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Geological maps and cross-sections of Southern Sweden

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1. PREFACE

The Geological Survey of Sweden (SGU) and Softrock Consulting, Genarp have compiled the present geological maps and cross-sections of southern Sweden – including the surrounding offshore areas – by order of the Swedish Nuclear Fuel and Waste Management Co (SKB) and South Sweden Power Supply (SK).

The purpose of this compilation was to produce a basis for forming a judgement of the stability of the bedrock of southern Sweden.

The maps and cross-sections are based on both published and unpublished material.

The present report is meant to give complementary information to the maps and cross-sections (numbered from 1 to 44). Copies of these are available at the Geological Survey in Lund.

At the end of this report reduced scale versions of the maps and cross-sections are added (Pl. 1–44).

Kent Larsson has prepared the part of the work dealing with the sedimentary rocks, and the crystalline rocks have been treated by Karl-Axel Kornfält.

Lund 87 12 01

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2 PRECAMBRIAN ROCKS

2.1 INTRODUCTION

The present report is meant to give complementary information to the maps of solid rocks, which have been compiled by the Geological Survey of Sweden(SGU), by order of the Swedish Nuclear Fuel and Waste Management Co (SKB) and South Sweden Power Supply (SK). The work has been performed at the local branch of the Geological Survey in Lund under the management of Karl-Axel Kornfält. The local branch of the Geological Survey in Göteborg has compiled the maps of the bedrock Göteborg and Borås.

The purpose of the work was to compile maps of the bedrock to the scale of 1:250 000 as well as to the scale of 1:1 000 000, covering an area corresponding to the mapsheets to the scale of 1:250 000: Göteborg, Borås, Jönköping, Oskarshamn, Malmö, Karlskrona and Kalmar (see Fig. 1).

Also lineament maps to the scale of 1:250 000, covering the same area, have been compiled (see below).

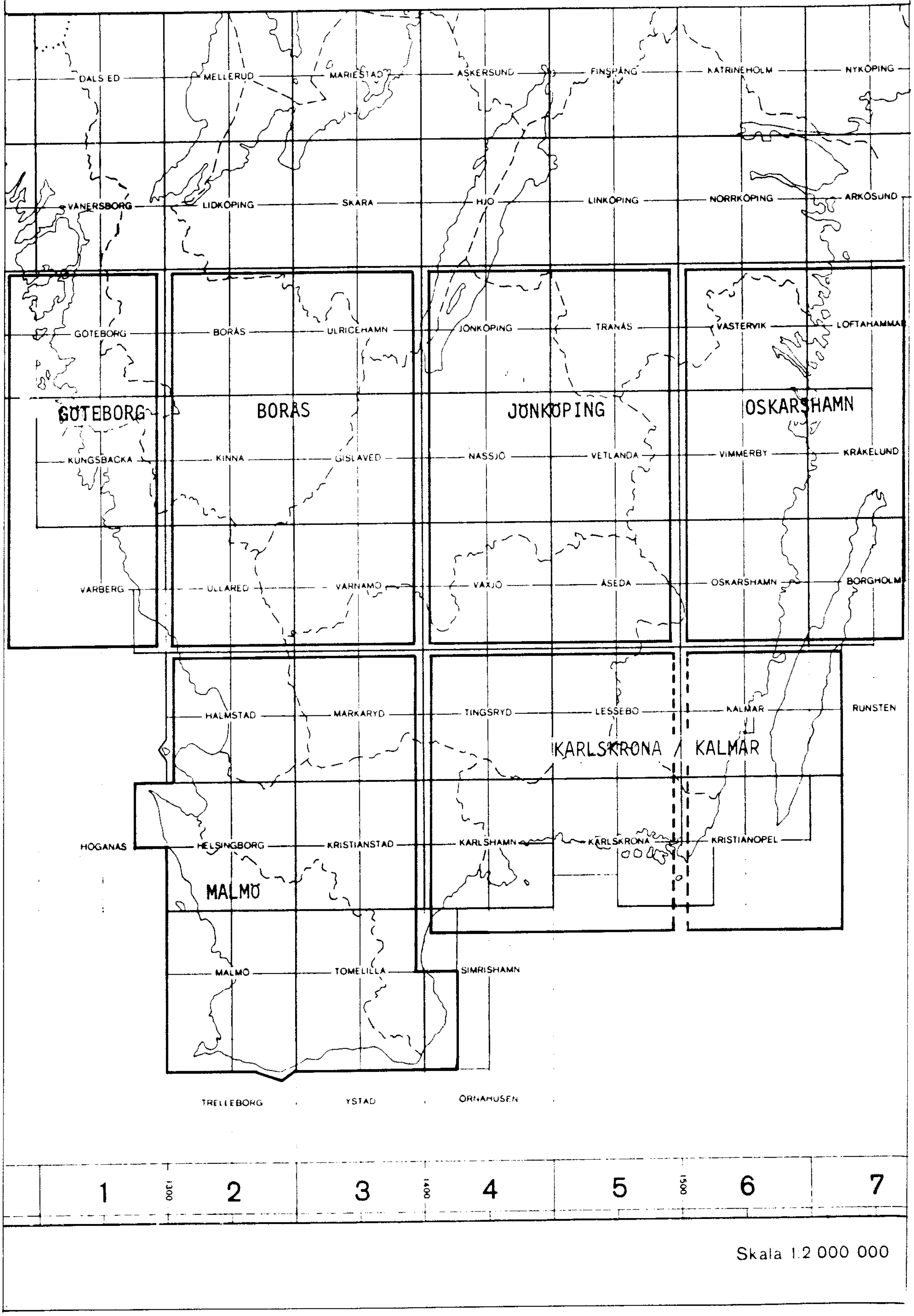
2.2 RELIEF MAPS (Pl. 1–8)

The interpretation of lineaments is based on relief maps from the National Land Survey (LMV). These maps have been produced with computer assistance from terrain height data bases stored in a grid of 50 m (Elvhage & Andersson 1986).

For some areas no such height data bases exist at present. These areas are blank on the map.

The position of the light source is in the north-west on all maps with the exception of the map Malmö, where it is in the south-west.

Fig 1. The subdivision in map-sheets to the scale of 1:250 000
of the actual area.



2.3 MAPS OF THE BEDROCK

2.3.1 Maps of the bedrock to the scale of 1:250 000 (Pl. 16–21)

These maps have the following designations (see Fig. 1):

Göteborg
Borås
Jönköping
Oskarshamns
Malmö
Karlskrona/Kalmar

Some of these maps have been published as "Provisional Maps" (PÖB) in the SGU series Ba (see Fig. 2), viz,:

Oskarshamn (Ba 34)
Jönköping (Ba 39)
Malmö (Ba 40)

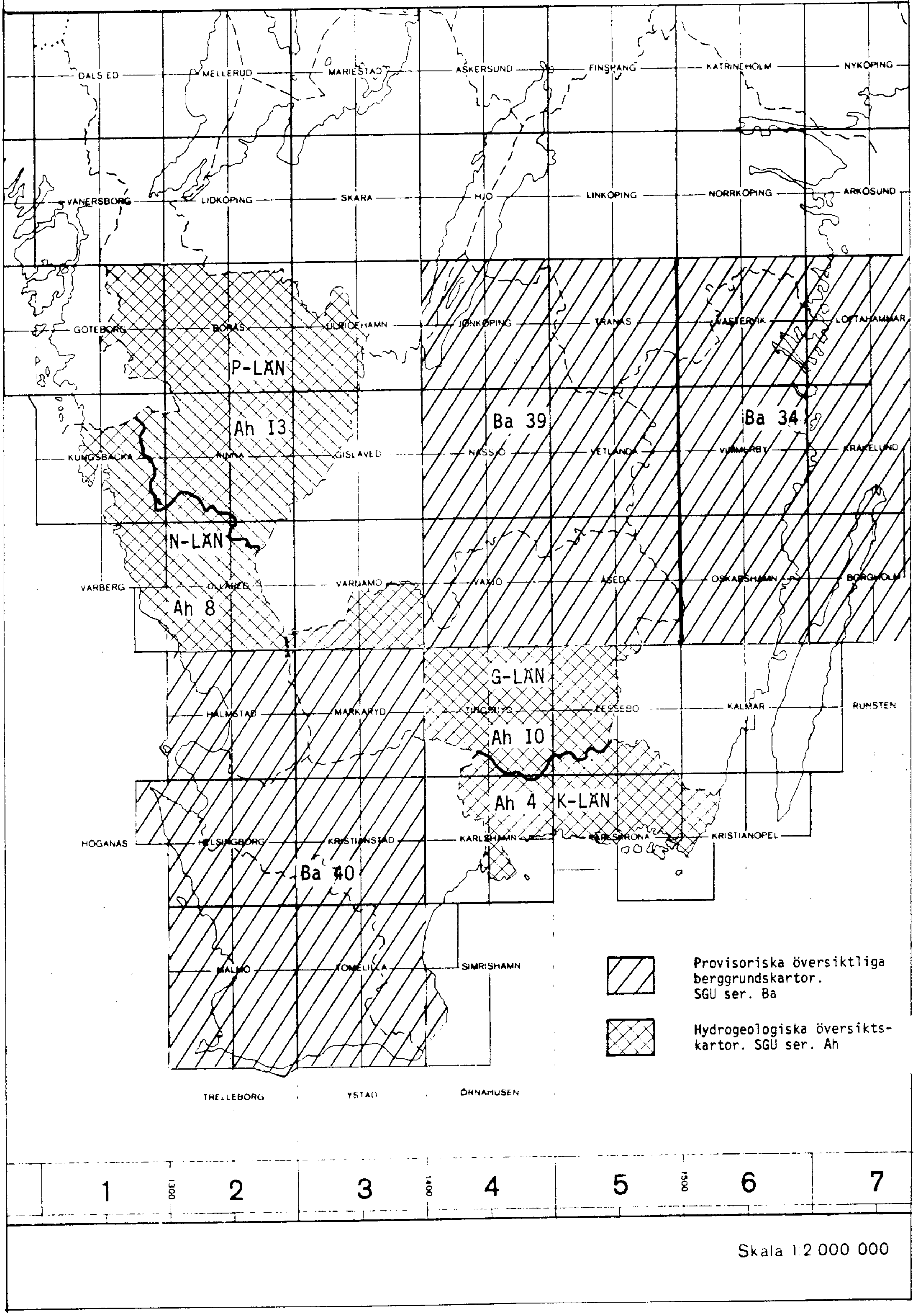
The other maps are based on the following material:

GÖTEBORG

SGU, series Ah, 1:250 000	Hallands län	Ah 8
	Älvsborgs län	Ah 13
SGU, series Af, 1:50 000	Göteborg SO	Af 117
	Göteborg NO	Af 136
	Göteborg NV	Af 146
	Kungsbacka NO	Af 124
	Kungsbacka SO	In preparation

For areas not covered by the maps mentioned above, other maps in the SGU series Aa, Ab and Ac have been used. Also publications in SGU series C (531 and 553) and a map by P.H. Lundegårdh (published in Geologiska Föreningens Förhandlingar, volume 73) have been utilized.

Fig 2. Bedrock maps



BORÅS

SGU, series Ah, 1:250 000	Hallands län	Ah 8
	Älvsborgs län	Ah 13
SGU, series Af, 1:50 000	Ulricehamn SV	In preparation
	Ulricehamn SO	In preparation
SGU, series Ba, 1:250 000	PÖB Borås	In preparation

For areas not covered by the maps mentioned above, other maps in the SGU series Aa and Ab have been used.

KARLSKRONA/KALMAR

SGU, series Ah, 1:250 000	Blekinge län	Ah 4
	Kronobergs län	Ah 10
SGU, series Af, 1:50 000	Karlshamn NV	Af 135
	Karlshamn NO	Af 154
	Karlshamn SV	In preparation
	Karlshamn SO	In preparation
SGU, Series Ba, 1:250 000	PÖB Karlskrona	In preparation

For areas not covered by the maps mentioned above an old map of solid rocks (published 1906) to the scale of 1:200 000, has been used (SGU A1a5).

Areas colored manually

Areas not covered by printed maps to the scale of 1:250 000 have been colored manually. These map sections have thereafter been put together with the printed maps.

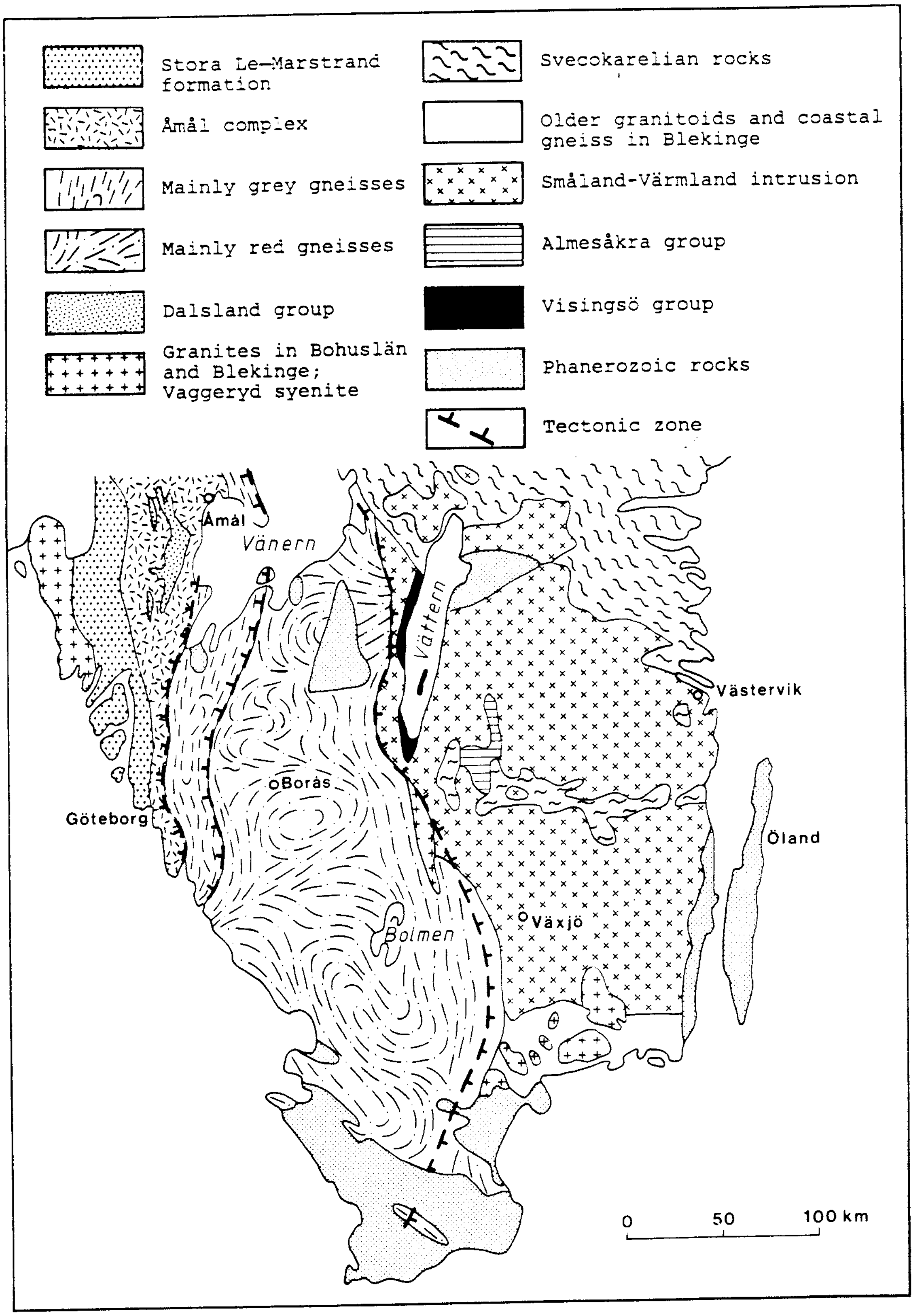


Fig 3. Major lithologic and tectonic units in southern Sweden. Modified from Samuelsson 1982.

2.3.2 Map of the bedrock to the scale of 1:1 000 000 (Pl. 22)

The six maps to the scale of 1:250 000 were reduced photographically to the scale of 1:500 000. A new, simplified map was drawn manually on plastic film and thereafter reduced photgraphically to the scale of 1:1 000 000.

2.3.3 A brief description of the Precambrian bedrock of southern Sweden

2.3.3.1 *Introduction*

The following survey of the Precambrian bedrock of southern Sweden is taken mainly from "The Precambrian of Sweden" (Lundqvist 1979). Also recent papers by Gorbatschev (1980), and Gaál & Gorbatschev (1987), dealing with the development of south Sweden have been used. The descriptions to what is called Provisional Maps to the scale of 1:250 000 (SGU Ba 34, 39, 40) give also a good survey of the bedrock in the described areas. The locations of lineaments and major fracture zones described in published papers and maps and mentioned in this survey are found in the "Reference Maps". Also references to the new Geological Survey (SGU) maps to the scale of 1:50 000 (Ser Af) are found there.

2.3.3.2 *General features* (see Fig. 3)

Lundqvist (1979) has in his review of the Swedish Precambrian distinguished two major tectonic units: The Svecokarelian orogenic belt with its post- and anorogenic complexes, and the gneisses in south-western Sweden affected by the Sveconorwegian regeneration.

The Småland-Värmland granites and related volcanics which form the eastern part of the bedrock of south Sweden are regarded as representing a subsequent magmatism of the Svecokarelian orogeny.

The Blekinge region is according to Lundqvist (op. cit.) not readily attributable to either of the main tectonic units, and is therefore treated as a sub-unit by him.

2.3.3.3 *Major tectonic zones*

The SW-Swedish gneisses (called the Southwest Scandinavian Domain by Gaál & Gorbatscev 1987) are separated from the Småland-Värmland intrusions (called the Transscandinavian Granite-Porphyry Belt by Gaál & Gorbatschev 1987) by the "Protogine Zone".

This zone is an indistinctly delimited belt of shearing and faulting accompanied by intrusions of granite, syenite and hyperite dolerites. The syenites have given Rb-Sr ages of 1 184 Ma (Skåne, Klingspor 1976) and 1 127 (Vaggeryd, Patchett 1978). The hyperite dolerites are somewhat older (Johansson, in preparation).

The N–S trending Protogine Zone touches the western shore of Lake Vättern and continues southwards as far as Romeleåsen in southern Skåne. The Västanå Tectonic Zone in north-eastern Skåne may be a branch of the Protogine Zone running in SSE.

The shear zones, typical of the Protogine Zone, are rather narrow and there are unsheared rocks in between them. It is likely that movements along the shear zones have taken place repeatedly from shortly after the formation of the Småland granite until the final stages of the Sveconorwegian orogeny about 900 Ma ago.

Because of the difference between the better preserved Småland-Värmland intrusions in the east and the polymetamorphic SW-Swedish gneisses in the west the Protogine Zone has sometimes been interpreted as a suture of continent collision. This opinion has been contradicted of, among others, Gaál and Gorbatschev (1987).

The faulting along the Protogine Zone has resulted in a relative uplift of the crustal segment made up of the SW-Swedish gneisses (Welin & Blomqvist 1966). Dolerite dikes (870–975 Ma, Patchett 1978), running parallel to, and east of, the Protogine Zone are probably connected with this faulting.

The southern part of what is called the Mylonite Zone can be followed from Lake Anten (in the northern margin of the enclosed map) southwards through Lake Mjörn to northern Halland. The rocks in the Mylonite Zone are strongly sheared and in part mylonitized. Two major phases of mylonitization have been distinguished (Samuelsson 1978). Both of these are most likely older than c. 900 Ma.

Probably of the same age is the Göta älv-Kungsbacka fjord Tectonic Zone somewhat further to the west of the Mylonite Zone.

2.3.3.4 *The SW-Swedish gneisses*

South-western Sweden belongs to the major tectono-stratigrafic unit, usually called the SW-Swedish gneisses (Lundqvist 1979). This unit is dominated of strongly foliated granitoid gneisses of plutonic origin. The gneisses can be divided into red and grey types, of which the red one occurs mainly in the east and the grey in the west.

Typical of the SW-Swedish gneiss complex is a compositional banding between different types of foliated granitoids. Also amphibolites are occurring in this banding. The gneisses are generally intensely deformed and the structures usually show gentle or moderate dips.

The SW-Swedish polymetamorphic gneisses are mainly composed of rocks which are 1500–1750 Ma old. They have later been reworked during a magmatic-metamorphic event about 1500–1400 Ma ago and another c. 1250–900 Ma ago (cf. Gaál & Gorbatschev 1987).

The predominant metamorphic grade is amphibolite facies but in Halland, around the towns of Varberg, Laholm and Halmstad, there is a region affected by granulite metamorphism. Here charnockitic rocks occur. Also in north-western Skåne there are small areas with charnockitic rocks.

In the region west of Göteborg a N–S trending belt of supracrustals occurs. This formation, called the Stora Le-Marstrand formation, is composed of subgreywacke to greywacke gneiss with minor quartzitic layers, mica schist, and basic to intermediate metavolcanics.

East of the Stora Le-Marstrand formation a narrow belt of intrusive and supracrustal rocks occurs. These rocks which are indistinctly deliminated from the SW-Swedish gneisses, belong to the Åmål complex which ranges above all further to the north, west of Lake Vänern.

2.3.3.5 *The Blekinge region*

In Blekinge there are gneisses (called coastal gneisses) which look like varieties of the SW-Swedish gneisses. However, the tectonic style of the SW-Swedish gneisses cannot be recognized in the coastal gneisses. The age of the latter is determined to c. 1690 Ma (Johansson & Larsen, in prep.). The coastal gneiss is probably of supracrustal origin as it grades into acid Västanå metavolcanics.

Younger than the coastal gneiss are porphyritic granites forming the Karlshamn granite group. In addition to the greyish red, medium- to coarse-grained Karlshamn granite proper, there is also a fine- to medium-grained granite, called Spinkamåla granite. The mentioned granites are forming several massifs of different sizes in Blekinge and southern Småland. Recent dating of the Karlshamn granite has yielded ages of c. 1400 Ma (Åberg et al. 1986). Belonging to the Karlshamn granite group is also a red, K-feldsparrich granite with typical biotite schlieren, called Vånga granite.

The third rock, typical of Blekinge, is a granodiorite to tonalite – often porphyritic – called Tving granite. This granitoid is very similar to the Småland granite but is usually more or less gneissose. Dating of the Tving granite has given an age of c. 1770 Ma (Johansson & Larsen, in prep.).

2.3.3.6 *Region of Småland intrusion*

In Småland, granites are the most common intrusions. Among them monzonites and monzodiorites occur. Granodiorite, diorite and gabbro are subordinate. There are two varieties of granites, one porphyritic and one even-grained. Somewhat older than the mentioned granites is a suite of differentiated igneous rocks (from gabbro to granite).

To the north of Oskarshamn there occur small massifs of younger (anorogenic) granites (c. 1377 Ma; Åberg 1978) within the Småland granites.

There are also large areas of acid volcanics (Småland porphyries). They are structurally and texturally well preserved with phenocrysts of quartz and feldspar. Ignimbrite structures and textures are common. They are accompanied by volcanics of dacitic to andesitic composition.

Porhyritic dikes (sometimes of composite character) cutting the Småland granites and porphyries are rather common in east Småland.

The datings of the porphyries have yielded 1837 Ma (Åberg & Persson 1984) and the granites c. 1700–1750 Ma (Aftalion et al. 1981, Wilson et al. 1986).

The deformation of the Småland granitoids and porphyries is as a rule very weak.

In Småland there are also older Svecokarelian complexes, including metasediments, metavolcanics and gneissose granitoids. Such complexes occur in the Västervik and Vetlanda-Oskarshamn regions.

The Småland granites are overlain by the Almesåkra and the Visingsö groups.

The sedimentary Almesåkra group has been included in the Jotnian complexes and consists of arkose, sandstones, shales and conglomerates. There are also dikes of dolerite.

The sedimentary Visingsö group is composed of sandstones, arkoses, shales with limestone intercalations, and conglomerates. The microfossil content indicates a deposition in late Precambrian time c. 700–850 Ma (Vidal 1974).

2.3.3.7 *Alkaline rocks*

A very small alkaline intrusion with various nepheline-syenitic rocks occurs at Norra Kärr, east of Lake Vättern. An age determination has given 1545 Ma (Blaxland 1977).

2.3.3.8 *Dolerite and basalt*

Besides the mentioned hyperite dolerite dikes in the Protogine Zone, there are a great number of Permo-Carboniferous, NW–SE dolerite dikes in Skåne. They are mentioned in the phanerozoic part of this description (see chapter 3.5.1.6). Geographically associated with these dolerite dikes are basalts which intruded during the Jurassic time.

2.4 LINEAMENT MAPS TO THE SCALE OF 1:250 000 (Pl. 9–14)

2.4.1 General outline

The term lineament can be defined in many different ways, which has been discussed among others by O'Leary et al. (1976). They proposed the following general definition:

"A lineament is a mappable, simple or composite linear feature of a surface, whose parts are aligned in a rectilinear or slightly curvilinear relationship and which differs distinctly from the patterns of adjacent features and presumably reflects a subsurface phenomenon".

A lineament generally indicates a break in the crust of the earth. Lineaments occur in all sizes, from thousends of kilometers in length to only some kilometer. They may be hidden entirely or partially under quaternary deposits or water. The longer a lineament the more important.

The lineaments indicated on the enclosed maps usually are valleys or other prominent topographic features which are visible in the "three-dimensional" relief maps. In areas with low relief some of the lineaments might be quaternary features of some kind. Interpretation of lineaments with the use of pictures or maps is a very subjective method. Furthermore, aerial photos, satellite images and large scale maps are either hard to obtain or difficult to survey. In contrast to this it is possible for the reader to interprete the relief maps himself and judge the probability of every proposed lineament.

2.4.2 Classification

The lineaments have been classed in the following two groups as regards their magnitude on the relief maps:

a) A heavy line denotes valleys and other topographic features which are clearly visible on the relief maps to the scale of 1:250 000 or on the height curve maps to the scale of 1:100 000 or 1:50 000 (see next chapter).

b) A thinner line denotes less prominent valleys and other topographic features on the relief maps or height curve maps. Some of these lineaments can possibly be caused by quaternary features of some kind.

2.4.3 Map scale and lineaments

The relief maps cover only areas with a computerized height base data grid. For areas not yet covered by this grid, special topographic maps (to the scale of 1:100 000 and 1:50 000) with height curves only, have been used.

The result shows that the lineament density is higher on the topographic maps than on the relief maps. However, the long and broad lineaments were more difficult to observe on the detailed topographic maps.

2.4.4 Reference maps (to the scale of 1:250 000) (Pl. 23–28)

Earlier geological surveys of the region have pointed out some tectonic lines. Faults and fracture zones thus noticed in published and unpublished geological works are shown by dotted lines on special reference maps. A figure on these maps gives reference to the literature.

2.5 COMMENTS ON THE LINEAMENT MAPS

2.5.1 Lineament density

The frequency of distinct lineaments varies considerably from area to area. This is best seen on the lineament map to the scale of 1:1 000 000.

Concentrations of distinct lineaments are found mainly between Göteborg and Lake Vättern, in Blekinge, and in northern Småland. In southern and central Småland there are only a few distinct lineaments.

The absence of distinct lineaments in certain areas may either depends on the presence of few large fracture zones, or a leveled bedrock covered with quaternary deposits.

