STRATIGRAPHICAL POSITION OF THE GUDÅ CONGLOMERATE ZONE

By Fredrik Chr. Wolff.

Abstract.

The Gudå conglomerate zone has been considered to be of Upper Ordovician to Lower Silurian Age. The main argument for this conclusion has been that the conglomerates of this zone have the same pebble composition as some proved Ordovician — Silurian conglomerates. The author describes shortly a number of localities in the Gudå-conglomerate zone, and by comparison with descriptions on localities of conglomerates of known age, he concludes that the former conglomerates are more likely of Lower Ordovician age.

1. Introduction.

In most areas in the Norwegian part of the Caledonian mountain-chain fossiliferous horizons are scarce, and stratigraphical correlation has therefore had to be based on stratigraphical succession or lithological units only. This has led to (and will probably also in the future lead to) attempts to correlate horizons from widely different time periods. Conglomerate horizons have often been misused in this manner. There has been an extended tendency to think that conglomerates of similar pebble-compositions are deposits of the same age. This concerns for example the correlation between the quartzite conglomerates of Vojtja, Lyngestein, Kjølhaugen, Portfjell, Hegsjøfjell, Skjækerstøtene and Gudå, which all have been considered to be of Upper Ordovician to Lower Silurian age.

In the following the stratigraphical position of these and some other quartzite conglomerates are discussed. Their adjacent rock types are also taken into account.

2. Conglomerates of undoubted Upper Ordovician to Lower Silurian Age.

a) The Vojtja quartzite conglomerate (in the Swedish Caledonides northeast of the Trondheim region) is overlain by the Slätdal limestone containing Holorhynchus (Kulling 1933), which is characteristic of

stage 5b, the top of the Upper Ordovician in the Oslo region. On top of this limestone follows a series of quartzite and black shale.

b) The Lyngestein conglomerate (plate 2) rests on the Hovin sandstone, which is considered to extend up into the lower portion of the Upper Ordovician (Kiær 1932). This opinion is based on findings of Nitulites and Theca in the Hovin sandstone, indicating a Caradocian age.

c) The Kjølhaugen conglomerates (plate 2) is overlain by sandstone and black shale containing Rastrites (Getz 1890) indicating the upper part of Lower Silurian.

These three conglomerates have the following features in common:

1. They are dated by findings of fossils to upper part of the Upper Ordovician or lower part of Lower Silurian.
2. They lie in lowgrade metamorphic rocks and are usually not seriously deformed.

3. Conglomerates of Lower Ordovician age.

At Svorkmo north of Løkken Mine (plate 2), just below the greenstone lavas of type Støren group, a deformed quartzite conglomerate is present (Carstens 1954). This conglomerate lies in a series of micaschists of the Røros group, where zones of crystalline limestone also are intercalated. Here is a case of a quartzite conglomerate, which is demonstrably older than the lowest Ordovician.

Foslie (1923) describes the Portfjell conglomerate (Kjerulf 1876). This conglomerate, which also is associated with crystalline limestone and greenstone, lies in a sequence so strongly deformed that it is difficult to decide whether the layering is normal or inverted. Foslie (1959) considered this conglomerate to be contemporaneous with the Swedish Vojtja conglomerate by comparison of the quartzite pebbles of the two conglomerates.

Kulling (1955) opposed this correlation and considered the Portfjell conglomerate to be much older and to represent the Ropen quartzite conglomerate of the Ro series in the Swedish Caledonides northeast of the Trondheim Region.*) Kulling also points out that the Ropen quartzite conglomerate and similar conglomerates in this part of the

*) After the present paper had gone to press T. Strand published a note in which he arrives at the same conclusion as Kulling. See NGU nr. 223.

Caledonides lies in high-grade metamorphic schists with trondhjemitic intrusions.

These two conglomerates have the following features in common:

1. They are overlain by greenstone lavas of the Støren group and associated with limestone.
2. They are lying in high-grade metamorphic rocks and are strongly deformed.

4. Conglomerates of unknown age.

a) In Hegsjøfjell (plate 2) a strongly deformed quartzite conglomerate is found. This conglomerate is resting on a garnetiferous micaschist and is overlain by micaschist and amphibolite.

