnabecken, 600 m S.E. of (50). 5 m band of quartz-musc. schists and quartzites. 5 x 1/2 m body of kyanite rock. Bi.psammites above, fine-moderate grained bi.-g.m. gneiss, with rusty weathering cavities below.
Augen gneiss 70 m north. 47/206.

BOLNA 7th August.

52) Bolna railway cutting 150 m N.E. of Bolna Station. Massive psammites and moderate grained g.m. gneisses. 60/216.

N.W. of Bolna in stream 200 m east of (48), ~1/2 m. Clean white quartzite, between biotite schists. No kyanite seen. Irregular augen gneiss to north, green mica gneiss to south.
Dip steep south.
Semicontinuous outcrop upstream.
100 m north of (N 20), same zone includes g.m. s.p.s., white weathering s.p.s. orgnge-weathering qtz-g.m.-pyrite schist. Not convincingly rich in alumina.
To south: moderate-grained v. massive g.m. gneiss, and very massive pale bi.-musc. s.p.s. with ptygmatic qtz veins, and contartion, microfolding.
Band of orange-weathering schist runs west of (N 20).

53) 500 m west of (N 20), 400 m east of (51). 150 m east of large pond at head of gully. Crags of very massive moderate-grained bi.-g.m.s.p.s. overlook lake. Just south, above, band of qtz-musc. schists etc. 1 m x 20 cms body of kyanite rock. No appreciable contortion. 35/196.
Aluminous zone continuous past (51) to Bolnabecken.

N 25) Bolnabecken, 400 m west of (51). Aluminous band, wisth of outcrop on ground: 50 m.

Band includes 1 - 2 cm band of coarse-grained blue kyanite. Impersistent.

Sequence seen:

Mod.grained bi.-g.m.s.p.s.
" " g.m.s.p.s.
Orange-weathering qtz-musc.-pyrite schist. Sample x3.
Mod. grained g.m.s.p.s.
Orange qtz-musc.-pyrite schist
up ↑ Fine-grained musc. s.p.s.
Quartz-musc. schist
Kyanite band
Quartzite
Qtz-g.m. schist
Microfolded g.m. magnetite schist, rusty cavities
Fine-grained bi. gneiss
Mod.grained bi.gneiss with square 2-3 mm felspars.

Traverse further S.E. downstream, g.m.s.p.s. and bi.-felspar. gneiss rich in magnetite.
Upstream: Variable gneiss, including very biotite-rich gneiss. Then coarse irregular augen-gneiss.

Zone followed west from stream. Strongly contorted qtz-musc. schist in 20 cms bands, parallel to regonial schistosity. Also 1/2 m fine-grained massive quartzites. No kyanite. Some crystalline qtz-felspar bodies.

N 26) 600 m west of (N 25). Straight along strike. Hard, orange-weathering, qtz-kyanite-muscovite-pyrite rock. Locally very rich in kyanite. Thickens from 0 - 1½ m in 25 m continuous outcrop. Then sporadic outcrop of 1 - 2 m thick kyanite rock over next 100 m. Partly obscured by drift. Sample. 20/158.
Moderate-grained bi.-g.m.s.p.s. with rusty cavities above.

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Augengneiss above.

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Further west, augen gneiss seen, gabbro above.
50 m no exposure between. 20°/126

54) In stream, 1-5 kms west of graphite schist outcrop in Bolnabecken, 2-1 kms west of loc (50). Folded graphite schist and associated biotite schist, green mica schist. Substantial outcrop of folded schists in this area, but no quartz seen. anticline: (25/106 (55/234

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Traverse south of buckled and contorted gneiss. Much isoclinal folding. Sheet dip nearly parallel to hillside. Slovly up section.

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No kyanite seen. Much contortion: Tight metre-scale folds. Second schistosity in fold cores.

Ridge runs west up towards Raufjellet. 500 m west, on north side of ridge, at bottom, large area of rusty weathering muscovite schists. Near horizontal. Above south onto ridge, flow-folded massive white psammites. On ridge, qtz-musc. schists.

56) West end of alumina-zone ridge, 600 m west of (55). Massive kyanite rock. 50/050.
Very rich in blue kyanite: 0.3 - 1.0 cms length. Zone 15 m wide on ground.
Continuous exposure south for 60 m. Then zone widens: Kyanite band buckled, locally near horizontal. Some obscuration by drift. Traced for a further 150 m into gully. Bands of blue, white and grey kyanite rock seen. All rich in kyanite.

