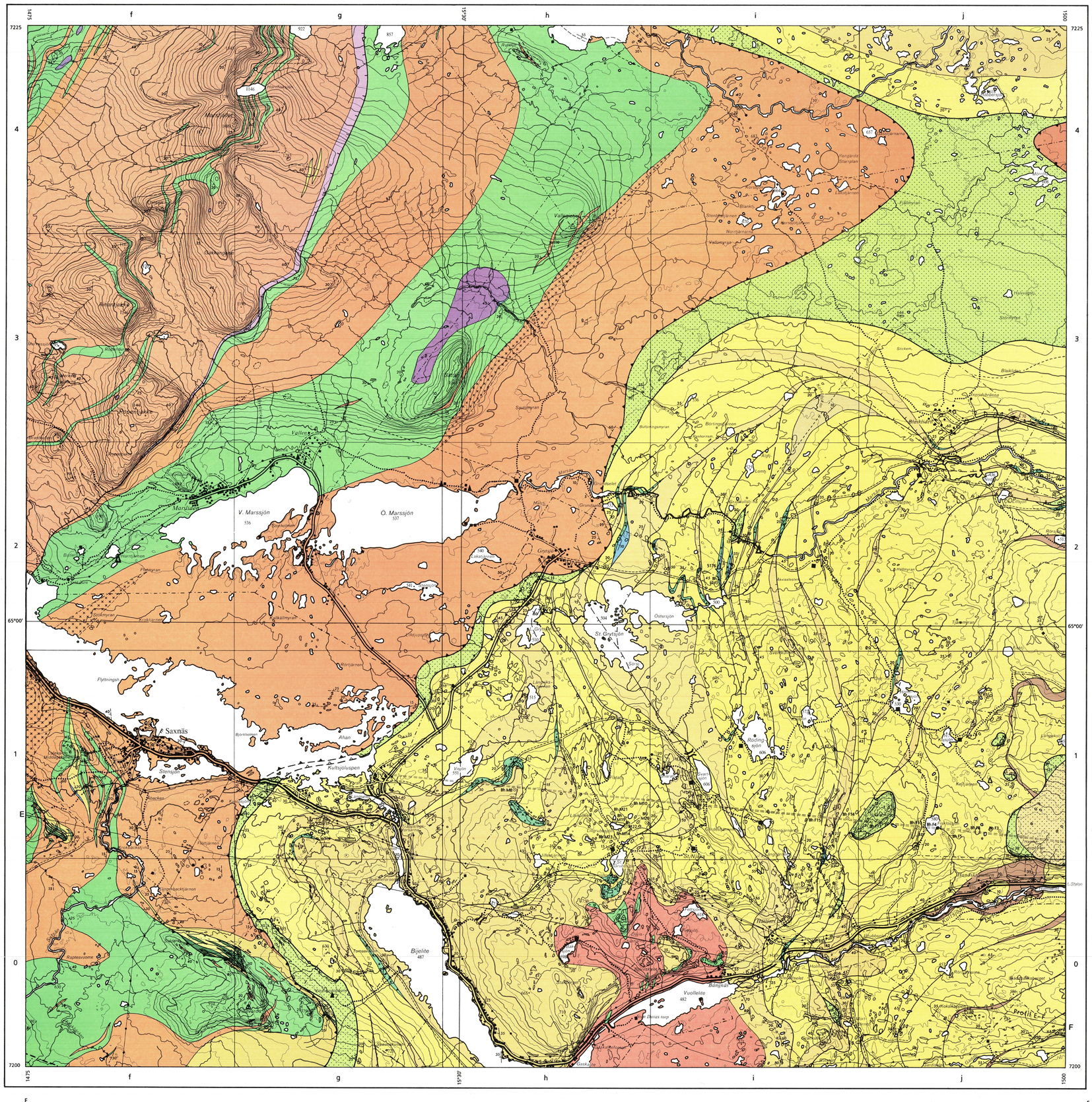

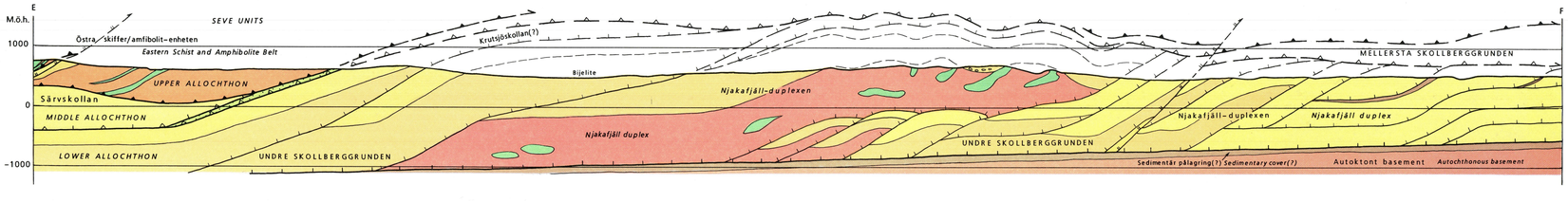

ÖVRE SKOLLBERGGRUNDEN / *UPPER ALLOCHTHON*

SEVEBERGARTER / *SEVE ROCKS*

- Ultramafiska bergarter (dunit, peridotit, serpentinit) / *Ultramafic rocks (dunite, peridotite, serpentinite)*
- Marmor, i allmänhet kalcitisk, kalksilikatbergarter / *Marble, generally calcitic, calc–silicate rocks*
- Amfibolit, granatamfibolit; mindre inslag av gnejs eller glimmerskiffer / *Amphibolite, garnet amphibolite; minor intercalations of gneiss or mica schist*
- Glimmerskiffer, gnejs, i allmänhet granat–biotit–muskovit(±fengit)–förande; mindre inslag av amfibolit / ortognejs (Nuortenjuone–gnejsen) / *Mica schist, gneiss, generally garnet–biotite–muscovite(±phengite)–bearing; minor intercalations of amphibolite / orthogneiss (Nuortenjuone Gneiss)*
- Gnejs, högmetamorf (kyanit–sillimanit–kalifältspat), migmatitisk (Marsfjällsgnejs) / *High-grade gneiss (kyanite–sillimanite–K-feldspar), migmatitic (Marsfjället Gneiss)*
- Kvartsit, fältspatkvartsit, meta-arkos, kvartsitisk gnejs / *Quartzite, feldspathic quartzite, meta–arkose, quartz–rich gneiss*
- Mylonit, blastomylonit / *Mylonite, blastomylonite*
- Överskjutning vid basen av den centrala Sevedelen / *Low–angle thrust at the base of the Seve 'Central Belt'*
- Överskjutning vid basen av Seve skollkomplexet / *Low–angle thrust at the base of the Seve Nappe Complex*

