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Sammendrag The Kautokeino "greenstone belt" is divided into an older (probably late archean) and a younger (probably middle proterozoic rift zone) complex. The older complex (Bæljavarri, Avzzejavri, Masi and Cascias group) consists of komatiites, amphibolites (metamorphic basalts, tuffs and tuffites), quartzites, mica shists and gneisses, graphite shists, granitic to dioritic intrusives. The younger complex (Stuorajavri and Carajavri group) consists of metabasalts overlain by basaltic tuffs, vulcanogenic sediments, graphite shists, argillite, sandstones and conglomerates. The Stuorajavri group and its environment are intruded by numerous diabase dykes. Transformation of rocks into more or less albite and carbonate is rather common. Mineralizations of chalcopyrite-magnetite or hematite can be correlated with albite-carbonate rocks. Cu-Au-mineralizations of the Biddjovagge type seems to belong to a special level with albite felsite and graphite shists close to the border zone of the N-S-trending rifts (under the Stuorajavri basalt).				

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Geological map Kautokeino - Raisjavri

FORDELING

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RESYMÉ:

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INTRODUCTION

This preliminary report gives the conclusions and general experiences from the regional geological mapping of summer seasons 1981 and -82 in the Kautokeino - Bidjovagge area in Finnmark.

Most of the area has been surveyed with helicopter geophysics by NGU (Norwegian Geological Survey) in 1980 and -81 and DIGHEM in 1982. The area is covered by thick or thin moraine and is generally badly exposed. The geological map is mainly constructed by means of the geophysical anomalies and contrasts. The stronger EM-anomalies are caused by graphite schists and show the strike direction of the rock series.

The basic volcanic rocks (basalt, diabase, gabbro) usually have high magnetic susceptibility, and sedimentary and acid rocks often have low magnetic susceptibility. The eastern part of the mapped area (Gæsjavri - Coavjebåttus-cåkkat - Mieron) is not covered by helicopter geophysics, but some parts of it are surveyed with VLF, magnetic or Slingram on the ground (by NGU. in the 1960's). The eastern area has been mapped in cooperation with geologist K.I. Olsen.

Air photos (colour and IR) have also been useful for the geological interpretations.

STRATIGRAPHY AND POSSIBLE CORRELATIONS OF THE "KAUTOKEINO GREENSTONE BELT".

The supracrustal of the Kautokeino area can be divided into two main complexes, a younger and an older greenstone belt. The older complex is to belong to the middle-upper Archean rocks of the Baltic shield (lapponian). The younger complex belongs a N-S going (middle) Proterozoic rift zone.

The older series are mapped by geologist K.I. Olsen in the area south and east of Kautokeino. The following stratigraphy is proposed:

Bæljasvarri group, the lowest member, consists of komatiites, metabasalts and banded amphibolites.

Some outcrops with metabasalts at Jalgesvarri (lok. 755 805) and north of Mieroluppo (lok. 725 860) may be correlated with this group.

Avzzejavri group consists of biotite schists, homogenous amphibolites and metatuffites (foliated or layered amphibolites) with some graphite zones.