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Steep limb: 65/052.
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Traverse north to valley bottom, mapping augen-gneiss and graphite schist. Valley heavily covered by drift.

57) In stream, near head of Raufjellelven. 3-4 kms north west (along valley bottom) from (N 25). Large body of cavernous crystalline quartz and rusted ore mixed with schist. Augen-gneiss below (S.E.), graphite schist above. Zone probably connects southwards with graphite, around loc (54). To N.E. zone runs up hillside.
Near lake in stream: graphite schist 30/346.
5 m thickness of quartz visible.
N.E.of lake, quartz purer, less mixed with schist, less cavernous. Quartz band 3-5 m thick runs 300 m N.E. from lake. Then no exposure. 200 m N.E. uphill, in direct line, 3-5 m thick band of quartz with shallow dip forms wide outcrop. Some schist and coarsely crystalline potash felspar, but much pure massive quartz.
150 m long zone beyond with schists and some 1 m x 20 cms bodies of pure crystalline dolomite. Then 200 m long body of cavernous rusty quartz runs east. Thickness variable: 1/2 - 3 m.
Augen-gneiss above and below. Then zone disappears.

Small outcrop of horizontal graphite schist found 400 m south.

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Traverse north past Bolnajavre. Augen gneiss. N-W on hill above quartz, loc (57). Augen gneiss. West across stream, to north of loc (57). Augen gneiss.
South east along valley, bottom, to west of streams and lakes, past loc (57). Graphite schists and psammites outcrop for 1 km S.E. of (57). Then swings SW. Augen gneiss below, S.E.

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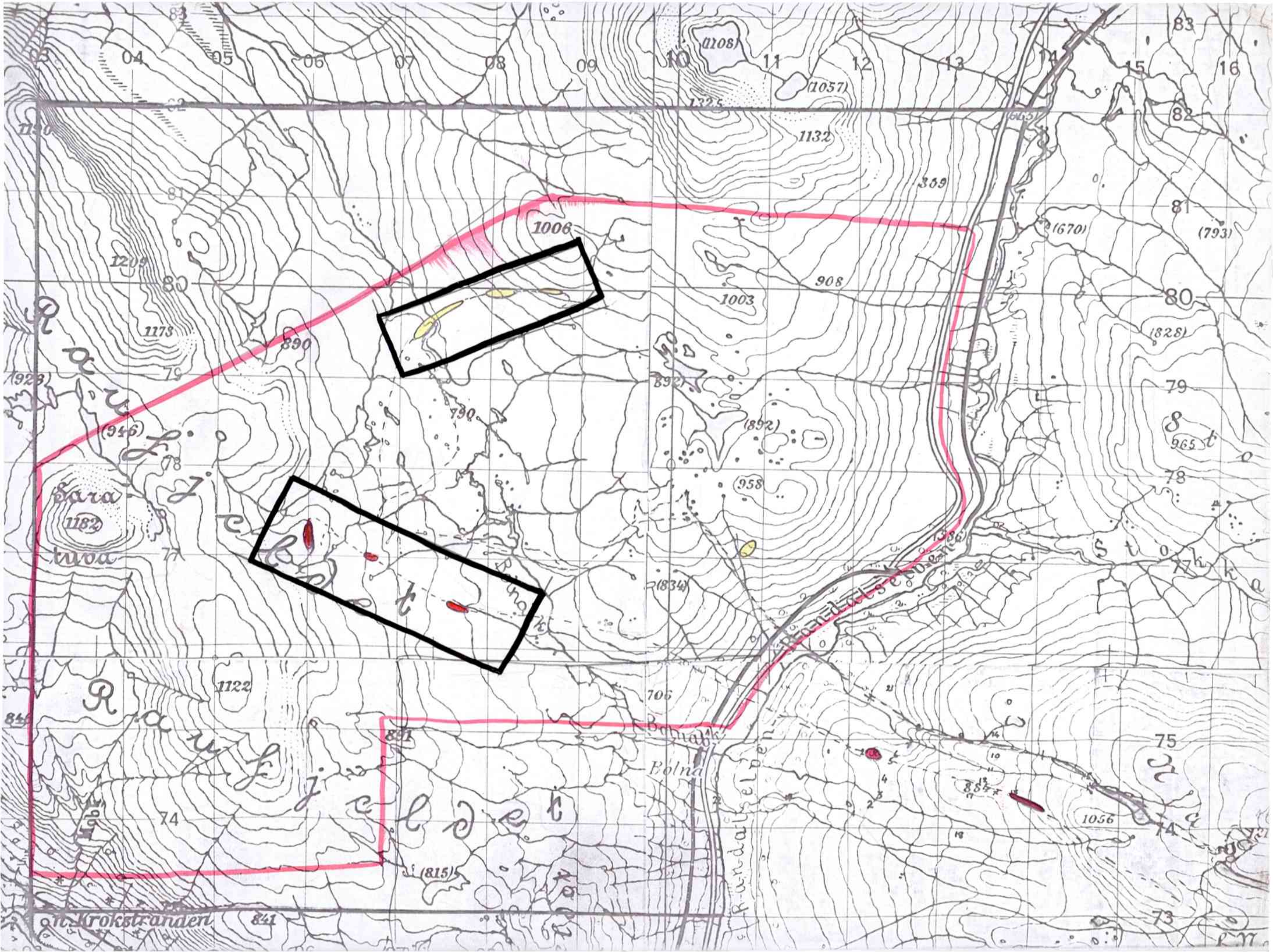
J.P. Platt