The high lineament density east of Göteborg coincides with two important tectonic zones, the Göta älv Zone and the Mylonite Zone.

2.5.2 Lineament length

The fault system which forms the Lake Vättern seems to continue as long lineaments in SSW-ly direction as far as to north-western Skåne and Halland. The area between Lake Vättern and Göteborg is also characterized of quite long lineaments.

The northwest-southeast trending lineaments which delimit the horsts of Skåne have also a considerable length.

2.5.3 Curved lineaments

Curved, and even wavy lineaments with high density occur in the north-western part of the relief map Borås. According to geologists familiar with this area, these lineaments are due to selective weathering along the schistosity directions of the bedrock. These lineaments are not, like the others, supposed to be caused by fractures or faults. Therefore they are not marked on the lineament maps.

2.5.4 The Protogine Zone

Older geological maps, i.e. the Map of the Pre-Quaternary Rocks of Sweden (SGU Ba 16) generally show a indistincly delimited fracture zone in about north–southerly direction, from the neighbourhood of Lake Vättern in the north to Romeleåsen in the south. This zone is called the Protogine Zone. It divides southern Sweden in two tectonic units with gneisses in the west and granites with volcanics in the east (see chapter 2.3.3.3).

The latest major movements along this zone occurred more than 900 million years ago. The movements were accompanied by intrusions of magma of basic to acid composition.

Along the Protogine Zone there are narrow zones of strongly schistose, sometimes even mylonitic rocks. However, shear zones with mylonites running in c. N–S are not limited to the Protogine Zone, but occur both to the west and to the east of this zone – often at a considerable distance. Fracture zones with mylonite are thus found in Blekinge, even as far east as in the Karlskrona area.

The interpretation of lineaments does not show any concentration of lineaments within the Protogine zone. The lineament map to the scale of 1:1 000 000 actually shows few distinct lineaments in this zone. Whether this is caused of an absence of fracture zones, or a covering of quaternary formations is hard to say without other investigations.

3 SEDIIMENTARY ROCKS

3.1 MAPS OF THE BEDROCK

3.1.1 Map of the bedrock to the scale of 1:1 000 000 (Pl. 22)

This map comprises the sedimentary sequence within the map area. The map is based on documentation collected during the regular bedrock mapping as well as from various prospecting works. A considerable amount of data from basic research is also included.

The documentation used from the various areas are as follows:

1. Central Baltic Sea including the offshore areas around Gotland and Öland: Flodén 1980, Winterhalter et al. 1981.
2. Hanö Bay: Kumpas 1980; OPAB seismics and well data
3. Bornholm area: Gravesen et al. 1982, Gravesen & Bjerreskov 1982, Vejbæk 1985.
4. Southern Baltic Sea: Dadlez 1974, Pegrum 1984.
5. Scania and adjacent offshore areas: Bergström et al. 1982, Bergström 1985, Chatziemmanouil 1982; OPAB seismics and well data; Swedegas seismics and well data; SGU seismics and well data.
6. Denmark and adjacent offshore areas: Baartman & Christensen 1975, Michelsen 1978, Michelsen et al. 1981, Priisholm & Christensen 1985, Sorgenfrei & Buch 1964.
7. Kattegatt: Baartman & Christensen 1975, Behrens et al. 1986, Pegrum 1984; OPAB seismics.

For the evaluation of the Swedish continental shelf, Ahlberg 1986 has been utilized. Regional tectonical assessments of the map area have been presented in Ziegler 1978 and Pegrum 1984.

In the evaluation of the Danish continental shelf, a number of DGU's publications have been used. However, the sesmic documentation is rather heterogenous, which means that the density of the information varies considerably, e.g. between Bornholm, Öresund, the Belts and southern Kattegat.

The surface geology presented on the map is partly much generalized due to the variable age of the various geological maps and also due to the fact that the older seismic material does not permit the modern approach of seismic stratigraphy as used by e.g. Kumpas (1982) in the Hanö Bay, and by Vejbæk (1985) offshore Bornholm. The onshore geology data is also varying from a quality point of view due to the incomplete cover of modern geological maps in all areas.

3.1.2 Map of the bedrock to the scale of 1:20 000 (Pl. 44)

This map has been made to cover an area 10 km around Barsebäck. The map shows the nature of the bedrock surface as seen on published geological maps. Some maps are rather old, however, and the various boundaries have been obtained from the modern hydrogeological map over the area (SGU Ag 13). The lineaments have been obtained from the available seismic material.

3.2 LINEAMENT MAP TO THE SCALE OF 1:1 000 000 (Pl. 15)

For the sedimentary areas, the major lineaments are outlined. These lineaments were derived from the interpretation of marine seismics, which for the offshore areas adjacent to Scania are obtained from the literature mentioned earlier.

The lineaments are divided into two groups depending on whether the throws are larger or smaller than 1000 m. Generally, the crystalline basement is included in these faults.

In several cases, especially in the central Baltic Sea area, the throws are small, and in such cases the lineaments are only marked with single lines. In cases where the lineaments are inadequately confirmed, they are marked by a dotted line.

From the persistence and frequency of the faults the extension of the Tornquist Zone is pronounced. The major dislocation zone comprises the faults and/or the flexures which form the Fjerritslev Fault in northern Jutland and continues southeastwards as the Grenå-Helsingborg Fault in Kattegat and the Landskrona-Romeleåsen Fault and Flexure Zone through Scania and further down to Bornholm. The crystalline basement is down-faulted more than 2000 m along this dislocation zone. The lineament is transected clearly between Scania and Bornholm by a NE–SW orientated fault system, which also defines the Rönne Graben, in which the basement is down-faulted more than 7000 m.

On the map, only lineaments appearing at the bedrock surface have been marked. For that reason another major structural element does not show up on this map, i.e. the Ringköbing-Fyn High, which is developed along a west–east axis from the North Sea to southeast Denmark. Within this high, the crystalline basement is raised to 800–1000 m below the surface. The slopes of this high are limited by faults, but these are covered by Mesozoic sediments and no reactivation has taken place during the Mesozoic.

In the central Baltic Sea area, the lineaments commonly show a north–south direction and the throws are small. Seismic surveys have shown that several lineaments form the continuation of lineaments which are developed on the Swedish mainland, but several of these are covered by Palaeozoic sediments, which suggests a considerable age of these lineaments.

3.3 STRUCTURAL MAPS TO THE SCALE OF 1:1 000 000 (Pl. 30–32)

The information used for the compilation of the structural maps was mainly obtained from seismic surveys. For the map showing the position of the basement surface, gravimetric and airmagnetic data have been used as well. The seismic data are rather heterogenous, deriving from different generations of surveys, which means that the source material varies considerably as to quality and resolution. This has a particular effect on the mapping of the vertical extension of the faults, but also on the identification of seismic reflectors. Certainly, the most modern seismics have permitted the safest interpretation, i.e. the material deriving from the surveys performed by OPAB and Swedegas during the last two decades. In the Danish areas outside the Bornholm area, the interpretation by Baartman (1977) was used. The offshore area surrounding Bornholm was recently mapped seismically by Vejbæk (1985).

In two of the three structural maps, depths have been expressed in two-way travel time, i.e. the time recorded for a seismic signal to travel from the surface down to the reflector and back again. This is also the normal way of presenting seismic data, especially when no reliable velocity data are available. Within the mapped area, the seismic velocities vary considerably due to the wide variation in tectonical and lithological development. Thus, no attempts have been made to express the structural maps for Base Upper Cretaceous or Top Palaeozoic in metric depths. The structural map for Top Crystalline Basement is expressed in metric depth as additional geophysical information was available, i.e. from gravimetric and magnetometric data. Another reason for this presentation is the fact that published depth maps of the crystalline basement in the Baltic Sea are mainly expressed in metric depths.

3.4 CROSS-SECTIONS (Pl. 33–40)

The cross-sections produced have also been compiled from seismic data, especially for the main structural features. Attempts have been made to locate these sections close to deep wells, which have provided additional data on lithological characteristics, stratigraphy and thickness properties of the sedimentary sequence. It must be emphasized, however, that these sections only exhibit the main features of the structural conditions of the sedimentary cover, and no details can be given in the scale used. The deeper parts below the penetrated sequence are only tentatively outlined. This is particularly true for the central parts of the Norwegian-Danish Basin, where e.g. the area in northern Jutland on good reasons may be expected to possess a sedimentary cover of more than 8000 m.

3.5 SHORT SUMMARY OF REGIONAL GEOLOGY AND TECTONICS

3.5.1 Denmark - Kattegat - Scania - Bornholm

3.5.1.1 *Introduction*

The following account is based on information from well data, seismic data and documentation on the surface geology from the area treated. A general review of the geological and structural conditions of the area was presented in Ziegler (1978). More detailed stratigraphical and litho-facial data have been published from the Danish part by e.g. Bertelsen (1978, 1980), Michelsen (1978), Stenestad (1972), and Larsen (1966). The geological conditions around the Cretaceous–Tertiary boundary were treated in detail in Birkelund & Bromley (1979). Well data have been published by Sorgenfrei & Buch (1964), Rasmussen (1974, 1978), Michelsen (1976) and in DGU's "Well Data Summary Sheets", vol. 1–3 (1981–1982).

A regional seismic mapping of the Fennoscandian Border Zone was presented by Baartman & Christensen (1977). In this work a structural map with main lineaments within the Danish area was included.

The geological and tectonical conditions in Scania were summarized by Bergström et al. (1982) and Bergström (1985). The major part of seismic data and well data from Scania and adjacent offshore areas are still unpublished.

3.5.1.2 *Structural conditions*

The following major structural elements may be distinguished:
The Fennoscandian Border Zone forms the northeastern limit of the Tornquist-Teisseyre Lineament, which separates the more stable Fennoscandian Shield from the more mobile Danish-Polish Trough. This Border Zone forms a complicated tectonized zone with a history which extends at least back to Late Carboniferous–Early Permian with several later periods of reactivating during the Kimmerian (Jurassic–Early Cretaceous) and Laramidian (Late Cretaceous–Early Tertiary) tectonic phases. There are reasons to believe that some tectonic lineaments were formed already in the early Palaeozoic.

The Fennoscandian Border Zone extends from the North Sea (Pegrum 1984) over northern Jutland, Kattegat, Scania down to the southern Baltic and Poland. Bornholm forms a horst structure located within the Border Zone separated from Scania by major faults which i.a. limit the Rönne Graben, which is filled by thick Palaeozoic and Mesozoic sediments.

The Ringköbing-Fyn High and its eastern part, the Mön Block, is a Variscan (Late Palaeozoic) structural element with raised crystalline basement, extending from the North Sea eastwards. This system of structural highs separates the Norwegian-Danish Basin in the north from the North German Basin in the south. The Ringköbing-Fyn High is transected by several grabens, the Horn Graben being the most significant.

In general, the structural pattern in Scania, with lineaments, geological boundaries and dolerite dikes, is strongly dominated by a northwest—southeast trend. In the north, the basement surface is dipping gently towards the south below mainly Upper Cretaceous rocks in the Båstad and Kristianstad Basins. The northern limits of these sedimentary areas are denudation boundaries and numerous outliers of Cretaceous sediments occur north of the present northern limit (Lidmar-Bergström 1982). The Cretaceous basins are rather shallow, obtaining their maximum dephts in the south, where the basins are limited by faults.

These faults commonly define the northern limit of the Fennoscandian Border Zone, which broadly defined can be recognized as a major inversion axis (Ziegler 1975). In general terms, the Fennoscandian Border Zone in Scania and Bornholm is defined by a series of large basement blocks tilting towards the southwest. These basement blocks have been exposed along the northeastern limit of the Border Zone. Towards the southwest follows a series of Cambrian to Silurian rocks, which in the northwest are covered by Triassic and Jurassic rocks. The latter sediments are also found resting directly on the basement, especially in the northwest.

The tilted basement blocks extend to a line from Landskrona over Fyledalen to the southeasternmost corner of Scania. The southwestern boundary is formed by the important Landskrona-Romeleåsen Fault and Flexure Zone and by the Fyledalen Fault and Flexure Zone. The basement part of the block is exposed in the Romele Horst, while its northeastern part, the Vomb Basin, exposes a sedimentary sequence of approximately 1000 m of Upper Triassic to Upper Cretaceous sediments resting directly on the basement. The Vomb Basin is transected by a fault system extending from the southern part of the Vomb Basin. Southeast of this fault system the Basin is still deeper.

The triangular part forming southwest Scania belongs from a geological point of view to the Danish-Polish Trough. Within this part, the crystalline basement is found deeper than in any other part of Scania. The largest depth of about 2800 m is found in the Falsterbo region. There, the basement is covered by more than 800 m of Cambrian to Silurian sediments. Closer to the Landskrona–Romeleåsen Lineament Palaeozoic strata are missing entirely. The lowermost part of the Mesozoic comprises Lower Triassic beds in the southwest and Upper Triassic beds in the northeast, and the strata are terminated by Upper Cretaceous beds. The major part of the almost 1900 m thick Mesozoic sequence is composed of Upper Cretaceous sediments. At the very top of the sequence, about 200 m of Lower Tertiary chalks are developed, locally covered by thin beds of mudstones and marly sediments.

3.5.1.3 *The Crystalline Basement*

The crystalline basement is exposed only in Scania and on Bornholm. On Bornholm, these rocks have been divided into a group of early orogene granitic gneisses of possible Svecofennian age (1650 Ma) and another group of intrusive post-orogene granites with an age of about 1350 Ma. These granites correlate with similar anorogene granites in Blekinge.

Crystalline bedrock has also been penetrated in some onshore wells located on the Ringköbing-Fyn High, and within the Fennoscandian Border Zone in northernmost Jutland. Radiometric datings of material from Fyn and Jutland have yielded ages of 800 to 900 million years, which agree with ages obtained in South Norway and southwest Sweden.

In Scania the crystalline basement is exposed within the Border Zone in a mosaic pattern of faulted blocks where generally the southwesternmost parts of the blocks show exposed basement, e.g. at Romeleåsen. Other significant basements horst are Söderåsen, Kullaberg, Hallandsåsen, Linderödsåsen and Nävlingeåsen. Along the Fyledal Fault some small basements horsts appear as well.

Caledonian ages (420 Ma) have been obtained from low metamorphic rocks in wells immediately to the south of the RFH in northernmost Germany. This shows that a branch of the Caledonian Orogen extends from the major Scottish-Norwegian Caledonides towards the southeast into Poland, where it forms a Late Silurian fold belt (Ziegler 1978).

3.5.1.4 *The Lower Palaeozoic*

Cambro-Silurian sediments are exposed along a system of slightly west-northwesterly tilted blocks on the southern part of Bornholm. The crystalline basement is covered by about 100 m Upper Precambrian(?) to Lower Cambrian continental, arcosic sandstones, which are succeeded by c. 60 m of Lower Cambrian marine sandstones and 100 m of glauconitic siltstones. This sequence is followed by 120 m of mainly dark marine shales from Middle Cambrian to lowermost Upper Silurian.

Additional well data from Lower Palaeozoic rocks are few from Denmark. A sequence of about 350 m sandstone and shale from Lower Cambrian to Lower Silurian has been penetrated at Slagelse 1 located on the up-thrown side of a tilted fault block (Poulsen 1974). About 300 m of tilted Upper Silurian clastic sediments and basaltic volcanites have been penetrated on Jutland at Rönde 1 (Christensen 1971).

Seismic data indicate a thick, undeformed Lower Palaeozoic sequence in Skagerrak, northern Jutland and in Kattegat. On Jutland there are seismic evidences on a system of north-south faulted, tilted blocks below the distinct seismic reflector at the base of the Zechstein. Locally, several kilometers of Palaeozoic sediments are indicated.

In Scania the Palaeozoic sequence is similar to the sequence developed on Bornholm. The major difference is found in the more complete sequence in Scania and the thicker strata. Particularly, the Silurian sediments show considerable thickness, up to 2000 m, as a result of a rapid sedimentation in NW–SE orientated troughs, which accumulated large amounts of mud within a short period. Most likely these subsiding troughs are connected with movements within the German-Polish branch of the Caledonian Fold Belt. At the end of the Silurian there is a distinct shallowing of the marginal areas and in Scania shallow water carbonates and sandstones of regressive character are deposited.

3.5.1.5 *The Devonian - Carboniferous*

In Devonian and Carboniferous time the major part of the mapped area formed a positive area, probably acting as a source area for the clastic material, which was deposited south- and southwestwards in northern Europe. On Falster, south of the Mön Block, more than 500 m of Lower Carboniferous limestones and sandstones, partly carbonaceous, have been penetrated at Örslev 1 (Michelsen 1971, Berthelsen 1972).

3.5.1.6 *The Permian*

In Late Carboniferous–Early Permian time lateral fault movements occurred along the Tornquist lineament simultaneously to the intrusion of dolerite swarms along NW–SE fracture systems in Scania. These fracture systems originate in tensional movements occurring in a SW–NE direction. The Oslo Graben with its alkaline volcanites can also be regarded as a tensional structure caused by these movements (Ziegler 1978). The same structure and age is also found in the Horn Graben, which transects the Ringköbing-Fyn High in the North Sea.

Along the southern part of the Ringköbing-Fyn High, alkaline volcanites of Early Permian age have been penetrated (Dixon et al. 1980). On either side of the High, red sediments of supposed Rotliegendes age were deposited. The deep position of these sediments in the more central parts of the basins have not permitted a full penetration of these strata. Thus, the distribution and facies conditions are poorly known.

In Late Permian time marine basins extended into the Danish area on both sides of the Ringköbing-Fyn High. These basins form the first in a number of marine basins, which later during the Mesozoic era would determine the sedimentary pattern within the area to a considerable extent.

The Zechstein transgression included deposition of thin deep-water carbonates and laminated anhydrites in the central parts of the basin, and thick shallow-water carbonates and massive anhydrite beds along the margins of the basin and along local highs. An arid climate, restricted influx of sea water and periodic sea level changes resulted in deposition of cyclic Zechstein evaporites. In southern Jutland carbonate-anhydrite facies prevailed along the margin of the southern Zechstein Basin and this facies gradually changed towards a halite facies in the very southern part.

In the central part of the Norwegian-Danish Basin more than 1000 m of evaporites were deposited. Three evaporation cycles have been distinguished, two of which with potassium precipitation.

Halokinetic movements of Zechstein salts started in late Triassic time and locally these movements are still active. Two main areas of salt diapirism, with diapirs penetrating several kilometers of younger sediments can be distinguished in northern Jutland and in southern Jutland – northern Germany.

3.5.1.7 *The Triassic*

The main structural elements which formed in late Palaeozoic time have controlled the Triassic sedimentation to a considerable extent. The Ringköbing-Fyn High was transected by a number of grabens both in the offshore and onshore Danish areas.

Within the Danish part of the Norwegian-Danish Basin a considerable subsidence of the area took place, which also made an accumulation possible of more than 6000 m of Triassic sediments. The Ringköbing-Fyn High has possibly acted as a positive area in Early and Middle Bunter time and the two basins on either sides of the High have been linked together via narrow troughs. Except for the block west of the Horn Graben in the North Sea and the Stevens Block in southwest Sealand, the Ringköbing-Fyn High was covered by sediments in Late Bunter and this condition prevailed into the Middle Jurassic. Until Late Triassic (Keuper), the Fennoscandian Border Zone formed an elevated area with a restricted deposition of sediments. In Keuper time the blocks north of the Fjerritslev and Grenå-Helsingborg Faults were covered by sediments and rather thick Late Triassic sediments were deposited. Simultaneously, the previously mentioned salt movements were initiated in the Danish Subbasin as a result of the thick overburden of Triassic sediments. Due to these movements, the thickness of the Late Triassic, Jurassic, Cretaceous and Tertiary sediments show a considerable variation within the Subbasin.

During the Triassic, the sediment producing area was situated in the north and the northeast and the depocenter was located southwest of the Fjerritslev Fault in northern Jutland. Along the Fennoscandian Border Zone, thick, coarse, arkosic sandstones were deposited as alluvial cones along the faults which restricted the Subbasin. In the other areas, continental sedimentation alternated with brackish and marine sedimentation.

The Bunter sediments with claystones and sandstones are mainly fluviatile on the Ringköbing-Fyn High, but clays dominate south of this High. North of the High, the sediments become coarser. Locally, there are limestone and anhydrite beds, which formed when shollow water ponds evaporated. In the Middle Triassic, marine conditions prevailed in the south. The Lower Keuper sediments are similar to sediments from the Middle Bunter and have a regressive character. In Middle Keuper, a new transgressive period started with deposition of claystones and siltstones. The maximum of this transgression occurred in Late Keuper with deposition of grey claystones and limestones, which partly are dolomitic. Reactivation of block movements raised the relief of the positive areas, which yielded clastic material to the basinal parts. Eventually, the major part of the sedimentation took place within the Fennoscandian Border Zone area in Late Rhaetian and Early Jurassic time and the depocenters migrated towards the northeast.

3.5.1.8 *The Jurassic*

Structurally, the Jurassic is characterized by periods of block movements along the Fennoscandian Border Zone and successive transgressions of this zone. The subsidence of the Danish Subbasin continued and more than 1200 m of sediments were deposited.

In the first part of the Early Jurassic, the first major transgressions in Mesozoic time took place. In the Danish Subbasin more than 900 m of marine shelf deposits of claystones accumulated. Simultaneously, fluviatile-deltaic sediments were deposited in the central part of the basin northeast of the Fjerritslev Fault on northern Jutland and in Scania. In Early Pliensbachian the main transgression occurred into the Fennoscandian Border Zone (Michelsen 1975). At the end of the Early Jurassic, the subsidence rate of the Subbasin decreased and lagoonal conditions prevailed in the central part.

In the Middle Jurassic, the Mid-Kimmerian movements caused an elevation of the basinal area southwest of the Fennoscandian Border Zone and the block faulted parts within the Border Zone were reactivated. Simultaneously to these movements, there was also a volcanic activity in Scania. The elevation and tilting of the blocks caused a considerable erosion and locally this erosion penetrated down into Upper Triassic strata. The reactivation of the block movements also caused a vast deposition of clastic material under fluvitile-deltaic facies regimes. At the transition to the Late Jurassic the deltaic plains were flooded and covered by clay- and siltstones. In the central part of the Subbasin a certain subsidence occured. The transition to the Cretaceous is characterized by a deposition of marine and shallow water sandy sediments due to movements within the Fennoscandian Border Zone. As a result of this Late Kimmerian tectonic phase angular unconformities formed at some places, e.g. in Scania along the Fyledal Fault.

3.5.1.9 *The Lower Cretaceous*

The Early Cretaceous is characterized by shallow marine conditions with a deposition of claystones and the Ringköbing-Fyn High and Bornholm were covered by the sea. At the end of this period the sedimentation pattern changed and the sediments became more calcareous. Red marls were deposited in the central parts of the basin, but along the more marginal areas, e.g. in northern Jutland, Scania and Bornholm, deposition of greenish glauconitic sandstones took place.

3.5.1.10 *The Upper Cretaceous*

The Late Cretaceous is dominated by carbonate facies with only two major events of clastic depostion along the Fennoscandian Border Zone in Campanian and mid-Maastrichtian times. Global sea level changes resulted in vast transgressions and the entire area was covered by the sea. A depocenter with accumulation of more than 1500 m of sediments was formed within a NW–SE orientated zone south of the Fjerritslev and Grenå–Helsingborg Faults and their continuation to the southeast. The zone northeast of this lineament is characterized by inversion movements in the Late Cretaceous-Early Tertiary when parts of the Jurassic and Triassic sequences were exposed due to erosional events. Thus, the mosaic bedrock pattern of exposed rocks of various ages, characterizing the Fennoscandian Border Zone today, was initiated. In Kattegat, the development of the Grenå–Helsinborg Fault is interpreted as the result of compressive tectonic forces, which i.a. has resulted in the lack of Upper Cretaceous sediments northeast of this fault zone. In Scania, this fault zone is partly developed as a combination of faults and flexures, which indicate repeated tectonic events during the Late Cretaceous and the Early Tertiary.

3.5.1.11 *The Tertiary*

As a result of the plate-tectonic movements, the Greenland-Norwegian Sea opened at the Paleocene–Eocene transition and the entire North Sea started to subside, mainly along the former Mesozoic troughs. In the marginal parts of the basin the carbonate sedimentation continued during the Danian with only some minor sedimentation breaks. Towards the end of this epoch the sedimentation changed and marls and clays were deposited. During the subsequent epochs, the deposition of marine claystones was only interrupted by volcanic ash deposition at the Paleocene-Eocene boundary. Later the sedimentation became more sandy due to the westward migration of the coastline over the Danish area. In Scania the sea regressed alredy in the early Eocene and probably the area has been above sea-level since then. From a tectonic point of view the Fennoscandian Border Zone has been stable in Tertiary time and only isostatic crustal movements have occurred due to repeated glaciations during the Pleistocene with large ice sheets covering the Fennoscandian Shield.

The question on neo-tectonic movements is still a matter of discussion, e.g. evidences have been pointed out from Kullaberg (Lagerlund 1977) that crustal movements have occurred during the Quaternary. There are also other opinions on this topic, however.

3.5.2 Öland - Gotland - Central Baltic Sea

The sedimentary area northeast of the Tornquist Lineament in the central Baltic shows a clearly different tectonical and sedimentological history compared to the southern part of the map area treated previously. The type of sediments developed is much the result of a position of the area on a stable platform in early Palaeozoic time, and slow subsidence of the basement. The stable tectonic conditions have also resulted in little dislocation along the lineaments. Structurally, the central Baltic basin shows a questa development, with strata becoming progressively younger towards the southeast. The dip of the strata is small, averaging one or two degrees towards the southeast. The vertical variation in consolidation of the sediments has resulted into a marked cliff morphology of the sea bottom, and this morphology is also well demonstrated on the west coasts of the islands of Öland and Gotland. The westernmost part of this questa landscape exposes Lower Cambrian sandstones which form the western shore and the sea bottom of Kalmarsund. This sandstone deposited on a rather smooth basement surface, but there are some remarkable exceptions to this smooth morphology as several monadnocks occur, e.g. at Mossberga on Öland and east of Öland in the Baltic sea. The island of Blå Jungfrun in northern Kalmarsund is also a monadnock of crystalline basement.

Middle and Upper Cambrian strata form the bedrock of the western part of Öland with a narrow belt of grey shales and black alum shales. In the latter shales there are several breks in sedimentation which partly are marked by conglomerates. This suggests a variability in the position of the shoreline in Late Cambrian time. Towards the central part of the Baltic there is a distinct thinning of the alum shales and below Gotland the formation is only represented in the southernmaost part of the island with some meters.

The main part of Öland and the sea bottom between Öland and Gotland are formed by Ordovician limestones. These are succeeded by Silurian marlstones and limestones which are only exposed on Gotland. The Ordovician strata are not fully represented within the area, but there are considerable stratigraphical gaps, which show that the area was probably above sea level in Late Ordovician time. The limestones are clearly of shallow water character and they are built up by various calcareous organisms. Compared to Scania and Bornholm, the Palaeozoic sequence is rather different, both from a facial point of view and in thickness. The supply of terrigenous material has been much larger within the Fennoscandian Border Zone in Ordovician time and this continued also during the Silurian. In the Baltic area the Silurian deposits are mainly developed in a carbonate facies and reef structures are of frequent occurrence at several stratigraphical levels. These reefs formed along a shoreline which migrated southeastwards during the Silurian, and this process is particularly well observed on Gotland. At the end of the Silurian the area was influenced to some extent by the mountain-building movements forming the Caledonides in the west, and thus some minor dislocations and fault movements affected the area. This can also be seen in occasional changes in sedimentation pattern at some levels with more coarse-grained sediments. There are also numerous horizons with bentonite ash layers which prove a volcanic activity at several occurrences during the Ordovician and Silurian. These bentonites form excellent index horizons and also faciliate long-distance correlation of the strata.