MELLERSTA SKOLLBERGGRUNDEN / *MIDDLE ALLOCHTHON*

SÄRVSKOLLAN / *SÄRV NAPPE*

- Ortfjällsdiabas / *Dolerite*
- Fältspatkvartsit, meta-arkos / *Feldspathic quartzite, meta–arkose*
- Överskjutning vid basen av Särvskollan / *Low–angle thrust at the base of the Särv Nappe*

STALONSKOLLAN / *STALON NAPPE*

- Meta-arkos / *Meta–arkose*
- Mylonit, grönskifferaktig / *Mylonite, greenish, schistose*
- Överskjutning vid basen av Mellersta skollberggrunden / *Low–angle thrust at the base of the Middle Allochthon*

UNDRE SKOLLBERGGRUNDEN / *LOWER ALLOCHTHON*

BLAIKSKOLLAN / *BLAIK NAPPE COMPLEX*

- Alunskiffer (Fjällbrännaformationen) / *Alum shale (Fjällbränna Formation)*
- Grå, grön eller röd skiffer / *Grey, green or red shale* (Gärdsjöformationen / *Gärdsjön Formation*)
- Kvartsit med skifferinlagringar / *Quartzite with shale intercalations* (Gärdsjöformationen / *Gärdsjön Formation*)
- Tillit / varvskiffer (Långmarkbergsformationen) / *Tillite / glacial clay (Långmarkberg Formation)*
- Dolomit (Kalvbergsformationen) / *Dolomite (Kalvberget Formation)* (Risbäcksgruppen / *Risbäck Group*)
- Arkos (sparagmit) med skifferinlagringar / konglomerat / *Arkose with shale intercalations / conglomerate* (Risbäcksgruppen / *Risbäck Group*)
- Gabbro, amfibolit (proterozoisk) / *Metagabbro, amphibolite (Proterozoic)*
- Granit till syenit (proterozoisk) / *Granitoid (Proterozoic)*