14.8.1969



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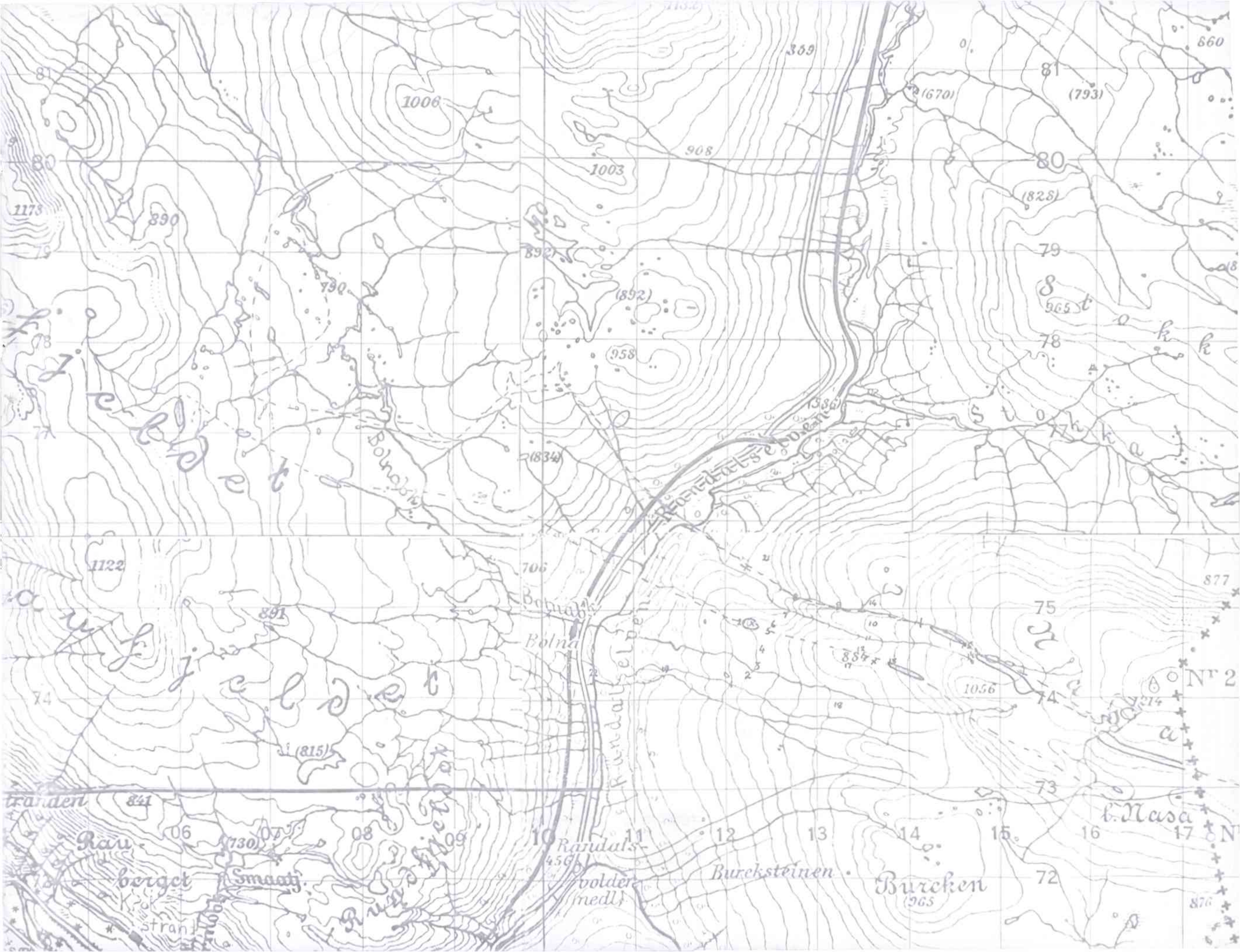
Randalselva
n. Krokstranden