These data are taken from a map made by Foslie (Jævsjø) published by Oftedahl (Foslie 1959). Foslie considered this conglomerate to be contemporaneous with the Portfjell conglomerate, which he supposed to be contemporaneous with the Vojtja conglomerate (Silurian).

If Kulling's opinion is correct, and Foslie's parallelism between the Hegsjøfjell and the Portfjell conglomerates holds, the Hegsjøfjell conglomerate must then be equivalent to the Ropen conglomerate.

b) The Skjækerstøtene conglomerate lies along strike from Hegsjøfjell, less than 20 km southwest (plate 2). This conglomerate is also a strongly deformed quartzite conglomerate where the pebbles are drawn out to long rods. It also rests on a garnetiferous micaschist and is overlain by amphibolite. The present author (Wolff 1960) correlated this conglomerate with the Portfjell and by accepting Foslie's opinion suggested a Silurian age.

c) Following the zone of the Hegsjøfjell – Skjækerstøtene conglomerates about 60 km southwest we find the Gudå conglomerate (plate 2). This quartzite conglomerate is so seriously deformed, that its conglomeratic character has been doubted (Bäckstrøm 1890) and the name "kvartskakelag" (meaning quartzcake layers) has been applied. A similar name has also been applied to the Portfjell conglomerate by Hauan (Foslie 1923). The Gudå conglomerate has later been proved to be a real conglomerate (Kautsky 1947), and the same holds for the Portfjell conglomerate (Foslie 1923).

West of the Gudå conglomerate lies a series of quartz-biotite-kyaniteschists with hornblende and garnet. About 10 km north of Gudå, in the mountain Blåstøten a limestone horizon is found somewhat to the

west of the level of the conglomerate. At Gudå a limestone layer is intercalasted in the conglomerate. East of the conglomerate an amphibolite zone of 6 km thickness is found.

d) The Bukkhammer — Usmadam metaconglomerate (Kisch 1962) lies in the same zone about 40 km southwest of Gudå (Plate 2). West of this quartzite metaconglomerate in a series of micaschists containing staurolite and kyanite, a zone of crystalline limestone (the Vollfjell limestone) is located. To the east of the conglomerate lies an amphibolite group, which acording to Kisch consists of "metabasites, in part metamorphosed tuffs, or reworked tuffs, oligoclase-amphibolite and other amphibolitic varieties". He considers it to lie below the conglomerate, and therefore, under the assumption that the amphibolite group is equivalent to the Støren greenstone in the west, to be contemporaneous with the Venna conglomerate (Table I). The main reason for this conclusion seems to be that the schistosity dips towards west, and therefore gives the impression that the conglomerate rests on the amphibolite group. The present author thinks that Kisch's assumption, that the amphibolite group is equivalent to the Støren greenstones is correct, but that the metaconglomerate is not equivalent to the Venna conglomerate. The arguments for this will be presented later (paragraph 5).

The conglomerate mentioned in this paragraph have the following features in common:

1. They are adjacent to amphibolites (metabasites): volcanics.
2. They lie in high-grade metamorphic rocks and are seriously deformed.

5. The distribution of the different stratigraphical units in the northern part of the Trondheim region.

The discussion above has been based on stratigraphical correlations only. In the following the general geological map (Plate 2) of the northern Trondheim region and sections across it (Plate 1) are discussed. This discussion leads to the assumption that the conglomerates of unknown age occupy a low position in the stratigraphical sequence.

The map (Plate 2) and the profils (Plate 1) of the region in question are now discussed. Section A-B shows the following profile from west to east: Micaschist, crystalline limestone, quartzite-conglomerate, and michaschist of the Røros group. Then greenstones of the Støren group, then in a double syncline beds of the lower Hovin group and farther