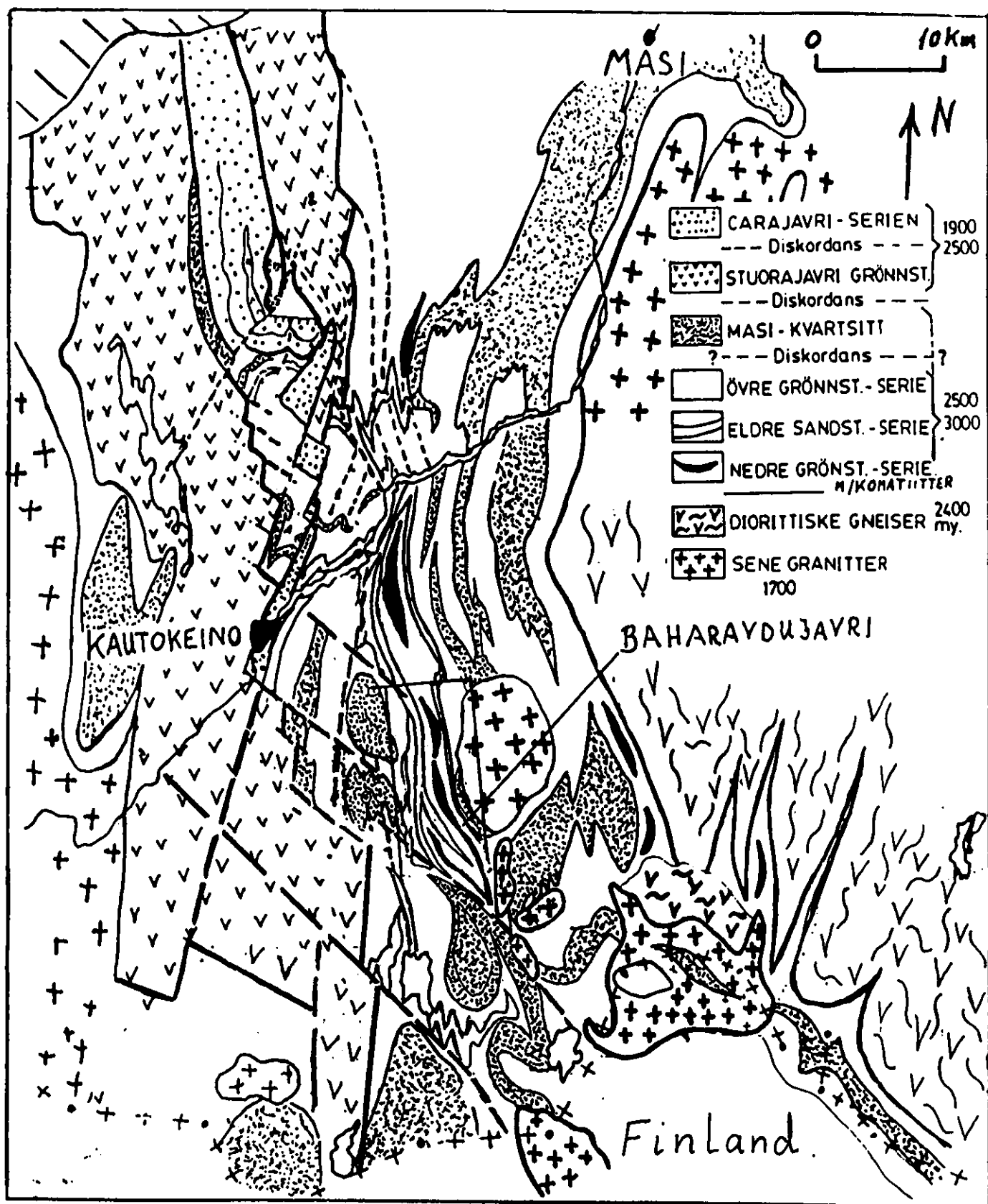


Fig. 1b) Kautokeino greenstone belt.

Stuorajavri grønnst. = Younger greenstone series

Çarajavri-serien = The sandstone / argillite series

Masi - kvartsitt = Quartzite / Mica (fuchsite) - shist / gneiss

Övre grønnst.-serie = Metatuffites / mica shists / metabasalts.

Nedre " " = Basic / Ultrabasic volcanics / tuffites.

(vzzejavri - Castias)
(Bølgasvarri)

The amphibolites and biotite schists in the eastern part, north-east of Kautokeino, are correlated with this group.

Masi quartzites, is the upper member with metasediments, from relative pure quartzites to more mica- and feldspar-rich sediments (schists and gneisses).

Several outcrops with quartzites are correlated with the Masi quartzite. They seem to occur in close connection to the Avzzejavri amphibolites. It is uncertain whether they represent some different levels within the amphibolites (metatuffites) or some repeated complex folds (synclinals) of the same unit. In the Cunucærro - Goaskinvarri - Addjit area west of Kautokeino, more feldspathic sediments occur in a complex dome structure.

Stuorajavri group consists of vulcanogenic rocks of the younger greenstone complex. It consists of basalts (well exposed on eastern shore of Stuorajavri) with overlying laminated green tuffs, dolomite and carbonate schists, graphite schists, tuffites and argillite. At the eastern border, the Stuorajavri basalt lies in contact with quartzite (Masi) at lok. 680 804 and lok. 753 757. The volcanics are deposited in an active rift zone with basic volcanism and sedimentation in a shallow sea water environment. The supracrustals are intruded by numerous diabase dikes and subrounded bodies.

The basalt, tuffs and tuffites south-east of Gæsjavri (830 800) are correlated with the Stuorajavri group.