The end of the Silurian and the beginning of the Devonian are characterized by a regression of the sea within the Baltic area linked with a coarse clastic deposition. From this time, a continental period started, which would extend several million years forwards and most probably no marine sedimentation of Mesozoic or Cenozoic strata took ever place up to recent times. Only the areas immediately adjacent to the Tornquist Lineament were transgressed by the Mesozoic seas, e.g. the Båstad and Kristianstad Basins and the Hanö Bay.

R E F E R E N C E S

Åberg, G. 1978: Precambrian Geochronology of south-eastern Sweden. GFF 100, pp. 125–154.

Åberg, G., Kornfält, K.-A. & Nord, A. 1986: Further radiometric dating of the Karlshamn granite, south Sweden. GFF 107, pp. 197–202.

Åberg, G. & Persson, L. 1984: Radiometric dating of Precambrian rocks in Småland, southeastern Sweden. GFF 106, pp. 319–329.

Ahlberg, P. 1986: Berggrunden på kontinentalsockeln. SGU Rapporter och meddelanden no 47.

Aftalion, M., Fallick, A.E. & Wilson, M.R. 1981: Age and isotope studies in Norrbotten and Småland: preliminary results. GFF 103, pp. 519–520.

Baartman, J.C. & Christensen, O.B. 1977: Contributions to the interpretation of the Fennoscandian Border Zone. DGU II. Raekke, nr 102.

Behrens, K., Hansen, J., Flüh, E., Goldfuss, S. & Hirschleber, H. 1986: Seismic investigations in the Skagerack and Kattegat. Tectonophysics 128, 209-228.

Bergström, J. 1985: Zur tektonischen Entwicklung Schonens (Südschweden). Zeitschrift für angewandte Geologie.

Bergström, J., Holland, B., Larsson, K., Norling, E. & Sivhed, U. 1982: Guide to excursions in Scania. SGU Ca 54.

Bertelsen, F. 1972: A lower Carboniferous microflora from the Örslev No.1 borehole, island of Falster, Denmark. DGU, Raekke II, nr 99.

Bertelsen, F. 1978: The Upper Triassic - Lower Jurassic Vinding and Gassum Formations of the Norwegian-Danish Basin. DGU, Ser. B 3.

Birkelund, T. & Bromley, R.G.(ed.) 1979: Cretaceous-Tertiary Boundary events (Symposium).I. The Maastrichtian and Danian of Denmark.

Blaxland, A.B. 1977: Agpaitic magmatism at Norra Kärr? Rb-Sr isotopic evidence. Lithos 10, pp. 1–8.

Chatziemmanouil, J. 1982: The Upper Cretaceous of the Vomb Trough, southern Sweden. Part 1. Structure geology and sedimentology. Stockholm Contr. in Geology 38 (5).

Christensen, O.B. 1971: Den stratigrafiske inddelning af praezechstein aflejringer i Rönde nr. 1. In: Rasmussen et al. 1971: Dybdeboringen Rönde nr 1 på Djursland. DGU, Raekke III, nr 39.

Dadlesz, R. 1974: Some geological problems of the Southern Baltic Basin. Geologica Polonica, Vol. 24, No 1.

Dixon, J.E., Fitton, J.G. & Frost, R.T.C. 1980: The tectonic significance of post-Carboniferous igneous activity in the North Sea Basin. Petrol. geol. continental shelf NW Europe (Conference). Paper No 30.

Elvhage, C. & Andersson. P. 1986: The use of elevation data bases in computer assisted cartography. LMV-rapport 1986:17.

Flodén, T. 1980: Seismic stratigraphy and bedrock geology of the Central Baltic. Stockholm Contr. in Geology, Vol. 35.

Gaál, G. & Gorbatschev, R. 1987: An Outline of the Precambrian Evolution of the Baltic Shield. Precambrian Research 35, pp. 15–52.

Gorbatschev, R. 1980: The Precambrian development of southern Sweden. GFF 102, pp. 129–136.

Gravesen, P. & Bjerreskov, M. 1982: Guide to excursion in Bornholm during 8th annual working meeting in Sweden and Denmark. IGCP No 86.

Gravesen, P., Rolle, F. & Surlyk, F. 1982: Lithostratigraphy and sedimentary evolution of the Triassic, Jurassic and Lower Cretaceous of Bornholm, Denmark. DGU, Ser. B 7.

Johansson, Å. & Larsen, O. (in press): Radiometric age determinations and Precambrian geochronology of Blekinge, southern Sweden. Submitted to GFF 1987 10 05.

Klingspor, Inger 1976: Radiometric age-determinations of basalts, dolerites and related syenite in Skåne, southern Sweden. GFF 98, pp. 195–216.

Kumpas, M. 1980: Seismic stratigraphy and tectonics in Hanö Bay, Southern Baltic. Stockholm Contrib. in Geology, Vol. 34:4.

Lagerlund, E. 1977: Förutsättningar för moränstratigrafiska undersökningar på Kullen i Nordvästskåne - teoriutveckling och neotektonik. Univ. of Lund. Dept. of Quaternary Geology, Thesis 5.

Larsen, G. 1966: Rhaetic-Jurassic-Lower Cretaceous Sediments in the Danish Embayment. (A Heavy-Mineral Study). DGU II, Raekke, No 91.

Lundqvist, T. 1979: The Precambrian of Sweden. SGU C 768.

Michelsen, O. 1975: Lower Jurassic biostratigraphy and ostracods of the Danish Embayment. DGU II, Raekke, No 104.

Michelsen, O. 1976: Kortfattet oversigt over de geologiske forhold i den danske del av Nordsöen. DGU, Årsbog 1975.

Michelsen, O. 1978: Stratigraphy and distribution of Jurassic deposits of the Norwegian-Danish Basin. DGU, Ser B 2.

Michelsen, O. et al. 1981: Kortlaegning af potentielle geotermiske reservoirer i Danmark. DGU, Ser B 5.

O'Leary, D.W., Friedman, J.D. & Pohn, H.A. 1976: Lineament and linear, a terminological reappraisal. Proceedings of the Second International Conference on Basement Tectonics, pp. 571–577. Basement Tectonics Committee, Inc., Denver, Colorado.

Patchett, P.J. 1978: Rb/Sr ages of Precambrian dolerites and syenites in southern and central Sweden. SGU C 747.

Pegrum, R.M. 1984: The extension of the Tornquist zone in the Norwegian North Sea. Norsk Geol. Tidskr., Vol. 64, pp. 39-68.

Poulsen, C. 1974: Further contributions to the knowledge of the Paleozoic of Slagelse no 1, Western Sealand. DGU, II. Raekke, No 101.

Priisholm, S. & Christensen, S. 1985: Assessment of Geothermal Resources and reserves in Denmark. DGU, Ser.C 2.

Rasmussen, L.B. 1974: Some geological results from the first five Danish exploration wells in the North Sea. Dansk Nordsö A-1, A-2, B-1, C-1, and D-1. DGU, III, Raekke, No 42.

Rasmussen, L.B. 1978: Geological aspects of the Danish North Sea sector. With a report on the wells Dansk Nordsö E-1, E-2, F-1, G-1, H-1, I-1, J-1, and K-1. DGU, III, Raekke, No 44.

Samuelsson, L. 1978: Beskrivning till berggrundskartan Göteborg SO. Description to the map of solid rocks Göteborg SO. SGU Af 117.

Samuelsson, L. 1982: Beskrivning till berggrundskartan Kungsbacka NO. Description to the map of solid rocks Kungsbacka NO. SGU Af 124.

Sorgenfrei, T. & Buch, A. 1964: Deep tests in Denmark 1936-1959. DGU, III, Raekke, No 36.

Stenestad, E. 1972: Traek af det danske bassins udvikling i övre Kridt. DGU, Årsskrift for 1971, pp. 63-69.

Vejbaek, O.V. 1985: Seismic Stratigraphy and Tectonics of Sedimentary Basins around Bornholm, Southern Baltic. DGU Ser. A 8.

Welin, E. & Blomqvist, G. 1964: Further age measurements on radioactive minerals from Sweden. GFF 88, pp. 3–18.

Vidal, G. 1974: Late Precambrian microfossils from the basal sandstone unit of the Visingsö beds, south Sweden. Geol. Palaeontol. 8, pp. 1–14.

Wilson, M.R., Fallick, A.E., Hamilton, P.J. & Persson, L. 1986: Magma sources for some mid-Proterozoic granitoids in SE Sweden: geochemical and isotopic constraints. GFF 108, pp. 79–91.

Winterhalter, B., Flodén, T., Ignatius, H., Axberg, S. & Niemistö, L. 1981: Geology of the Baltic Sea. In: The Baltic Sea, Elsevier Oceanography Series 30.

Ziegler, P.A. 1975: Geologic evolution of the North Sea and its tectonic framework. Bull. Am. Assoc. Petroleum Geol., Vol. 59, 1073-1097.

Ziegler, P.A. 1978: North-western Europe. Tectonics and Basin Development. Geologie en Mijnbouw 57(4), pp. 589-626.

MAPS AND CROSS-SECTIONS (Plate 1-44)

Relief maps in 1:250 000

1 Göteborg
2 Borås
3 Jönköping
4 Oskarshamn
5 Malmö, northern part
6 Malmö, southern part
7 Karlskrona
8 Kalmar

Lineament maps in 1:250 000

9 Göteborg
10 Borås
11 Jönköping
12 Oskarshamn
13 Malmö
14 Karlskrona/Kalmar

15. Lineament map in 1:1 000 000

Maps of the bedrock in 1:250 000

16 Göteborg
17 Borås
18 Jönköping
19 Oskarshamn
20 Malmö
21 Karlskrona/Kalmar

22. Map of the bedrock in 1:1 000 000

Reference maps in 1:250 000

23 Göteborg
24 Borås
25 Jönköping
26 Oskarshamn
27 Malmö
28 Karlskrona/Kalmar

29. Seismic cross-sections to 60 km depth

Structural maps in 1:1 000 000

30 Surface of the basement
31 Surface of Palaeozoikum
32 Surface of Upper Cretaceous

33. Map of geological cross-sections in 1:1 000 000

Geological cross-sections

34 Section A Öland-Gotland
35 Section B Öland-Östersjön
36 Section C Blekinge-Bornholm
37 Section D Mellanskåne-Sydostskåne
38 Section E Skåne-Falster
39 Section F Skåne-Jylland
40 Section G Ringhals-Nordjylland