to the east again greenstones of the Støren group. In the easternmonst part of the profile in the Gauldalen valley, beds from the lower and upper Hovin group overlain by the Lyngestein conglomerate and the Sandå beds of the Horg group occur. Section C-D, shows in the western part of the Stjørdalen valley, beds of the upper Hovin group, consisting of sandstones, polygenous conglomerates (Volla/Hopla), and rhyolite tuffs. To the east, the lower Hovin beds of dark shales, rhyolite, limestone, sandstone, and at the bottom the Stokvola breccia (Vennaconglomerate) occur. Both in the limestone and the shale of this group, fossils are found indicating the lower Hovin group (Middle Ordovician) (Carstens 1960). Below the Stokvola breccia lie the greenstones of the Støren group. This section shows still older layers from west to east, although the layers are dipping in an easterly direction. The beds are therefore probably overturned. Further to the east we find micaschists, which the author believes is a continuation further down in the sequence. They are most likely belonging to the Røros group. These micaschists are frequently intruded by trondhjemitic sills, and also at one locality, Dyrehaugen (Plate 2), by a noritic intrusion, these traits might suggest a low position in the Cambro-Silurian sequence.

At the Swedish border, the black shales at Kjølhaugen are dated by Rastrites (Silurian). To the west of Kjølhaugen sandstones, chlorite schists, and limestone (farm Brenna) occur. In this group no fossils are found, but they most likely lie below the Silurian beds at Kjølhaugen, and therefore belong to the Hovin group (upper and lower part). Just west of the limestone at Brenna, lie the amphibolite zone, which the author considers to be metabasites of the Støren group. The layers are here dipping towards west, but are again probably overturned. The arguments for this assuption is based on lithostratigraphical correlations only. In that the conglomerate here is associated on one side of a persistent zone of amphibolite, limestone and chlorite-schists, which again are overlain by evident Silurian beds, and the other (below) of micaschist. This succession fits so well into the stratigraphical scheme from other parts of the Trondheim region, that it would be reasonable to make the above mentioned assumption.

According to this profile, the Gudå conglomerate is located on the border between the Røros and the Støren group (Table I). Near the zone of the conglomerate trondhjemitic sills frequently occur, such intrusives also occur near the Ropen and contemporaneous conglomerates in Sweden, as pointed out by Kulling (1955). It should here be

remembered that the Ropen conglomerate also is supposed to be of the age here mentioned for the Gudå-conglomerate (Lower Ordovician).

Along the Swedish border a tectonic break is found. The various rock types east of this line are considered to belong to an other tectonic unit and are therefore beyond the scope of this discussion.

6. Conclusion.

There are two points of importance in the discussion of the age problem of the conglomerates of paragraph 4:

a) The interpretation of the geological maps and sections suggest a Lower Ordovician age.

b) In trying to fit the sequence of the conglomerate and its adjacent rocks into the established stratigraphical schemes of other well known parts of the Caledonides, we find that our sequence is in agreement only when the conglomerates are placed in the Lower Ordovician (Table I).

The earlier conclusions to this problem are based on:

a) Comparison of pebble composition of this and some proved Silurian conglomerates.

b) That the conglomerate possibly overlie a similar rock type as does a known conglomerate (Venna) in an other area.

To the present author these two last arguments seem so weak compared with the two first ones, that he is convinced of the Lower Ordovician age of the Hegsjøfjell-, Skjækerstøtene-, Gudå-, and Bukkhammer — Usmadam conglomerates, whilst no better counterarguments are presented.

References.

Bäckström, H., 1890.Om kvartskakelagren vid Gudå, Norge. Geol. Fören. i Stockholm förh. B. XII, 1900.

Carstens, C. W., 1954. I Løkken Verk, en norsk grube gjennom 300 år. Trondheim 1954.

Carstens, H., 1960. Stratigraphy and Volcanism of the Trondheimsfjord area, Norway. Guide to Exc. A 4 and C 1, Int. Geol. Congr., Oslo 1960.

Foslie, S., 1923. Innberetning for 1922, N.G.U. 98. Kristiania 1923.

Foslie, S. and *Oftedahl, Chr.*, 1959. Geologisk kart Jævsjø. N.G.U., Oslo 1959.

Getz, A., 1890. Graptolitførende skiferzoner i det Trondhjemske. Nyt Mag. for Nat. Vid. XXXI.

Kautsky, G., 1947. Die «Kvartskakelager von Gudå. Fören. i Stockholm Förh., B. 69, häfte 2.