BETECKNINGAR / *SYMBOLS*

- Fossil-lokal / *Fossil locality*
- Uppåt i lagerföljd / *Way–up determination*
- Häll, observerad yta av blottat berg / *Observed outcrop*
- Häll eller välblottade områden, överfört från äldre kartor / *Outcrop or exposed area, transferred from previous maps*
- Kärnborrhål / *Drillhole site*
- Stalontunnelns sträckning / *Trace of tunnel to hydroelectric power station*
- Lineation p.g.a. mineralorientering eller skärande förskiffringar / *Mineral lineation or intersection lineation*
- Veckaxel med gradtal för stupning / horisontell / *Fold axis, plunge in degrees / horizontal*
- Förskiffring med gradtal för stupning / horisontell / *Foliation, schistosity, dip in degrees / horizontal*
- Lagring med gradtal för stupning / horisontell / *Bedding, compositional layering, dip in degrees / horizontal*
- Förkastning, horisontalförskjutning / *Fault, (strike–slip, lateral ramp?)*
- Överskjutning repeterande tidigare skollgränser / *Out–of–sequence thrust, breaching thrust*
- Överskjutning mellan delskollor, mindre överskjutning / *Minor low–angle thrust*
- Bergartsgräns / *Lithologic boundary*
- Mineralförekomst; nr enl. SGUs förekomstregister / *Mineral deposit; no. acc. to SGU mineral deposit register*
- Höjdkurvor, 20 m ekvidistans / *Contour lines, interval 20 metres*

0 1 2 3 4 5 km

Skala 1:50.000

INDUSTRIELLA MINERAL OCH BERGARTER

SGU för ett register över malmer och mineraliseringar, vilka i fjällkedjan har beteckningen OREC, och över förekomster av industriella mineral och bergarter med beteckningen ORED.

I endast ett fåtal fall har bergarterna inom kartbladet kommit till ekonomisk användning. Vid Grytsjö (Zi) har dolomit (ORED 5176) bränts och utnyttjats som jordförbättringsmedel. Material (arkos och kvartsit) från Vattenfalls omfattande tunnelarbeten mellan Kultsjöluspen och Stalon på 1950-talet har använts för vägbyggen och ytbeläggningar.

Kartering och sammanställning av det geologiska kartbladet 23F Fatmomakke SO har under åren t.o.m. 1992 utförts av Ebbe Zachrisson, som också svarat för design- och layoutarbeten. Vad avser undre och mellersta skollberggrunden har kartering och tolkning utförts av Reinhard Greiling. I fältkartering och materialinsamling har dessutom F.-P. Bierlein, R. Brandt, G. Eberz, Ö. Einarsson, K. Geercken, J. Glass, G. Hentzschel, I. Höller, P. Kaiser, R. Kumpulainen, M. Schwab, P. Süss och T. Thelander deltagit. Kartbilden över Seve-berggrunden bygger till stor del på arbeten av holländska studenter och forskare under ledning av prof. H.J. Zwart (Univ. i Leiden/Utrecht), åren 1968–1979, speciellt på karta och beskrivning av R. Trouw (1973). Reproduktionsarbetena har utförts av I. Källberg.

Detaljkartor i 1:20 000 samt annat grundmaterial finns tillgängligt på SGU.
Detailed maps, generally at 1:20 000, are available for study at SGU.

Engelsk beskrivning och litteraturförteckning på bladets baksida.
English description and reference list on the back of this map sheet.

Referens till kartan: Zachrisson, E. och Greiling, R.O., 1993: Berggrundskartan 23F Fatmomakke SO, 1:50 000. – SGU Ai 78.

Topografiskt underlag enligt avtal med Lantmäteriverket. Geografiska längden är räknad från Greenwich. Gauss' projektion. Godkänd från sekretessynpunkt för spridning. Lantmäteriverket 1993-01-29.
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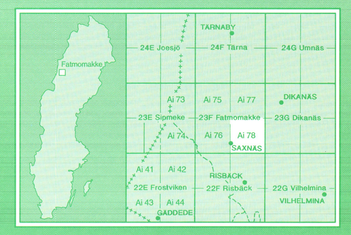
BERGGRUNDSKARTAN
23F FATMOMAKKE SO

SGU serie Ai nr 78

Berggrundskartan
23F Fatmomakke SO

Bedrock map

Skala 1:50 000



SGU
Sveriges Geologiska Undersökning

1993

KORTFATTAD BESKRIVNING

INLEDNING

Kartbladet 23F Fatmomakke SO är beläget inom den kaledoniska fjällkedjan, som är resultatet av en bergskedjebildning för ca 520–400 miljoner år sedan. Iapetus, det hav som i senprekambrisk tid gränsade till kontinenten Baltica, började då pressas ihop. Havsbottenskorpan pressades ner i subduktionszoner med samtidig utbildning av ö-bågar, både på den östliga (europeiska) och på den motsatta (amerikanska) sidan. Genom storskalade överskjutningar kom omfattande bergartskomplex att skjutas upp över den baltoskandiska urbergsskölden, vars västra randzon samtidigt kraftigt deformerades. Sådana överskjutna enheter benämnes skollor och kan ha transporterats flera hundratals kilometer åt öster eller sydost. De översta skollorna har i regel de längsta transportavstånden medan de undre enheterna är mer lokala och ofta innehåller bergarter som med stor sannolikhet tillhört det baltoskandiska underlaget.