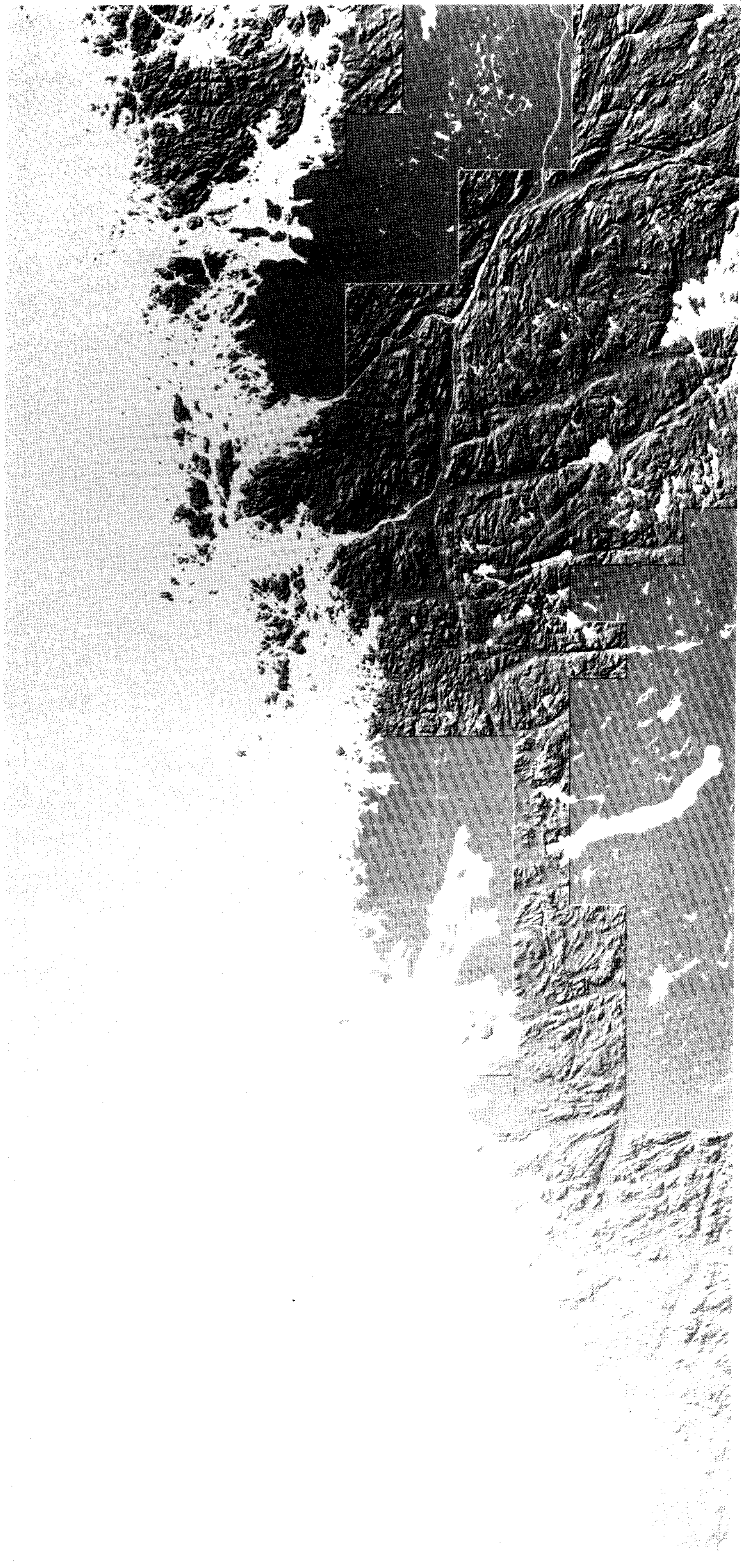
41 Palaeozoic stratigraphy

42 Mesozoic stratigraphy

43 Section H Söderåsen-Barsebäck

44 Map of the bedrock in 1:20 000 of Barsebäck with surroundings

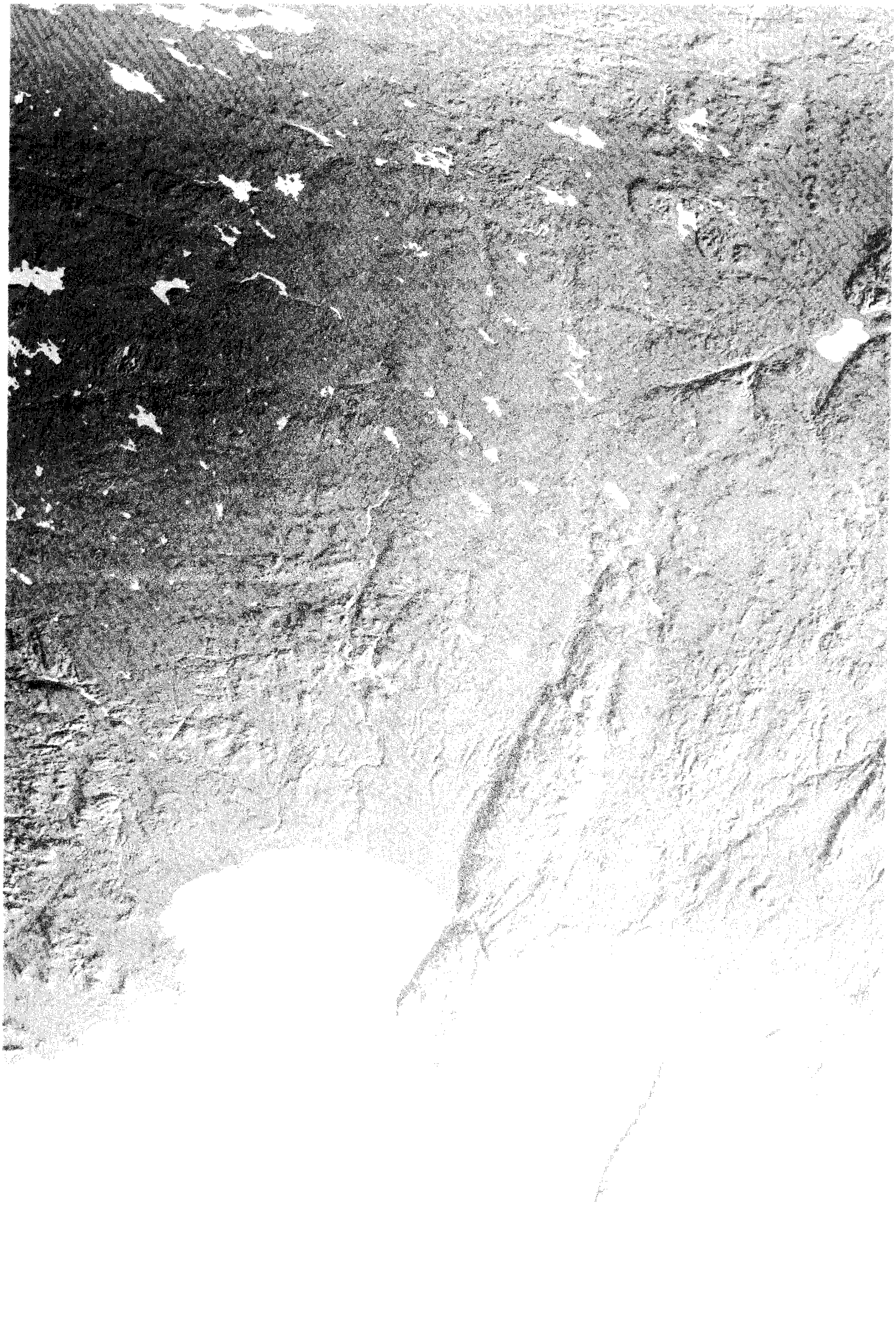
Pl. 1



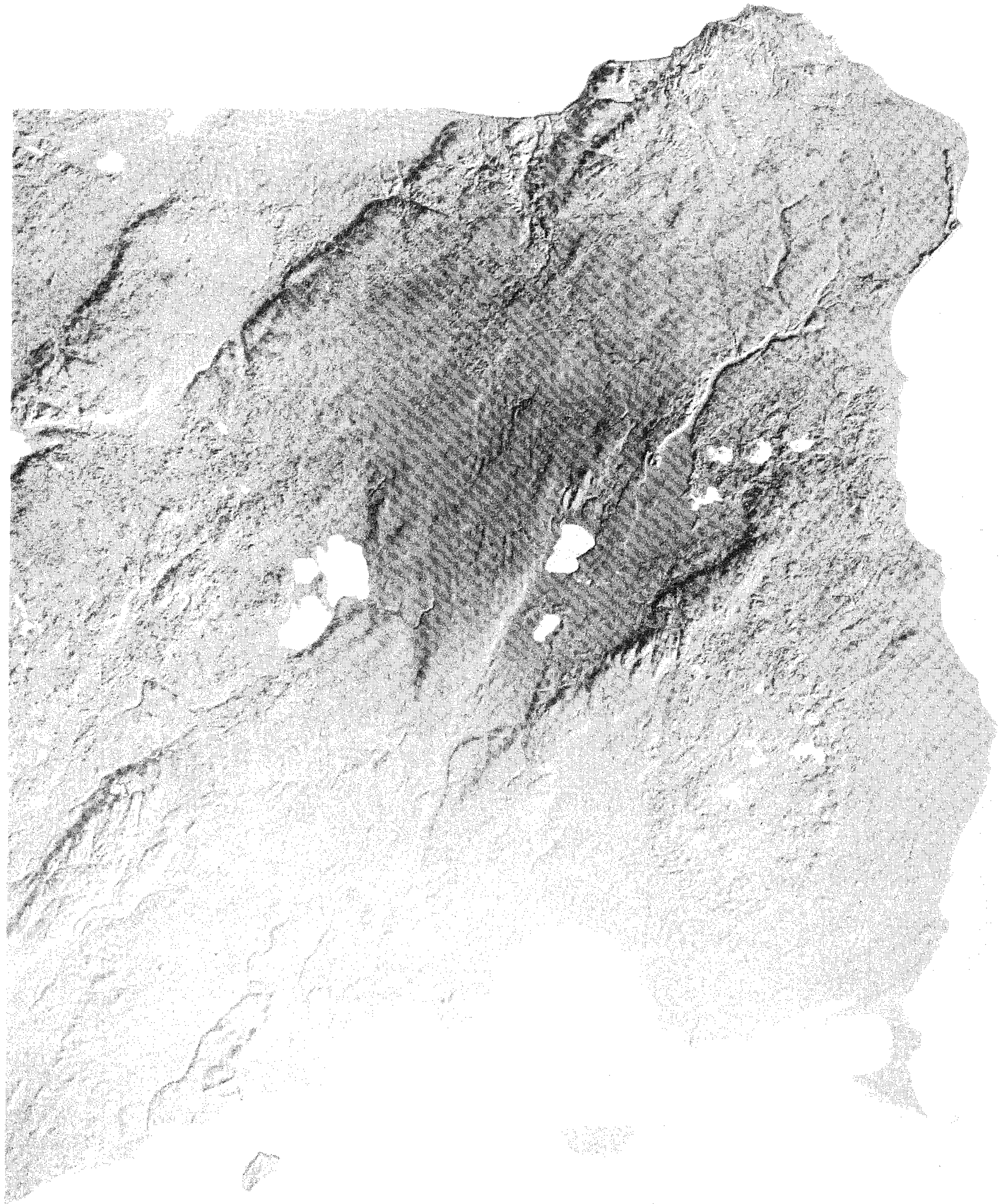
Pl. 3

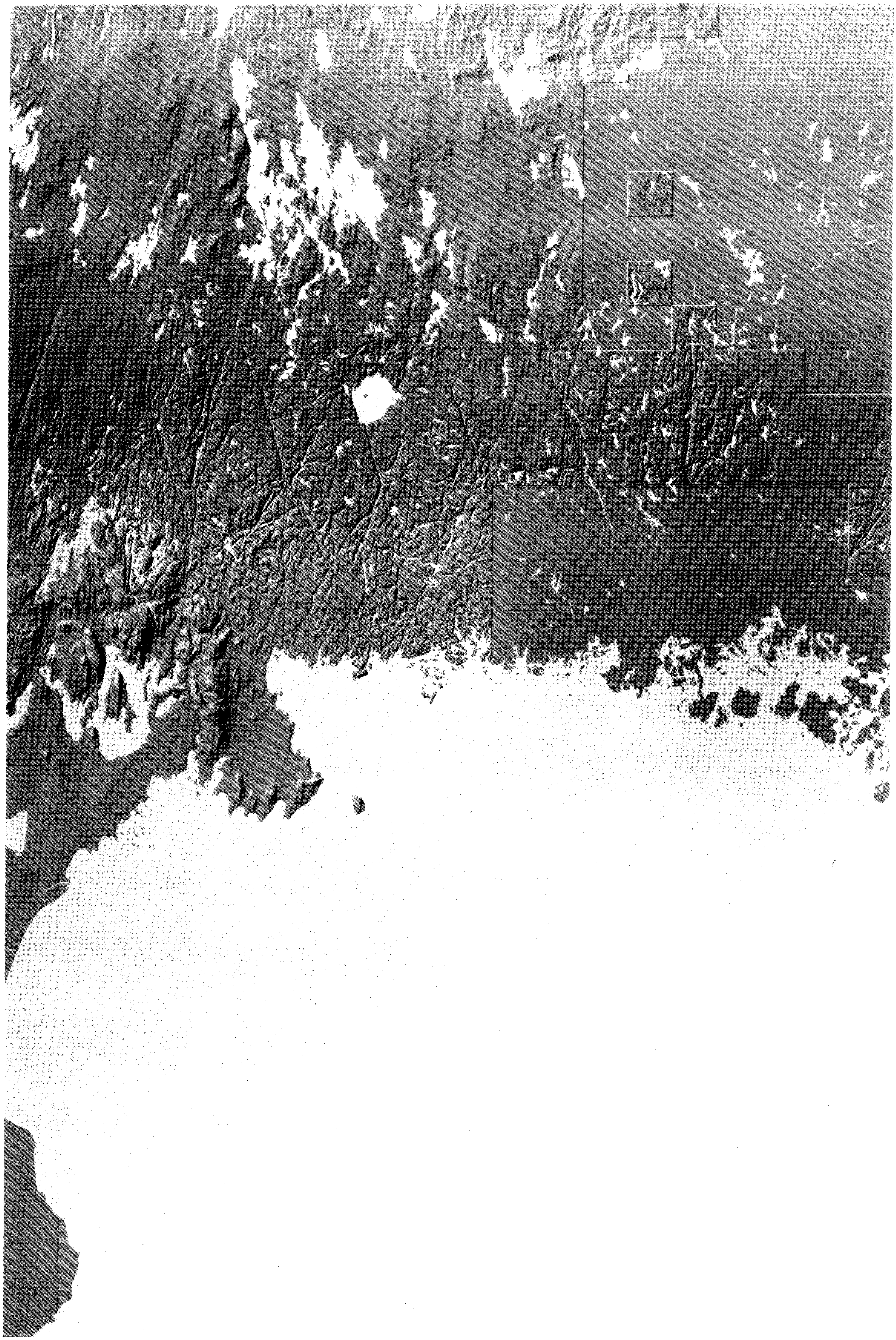
Pl. 4

Pl. 5

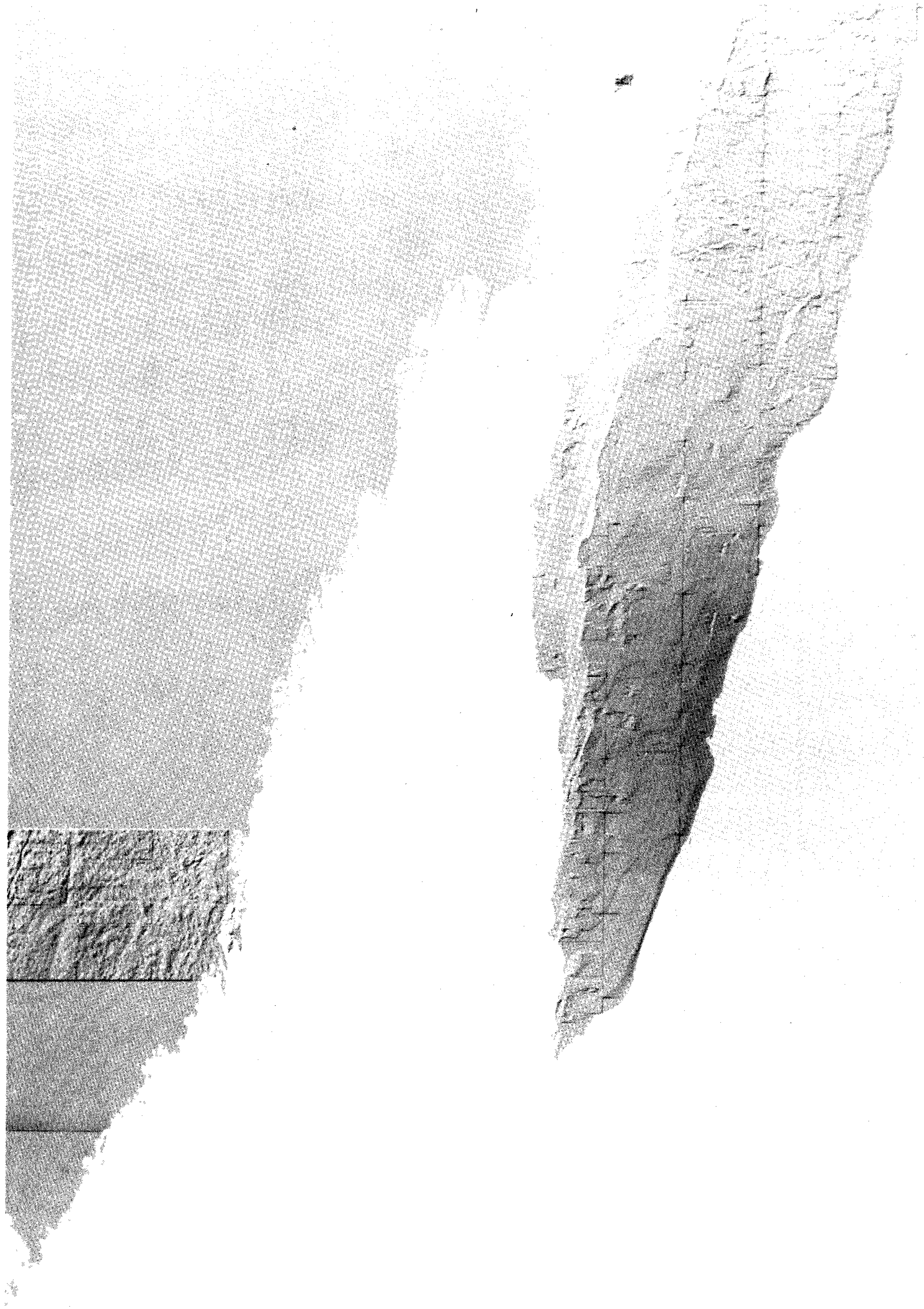


Pl. 6



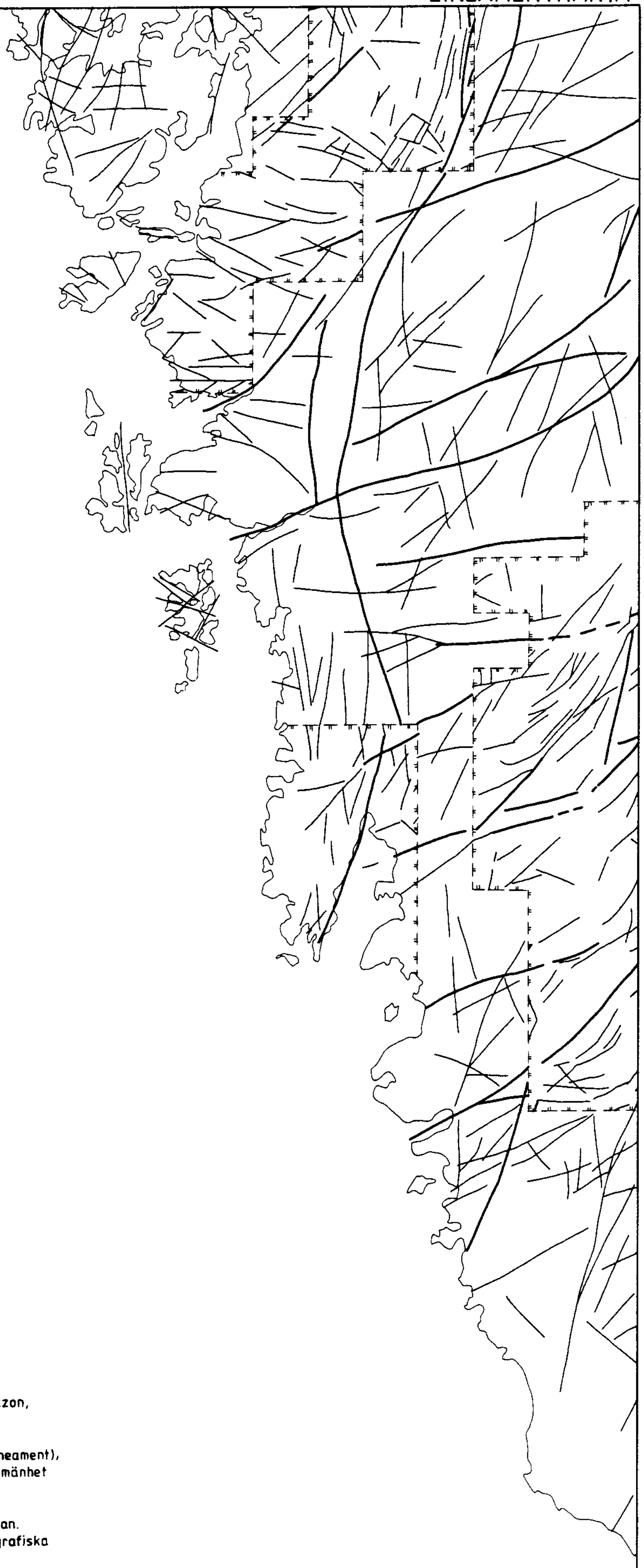


Pl. 8



Pl. 9

GÖTEBORG SKALA 1:250 000 LINEAMENTKARTA

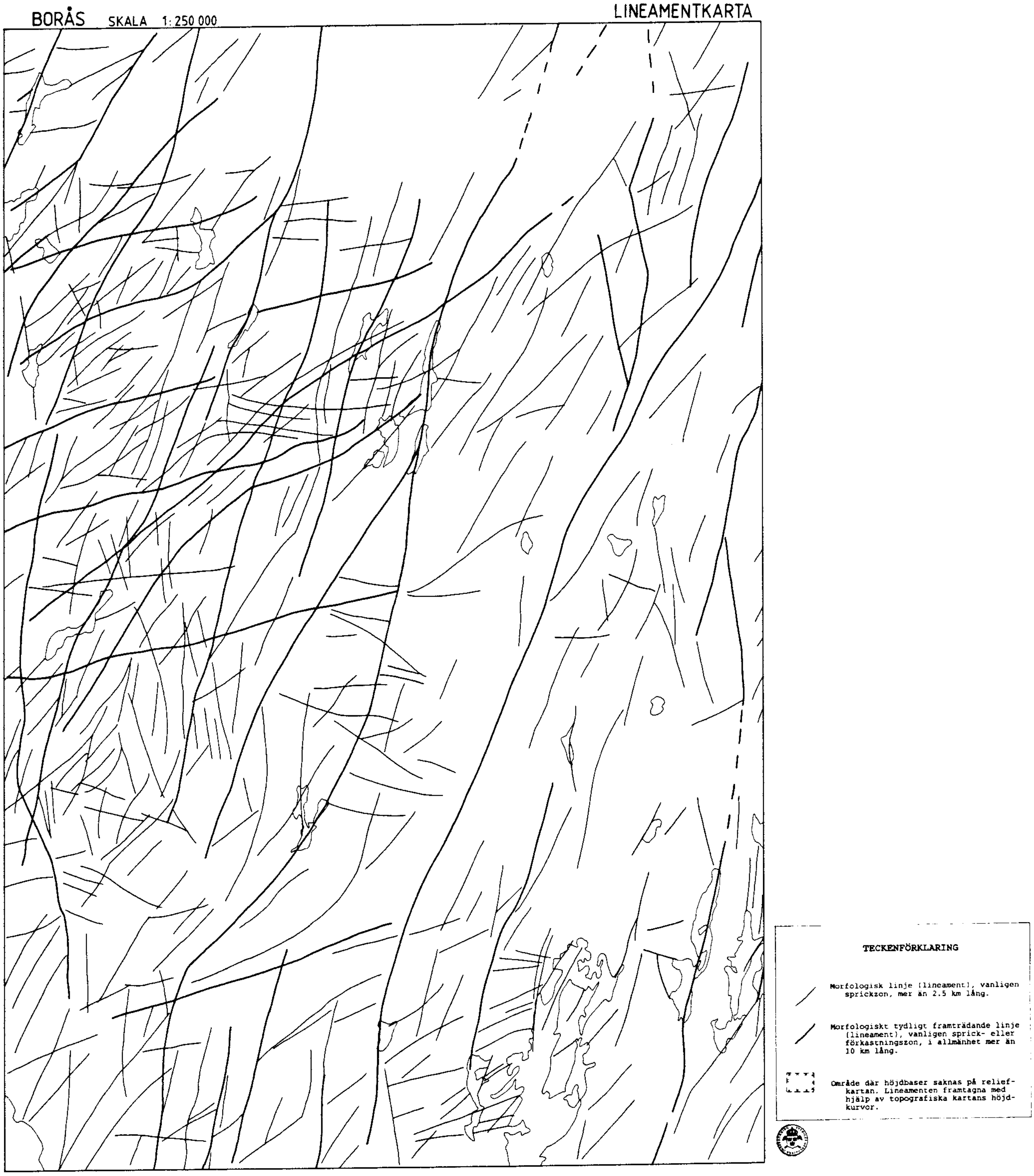


Morfologisk linje (lineament), vanligen sprickzon, mer än 2,5 km lång.

Morfologiskt tydligt framträdande linje (lineament), vanligen spricks- eller förkastningszon, i allmänhet mer än 10 km lång.

Område där höjdbaser saknas på reliefkartan. Lineamenten framtagna med hjälp av topografiska kartans höjdkurvor.

Pl. 10


BORÅS SKALA 1: 250 000
LINEAMENTKARTA
TECKENFÖRKLARING
Morfologisk linje (lineament), vanligen sprickzon, mer än 2.5 km lång.
Morfologiskt tydligt framträdande linje (lineament), vanligen sprick- eller förkastningszon, i allmänhet mer än 10 km lång.
Område där höjdbaser saknas på reliefkartan. Lineamenten framtagna med hjälp av topografiska kartans höjdkurvor.

Pl. 11

JÖNKÖPING SKALA 1:250 000

LINEAMENTKARTA

TECKENFÖRKLARING

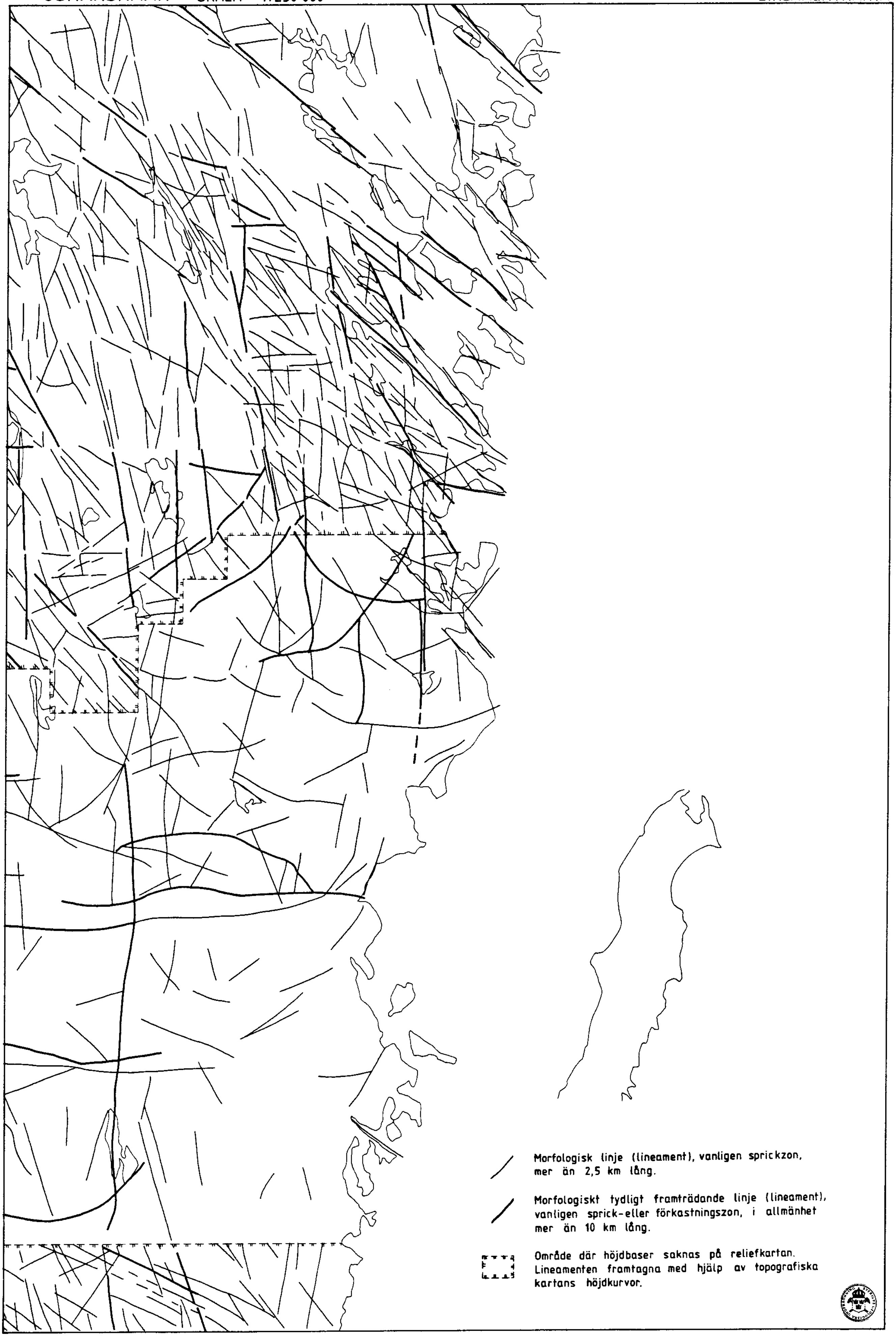
Morfologisk linje (lineament), vanligen sprickzon, mer än 2.5 km lång.

Morfologiskt tydligt framträdande linje (lineament), vanligen spricks- eller förkastningszon, i allmänhet mer än 10 km lång.

Område där höjdbaser saknas på reliefkartan. Lineamenten framtagna med hjälp av topografiska kartans höjdkurvor.

Pl. 12

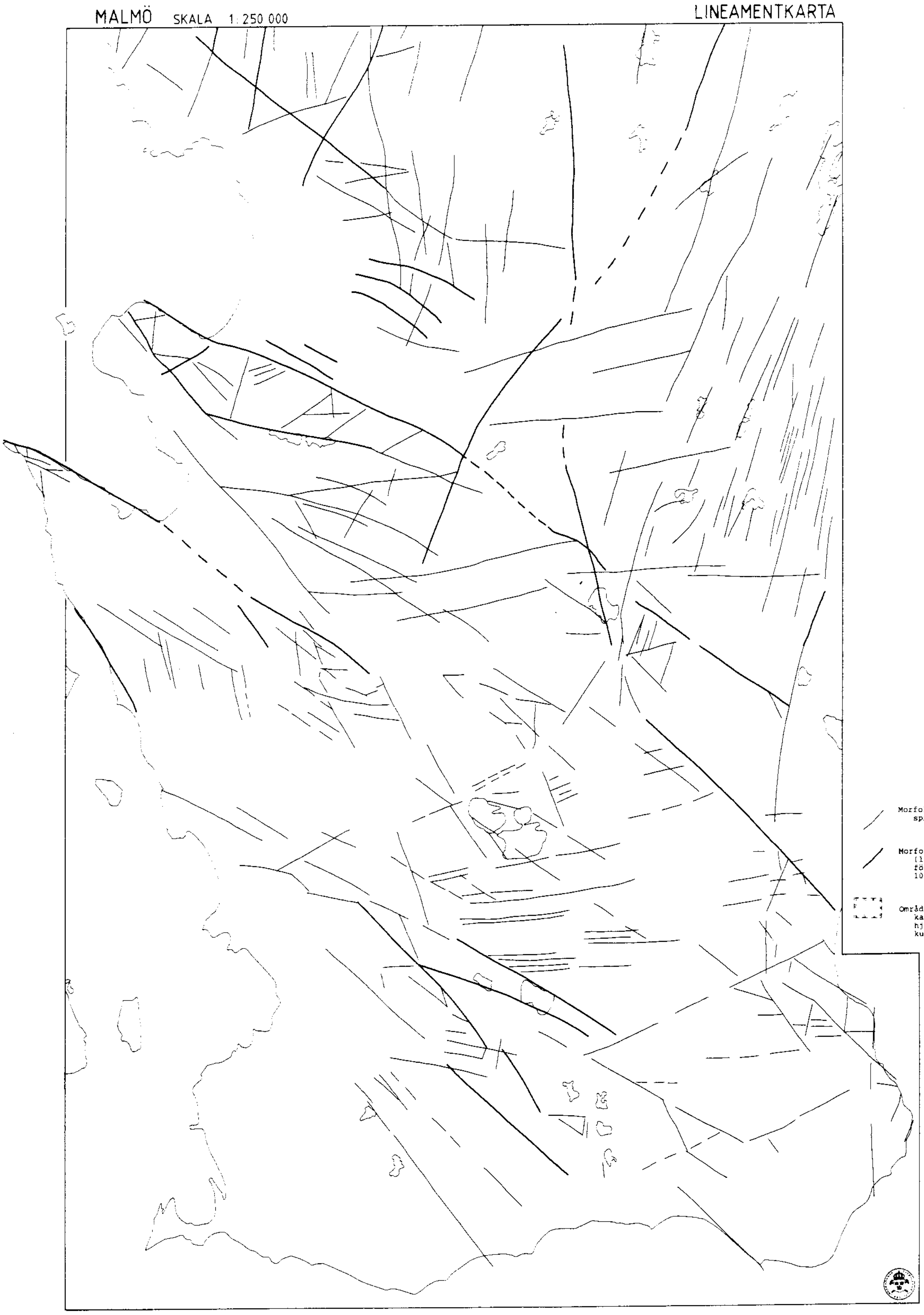
OSKARSHAMN SKALA 1:250 000 LINEAMENTKARTA



Pl. 13

MALMÖ SKALA 1:250 000

LINEAMENTKARTA



TECKENFÖRKLARING

Morfologisk linje (lineament), vanligen sprickzon, mer än 2.5 km lång.

Morfologiskt tydligt framträdande linje (lineament), vanligen sprick- eller förkastningszon, i allmänhet mer än 10 km lång.

Område där höjdbaser saknas på reliefkartan. Lineamenten framtagna med hjälp av topografiska kartans höjdkurvor.

KARLSKRONA / KALMAR SKALA 1:250 000 LINEAMENTKARTA

Pl. 14

LINEAMENTKARTA

Skala: 1: 1 milj.

Lineament i urberg

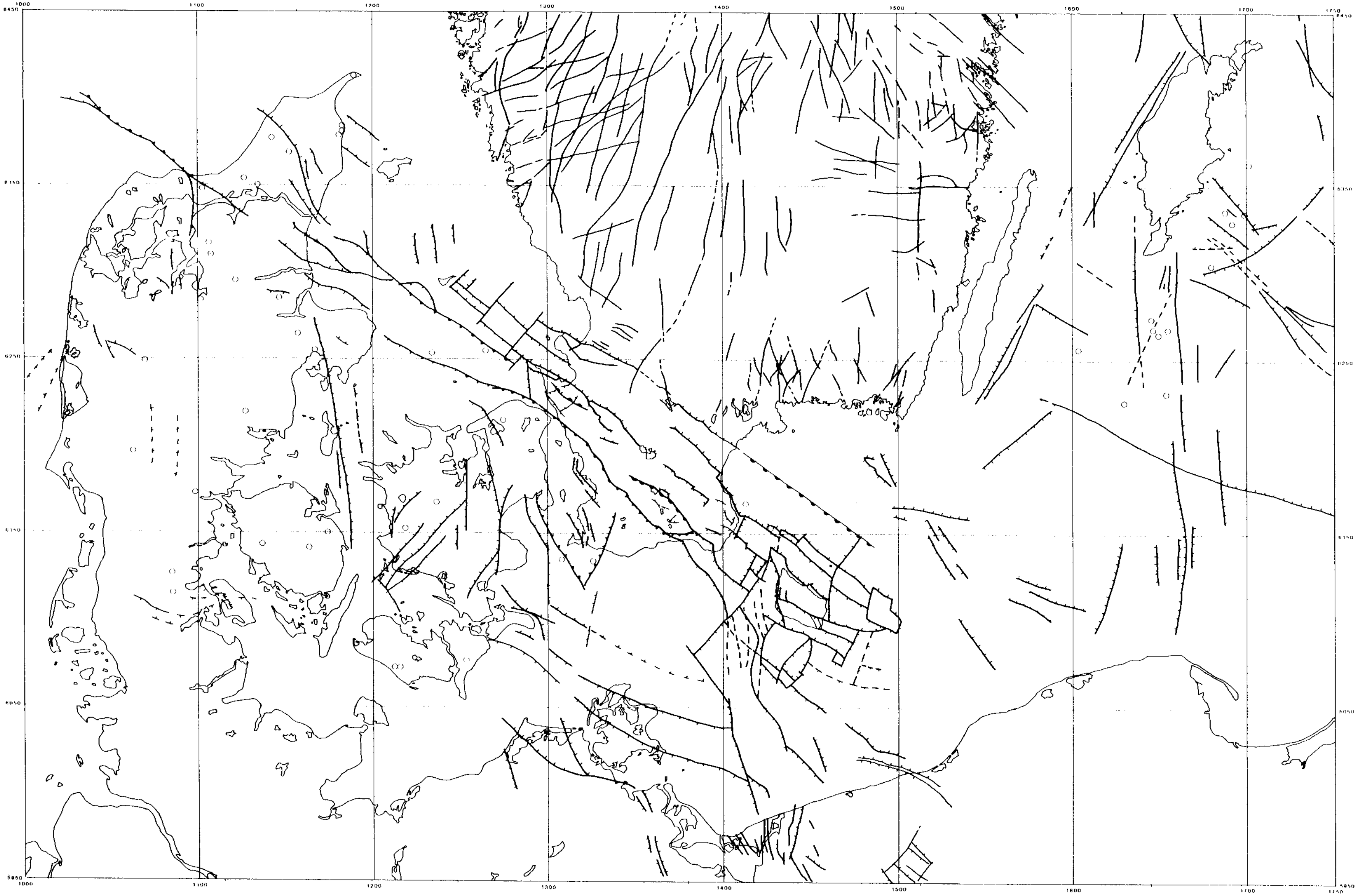
Lineament,osäkert

Förkastning

Förkastning
(över 1000 m språnghöjd)

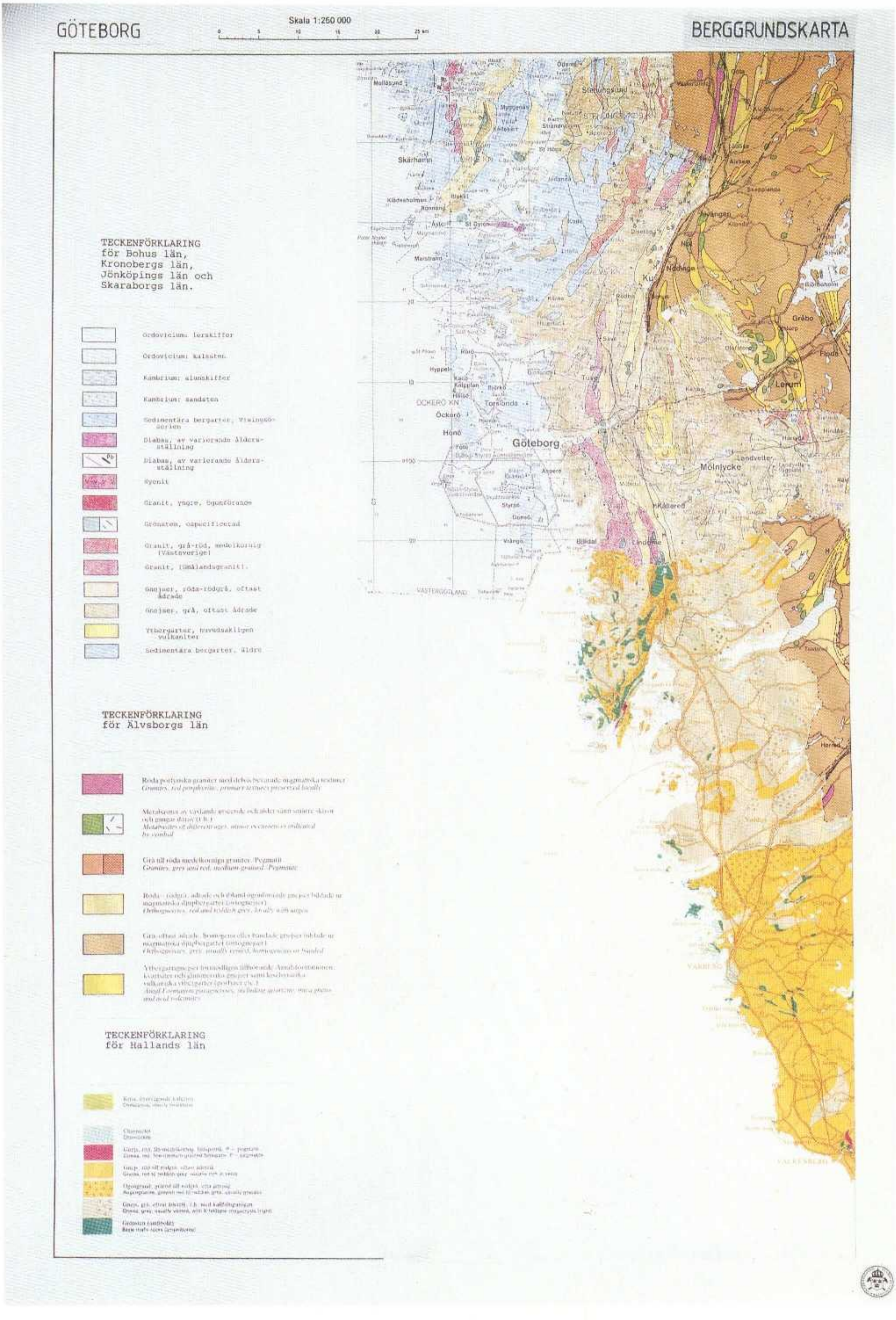
Förkastning,osäker

Flexur
(ställvis med förkastning)