Kisch, H. J., 1962. Petrographical and geological invetigations in the southwestern Tydal region, Sør-Trøndelag, Norway. Acad. Prosch., Amsterdam 1962.

Kulling, O., 1933. Bergbyggnaden inom Bjørkvattnet — Virisenområdet i Västerbottenfjällens centrale del. G.F.F., Bd. 55.

— 1955. Den kaledoniska fjällkjedjans berggrund inom Västerbottens län. 2. i beskrivning till berggrundskart över Västerbottens län. S.G.U. Ser. Ca. Nr. 37.

— 1958. Om begreppen Vojtjakonglomerat, rokonglomerat och mesketlava i Väterbottenfjällen. Geol. Fören. i Stockholm Förh. B. 80, häfte 2.

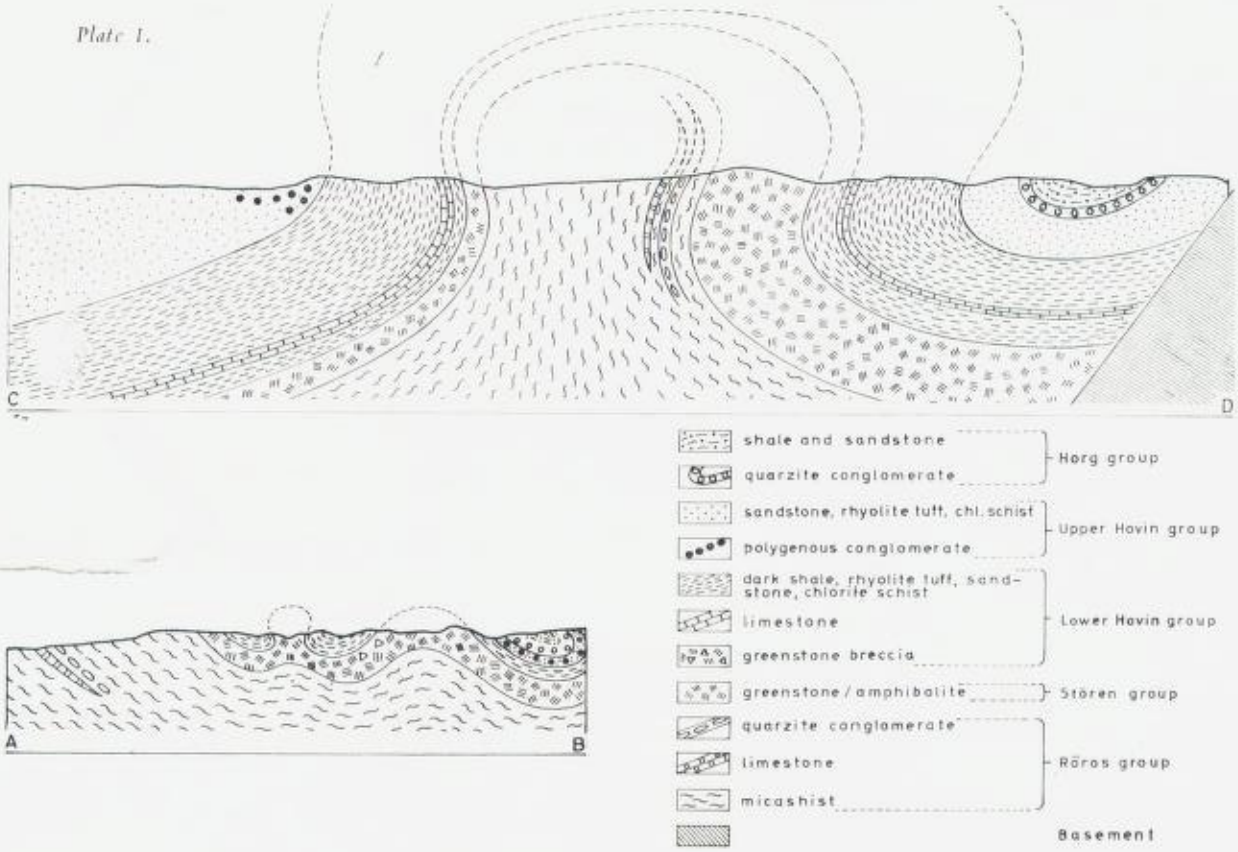
Vogt, Th., 1945. The Geology of the Hølonda — Horg district, a type area in the Trondheim region. N.G.T. 25, 1945.