Randalselven
Bolna
Randals-
volden
(nedl.)
Burcksteinen
Burcken
Smaatj.
Rau
berget
b. Nasa
Nr 2

Fjeldet
Stokk
Stokka
Randalselven
Bolna
Randals-
volder
(nedl.)
Burcksteinen
Burcken
(965)
Rau
berget
strand
b. Nasa
Nr 2
1006
1003
908
890
1173
1122
891
841
(815)
(730)
706
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(892)
958
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877
876
(670)
(793)
(828)
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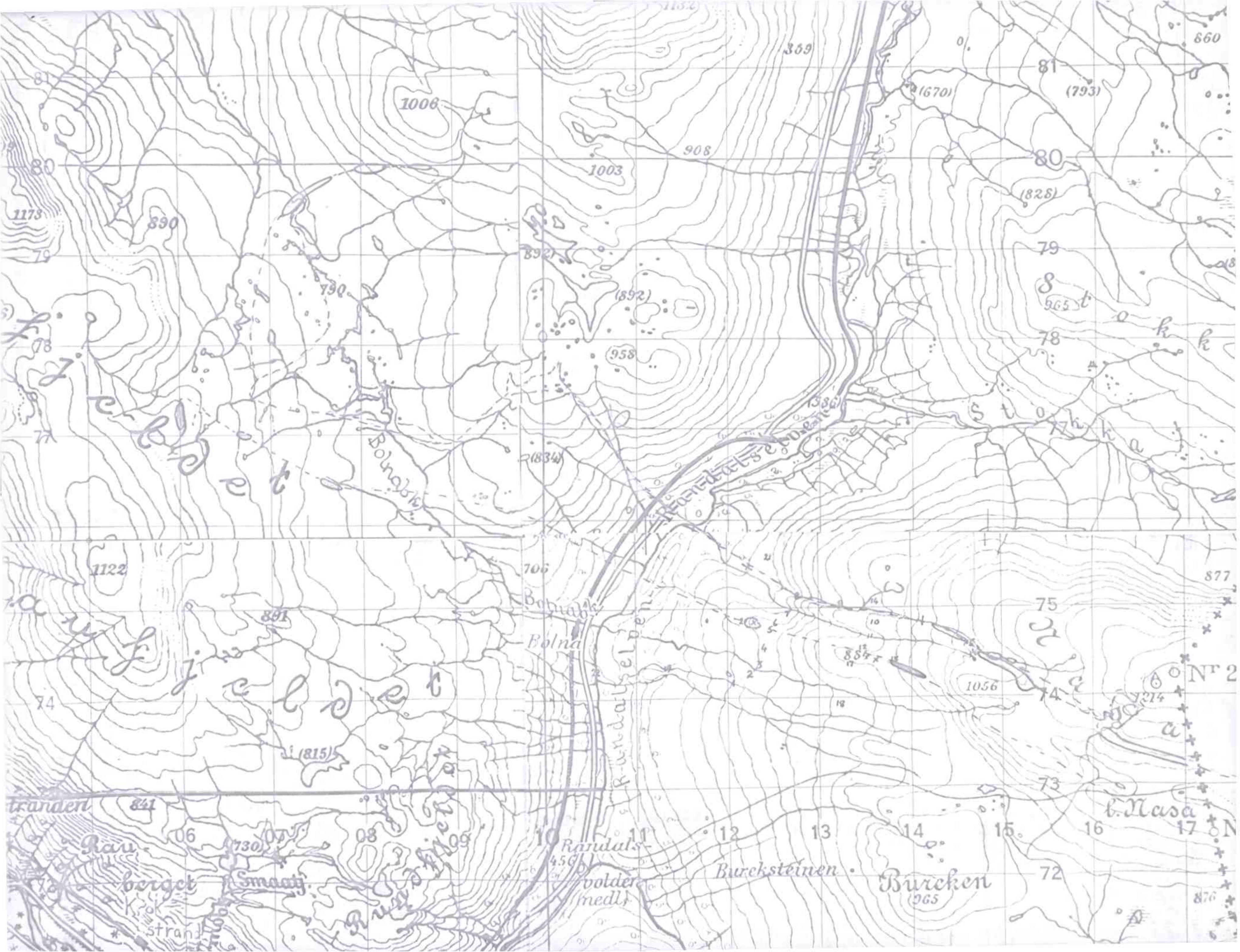