TEKTONISK INDELNING

Fjällberggrunden består i regel av en understa, tunn zon av rotfasta (autoktona) bergarter men uppbyggs i huvudsak av tektoniskt överskjutna (allokтona) enheter. Dessa kan indelas i den undre, mellersta, övre och översta skollberggrunden. Inom kartbladen 23F Fatmomakke är den översta skollberggrunden ej representerad. En översikt över de strukturella enheterna inom Ai 77–78 lämnas i nedanstående karta och diagram. De tektoniskt sett lägsta enheterna representeras av den undre skollberggrundens s.k. Blaikskolla, i kartbladens östra och sydöstra del. Kring dessa komplex och som smärre utliggare (*Klippen*) uppträder rester av den mellersta skollberggrunden, oftast i form av grönaktiga, starkt mylonitiserade bergarter. Huvuddelen av området intas av övre skollberggrunden som inom kartbladen domineras av dess undre högmetamorfa del, Seven. Denna gnejs–glimmerskiffer–amfibolit-berggrund delas i tre underavdelningar, av vilka den mellersta utgöres av den migmatitiska s.k. Marsfjällsgnejsen, vilken också bildar fjällområdets högsta delar. Endast allra längst i nordväst på Ai 77 möter ett parti av övre skollberggrundens undre Köli.

BERGARTERNAS ÅLDER

Utifrån tillgängliga data samt geologiska bedömningar och jämförelser med angränsande områden kan man uppskatta bergarternas ålder. Den undre och mellersta skollberggrundens arkos-, kvartsit- och skifferbergarter representerar troligen senproterozoiska–kambriska sediment, med medrivna rester av det prekambriska underlaget. I den sydöstra delen av kartbladet når lagerföljden i flera av de enskilda delskollorna i den undre skollberggrunden upp i den mörka alunskiffern. I denna har i en lokal strax väster om Stalon en trilobit (*Leiopyge laevigata*) från översta mellankambrium påträffats. Strax under alunskiffern uppträder ibland dm-tjocka lager eller linser av oren kalk, uppvisande "klöverdjur"-fossil. I den övre skollberggrunden kan Seven troligen innehålla såväl prekambriska som underpaleozoiska bergarter.

METAMORFOS

I samband med bergskedjeutvecklingen pressades bergarterna ned till relativt stora djup. Ökat tryck och förhöjd temperatur ledde till att de ursprungliga såväl sedimentära som vulkaniska bergarterna omvandlades genom den process som kallas metamorfos (omvandling). Den undre skollberggrunden karakteriseras av ringa eller låg metamorfos (anchi-zon) vilken bäst kan mätas genom ökande illitkristallinitet. Mellersta skollberggrunden förelägger i grönskifferfacies och har, åtminstone delvis, utsatts för retrograd metamorfos, relaterad till överskjutningarna. I den övre skollberggrunden uppträder Sevebergartena i regel i amfibolitfacies med hornblände och granat som indexmineral, medan den kyanit–kalifältspat-förande, migmatitiska Marsfjällsgnejsen med sina granat–klinopyroxen-förande metabasiska bergarter når upp till granulitfacies.

BERGARTER

Beroende på utgångsmaterialet och som följd av variationer i deformation och metamorfos föreligger inom kartbladsområdet följande huvudbergarter:

Arkos, som dominerar den pre-tillitiska lagerföljden i den undre alloktonen, utgöres av fältspatrika, relativt grova (ibland konglomeratiska) sandstenar. Innehållet av kalifältspat ger dem ibland en rödaktig färgton, men ljusare kvartsitiska led ingår. I äldre tid användes beteckningen "sparagmit" för dessa senprekambriska sandstenar.

Tillit är beteckningen på en äldre litifierad morän som indikerar en svunnen istid. Varvskiffer, som uppträder på ett par ställen i anslutning till tilliterna, representerar en glaciallera, ibland med identifierbara droppstenar som lossnat från smältande iberg.