Wolff, F. C., 1960. Foreløpige meddelelser fra kartbladet Verdal. N.G.U. nr. 211, Oslo 1960.

	Svorkmo — Lundamo Section A—B Carstens 1954 — Vogt 1945	Stjørdal — Meraker Section C—D Carstens 1960, Wolff 1964 — Getz 1890, Wolff 1964		Västerbotten the southern part of Södra Storfj. Kulling 1955 and others
Horg group	Shale and sandstone (The Sandå beds) Quartzite conglomerate (Lyngestein)	Absent	Shale and sandstone Quartzite conglomerate (Kjølhaugene)	Arenitic calcareous shale Shale Limestone Quartzite conglomerate (Vojtja)
Upper Hovin group	Rhyolite (Grimsås) Sandstone Polygenous conglomerate (Volla)	Polygenous conglomerate Rhyolite tuff Polygenous conglomerate and sandstone alternating Polygenous conglomerate (Hopla)	Sandstone Absent	Absent
Lower Hovin group	Dicranograptus black shale Rhyolite tuff (Espehaug, Hareklett) Sandstone and shale (Krokstad) Limestone (Holonda) Fossiliferous shale (Langeland) Greenstone conglomerate (Venna)	Dark shale Rhyolite tuff (Muruvik) Sandstone Limestone (Tautra, Forbordfj., Flora) Fossiliferous shale (Leksdal) Greenstone breccia (Stokvola)	Chlorite schist Limestone (Brenna) Chlorite schist Absent	»Tuffitic rocks«? Greentones and tuffs with ceratophyre and sediments intercalated. Intermitent conglomerate Arenitic shales (in west calcareous) Shales and polygenous conglomerate Polygenous conglomerate
Støren group	Greenstones	Greenstones	Amphibolite	Greenstones
Røros group	Micaschist Quartzite conglomerate (Svorkmo) Crystalline limestone Micaschist	Micaschist Absent Absent Micaschist	Micaschist Quartzite conglomerate (Hegsjøfj. Skjækerstøtene, Gudå and Bukkh. — Usmadam) Crystalline limestone Micaschist	Quartzite conglomerate (Ropen) Crystalline limestone Shale, arenitic shale etc.

Table I. Correlation table for beds of some Scandinavian Cambro-Silurian areas.

Plate I.



Profiles across the central and northern part of the Trondheim region.
Section A—B from Svorkmo to Lundamo. Section C—D from Stjørdal to Storlien.