Fjeldet
Fjeldet
Stokka
Randalsvand
Randalselven
Bolna
Bolnaak
Bolnaelv
Randals-volden (nedl.)
Burcksteinen
Burcken
965
Smaaaj
Rauberget
Krok strand
Randalstranden
841
(815)
891
1122
1173
890
1006
1003
908
(892)
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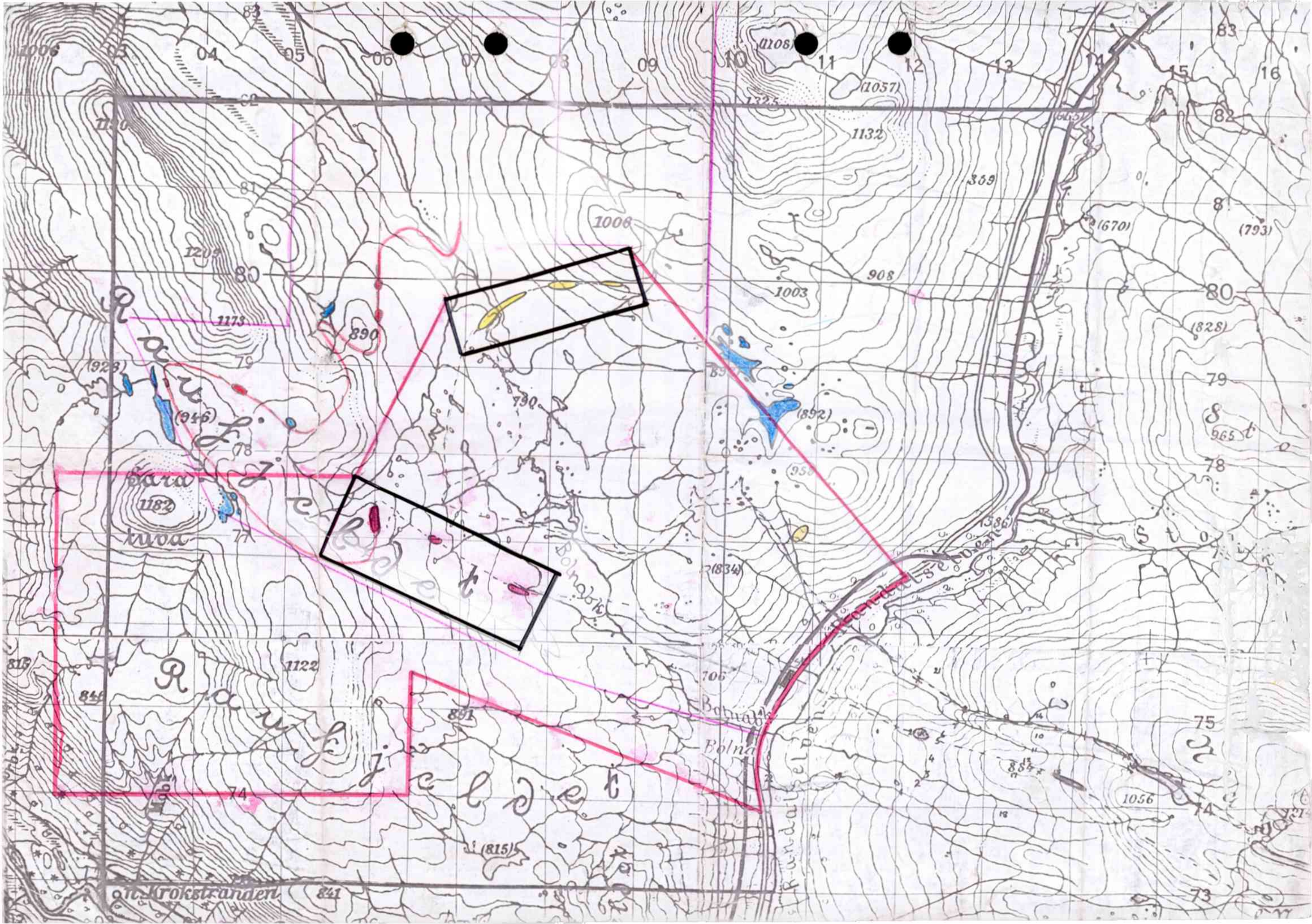
(670)
(793)
(828)
860
877
876
359
l. Masa
Nr 2