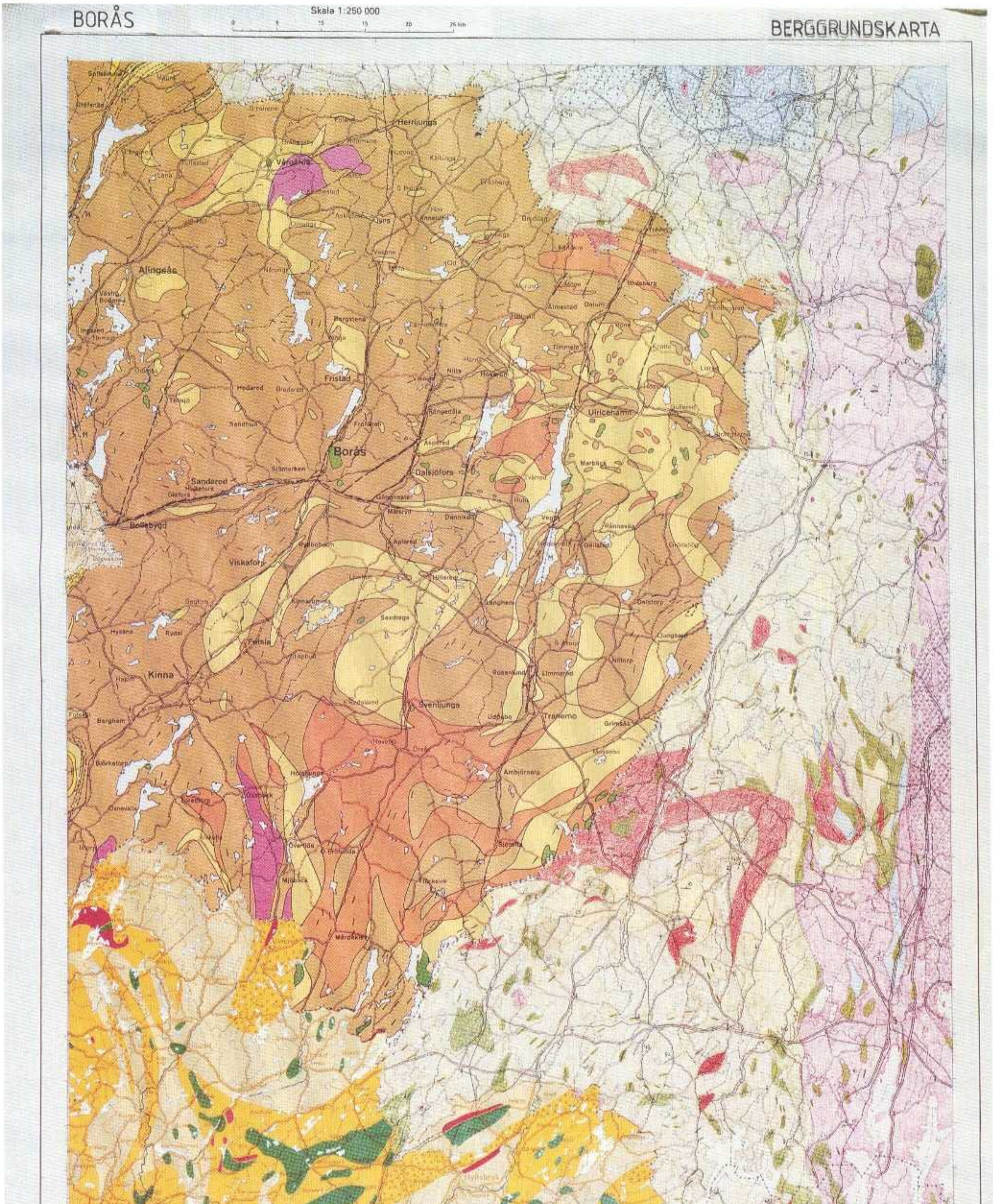
Pl. 15

Pl. 16

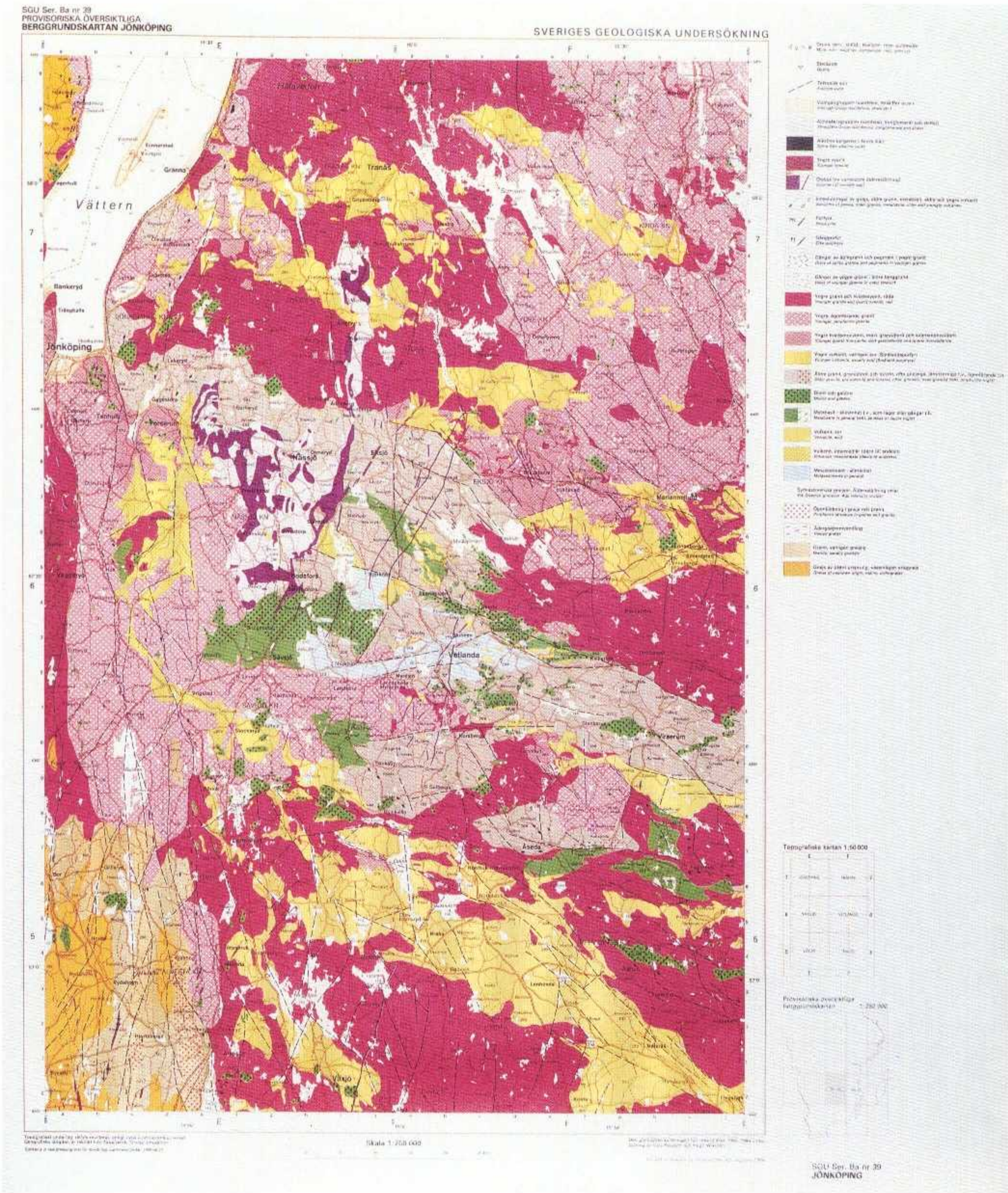


GÖTEBORG
Skala 1:250 000
BERGGRUNDSKARTA
TECKENFÖRKLARING
för Bohus län,
Kronobergs län,
Jönköpings län och
Skaraborgs län.
Ordovicium: lerskiffer
Ordovicium: kalksten
Kambrium: alunskiffer
Kambrium: sandsten
Diabas, av varierande ålders-ställning
Diabas, av varierande ålders-ställning
Granit, grå-röd, medelkornig (Västsverige)
Gnejser, grå, oftast ådrade
Yberqarter, huvudsakligen vulkaniter
TECKENFÖRKLARING
för Älvsborgs län
Grå till röda medelkorniga graniter. Pegmatit
TECKENFÖRKLARING
för Hallands län
Göteborg
Mölnlycke
Stenungsund
Lerum
Gråbo
Öckerö
Hönö
Kållered
Lindome
Landvetter

Pl. 17

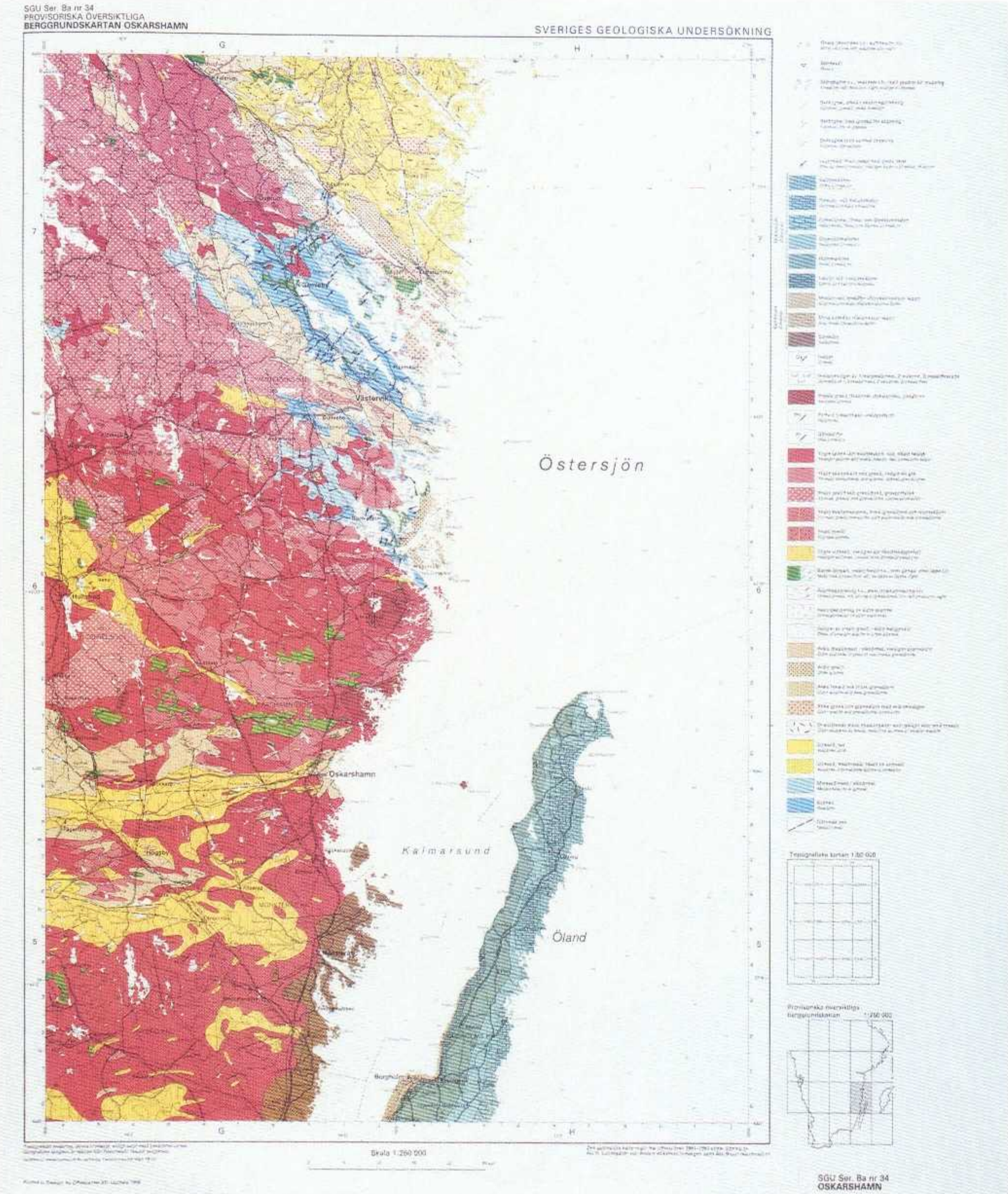

BORÅS
Skala 1:250 000
BERGGRUNDSKARTA
Herrljunga
Alingsås
Fristad
Borås
Ulricehamn
Dalsjöfors
Sandared
Bollebygd
Viskafors
Kinna
Svenljunga
Tranemo

Pl. 18

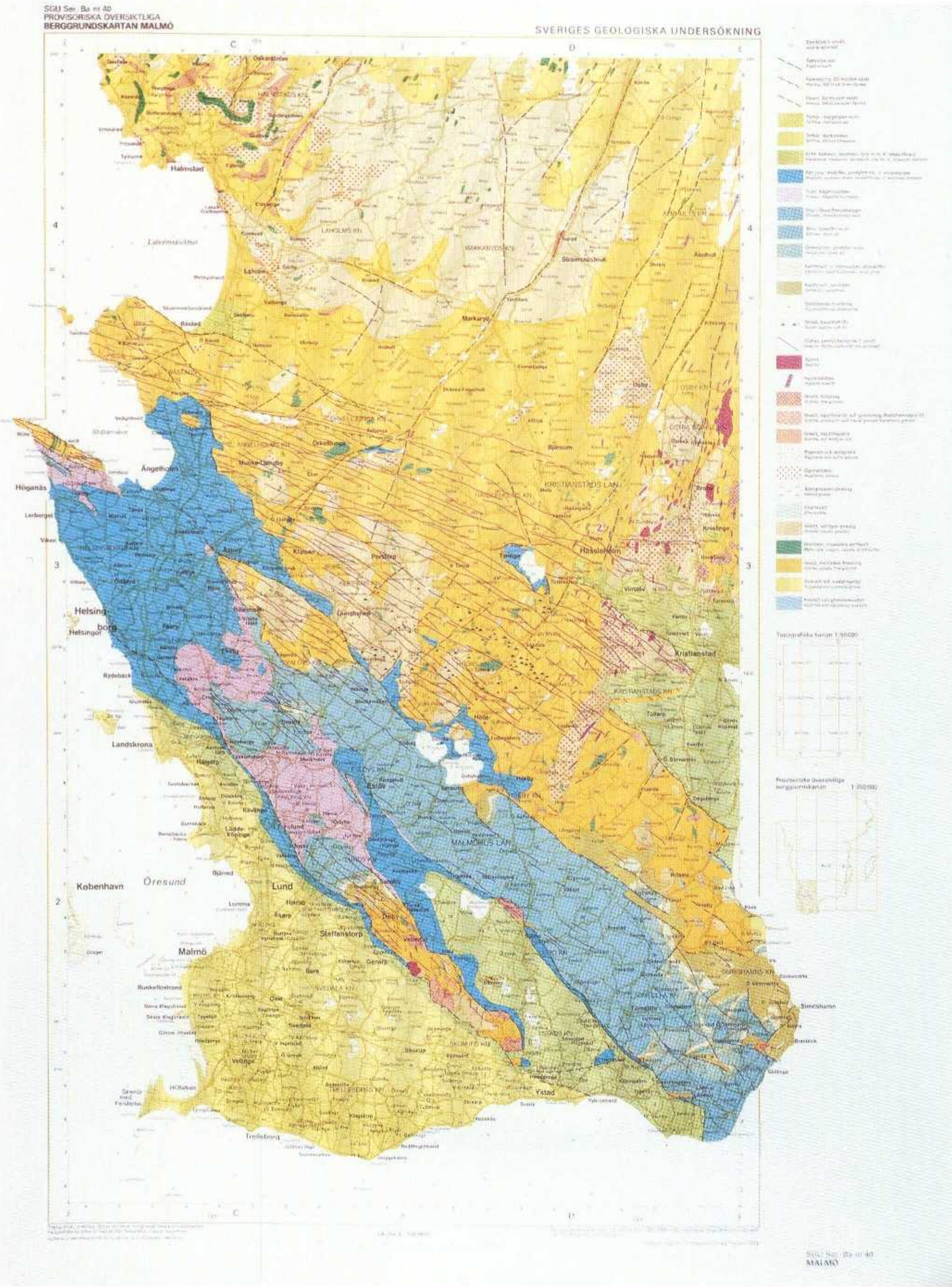


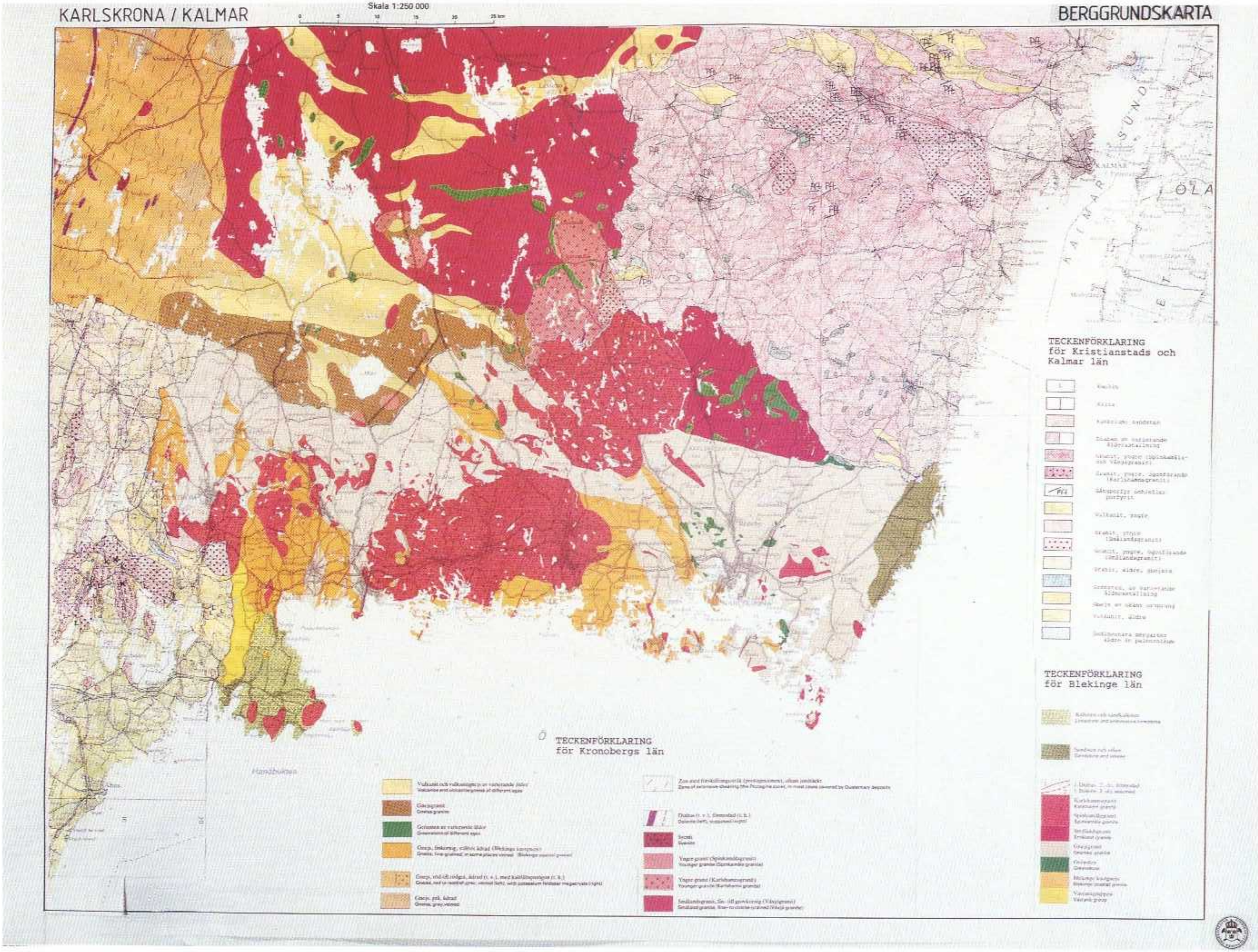
SGU Ser. Ba nr 39
PROVISORISKA ÖVERSIKTLIGA
BERGGRUNDSKARTAN JÖNKÖPING
SVERIGES GEOLOGISKA UNDERSÖKNING
Vättern
Jönköping
Tranås
Nässjö
Vetlanda
SGU Ser. Ba nr 39
JÖNKÖPING

Pl. 19


SGU Ser. Ba nr 34
PROVISORISKA ÖVERSIKTLIGA
BERGGRUNDSKARTAN OSKARSHAMN
SVERIGES GEOLOGISKA UNDERSÖKNING
G
H
Västervik
Östersjön
Oskarshamn
Kalmarsund
Öland
Skala 1:250 000
SGU Ser. Ba nr 34
OSKARSHAMN

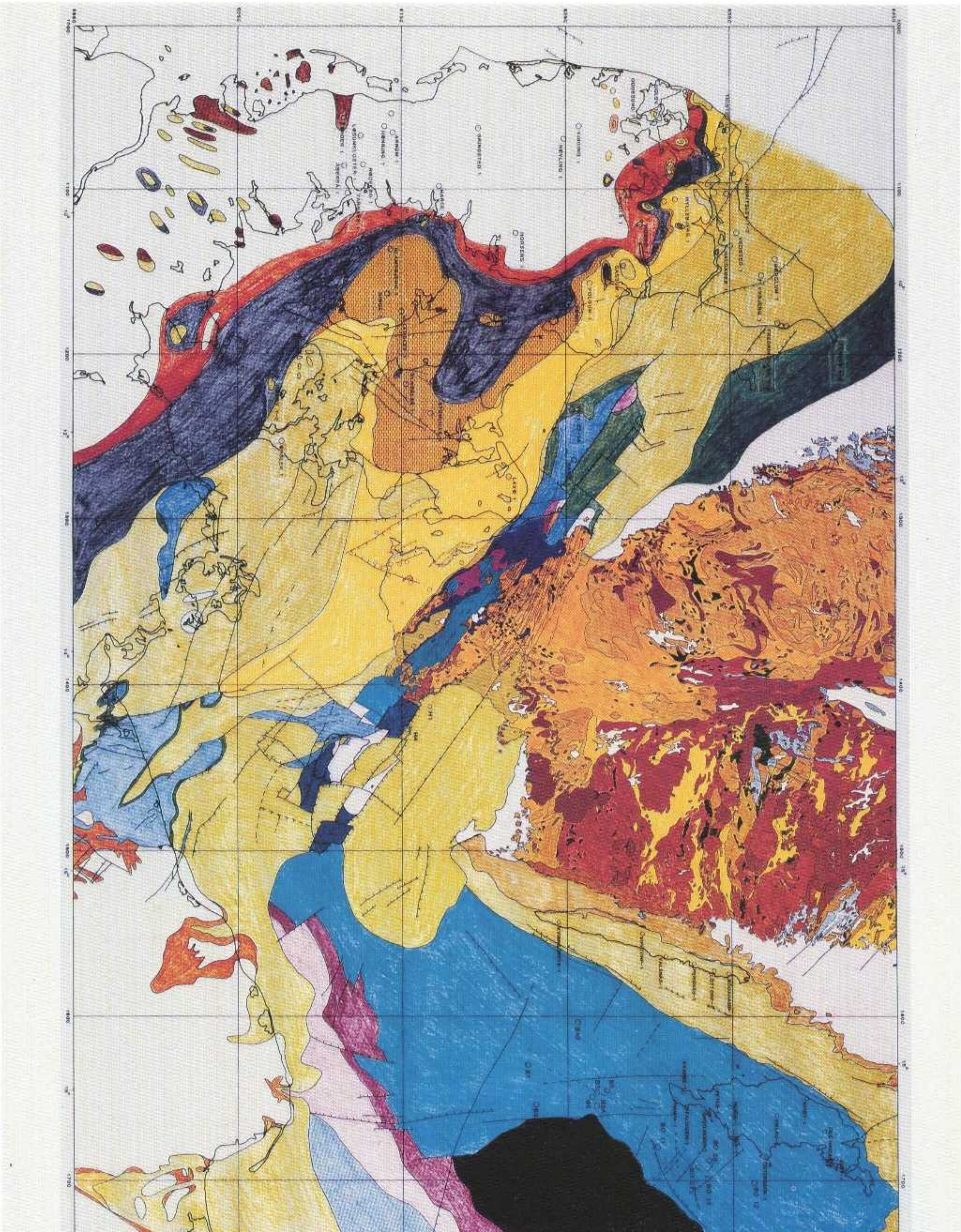
Pl. 20


SGU Ser. Ba nr 40
PROVISORISKA ÖVERSIKTLIGA
BERGGRUNDSKARTAN MALMÖ
SVERIGES GEOLOGISKA UNDERSÖKNING
Halmstad
Laholmsbukten
Markaryd
Ängelholm
Höganäs
Hässleholm
Kristianstad
Helsingborg
Helsingør
Landskrona
København
Öresund
Lund
Malmö
Staffanstorp
Ystad
Trelleborg
Simrishamn
KRISTIANSTADS LÄN
MALMÖHUS LÄN
SGU Ser. Ba nr 40
MALMÖ


KARLSKRONA / KALMAR
Skala 1:250 000
BERGGRUNDSKARTA
KALMAR SUND
KALMAR
ÖLA
TECKENFÖRKLARING
för Kristianstads och
Kalmar län
TECKENFÖRKLARING
för Blekinge län
TECKENFÖRKLARING
för Kronobergs län

Pl. 21

Pl. 22



GÖTEBORG SKALA 1:250 000

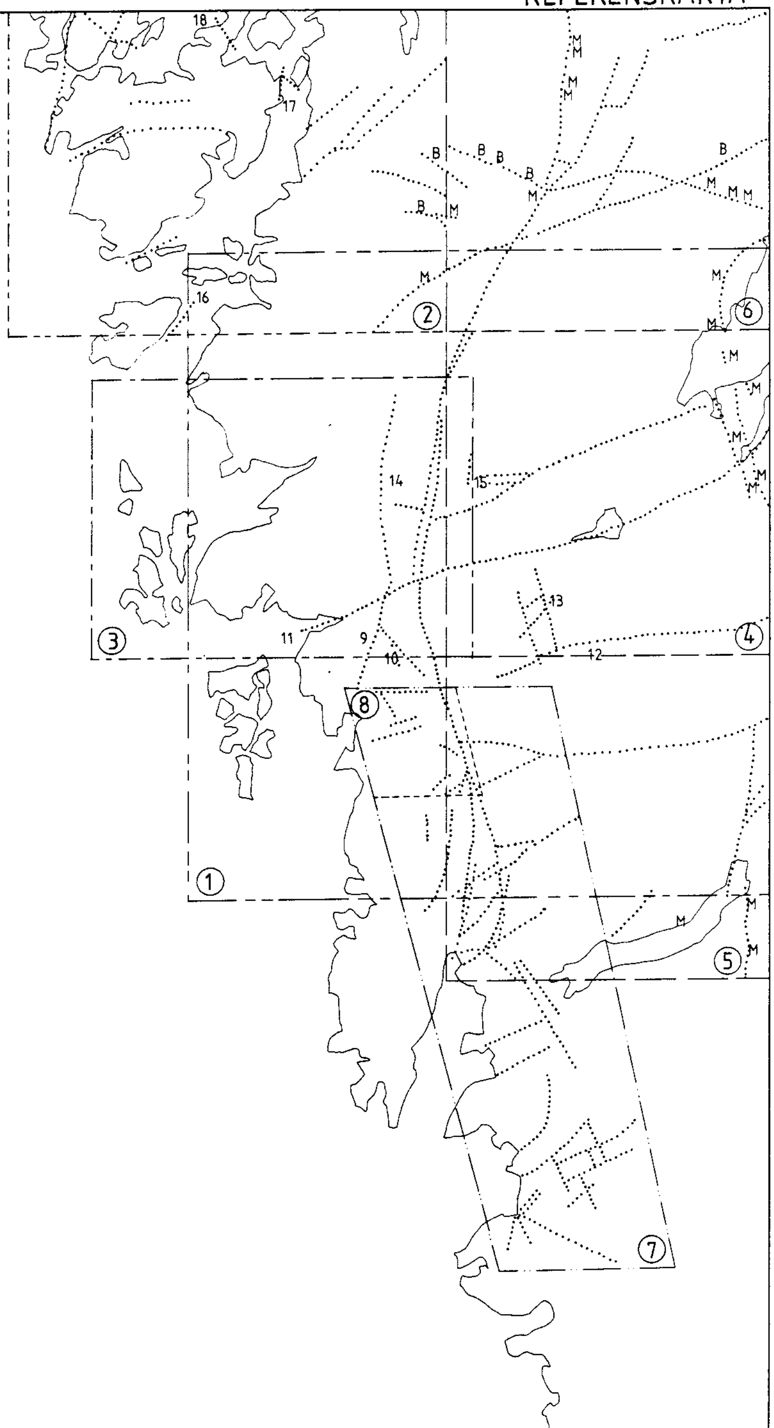
REFERENSKARTA

TECKENFÖRKLARING

Sprick- eller förkastningszon (lineament), framtagen med hjälp av provisoriska översiktliga berggrundskartor eller andra geologiska kartor (med siffra som hänvisar till referenslistan).