Structural map of the Tømmerås anticline

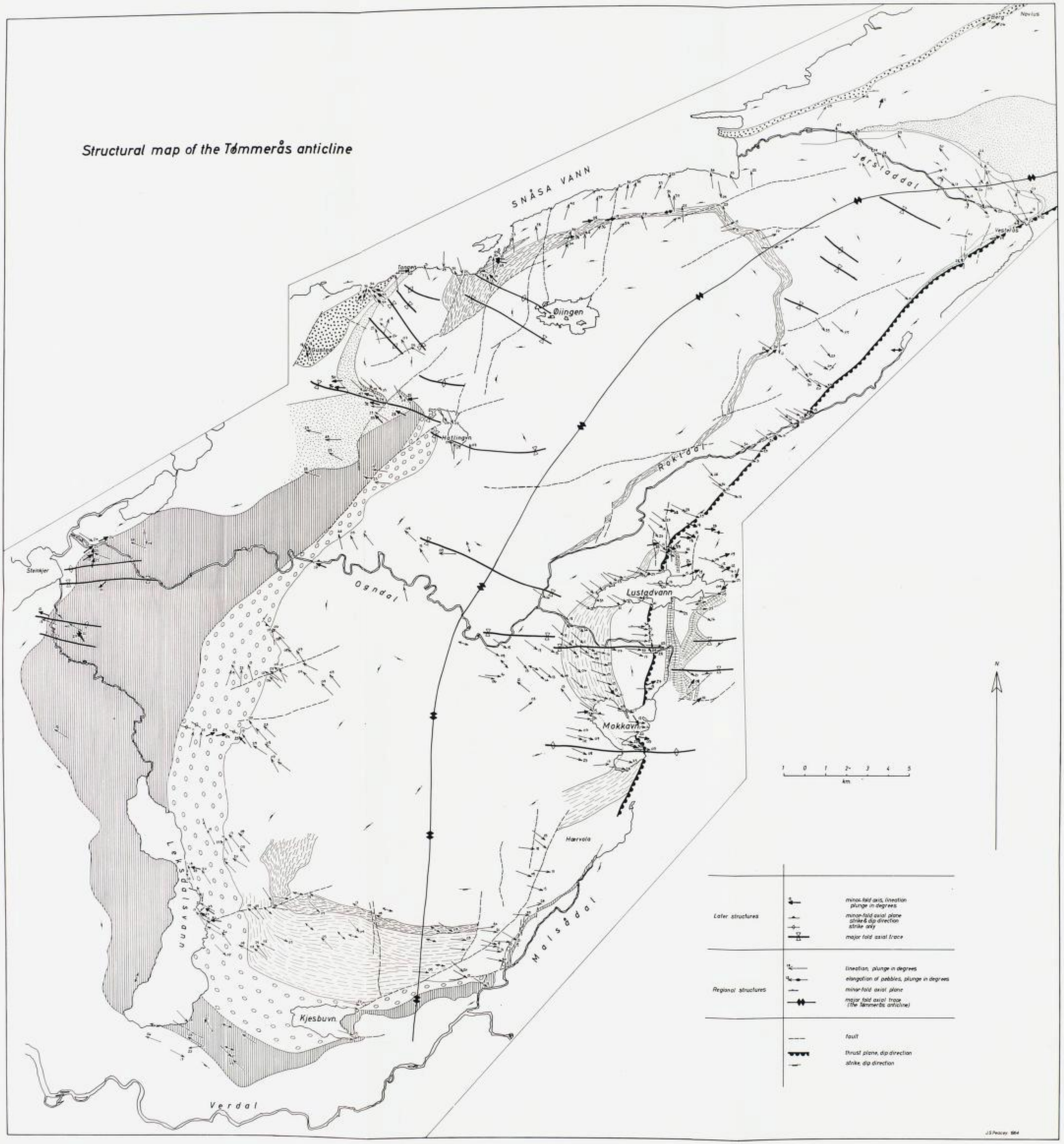


Fig. 33. Structural map of the Tømmerås anticline.