Kvartsit utgör huvuddelen av den post-tillitiska lagerföljden i den undre alloktonen. Den är lokalt mycket ren (>98% kvarts) men i regel något fältspatförande. Till skillnad från arkoserna utgöres dock fältspaten nästan enbart av plagioklas som vid vittring ger vita fläckar. Vissa horisonter, främst i den undre delen, är grövre, ibland konglomeratiska.

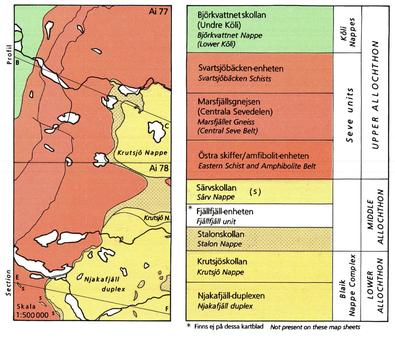
Glimmerskiffer och gnejs utgör huvuddelen av Seven. Utgångsmaterialet har mestadels utgjorts av sandiga och lerhaltiga sediment, vilket lett till att den nuvarande mineralogin domineras av kvarts, något fältspat, glimrar (biotit och muskovit) samt granat. I det centrala Sevebältets Marsfjällsgnejs har metamorfosen varit speciellt hög. Dessa bergarter innehåller sillimanit och kyanit samt ådror av segregerad (nybildad) kalifältspat, plagioklas och kvarts.

Amfibolit är en väsentlig beståndsdel inom Seven. Sannolikt representerar amfiboliten basiska intrusioner och/eller vulkaniter. Ursprunglig pyroxen har ersatts av hornblände (amfibol), vilken i kombination med kraftig deformation gett bergarten dess bandade, gröna utseende. Även andra mineral har omkristalliserat eller nybildats. Innehåll av epidot eller granat indikerar lägre resp. högre metamorfosgrad.

Ultramafiska bergarter uppträder i Seve-enheterna. De kan utgöras av duniter (huvudsakligen bestående av olivin), peridotiter (olivin och pyroxen) eller serpentiniter (serpentin).

(Fortsättning på kartans baksida.)

STRUKTURELLA ENHETER / *STRUCTURAL UNITS*



* Finns ej på dessa kartblad *Not present on these map sheets*

DESCRIPTION

General geology

The bedrock within the map sheet 23F Fatmomakke SE (Ai 78) forms part of the Scandinavian Caledonides. Most Caledonian rocks in Scandinavia are allochthonous and have been thrust east- or southeastwards onto the Baltoscandian platform. Regionally, the Caledonides are divided in ascending tectonostratigraphic order into the Autochthon (Parautochthon) and the Lower, Middle, Upper (Seve and Köli Nappes) and Uppermost Allochthons (Kulling 1972, Gee et al. 1985).

The lowermost units, up to and including the Seve units, are interpreted as part of the imbricated and shortened margin of Baltoscandia. Within the area, rocks of the Lower and Middle Allochthons are dominated by clastic cover sequences of Late Proterozoic–Cambrian age, derived from the continent Baltica, but also contain slices of Precambrian basement. Similarly, Precambrian rocks are probably involved in the Seve which is, however, dominated by quartz-rich metasedimentary units, supposed to be deposited along the western edge of the continent Baltica, and metabasic rocks of Late Proterozoic–Early Palaeozoic age, which represent intrusions and extrusions related to the opening of the Proto-Atlantic (Iapetus) Ocean (Stephens and Gee 1985, 1989, Stephens 1988).

All units have a complex tectonic and metamorphic history. The Seve units were affected by a Late Cambrian–Early Ordovician event, which locally produced high-grade, migmatitic assemblages. Deformation and metamorphism continued and the various complexes were successively brought together along a suture zone formed during collision of the continents Baltica and Laurentia in the Silurian–Early Devonian. After nappe emplacement onto the Baltoscandian platform, the Caledonian activity faded out.

Tectonostratigraphic units

The geological units distinguished on the map are principally lithological or lithostratigraphic in character. The tectonostratigraphic, generally flat-lying units are separated by major and minor thrusts, as demonstrated by the main map, the cross-sections and the structural inset map. These already established tectonostratigraphic units were locally disturbed by repeated out-of-sequence thrusting, which affected the relationship between the Middle Allochthon (Särv) and Seve, and between the Lower and Middle Allochthons.

Three major tectonostratigraphic units occur within the present map sheet, described in ascending order below.