Raufjeldet
Raufjeldet
Krokstranden
Bolna
Rundalselven
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1003
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730
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(793)
(828)
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841
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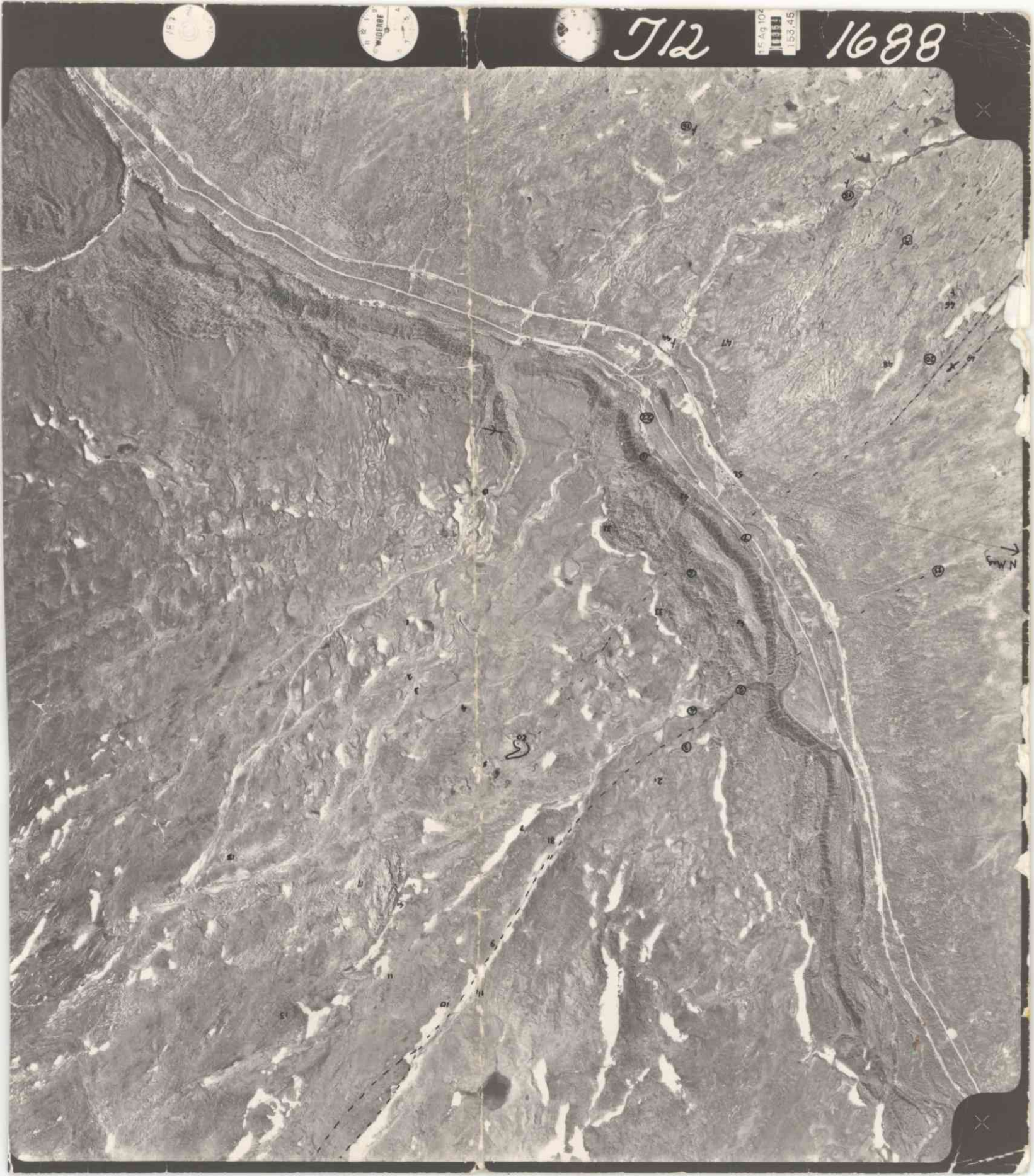
706