M Mylonit

B Breccia



Referenser till spricktektonik på bladet Göteborg

1. Samuelsson, Lennart, 1975: Paleozoic fissure fillings and tectonism of the Göteborg area, southwestern Sweden. SGU serie C 711.

2. Samuelsson, Lennart, 1987: Beskrivning till berggrundskartan Marstrand NO/Göteborg NV. SGU Serie Af nr 146.

3. Sandegren, R & Johansson, H.E., 1931: Beskrivning till kartbladet Göteborg. SGU serie Aa nr 173. STockholm.

4. Samuelsson, Lennart, 1978: Beskrivning till berggrundskartan Göteborg SO. SGU serie Af nr 117. Stockholm

5. Samuelsson, Lennart, 1982: Beskrivning till berggrundskartan Kungsbacka NO. SGU Serie Af nr 124.

6. Samuelsson, Lennart, 1985: Beskrivning till berggrundskartan Göteborg NO. SGU Serie Af nr 136. Uppsala.

7. Palmqvist, Kai; BERGAB 1975: Energiverket i Göteborg. Fjärrvärmehuvud- ledning Ringhals - Göteborg. Geologisk-tektonisk undersökning.

8. Palmqvist, Kai; BERGAB 1975: GRYAAB. Göteborgsregionens Ryaverksaktiebolag. Spillvattentunnel Näsetverket - Lindome. Detaljerad geologisk- tektonisk undersökning.

9. Palmqvist, Kai & Åkesson, Jan-Åke; BERGAB 1975: Energiverken i Göteborg. Guldhedstunnlarna. Geologisk - tektonisk undersökning.

10. Palmqvist, Kai & Ludvig, Bengt; BERGAB 1974: GRYAAB. Spillvattentunnlar till Ryaverket. Slottsskogen Annedal - Mölndalsån. Detaljerad geologisk-tektonisk undersökning.

11. Palmqvist, Kai & Åkesson, Jan-Åke; BERGAB 1977: Energiverksstyrelsens försörjningsdeligation. Hetvattenöverföring från Shell. Detaljerad geologisk-tektonisk undersökning.

12. Palmqvist, Kai & Åkesson, Jan-Åke & Ingemansson, Christer; BERGAB 1978: GRYAAB - Göteborgsregionens Ryaverksaktiebolag. Spillvattentunnel Hel- enevik - Solsten - Landvetter. Detaljerad geologisk-tektonisk undersökning.

13. Åkesson, Jan-Åke & Ingemansson, Christer; BERGAB 1979:GRYAAB. Göteborgsregionens Ryaverksaktiebolag. Spillvattentunnel Slamby - Öjersjö - Partille. Detaljerad geologisk-tektonisk undersökning.

14. Palmqvist, Kai & Nilsson, Lars; SIB 1971:GRYAAB Spillvattentunnlar till Ryaverket. Tagene - Halleröd - Ytterby. Geologisk-tektonisk undersökning.

15. Palmqvist, Kai & Nilsson, Lars; SIB 1969: Göteborgs stads VA-verk. Berg- tunnlar till Angered. Geologisk-tek- tonisk undersökning.

16. Palmqvist, Kai & Helander, Björn; BERGAB 1986: Statens Vägverk. Vägförvaltningen i Göteborg och Bohus län. Bro över Instö ränna.

17. Palmqvist, Kai & Åkesson, Jan-Åke; BERGAB 1980: Statens Vägverk. Vägförvaltningen i Göteborgs och Bohus län. Väg 160 Jölandar - Rotvik. Ny bro över Askeröfjorden. Geologisk undersökning.

18. Palmqvist, Kai & Åkesson, Jan-Åke; BERGAB 1977: Statens Vägverk. Vägförvaltningen i Göteborgs och Bohus län. Ny bro vid Skåpesund. Geologisk -tektonisk undersökning.

Larsson, Ingemar, 1967: Anisotropy in Precambrian rocks and postcrystalline deformation models. -Geografiska annaler 49 A, pp 237-246

Larsson, S.Å. & Fridh, B. & Haag, Ö., 1983: Hydrock - värmelager i berg. Chalmers/Göteborg Univ. Geol Inst. Publ B 222.

Nelson, Helge, 1923: Om förhållandet mellan tektonik och glacialerosion inom Säveåns flodområde. Lund.

Stanfors, R., 1966a: Avloppstunnel för Angered. I. Berggrundsförhållanden, Sydsvenska Ingenjörsbyrån, handlingar. Malmö.

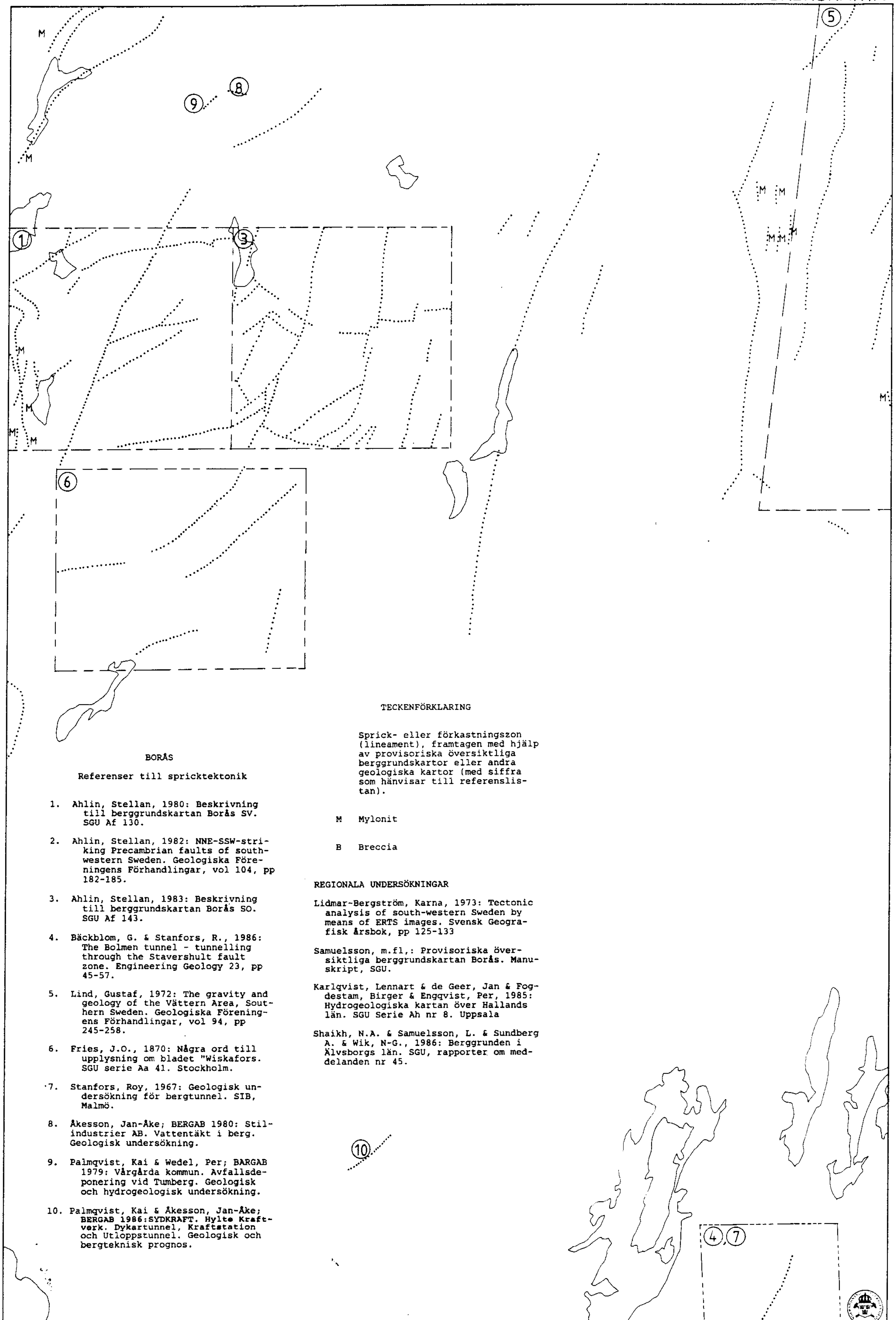
Stanfors, R., 1966b: Koppartrans Olje AB. Kylvattentunnel och bergrum för gaslagring. Geologisk-tektonisk undersökning. I. Berggrundsförhållanden. Sydsvenska Ingenjörsbyrån. Malmö.

Samuelsson, L., 1967: Breccia av paleozoiska bergarter 1.5 km väster om Bohus fästning, Kungälv. Geologiska Föreningens förhandlingar 89, pp 448-459.

Shaikh, N.A. & Samuelsson, L. & Sundberg A. & Wik, N-G., 1986: Berggrunden i Älvsborgs län. SGU, rapporter om meddelanden nr 45.

BORÅS SKALA 1:250 000

REFERENSKARTA



TECKENFÖRKLARING

Sprick- eller förkastningszon (lineament), framtagen med hjälp av provisoriska översiktliga berggrundskartor eller andra geologiska kartor (med siffra som hänvisar till referenslistan).

M Mylonit

B Breccia

REGIONALA UNDERSÖKNINGAR

Lidmar-Bergström, Karna, 1973: Tectonic analysis of south-western Sweden by means of ERTS images. Svensk Geografisk Årsbok, pp 125-133

Samuelsson, m.fl,: Provisoriska översiktliga berggrundskartan Borås. Manuskript, SGU.

Karlqvist, Lennart & de Geer, Jan & Fogdestam, Birger & Engqvist, Per, 1985: Hydrogeologiska kartan över Hallands län. SGU Serie Ah nr 8. Uppsala

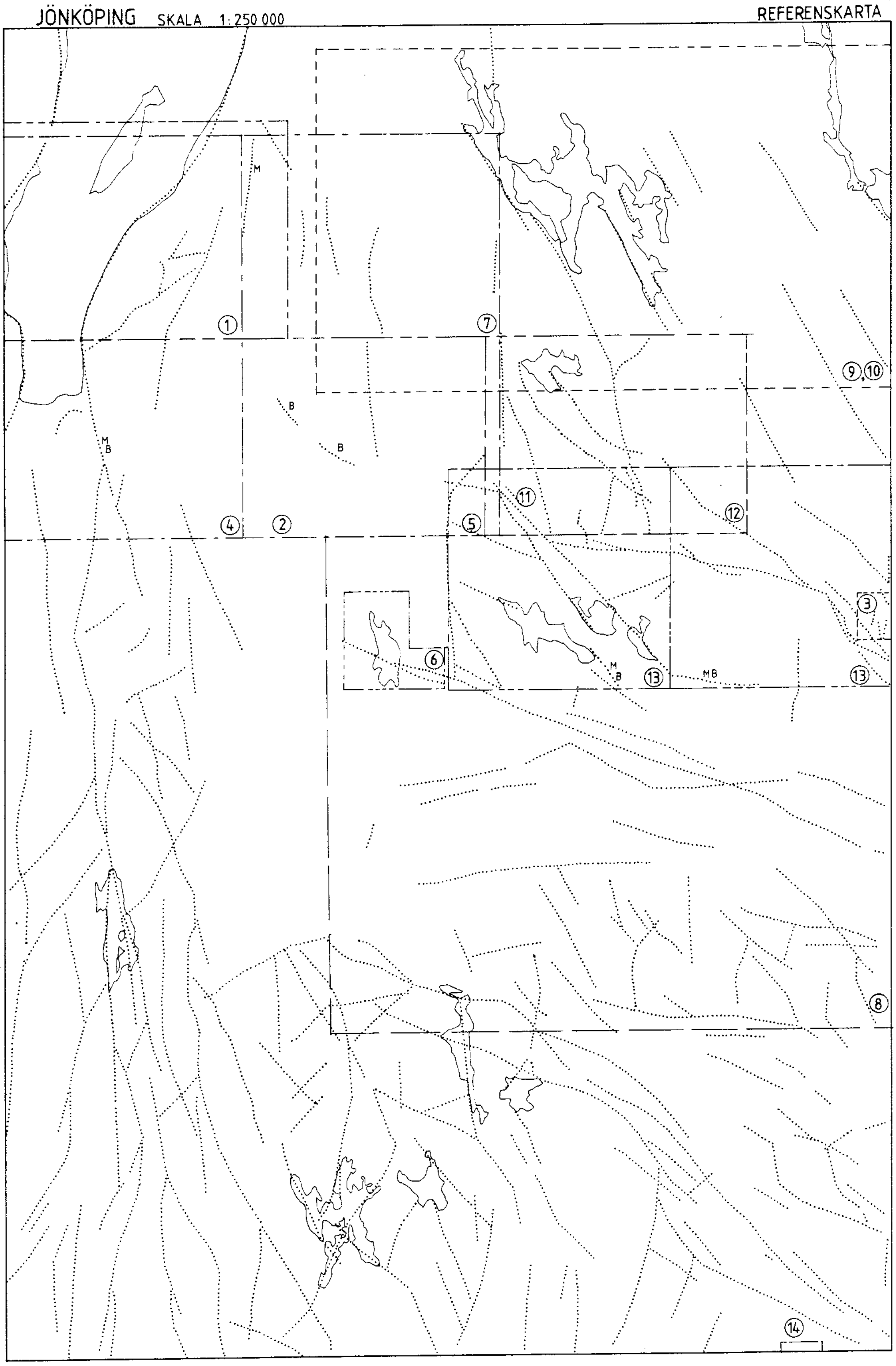
Shaikh, N.A. & Samuelsson, L. & Sundberg A. & Wik, N-G., 1986: Berggrunden i Älvsborgs län. SGU, rapporter om meddelanden nr 45.

BORÅS

Referenser till spricktektonik

1. Ahlin, Stellan, 1980: Beskrivning till berggrundskartan Borås SV. SGU Af 130.
2. Ahlin, Stellan, 1982: NNE-SSW-striking Precambrian faults of south-western Sweden. Geologiska Föreningens Förhandlingar, vol 104, pp 182-185.
3. Ahlin, Stellan, 1983: Beskrivning till berggrundskartan Borås SO. SGU Af 143.
4. Bäckblom, G. & Stanfors, R., 1986: The Bolmen tunnel - tunnelling through the Stavershult fault zone. Engineering Geology 23, pp 45-57.
5. Lind, Gustaf, 1972: The gravity and geology of the Vättern Area, Southern Sweden. Geologiska Föreningens Förhandlingar, vol 94, pp 245-258.
6. Fries, J.O., 1870: Några ord till upplysning om bladet "Wiskafors. SGU serie Aa 41. Stockholm.
7. Stanfors, Roy, 1967: Geologisk undersökning för bergtunnel. SIB, Malmö.
8. Åkesson, Jan-Åke; BERGAB 1980: Stilindustrier AB. Vattentäkt i berg. Geologisk undersökning.
9. Palmqvist, Kai & Wedel, Per; BARGAB 1979: Vårgårda kommun. Avfallsdeponering vid Tumberg. Geologisk och hydrogeologisk undersökning.
10. Palmqvist, Kai & Åkesson, Jan-Åke; BERGAB 1986:SYDKRAFT. Hylte Kraftverk. Dykartunnel, Kraftstation och Utloppstunnel. Geologisk och bergteknisk prognos.

Pl. 25



TECKENFÖRKLARING

Sprick- eller förkastningszon (lineament), framtagen med hjälp av provisoriska översiktliga berggrundskartor eller andra geologiska kartor (med siffra som hänvisar till referenslistan).

M Mylonit

B Breccia

JÖNKÖPING

Referenser till spricktektonik på bladet Jönköping

Siffror hänvisar till områden markerade på referenskartan.

1. Collini, Bengt & Geijer, Per & Munthe H. & Sandegren R., 1951: Beskrivning till kartbladet Gränna. SGU Aa 193.

2. Lind, Gustaf, 1972: The gravity and geology of the Vättern Area, Southern Sweden. Geologiska Föreningens Förhandlingar, vol 94, pp 245-258.

3. Persson, Lars, 1973: Sura vulkaniter, graniter och associerade bergarter i en del av nordöstra Småland. Geologiska institutionen, Lunds Universitet. Lund.

4. Munthe, Henr. & Gavelin, Axel, 1907: Beskrifning till kartbladet Jönköping. SGU serie Aa 123. Stockholm.

5. Hedström, Herman, 1917: Beskrivning till kartbladet Eksjö. SGU Serie Aa 129. Stockholm.

6. Röshoff, Kennert, 1973: Vulkaniter, sediment och plutoniter i Vetlandaområdet. Geologiska institutionen, Lunds Universitet. Lund.

7. Gavelin, Axel, 1912: Beskrivning till kartbladet Tranås. SGU serie Aa 135. Stockholm.

8. Persson, Torsten, 1969: Skuror och andra erosionsrännor inom Smålands Högland. Svensk Geografisk Årsbok årg 45, pp 73-98. Lund.

9. Björnsson, S., 1937: Sommen-Åsundenområdet. En geomorfologisk studie. Medd. Lunds. Geogr. Inst. Avh IV.

10. Björnsson, Sven., 1937: Tektonik och landformer kring sjöarna Sommen och Åsunden. Svensk Geografisk Årsbok, årg. 13, pp 119-139.

11. Nordström, Olof & Wendel, Bertil, 1952: Skurugata - en klippkanjon på sydsvenska höglandet. Svensk Geolgrafisk Årsbok, Årg. 28, pp 30-35.

12 Svedmark, Eugéne, 1907: Beskrifning till kartbladet Svinhult. SGU serie Aa 134. Stockholm.

13 Persson, Lars, 1985: Beskrivning till berggrundskartorna Vetlanda NV och NO. SGU, serie Af 150 och 151. Uppsala.

14 SKB 1987: Klipperåsområdet. SKB Teknisk rapport, 87-01.

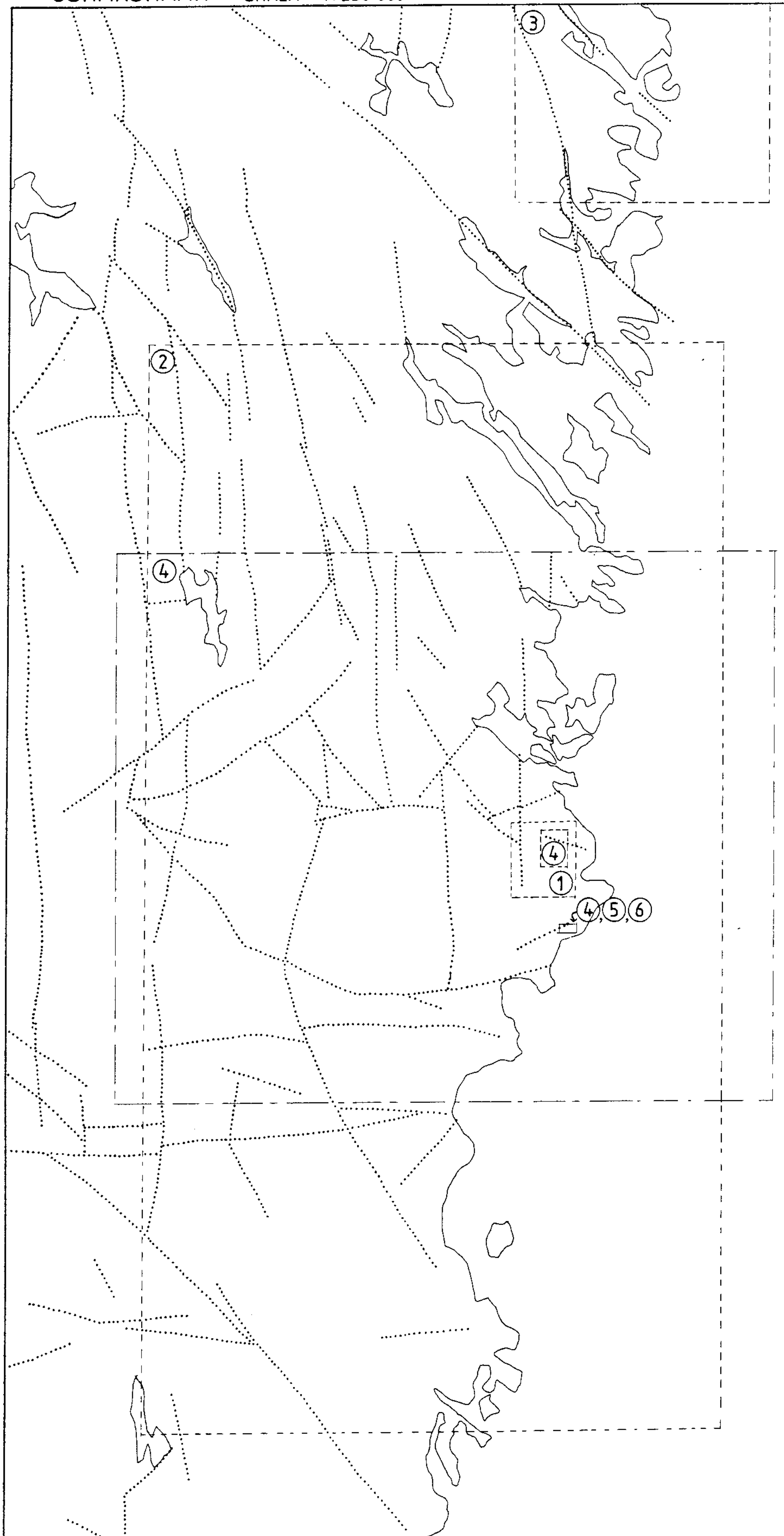
Timje, H., 1978: Rapport över seismiska mätningar i Silveråns dalgång inom kartbladet 6FVetland NO oc 6i och 7j under tiden 6-15 december 1977. SGU, intern rapport.

Knutsson, G., 1962: Älgutsbodatraktens geologi. Älgutsbodaboken 1962. Nybro.

Pl. 26

OSKARSHAMN SKALA 1:250 000

REFERENSKARTA



TECKENFÖRKLARING

Sprick- eller förkastningszon (lineament), framtagen med hjälp av provisoriska översiktliga berggrundskartor eller andra geologiska kartor (med siffra som hänvisar till referenslistan).

M Mylonit

B Breccia

Referenser till spricktektonik på bladet Oskarshamn.

1. Kresten, Peter & Chyssler, J., 1976: The Götemar massif in southeastern Sweden: A reconnaissance survey. Geologiska Föreningens Förhandlingar vol 98.

2. Nordenskjöld, C.E., 1944: Morfologiska studier inom övergångsområdet mellan Kalmarslätten och Tjust. Medd. Lunds. Geogr. Inst. Avh VIII.

3. Sandegren, R. & Sundius, N., 1928: Beskrifning till kartbladet Valdemarsvik, SGU serie Aa 158.

4. Gentzschein & Stejskal, 1984: Sammanställning och utvärdering av berggrundsgeologiska och hydrogeologiska förhållanden i Simpevarp. KBS Ar 84-14.

5. Stanfors & Hoffner, 1982: Oskarshamnsverket 3, geokartering. OKG Internrapport 1982.

6. Röshoff, K. & Stephansson,O. & Larsson, H. & Stanfors, R. & Eriksson, K., 1983: CLAB - an intermediate storage for spent nuclear fuel in Sweden. 5th International Congress on Rock Mechanics, pp E 151-159. Melbourne.

7. SKB 1987: Klipperåsområdet. SKB-Teknisk rapport, 87-01.

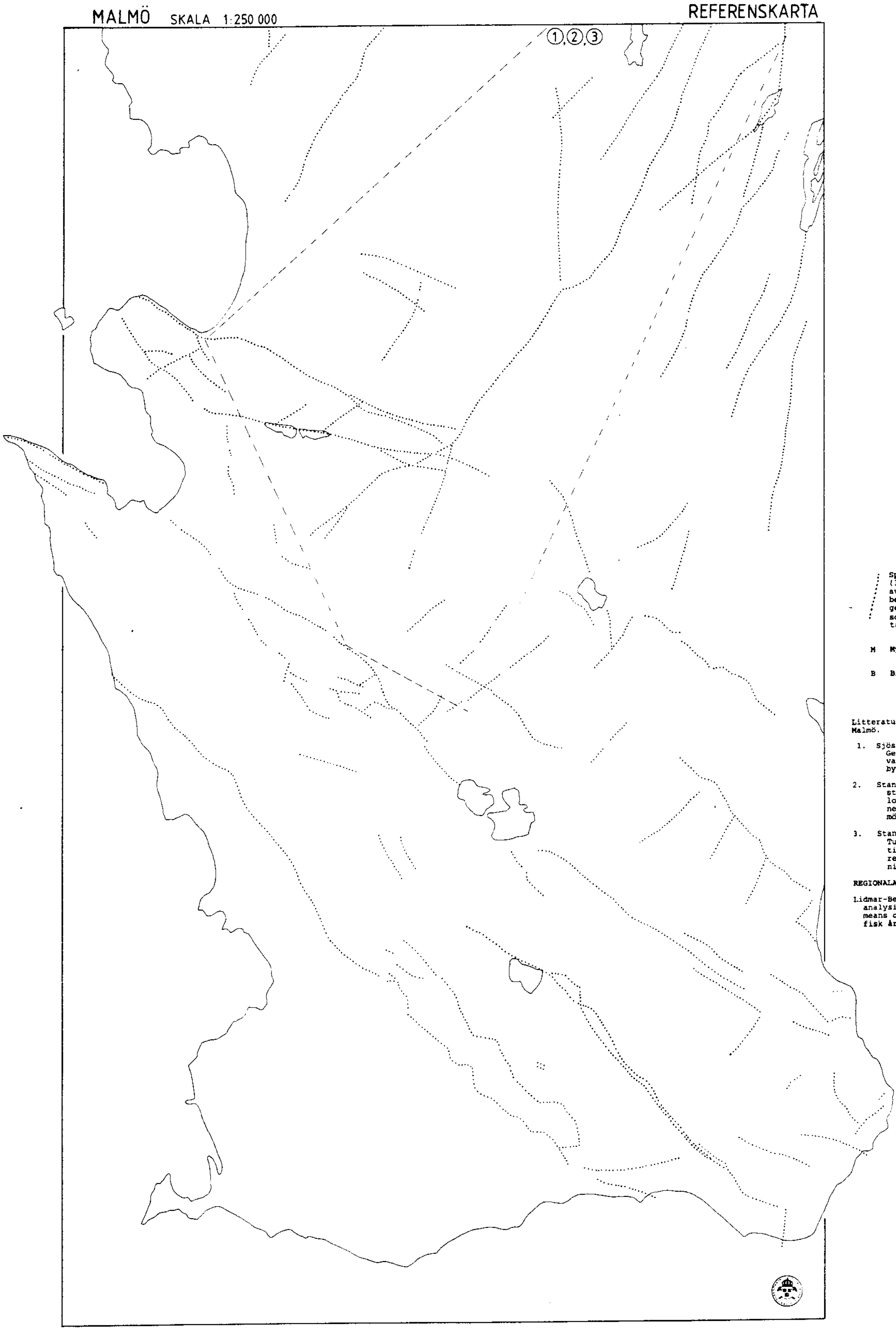
Asklund, B., 1923: Bruchspaltenbildungen im südöstlichen Östergötland nebst einer Uebersicht der geologischen Stellung der Bruchspalten Südostschwedens. Geologiska Föreningens Förhandlingar. Band 45, pp 249-285.