LOWER ALLOCHTHON

The Lower Allochthon is represented by the Njakafjäll duplex (Gayer and Greiling 1989), composed of numerous horses, some of which include Precambrian basement rocks. At the northern margin it is covered by the Krutsjö Nappe. Both units belong to the Blaik Nappe Complex (Kulling 1942).

Crystalline basement rocks form the basal part of an exposed, central horse of the Njakafjäll duplex. The major part of these rocks is made up of coarse-grained granites and syenites with minor bodies (xenoliths) of mafic and intermediate composition (Greiling 1982). The granitoids are reddish and/or greenish in colour with cm-size augen of K-feldspar. The primary porphyritic texture is brecciated and mineral aggregates show a preferred orientation leading to a gneissic texture. Plagioclase and orthoclase are sericitized; biotite and hornblende are partly altered to chlorite. Undulose extinction in quartz is common. The xenoliths are mainly amphibolites, composed of hornblende and plagioclase, with minor quartz. Biotite, chlorite, epidote and clinozoisite are secondary minerals.

The crystalline rocks are discordantly overlain by arkoses of the Risbäck Group, sometimes with a primary, depositional contact.

The *sedimentary succession* of the Lower Allochthon is comparable with the Jämtland Supergroup in the type area further south (Gee et al. 1974, 1978, Kumpulainen 1982). The Risbäck Group (with Kalvberget Formation), the Sjoutälven Group (with Långmarkberg and Gärdsjön Formations) and the Fjällbränna Formation are represented within the map sheet. The thickness of the sedimentary rocks is, in general, lower than in the type area.

The **Risbäck Group** at the southern border is contiguous with the type area further south (Kumpulainen 1982) and broadly comparable. However, a distinction between two major clastic successions, the lower Stor-Rajan Formation and the upper Mångmanberget Formation, separated by the finer clastic Tväråseliet Formation, could not be made. Due to thrusting, numerous repetitions and lack of a clear key horizon, it is as yet not possible to decide whether successions are stratigraphically coherent or structurally repeated. In the section along the road Bångnäs – Kultsjöluspen the sequence starts with coarse, often conglomeratic arkoses with dark to light reddish colours. These arkoses lie on top of the crystalline basement. The sequence gradually fines upwards and is at least several hundred metres thick. In the uppermost c. 50 m the characteristic reddish arkoses give way to an alternation of light to dark grey arkoses and dark grey, red or rarely green shales. At Trappstegsforsarna, this sequence is directly overlain by varved "clay" and tillite of the Långmarkberg Formation. Towards the east, southeast of Hällnäs, the upper part of the Risbäck Group is dominated by red shales, a few tens of metres thick, with rare light arkose interlayers.

The arkoses and shales are locally overlain by light-coloured dolomites, which belong to the **Kalvberget Formation** in the uppermost part of the Risbäck Group. Dolomites are most common to the northeast and east of Grytsjö and are up to 20 m thick (Kulling 1942).

The tillites of the **Långmarkberg Formation** vary considerably both in facies development and in thickness (up to c. 30 m). The most comprehensive description yet of the area's tillites is by Kulling (1942). Varved "clays" with grain sizes up to silt and fine sand occur, probably beneath the tillites 'sensu stricto'. Dm-size dropstones can be observed within the varved clays. The overlying tillites may contain angular to sub-angular m-size boulders of crystalline, granitoid rocks and arkoses in a psammo-pelitic matrix. Locally, pelite or dolomite fragments also occur.

The **Gärdsjön Formation** is dominated by massive, often white to light grey-coloured quartzites, composed mainly of quartz (>90%), with minor amounts of feldspar, detrital mica, clay minerals and chlorite. The grain size varies between coarse and very fine-grained; particles are well rounded and graded, or poorly sorted and angular. A characteristic layer of conglomeratic and coarse-grained quartzite occurs at the base of the Gärdsjön Formation, about 10 m thick and composed of generally well-rounded pebbles of milky or bluish quartz and white feldspar, up to 1.5 cm in diameter.

Within the quartzite, irregular layers of silt- and mudstone and grey, green and sometimes red shale occur. These fine-grained layers are also composed of at least 90% quartz. Some of them are more than 10 m thick and can be followed along strike for several kilometres, as shown on the map. Towards the top of the Gärdsjön Formation, psammites show graded bedding and a general fining upwards. The last few metres beneath the overlying Fjällbränna Formation are characterized by an alternation of fine sandstones, siltstones and dark grey, impure carbonates and marls containing minor fossils of Early Cambrian age ("klöverdjur", Kulling 1955, Asklund 1962). Two such fossil localities are indicated on the map (0j).