B16
1688


T12
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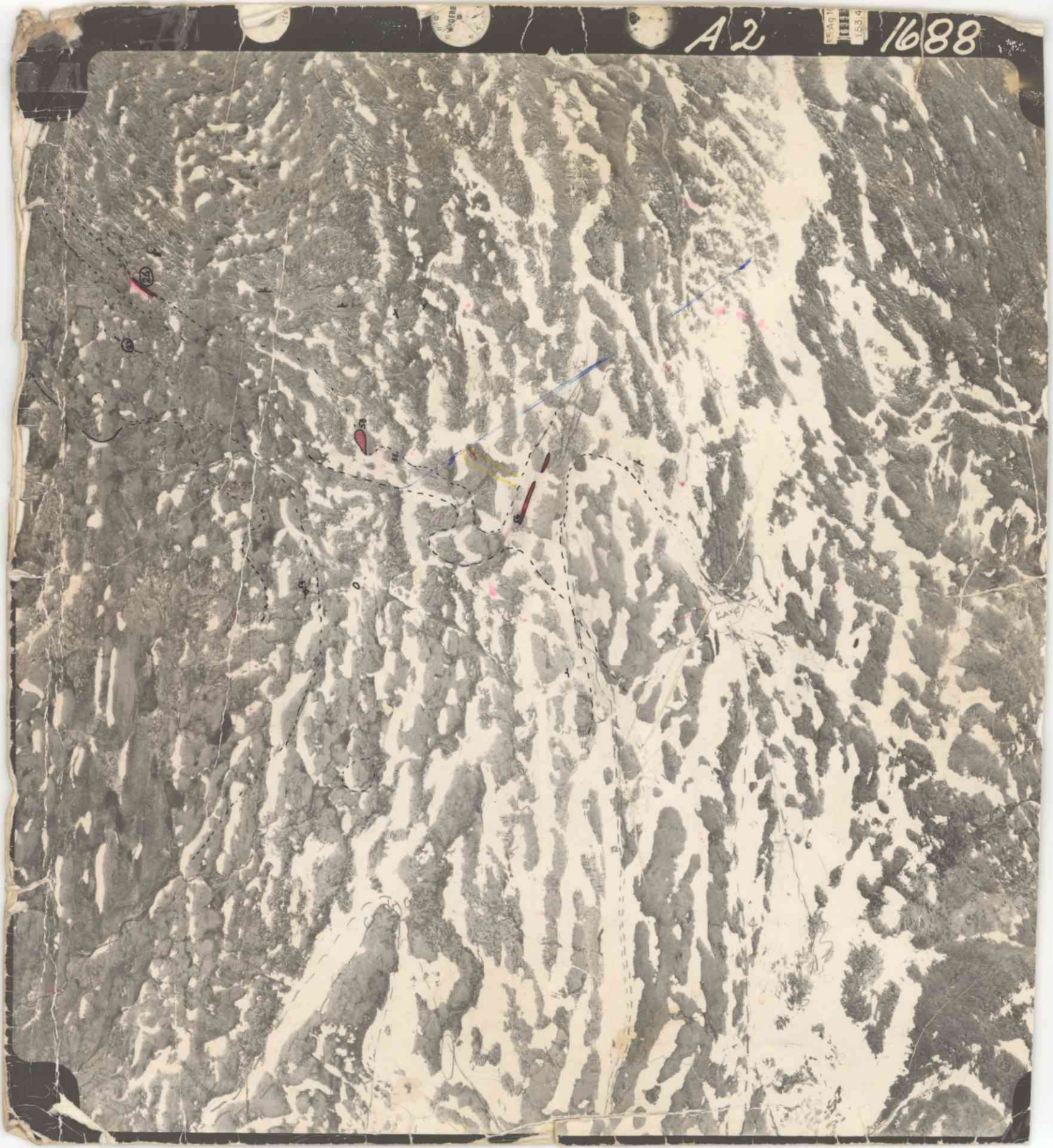