Lundegårdh, P.H. & Wikström A. & Bruun, Å., 1985: Beskrivning till provisoriska översiktliga berggrundskartan Oskarshamn. SGU serie Ba nr 34. Uppsala.

Nordenskjöld, Carl-Erik, 1937: Några sjötyper i Kalmar län. Svensk Geografisk årsbok, årg. 13, pp 109-118.

Svensson, Nils B., 1966: Lake Hummeln. SGU serie C 608. Stockholm.

Pl. 27



TECKENFÖRKLARING

Sprick- eller förkastningszon (lineament), framtagen med hjälp av provisoriska översiktliga berggrundskartor eller andra geologiska kartor (med siffra som hänvisar till referenslistan).

M Mylonit

B Breccia

Litteratur om spricktektonik på bladet Malmö.

1. Sjöstrand, B. & Stanfors, R., 1975: Geologisk undersökning för Sydvattentunneln. Väg- och Vattenbyggaren nr 8-9.

2. Stanfors, R. & Larsson, J. & Lindström, M., 1967: Sydvatten. Geologisk undersökning aför bergtunnel. Huvudrapport. Sydkraft, Malmö.

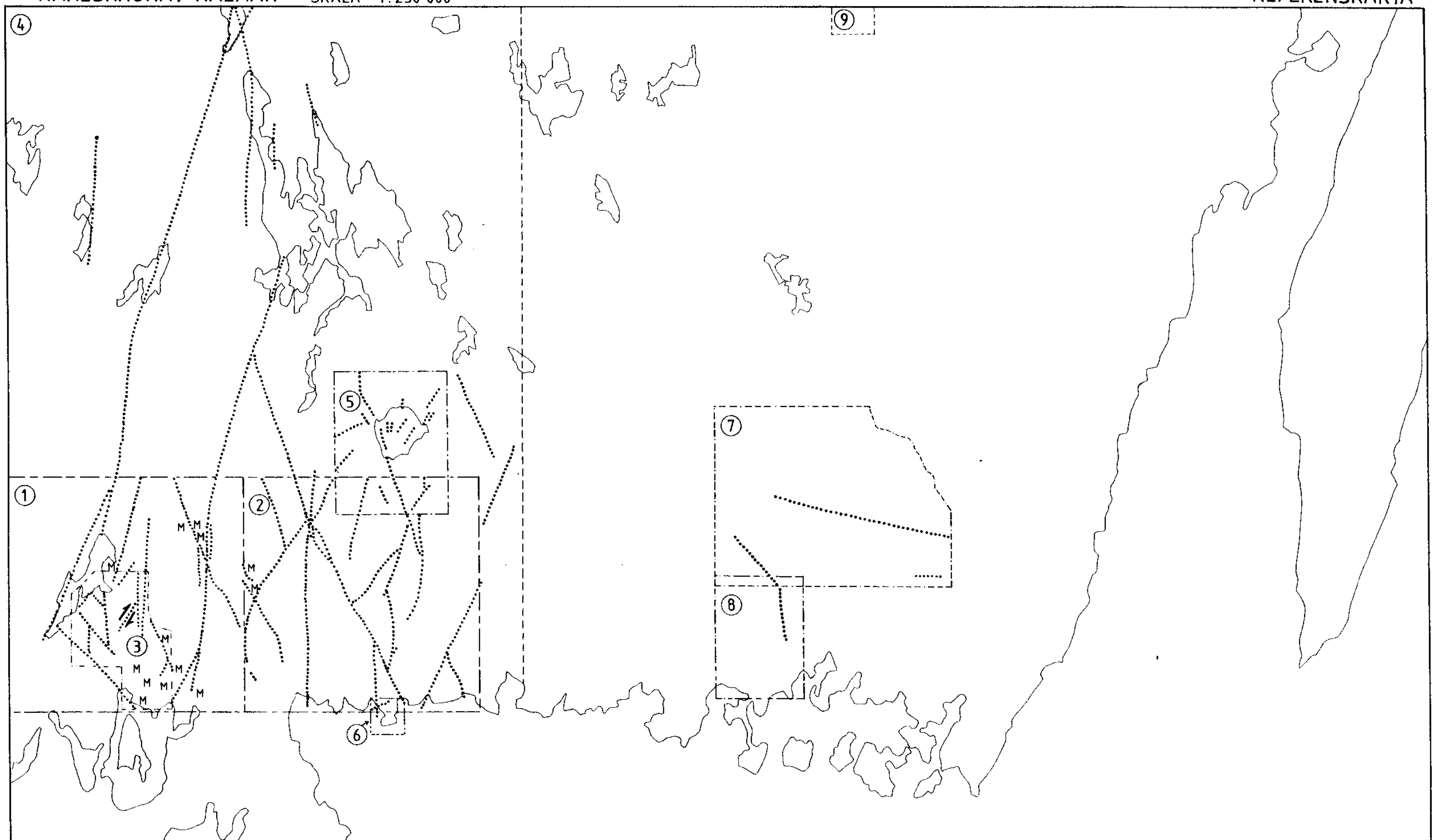
3. Stanfors, Roy, 1986: The Bolmen Tunnel project. Site investigations and correlation forecast - real time". Stiftelsen Bergteknisk forskning. Stockholm.

REGIONALA UNDERSÖKNINGAR

Lidmar-Bergström, Karna, 1973: Tectonic analysis of south-western Sweden by means of ERTS images. Svensk Geografisk årsbok, pp 125-133

KARLSKRONA / KALMAR SKALA 1:250 000

REFERENSKARTA



TECKENFÖRKLARING

Sprick- eller förkastningszon (lineament), framtagen med hjälp av provisoriska översiktliga berggrundskartor eller andra geologiska kartor (med siffra som hänvisar till referenslistan).

M Mylonit

B Breccia

KARLSKRONA / KALMAR

Referenser till litteratur om spricktektonik.

1. Kornfält, Karl-Axel & Bergström, Jan, 1983: Berggrundskartan Karlshamn NV. SGU serie Af 135. Uppsala.

2 Kornfält, Karl-Axel & Bergström,Jan, 1987 : Berggrundskartan Karlshamn NO. SGU serie Af 154. Uppsala.

3. Andersson, Wiking, 1975: Precambrian geology of the Västanå area, southern Sweden. Doktorsavhandling, Geologiska Institutionen, Lunds Universitet.

4.
5. Stanfors, Roy, 1973: Mienstrukturen - en kryptoexplosiv bildning i fennoskandias urberg. Doktorsavhandling, Geologiska Institutionen, Lunds Universitet.

6. Olkiewicz, Andrzej & Scherman, Sören & Kornfält, Karl-Axel, 1979: Kompletterande berggrundsundersökningar inom Finnsjö- och Karlshamnsområdena. SKBF-KBS Teknisk Rapport 79-05

7. Wiklander, Ulf, 1974: Precambrian petrology, geochemistry and age relations of northeastern Blekinge, Southern Sweden. SGU Serie C 704. Stockholm.

8. Larsson, Ingemar & Lundgren, Tom & Wiklander, Ulf, (Odaterad): Strukturgeologisk - hydrogeologisk undersökning av gnejsbergarter i östra Blekinge. Programrådet för radioaktivt avfall. Rapport PRAV 4.9.

9. SKB 1987: Klipperåsområdet. SKB-Teknisk rapport, 87-01.

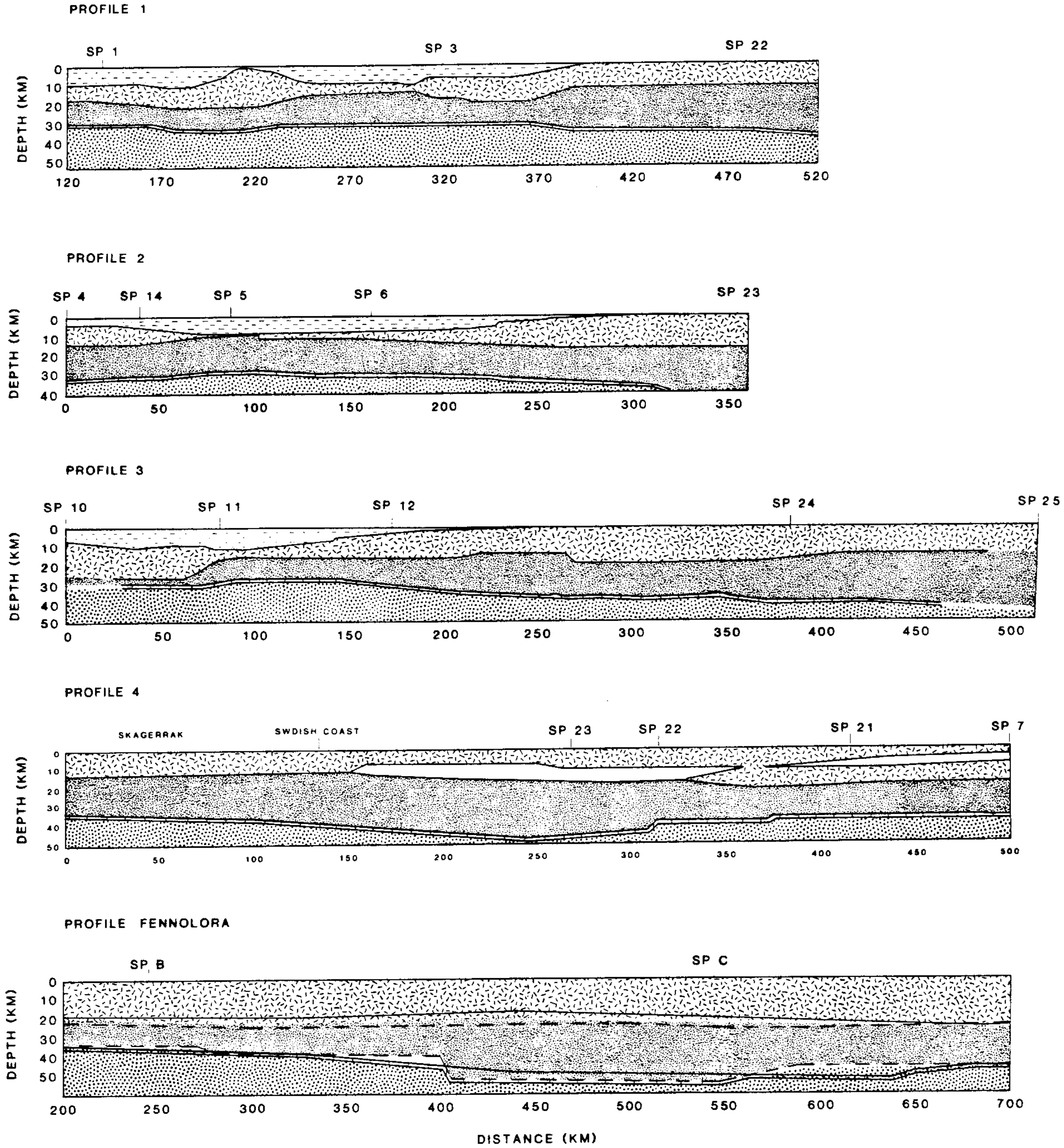
Björkman, Hans & Trägårdh, Jan, 1982: Differential uplift in Blekinge indicating late-glacial neotectonics. Geologiska Föreningens förhandlingar, vol 104, sid 75-79.

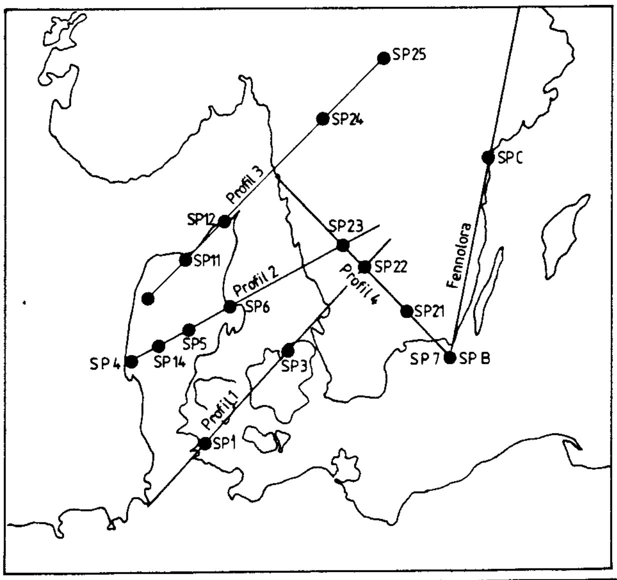
Larsson, Ingemar & Lundgren, Tom & Wiklander, Ulf, 1977: Blekinge kustgnejs, geologi och hydrogeologi. KBS teknisk rapport nr 25. Stockholm.

Mattson, Åke, 1967: Avjämningsytor och dalgenerationer i östra Blekinge. Årsskriften Blekinges Natur, sid 31-38.

Pl. 28

SEISMISKA PROFILER





Sedimentära bergarter

Övre skorpan, sial

Undre skorpan, sima

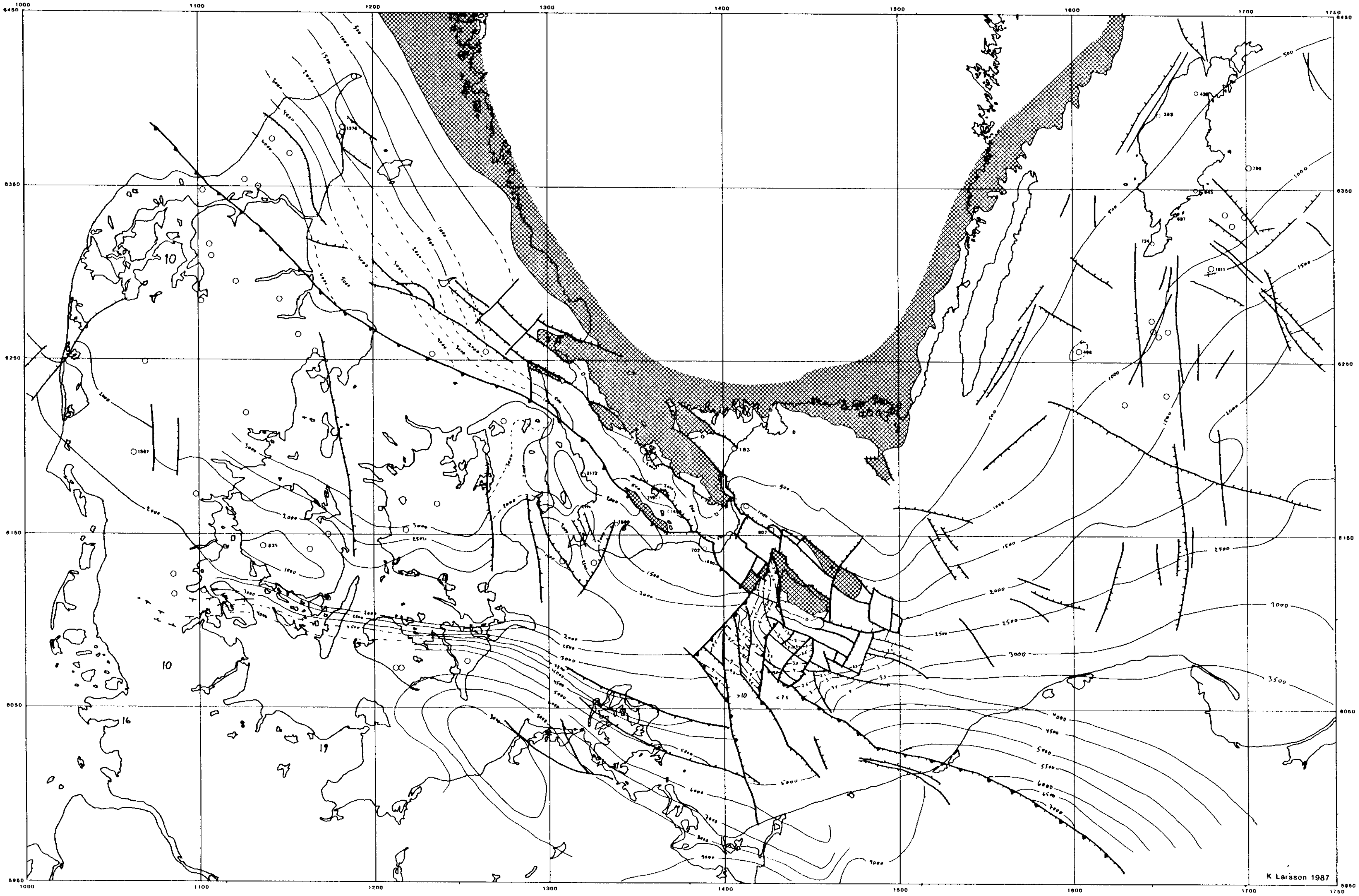
Manteln

Preliminära resultat av djupseismiska undersökningar

	Profil	Tolkning
EUGENO-S	1	Univ. Kiel, Hamburg, Köpenhamn.
	2	Univ. Kiel
	3	Univ. Leeds, Aarhus, Uppsala.
	4.	Univ Uppsala
FENNOLORA	Heldragen linje	Univ. Uppsala
	Streckad linje	Univ Zürich

Uppgifterna har lämnats av

Carl-Erik Lund
Fasta Jordens Fysik
Box 556
751 22 Uppsala



STRUKTURKARTA

Skala 1: 1 milj.

URBERGETS ÖVERYTA

Konturintervall: 500 meter

Datum: Havsytan

Förkastning

Konturlinje (m)

Borrhål med urbergets överyta i meter u. h.y.

10 Djup i km ner till urberget

Urberget som ytberggrund

Pl. 30

STRUKTURKARTA

Skala: 1: 1 milj.

PALEOZOIKUMS ÖVERYTA

Konturintervall: 100 ms TWT

Datum: Havsytan

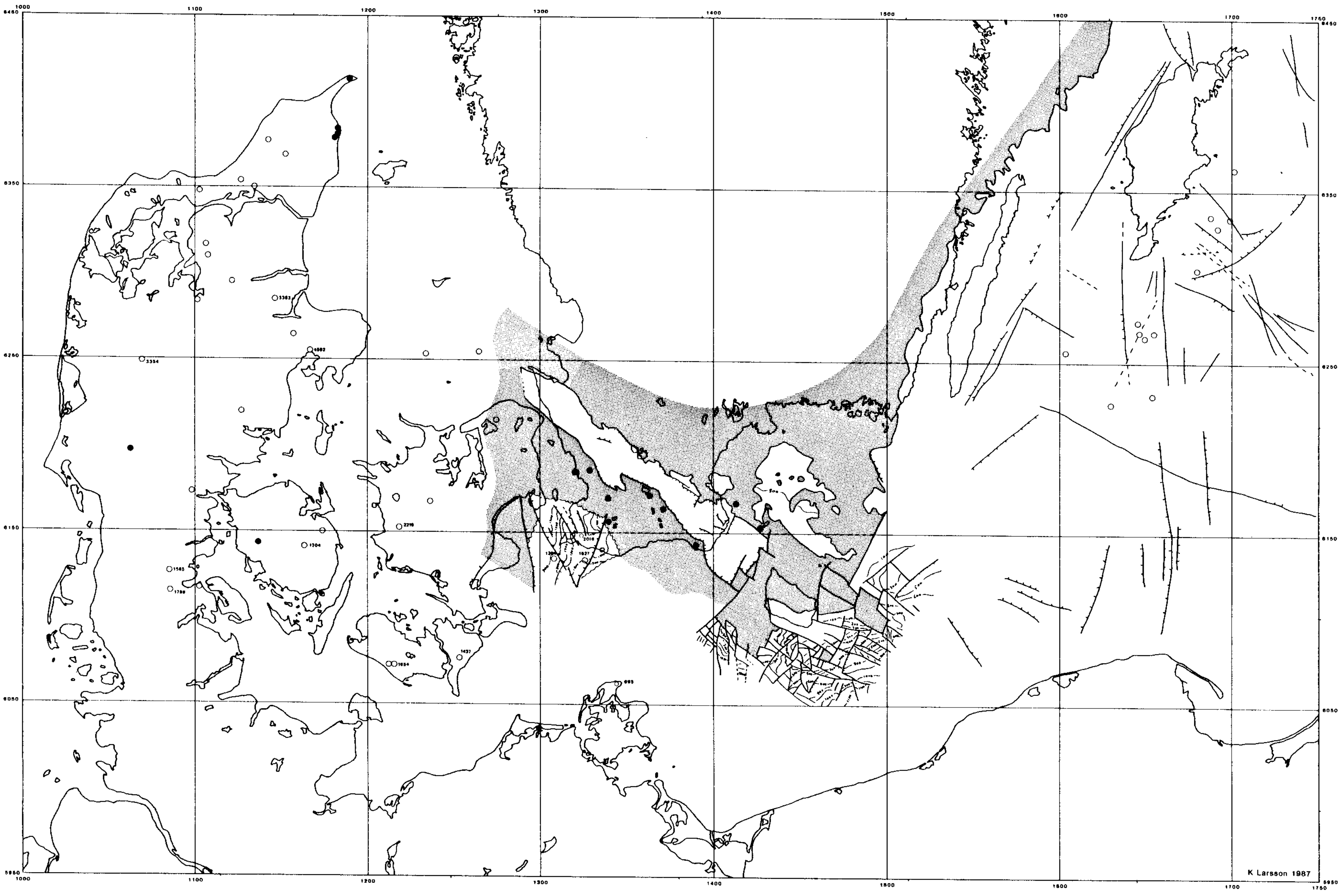
Paleozoikum saknas

Förkastning

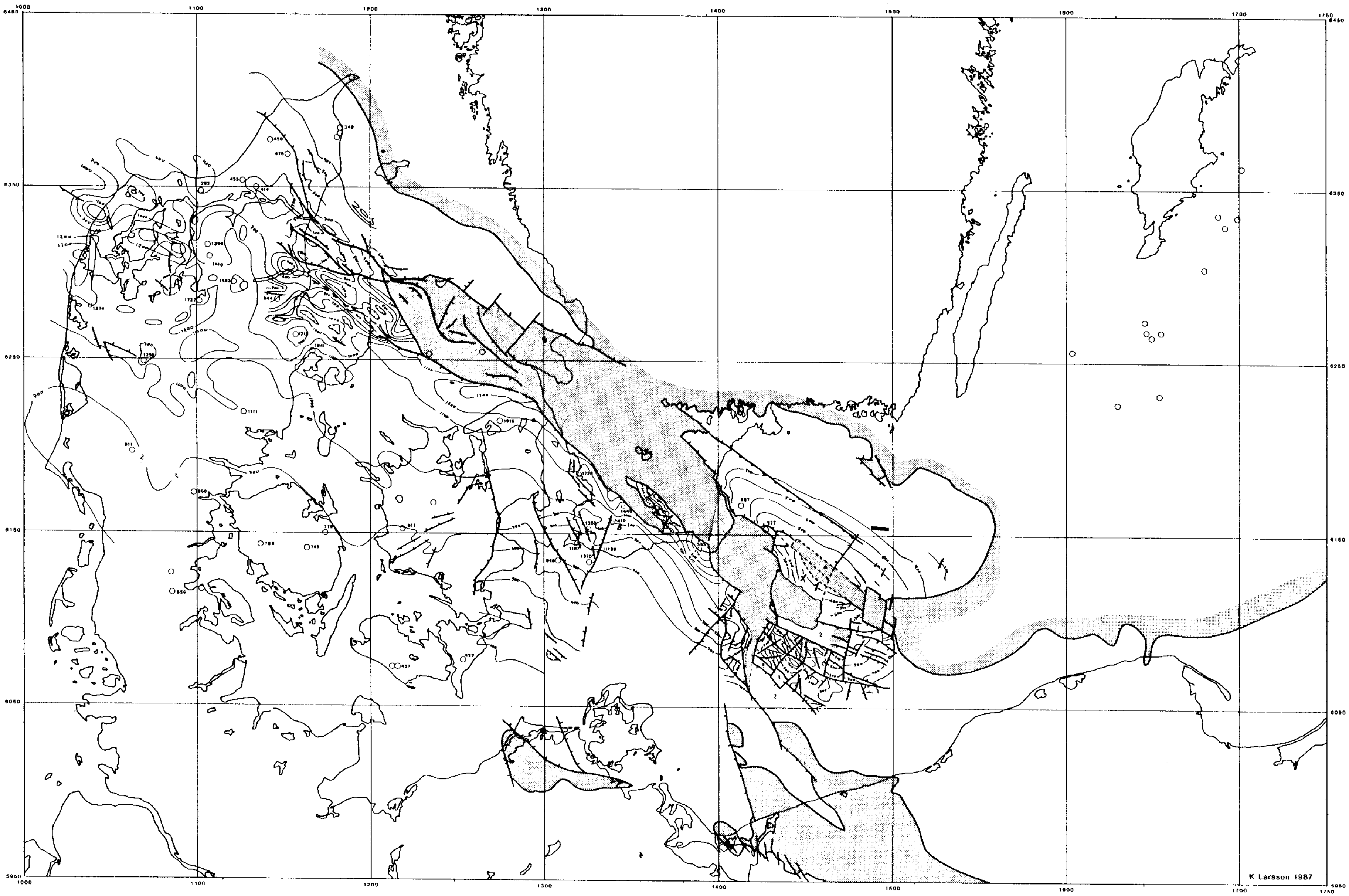
Isokron (ms twt)

Borrhål med paleozoikums överyta i meter u. h.y.

Borrhål utan paleozoiska lager



Pl. 31



STRUKTURKARTA

Skala: 1: 1 milj.