The **Fjällbränna Formation** contains black mudstones and shales (alum shale) with fine-grained, mainly submicroscopic clay minerals and variable contents of quartz and/or carbonate, sulphides (mostly pyrite) and organic matter. Andersson et al. (1985) give a stratigraphic age range of the Swedish alum shales from Middle to Late Cambrian and locally earliest Ordovician. A trilobite of late Middle Cambrian age (*Lejopyge laevigata*) has been found in a limestone lens in black shale (0j) along the main road to Stalon, close to the eastern margin of the map sheet (Gee 1972). The alum shale of the Fjällbränna Formation represents the highest stratigraphic unit of the Lower Allochthon in the area.

Structurally, the Lower Allochthon is exposed in a major regional antiform trending NNE–SSW, which was caused by the stacking of the Njakafjäll duplex (Gayer and Greiling 1989). The structural and metamorphic evolution involves a single pre-thrusting deformation phase which produced small-scale isoclinal or drag folds and a penetrative foliation in incompetent rocks, synchronous with illite recrystallization (Greiling 1985). Subsequent shearing and thrusting relates to nappe transport and stacking of horses, and the latter also led to folding in the overlying units. A late stage of compression is documented by out-of-sequence thrusts, which locally carried the Lower Allochthon over the Middle Allochthon (e.g. east of Grytsjö, L. Njakafjäll). Illite crystallinity data define a "metamorphic" grade between lower anchizone and epizone (Greiling 1985).

Not all of the horses and particularly not their bounding thrust surfaces could be mapped out in detail. The authors have, in places, inferred the course of thrust surface traces by trying to find a compromise between two extremes: a) Frequent thrusts; horse thickness similar to the inferred stratigraphic thickness of the sedimentary sequence, and b) few thrusts; horses considerably thicker than the sedimentary succession. Stretching lineations and branch line geometry suggest a tectonic transport direction towards the ESE (ca. 110°) which is consistent for all the horses in the Lower Allochthon (Gayer and Greiling 1989). North of Marsån and east of Blaikliden, the approximate E–W strike of thrusts implies the presence of lateral and oblique ramps. Towards the north, the Njakafjäll duplex is overlain by the Krutsjö Nappe, which is covered northwards by the overlying Middle Allochthon. The Krutsjö Nappe reappears at the northern map boundary, and in the Krutsjön area (Ai 77) it represents the only exposed unit of the Lower Allochthon.

MIDDLE ALLOCHTHON

The Middle Allochthon comprises two major units, the Stalon Nappe and the overlying Särv Nappe. The most important distinction between the two is the absence (Stalon) or presence (Särv) of Caledonian igneous rocks (e.g. Gee and Zachrisson 1979, Stephens et al. 1985). Both units cover only minor areas of the present map sheet.

The **Stalon Nappe** (Kulling 1942) is widely distributed between the Lower and Upper Allochthons and occurs as isolated *klippen* overlying the Lower Allochthon. It is composed of both crystalline, pre-Caledonian basement rocks, metasedimentary, generally psammitic rocks and mylonites. The different lithological units are separated by shear zones and primary basement/cover relationships are not preserved (Greiling 1985). The green mylonites were probably derived mainly from crystalline pre-Caledonian rocks (Greiling 1992), but well-preserved crystalline rocks are lacking within the area. The metasedimentary rocks consist of coarse meta-arkoses with subordinate pelitic interlayers. Lithological similarities suggest a correlation with the Risbäck Group.

The **Särv Nappe** is most completely developed and studied at its type locality in southern Jämtland (Gee et al. 1985a). It is composed of Late Proterozoic to Early Cambrian psammitic rocks (Kumpulainen and Nystuen 1985), cut by mafic dyke swarms of predominantly tholeiitic composition (Solyom et al. 1979). Similar metapsammites with well-preserved dykes occur in three small lenses to the southwest, south and southeast of Saxnäs. The geochemical composition of the mafic dykes (Eberz 1982) implies their correlation with the mafic dykes of the Särv unit further south (Greiling et al. 1984). The major part of the massive metabasic rocks with subordinate metapsammites at Mount Vinevare southeast of Saxnäs (Vinevare diabase of Kulling 1942) is, however, included in the overlying Seve unit.