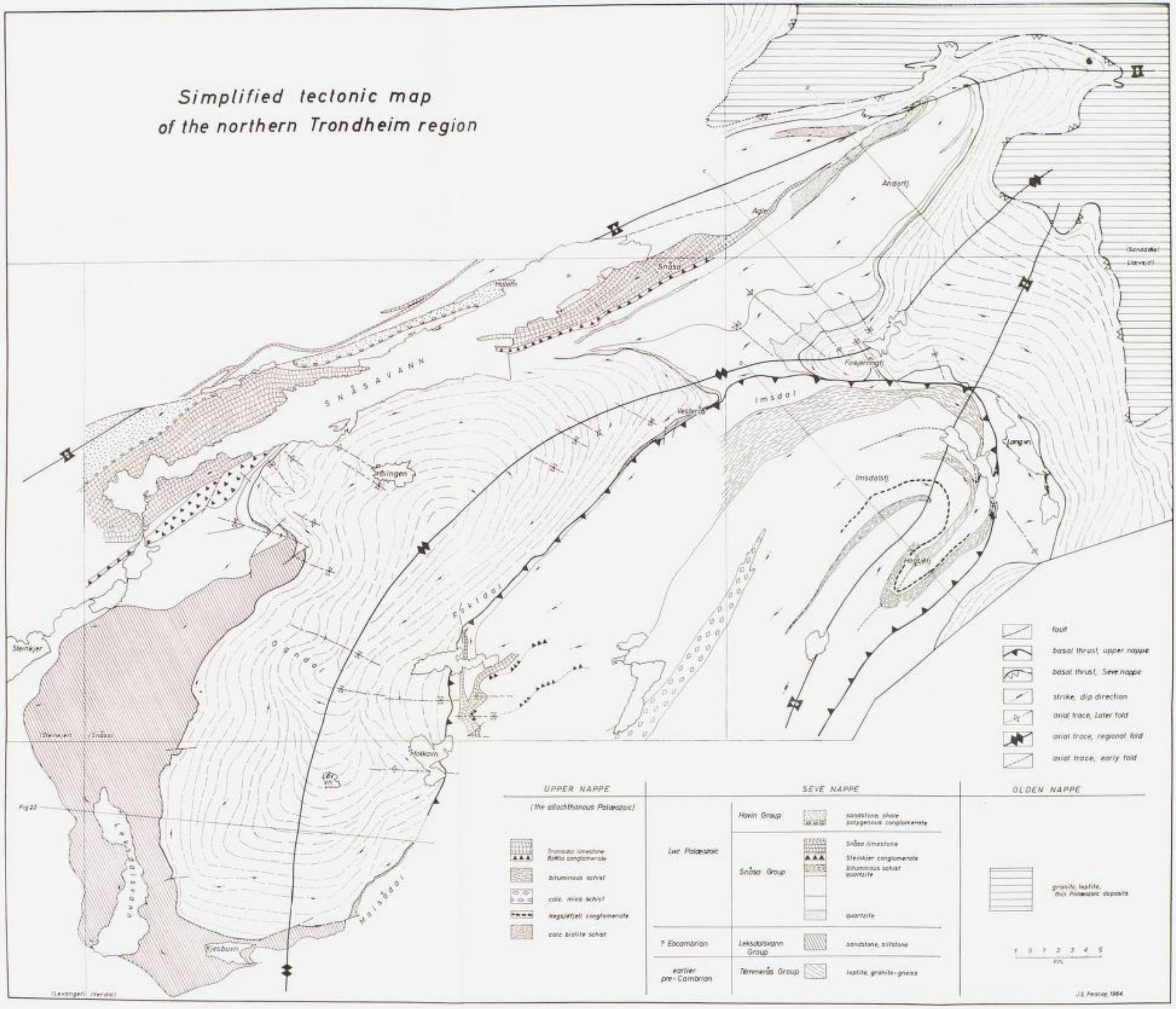


Fig. 34. Simplified tectonic map of the northern Trondheim region.