Carajavri group consists of sandstones, conglomerates, debris flows, siltstone and mudstone (gray schists). The EM-anomalies indicate graphite layers. The mudstones have a higher magnetic susceptibility. The grain size of the sediments generally decreases towards west and south from Gæsjavri. The Carajavri sediments are deposited discordantly on a narrow zone of amphibolites and quartzites between the volcanics of the Stuorajavri group.

Caskias group is a group of mainly amphibolites west of Stuorajavri from the Bidjovagge area in the north to the Cunucærro dome in the south. In earlier literature most of the greenstones (and amphibolites) in the Kautokeino area was named Caskias series. Two kinds of amphibolites are here differentiated, a layered (banded) or foliated amphibolite (metatuffites or -tuffs) and a coarser massive to well foliated amphibolite (metagabbro) with high magnetic susceptibility. The metatuffites contain at least two or three levels with graphite schists (one of them with albite felsite and copper-gold mineralizations at Bidjovagge). Close to the western border it is observed some localities with a layered carbonate rock (dolomite ?)

The Caskias group has great similarity to the Avzzejavri group further east, and they may be correlated. At some better exposed areas at Stalluvarri and Caskias further north no obvious discordance between Stuorajavri-type basalts (and tuffs) and the amphibolites are found. There is, however, a distinct metamorphic difference. It is a possibility that the Caskias amphibolites can be an upper member of the older greenstone complex over the Masi quartzites (late Archean - early proterozoic) - or to an early event in the (middle) proterozoic rift zone activities.

Raisædno group. The amphibolites in the western part of the area are dark and mostly homogenous and strongly foliated with lighter stripes or thin bands with white plagioclase and green pyroxene. A few outcrops with biotite gneiss and with garnet- mica-schist are observed. The western area is intruded by several granites and pegmatite dykes. The granite is pink, medium grained, massive to weakly foliated. The area may contain some older granitic gneisses (a possible basement for the greenstone complexes) as interpreted by several geologists, but this has not yet been proved.

The Raisædno amphibolites have some higher magnetic susceptibility than the granites (or granite gneisses). The regional geophysical picture indicates that the Caskias amphibolites lies discordantly over the Raisædno group, but the contact may be tectonic.

The intrusive granites are radiometric dated (Rb/Sr) to about 1.700 mill. years south-east of Kautokeino (K.I. Olsen). Their possible origin is anatexis of sediments, some greenstone series or older granitic gneisses during the main metamorphic event.

Albite- carbonate-rocks are some special rock types that are mapped separately in some areas. They include several different rock types which are altered to a mixture of more or less albite and carbonate. They can vary from coarse grained, often as fracture fillings to extremely fine grained (albite felsite). Fragments or remnants of the original rocks are often present, and the original structures may be well preserved. The albite- carbonate alteration is observed over greater areas, but seems to have a connection to the Stuorajavre group and its environments (Caskias and Avzzejavri group). It is observed in local breccia zones and small fracture zones. North of Kautokeino and west of Mieron the albite- carbonate transformation is more intense and regional. The albite- carbonate rocks (shown on the geologic map) contain zones with well rounded fragments like a conglomerate, with quartzite, amphibolite or felsic "pebbles" in a fine grained matrix of various composition. These "conglomerates" grade into brecciated quartzites, amphibolites or massive felsic rocks.

The origin of the albite- carbonate rocks is uncertain. They show many signs of tectonic (or sedimentary ?) brecciation and metasomatic activity. They have a connection to explosive volcanic activity with CO_2 -rich gases or boiling water, or in shallow levels in tectonic active zones (faulting in the rift zone) combined with magmatic activity. Intrusions of carbonatite magmas, have been proposed, but not proved. The REE-content in some carbonaterich rocks is low and indicates a sedimentary origin.

Tectonic development.

The older greenstone series of possible Archean age have a complex history with at least two fold phases and medium to high grade metamorphism (K.I. Olsen field reports).