Both nappe units of the Middle Allochthon share a common Caledonian *tectonic evolution* (Greiling 1989). In pelitic rocks, mineral assemblages representing an early peak of metamorphism are characterized by coexisting almandine garnet, biotite and muscovite and are indicative of the transition between greenschist and amphibolite facies metamorphism with minimum P–T conditions of about 500°C and 4 kb. Subsequent mylonitization is associated with retrogression of garnet and brown biotite into coexisting muscovite, chloride, green biotite and rare stilpnomelane in pelitic rocks, indicating lower greenschist facies metamorphic conditions. Less deformed domains still retain higher grade assemblages that remained apparently unaffected by retrogression.

Early Caledonian deformation in the Middle Allochthon is documented by recumbent, isoclinal folds with a penetrative schistosity, deformed by generally open folds attributed to a second structural phase. These latter folds are associated with an axial planar crenulation cleavage that may be penetrative in incompetent rocks. Subsequent deformation led to intense shearing and development of a penetrative mylonitic fabric in some structural units. In other units, penetrative deformation was restricted to their margins or to distinct internal shear zones with only a weak overprinting by a fracture cleavage. Associated with the planar mylonitic fabric is a strong lineation enclosing both relic mineral grains and newly formed minerals, indicating a tectonic transport direction towards the SE–SSE (ca. 140°). The Middle Allochthon was subsequently affected by out-of-sequence thrusts, which locally transported the Särv Nappe over the Seve. Later fault-bend folding occurred when the Middle Allochthon was transported as the passive roof of the Lower Allochthon.

SEVE UNITS

The higher-grade rocks in the structurally lower part of the Upper Allochthon are included within the Seve Nappes. Within the map area, they are represented by a sequence of mica schist, gneiss, amphibolite and minor marble, with bodies of ultramafic rocks.

The Seve rocks of the area were studied and described by Trouw (1973), who distinguished three separate units. The **Eastern Schist and Amphibolite Belt**, which in this context includes the Dikanäs and Grytsjö schists, forms the lowermost unit and dominates within the map area. A well-preserved to highly deformed gneissic granite (Nuortenjaure Gneiss) forms a recognizable unit that can be traced over a considerable distance. The Central Seve Belt is represented by the migmatitic **Marsfjället Gneiss**, characterized by K-feldspar and kyanite, and intercalations of metabasic rocks generally with the mineral association hornblende–plagioclase–garnet–clinopyroxene, suggesting granulite facies. Metamorphic conditions have been estimated (Sillanpää et al. 1987) to represent >600°C, c. 10 kbar and a burial depth of about 35 km. The lower, eastern contact is tectonic. It is marked by an impressive blastomylonite zone which developed under amphibolite facies conditions (Zwart 1974) and was reactivated under retrograde, low-grade conditions. The upper, western belt of schist and amphibolite, referred to as the **Svartsjöbäcken Schists,** has a gradational contact towards the structurally underlying Marsfjället Gneiss. No tectonic break has been suggested. The Marsfjället Gneiss and the Svartsjöbäcken Schists are correlated with the Lillfjället Gneiss and the Transition units, respectively, on the map sheets 22E Frostviken (Zachrisson and Sjöstrand 1990). The major part of the Seve on these map sheets (Sjouten, Gakkafjället, Blåsjöälven and eqv. units, including the Ertseke lens with abundant eclogites) are structurally related to the Eastern Schist and Amphibolite Belt on the Fatmomakke map sheets.

Cross section

The section is drawn assuming a sole thrust with a constant dip of 1.5° (cf. Gee et al. 1978, Bierlein and Greiling 1993) from the eastern Caledonian margin towards the WNW. It trends at a low angle to the tectonic transport direction of the Lower Allochthon (110°). Previous sections across the Njakafjäll duplex have been published by Kulling (1972) and Gayer and Greiling (1989). The former paper covers the Stalon tunnel section and related drillholes, both of which are shown on the map (location of drillholes from Kulling without field control). The present section shows the Njakafjäll duplex as a relatively simple hinterland-dipping duplex. Horses in the east are composed exclusively of the Sjoutälven Group (c. 300 m thick), whereas horses further west also contain the stratigraphically lower Risbäck Group, which is thickening westwards. The thickness of basement rocks in the horses can only be inferred from the sections.

An important feature are minor thrusts breaching the roof thrust of existing or developing duplexes, locally transporting a lower unit over an overlying major tectonic unit. Such out-of-sequence thrusts affect the contacts between the Särv and Seve Nappes and between the Lower and Middle Allochthons. Successively they cut across previous thrusts, making them inactive and coupling underlying tectonic units to the overlying nappe complex. Therefore, they may represent an important displacement mechanism in the moving orogenic wedge.

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SGU = Sveriges geologiska undersökning

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