A1
1688

Bolna
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Bolna
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04
05
06
07
08
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82
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1003
1209
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790
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78
958
Sara
1182
kvaa
77
Bolnabk
(834)
706
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74
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n. Krokstranden
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Randal
Randalselven
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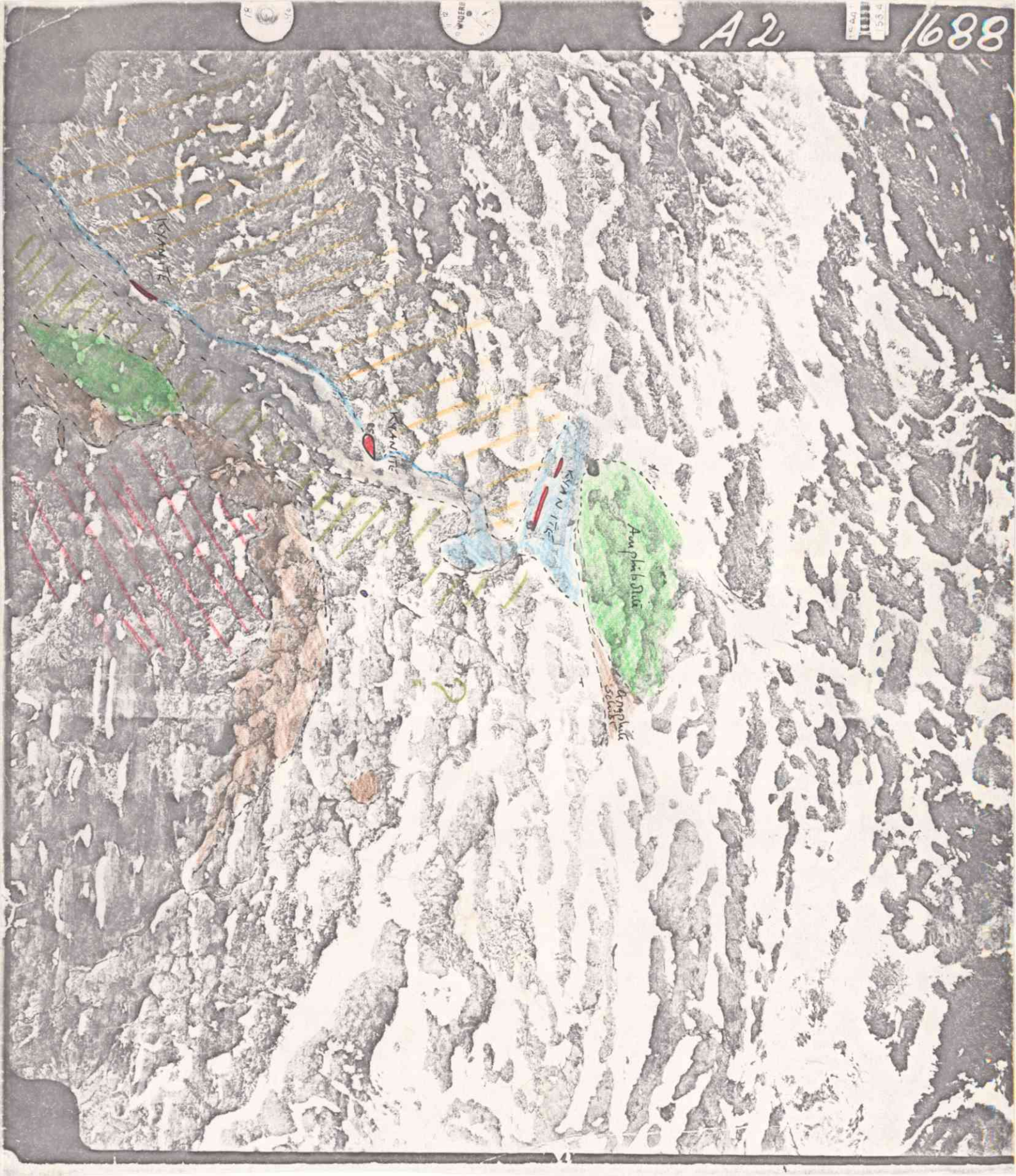
11
12

A4 1688


A2
1688
KYANITE
KYANITE
KYANITE
Amphibolite
amphibolite
SCALE

: F : Normal Sparagmite

: E : KYANITE Rock

: E : Alumina Zone

: D : Green-mica Gneiss

: C : Irregular Gneiss

: B : Crystalline QUARTZ

: B : Schists of Quartz Zone

: A : Basement Granite