The Stuorajavri group is deposited in at least two parallel N-S trending rift zones. The environments have undergone extensive block faulting and shear folding. The first deformation phase observed in the younger volcanics is a N-S going folding and faulting perhaps in connection to a compressive stage or subsiding of the rift zone. The volcanic rocks east of Stuorajavri seem to have several parallel synclinals and anticlinals with closed (almost isoclinal) to more open fold knees where one flank (eastern side of synclinal or western side of anticlinal) is termed by a fault. The graphite schists may be connected to some fault zones. The fold axes are usually flat-lying, in some area dipping to the north or south. Cuojavarri on the south-eastern end of Stuorajavri is a synclinal structure with axis dipping to the north ($20-40^\circ$) and axial plan dipping to the east.

The second fold phase is an asymmetric shear folding with axis dipping $20-30^\circ$ to NNE, often observed in mesoscopic folds. A set of smaller faults are parallel to the axial plan. Some late diabase dykes follow this direction.

The last fold phase is a flatlying E-W open folding with small amplitude, observed at a few localities.

General mineralogy.

Samples from 60 localities are examined in the microscope.

Amphibolites (older greenstone complex).

The amphibolites are usually well foliated where the amphibole (usually a blue-green hornblende) defines the foliation. Metatuffites have layers or bands of more plagioclase. The Raisædno amphibolites contains thin bands of clinopyroxene (pale yellow - green). Other minerals are quartz, cummingtonite, garnet, biotite, magnetite, sphene.

Biotite schists (Avzzejavri group) have a similar mineralogy, but much more biotite (yellow-brown) and quartz.

The quartzites (Masi) contains more or less feldspar (microcline) of both sedimentary and metamorphic origin. Some schists contain fuchsite. North of Cunucarro (lok. 628 695) is a red middle grained gneiss with microcline and remnants of a possible clinopyroxene (pale yellow-green), a charnokitic gneiss.

Basalts, tuffites and tuffs (Stuorajavre group). Primary volcanic structures are usually well preserved. The basalts are usually amygdaloid. On Balgat-njarga on the eastern shore of Stourajavri, pillow lavas are well exposed. The metamorphic minerals are clorite (pale yellow-bluegreen), epidote, biotite (green to brownish), muscovite and actinolite (pale green, green to bluegreen or deep blue at one locality) and albite.

Some minerals occur as porphyroblasts; biotite, scapolite, tourmaline (green to brown, or wine red to dark green) often with carbonate and thin actinolite needles. The amphibole needles are usually very thin with light green colour and no preferred orientation. At one locality a colourless amphibole, possibly a cumingtonite, is registrated.

The younger volcanites are metamorphosed in upper low grade (upper greenschist facies).

Mineralizations

The observed mineralizations can be divided into the following units.

1. Chalcopyrite (cp) - bornite (bn) impregnations are observed at some localities in Raisædno pyroxeneamphibolites west of Cunucarro. An outcrop (Loc. 613 655) is coloured green by malachite and consists of fine disseminated bornite grains in thin pyroxene band in the amphibolite. An examined sample (in microscope) contains some 1-2 % of bornite. A small grain of possibly erythrine is observed in hand specimen. No further chemical analyses are done. The mineralization can be traced in several outcrops more than 1 km to the southeast, it consist of cp and seems to be some weaker. The flower "viscaria alpina" is common in this area.
2. Mineralizations of cp are observed at some localities in the Stuorajavri basalts as small grains in some amygdales. The basalt is a possible source rock for Cu.
3. Mineralizations of the "Bidjovagge" type, cp impregnations and vein filling with some Au in a fine grained albite felsite associated with

graphite schist, was last summer discovered at Ucca Vuovdas, lok. 645 830 (1.0 ppm Au/1.88 % Cu over 1 m, Report 1398). This type of mineralization (Bidjovagge - Suovrarappat) is connected to graphite schists and felsite in close vicinity to a high magnetic diabase (or basalt). If we can correlate these diabases to the earliest eruption of basalt in the rift zone, it may be a possibility to correlate these Cu- Au- mineralizations to a stratigraphical level in the border zone of the rift (under the Stuorajavri basalt).

4. Mineralizations of cp, often with magnetite or hematite in thinner veins or breccias with albite-carbonate, is widely distributed in the Kautokeino area. It is observed in blocks and boreholes, is correlated to many rock types (often diabases), with Cu-content up to about 1 % and usually little Au.
5. An outcrop of 2 x 5 m with massive hematite is observed west of Mieron (Lok. 713 875) at the border of a greater area with albite- carbonate rocks. This mineralization is of principal interest because it demonstrates that the albite- carbonate alteration processes are able to concentrate some minerals to a possible massive ore.