Geological map of the Tømmerås anticline

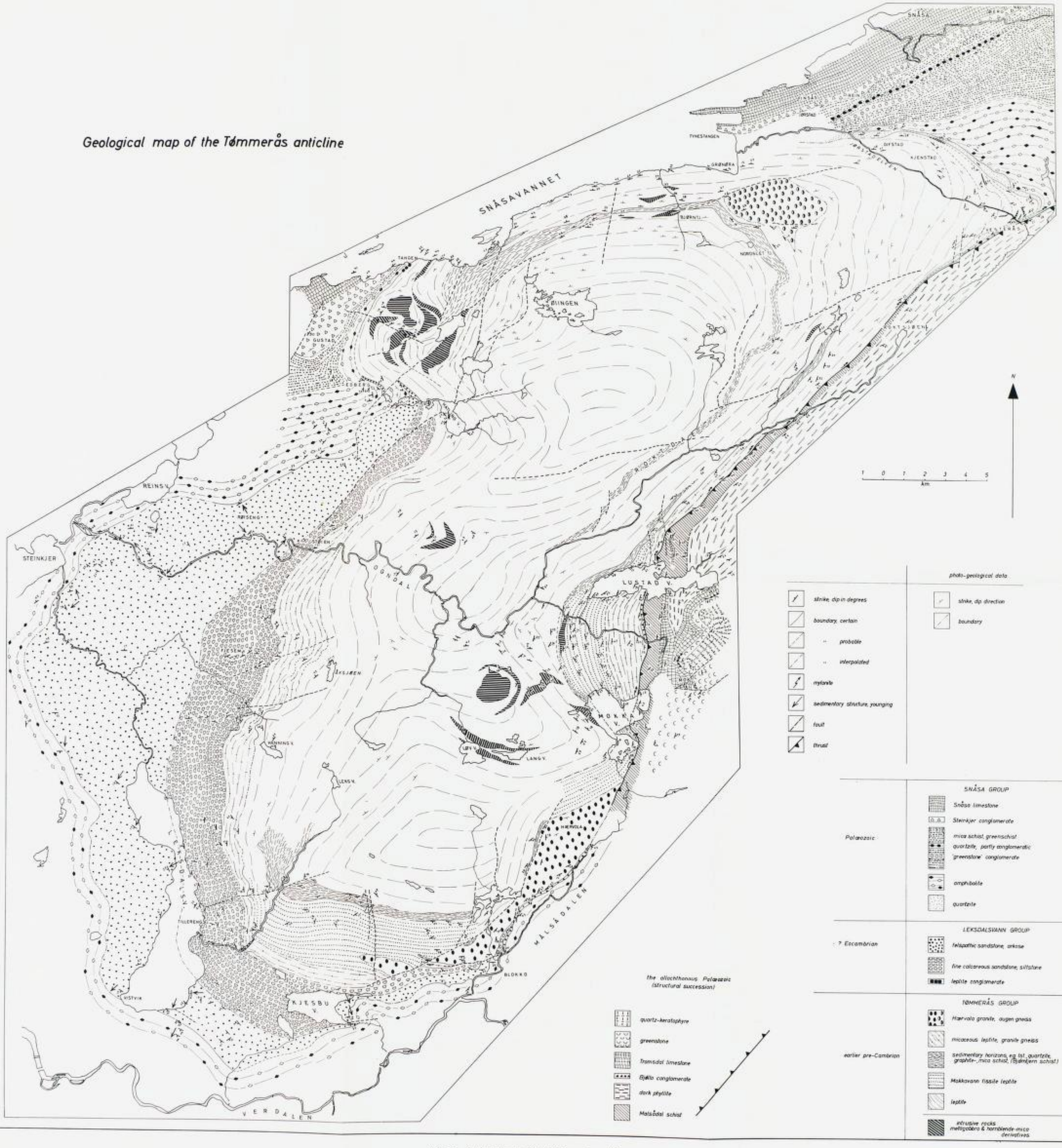


Fig. 32. Geological map of the Tømmerås anticline.

GEOLOGICAL MAP OF THE NORTHERN PART OF THE TRONDHEIM REGION

SCALE 1: 500 000

COMPILED AFTER:

C.W.CARSTENS–H.CARSTENS–S.FOSLIE–J.KIRSCH–CHR.OFTEDAHL–J.PEACY AND F.C.WOLFF

BASEMENT ROCKS OF THE TÅMMERÅS ANTICLINE

TRONDHEIMSFJORDEN

SNÅSAVANN

VERDALSØRA

LEVANGER

HOPLA

TAUTRA

FORBORSFJ.

STJØRDAL

TRONDHEIM

SVORKMO

LUNDAMO

ALDRA

GUDÅ

BRENNA

KIRKHAUGEN

OPPHAUGEN

SKJENKERSTENE

RØSJØFJ.

SELBUSJØEN

DURSHAMMER–TUNHAMDAM

LEGEND:

HORG GROUP *(Silurian)*

- Black shale and sandstone.
- Quarzite conglomerate.

UPPER HOVIN GROUP *(upper ordovician)*

- Sandstone, rhyolite tuff in west and chlorite schist in east.
- Polygenous conglomerate.

LOWER HOVIN GROUP *(ordovician)*

- Dark shale and rhyolite tuff in west, amphibolite in east.
- Sandstone in west and biotite schist in east.
- Limestone.
- Greenstone breccia / conglomerate.

STØREN GROUP *(lower ordovician)*

- Greenstone in west, amphibolite in east.
- Granodioritic gneis.

RØROS GROUP *(cambrian)*

- Quarzite conglomerate.
- Limestone.
- Micaschist often with trondhjemitic intrusions.

CALEDONIAN INTRUSIV

- Norite.

- Tectonic break
- Various rock types.
- Strike and dip.