ÖVERKRITANS BAS

Konturintervall : 100 ms TWT

Datum: Havsytan

Överkrita saknas

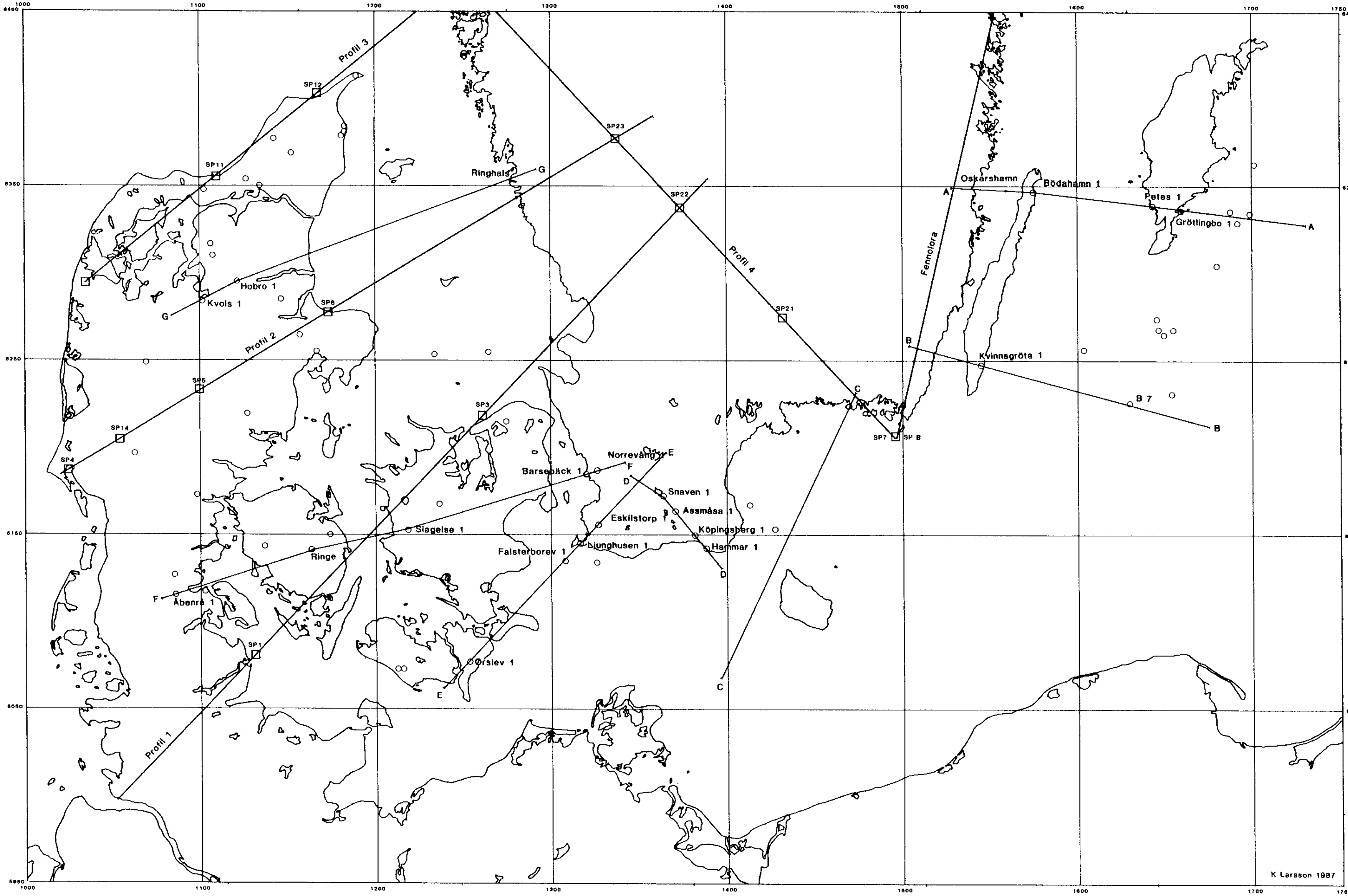
Förkastning

Flexur

Isokron (ms twt)

Borrhål med överkritans bas i meter u.h.y.

Pl. 32



LÄGESKARTA

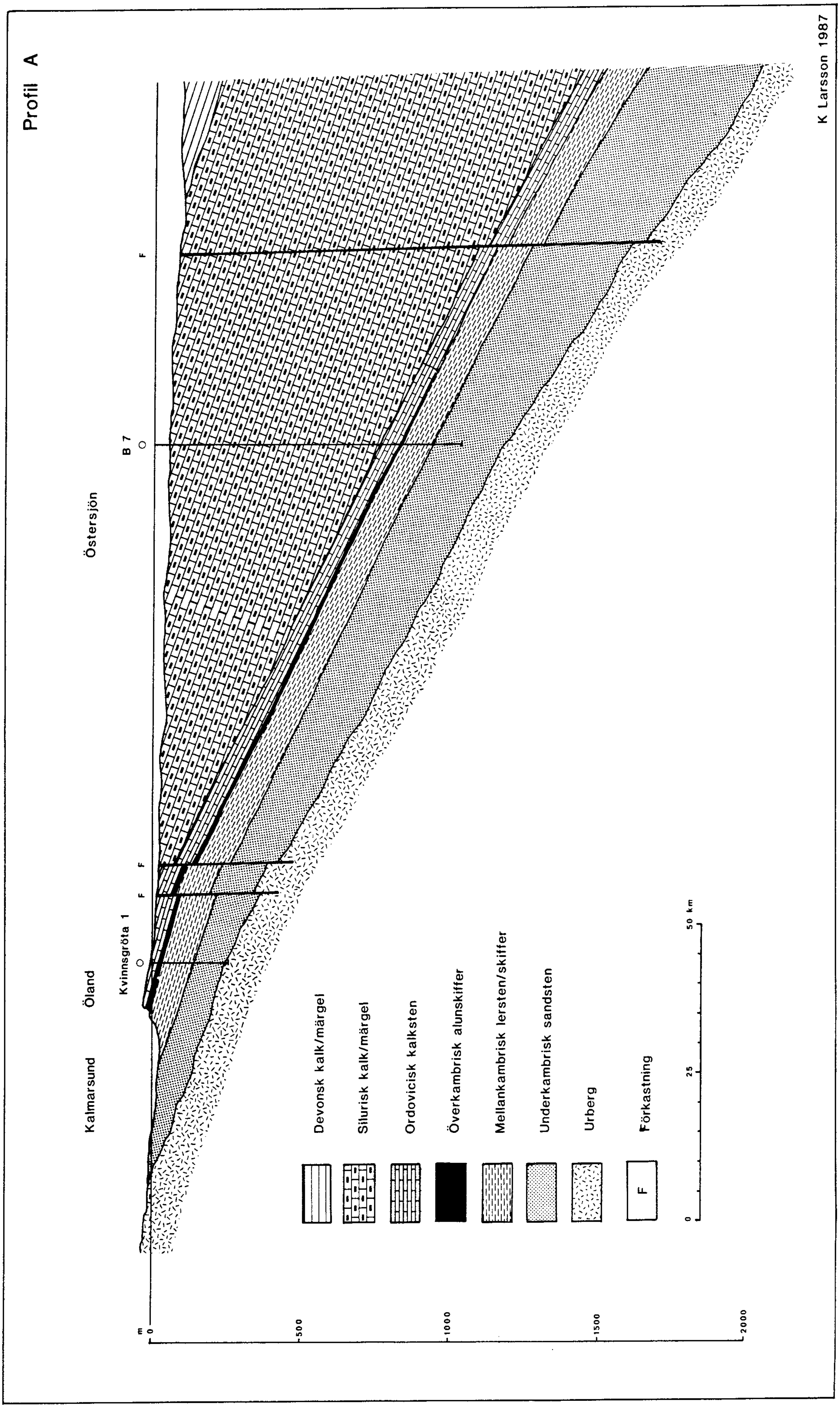
FÖR PROFILER

Skala 1: 1 milj.

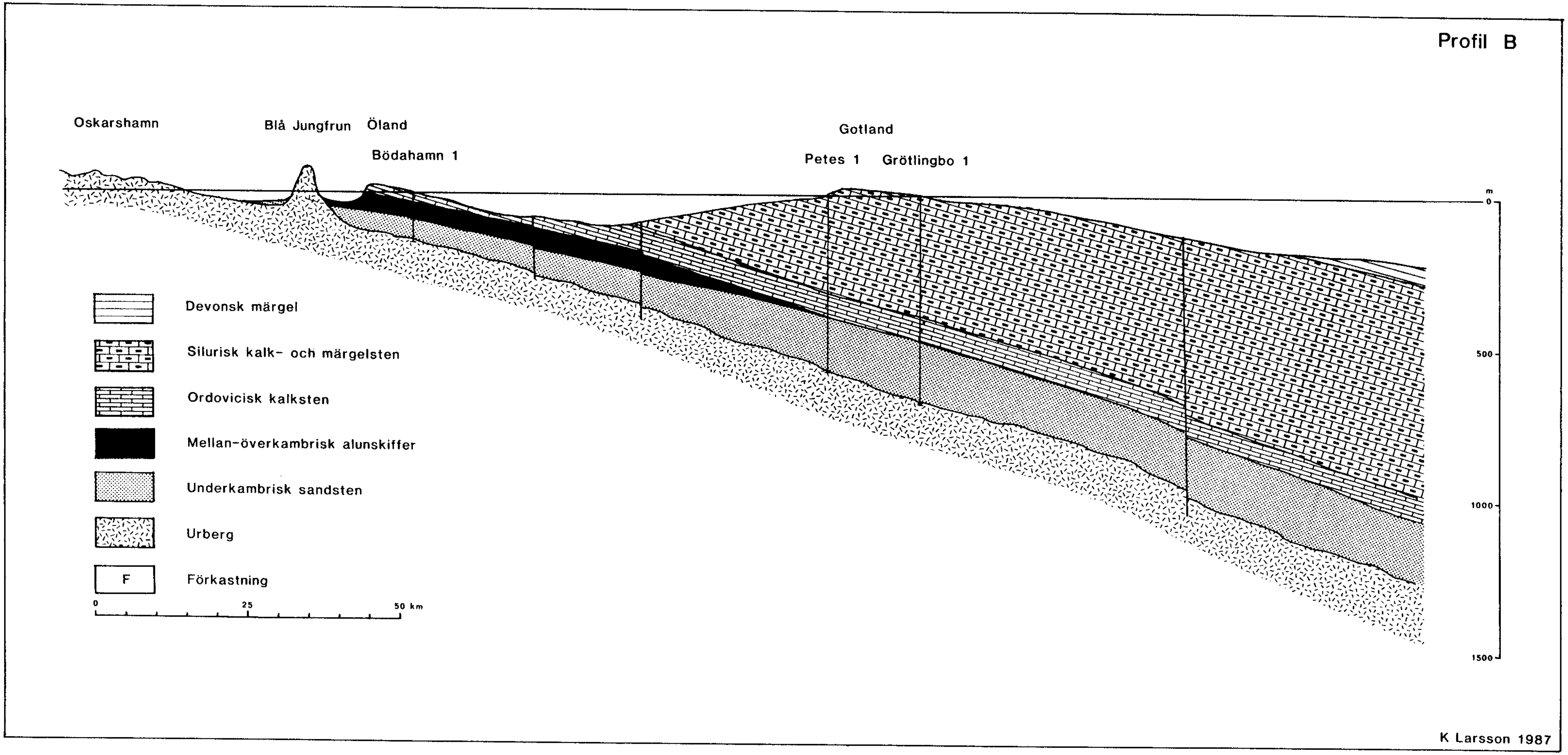
Profil 1-4	EUGENO-S
A - G	Profil A-G

Pl. 33

Pl. 34

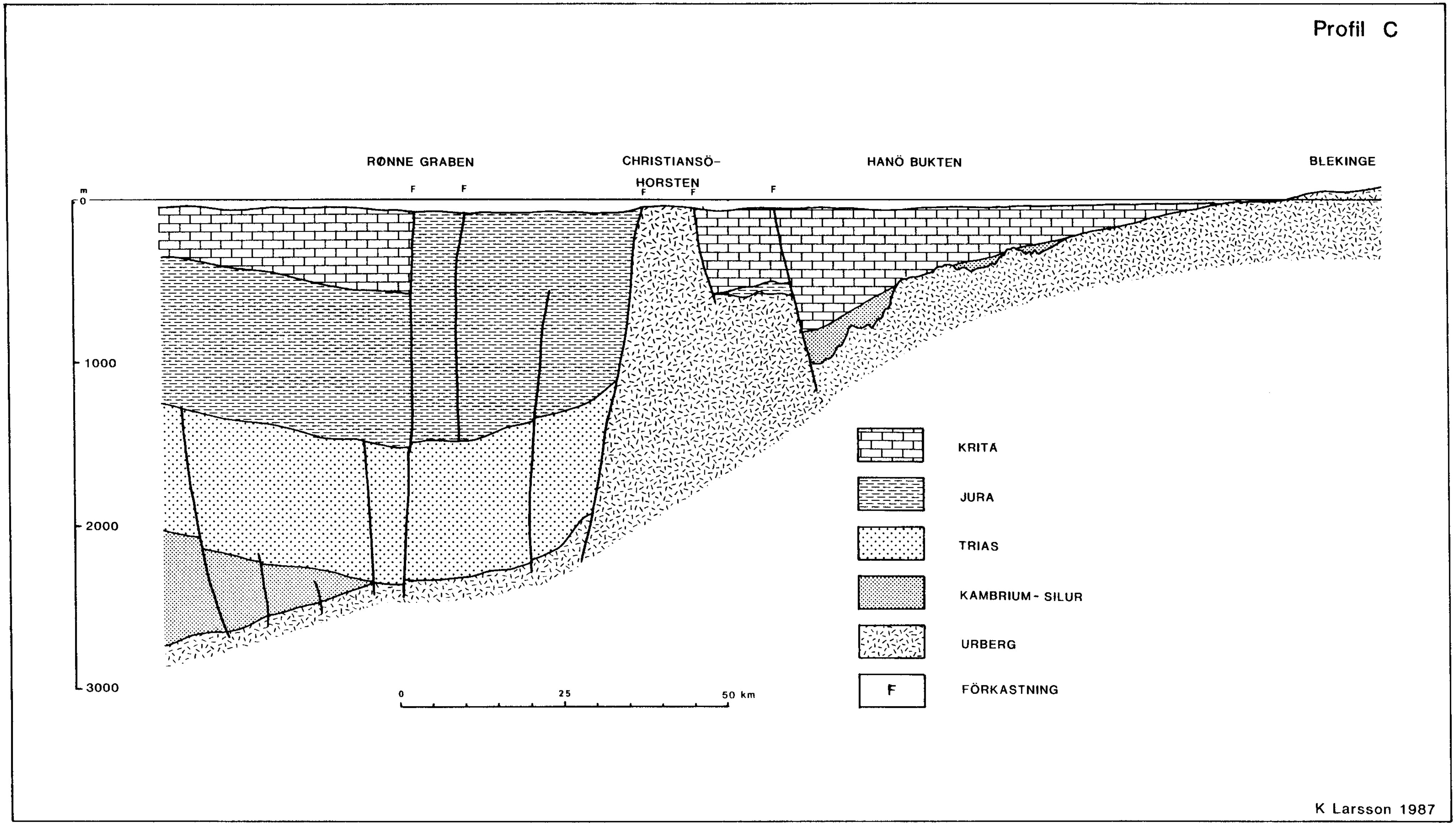


Profil A
K Larsson 1987
Kalmarsund
Öland
Kvinnsgröta 1
F
F
F
B 7
Östersjön
F
m
0
500
1000
1500
2000
Devonsk kalk/märgel
Silurisk kalk/märgel
Ordovicisk kalksten
Överkambrisk alunskiffer
Mellankambrisk lersten/skiffer
Underkambrisk sandsten
Urberg
F
Förkastning
0
25
50 km



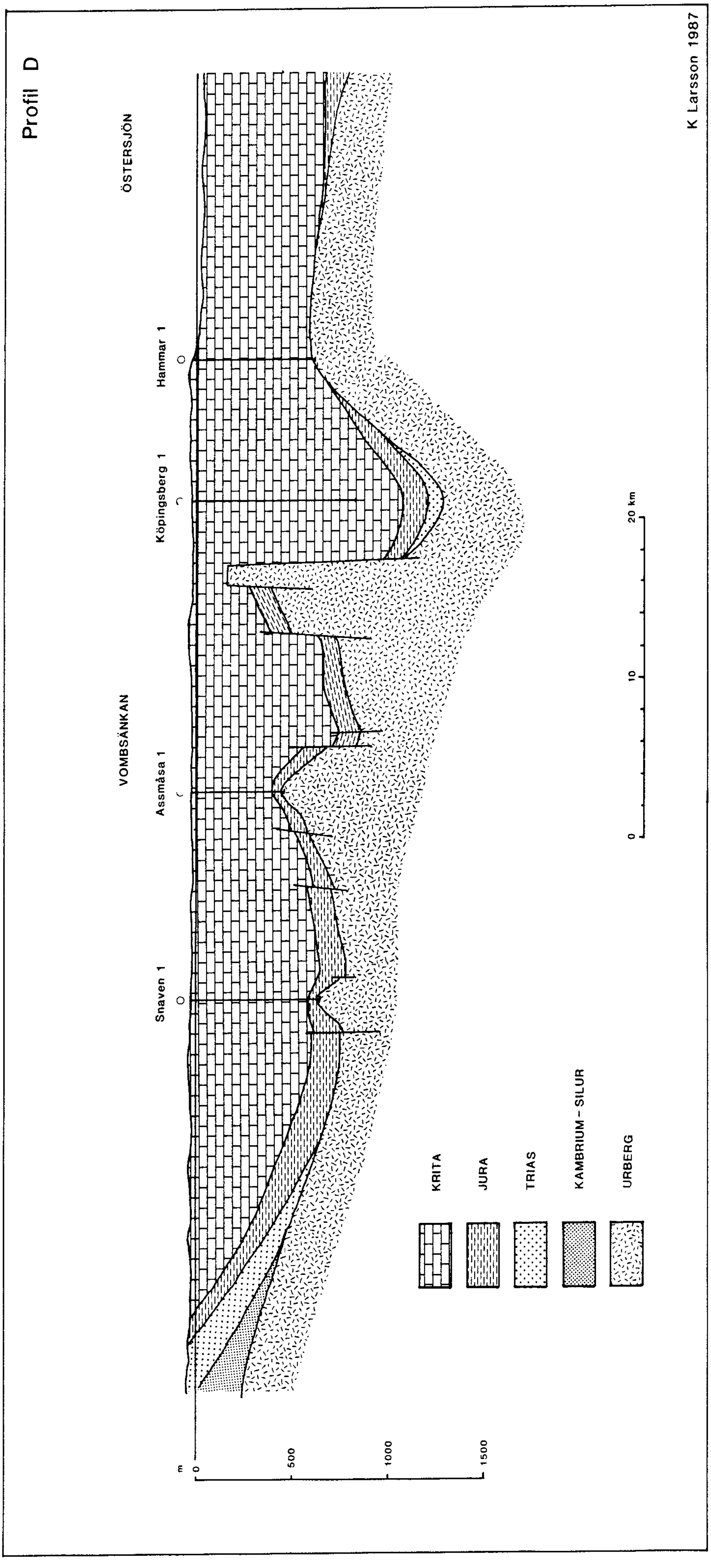
Profil B
Oskarshamn
Blå Jungfrun
Öland
Bödahamn 1
Gotland
Petes 1
Grötlingbo 1
m
0
500
1000
1500
Devonsk märgel
Silurisk kalk- och märgelsten
Ordovicisk kalksten
Mellan-överkambrisk alunskiffer
Underkambrisk sandsten
Urberg
F
Förkastning
0
25
50 km
K Larsson 1987

Pl. 35


Profil C
RØNNE GRABEN
CHRISTIANSÖ-
HORSTEN
HANÖ BUKTEN
BLEKINGE
F
F
F
F
F
m
0
1000
2000
3000
0
25
50 km
KRITA
JURA
TRIAS
KAMBRIUM - SILUR
URBERG
F
FÖRKASTNING
K Larsson 1987

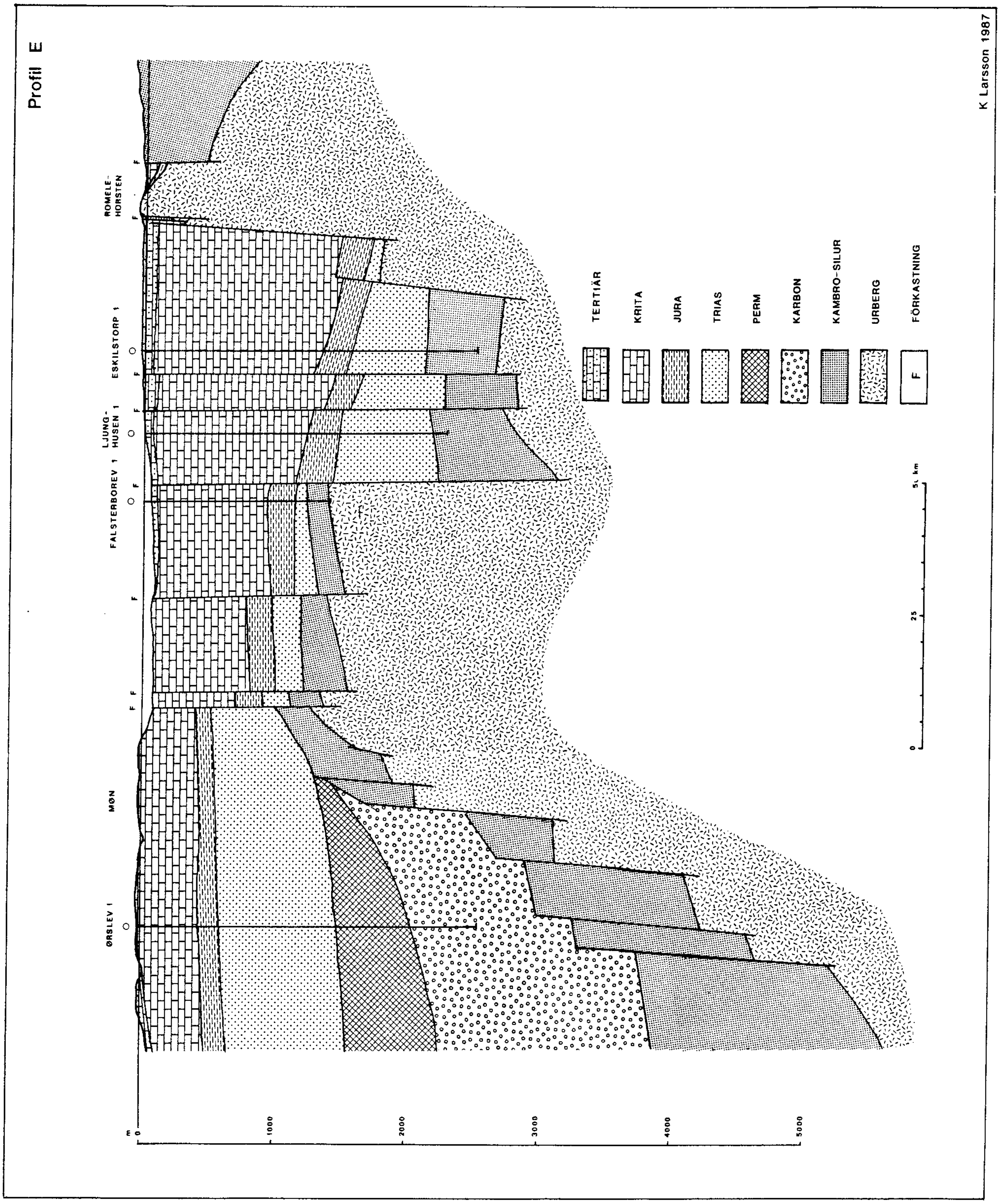
Pl. 36

Pl. 37

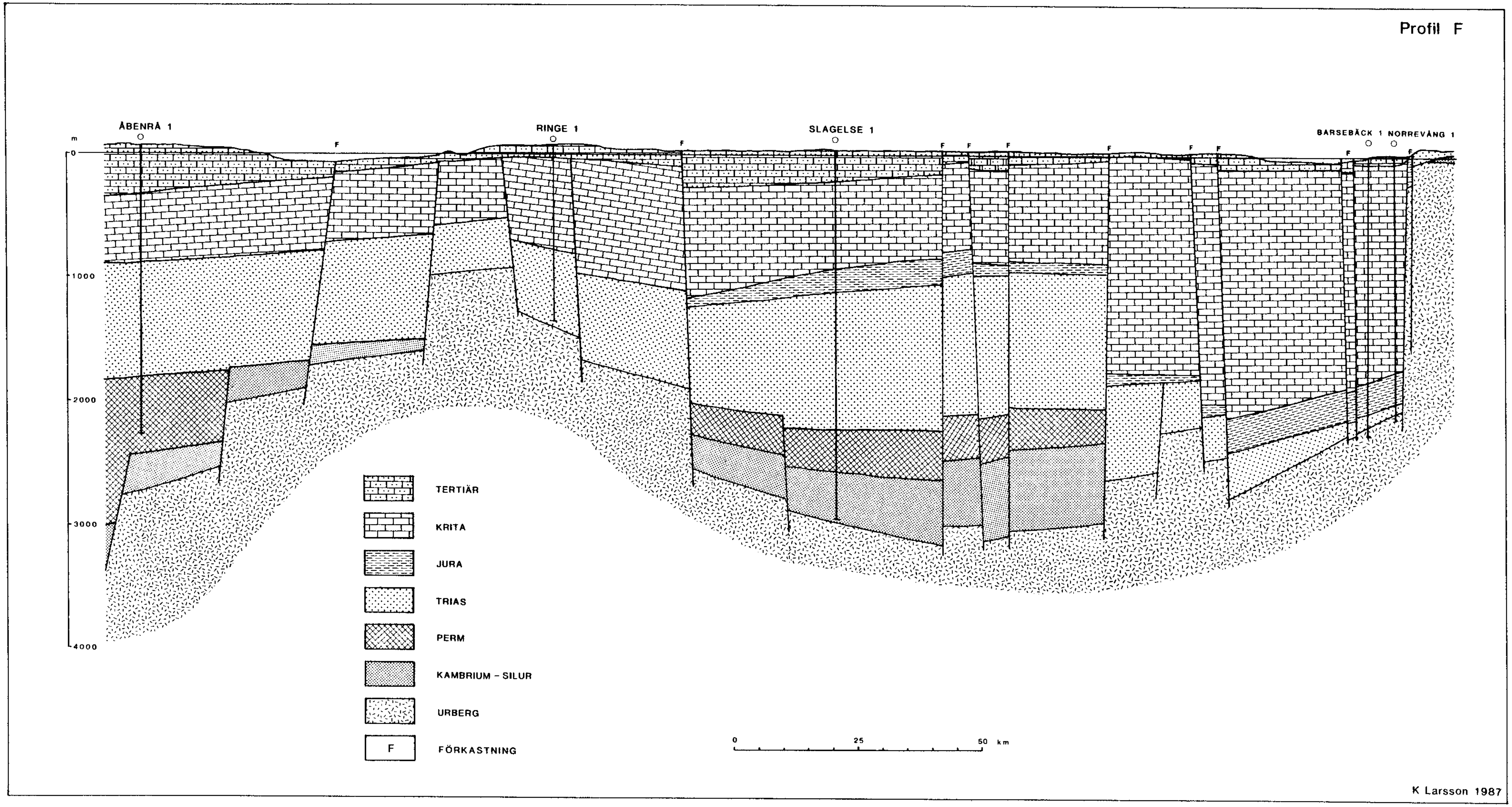


Profil D
K Larsson 1987
ÖSTERSJÖN
VOMBSÄNKAN
Hammar 1
Köpingsberg 1
Assmåsa 1
Snaven 1
KRITA
JURA
TRIAS
KAMBRIUM - SILUR
URBERG
0
10
20 km
m
0
500
1000
1500

Pl. 38

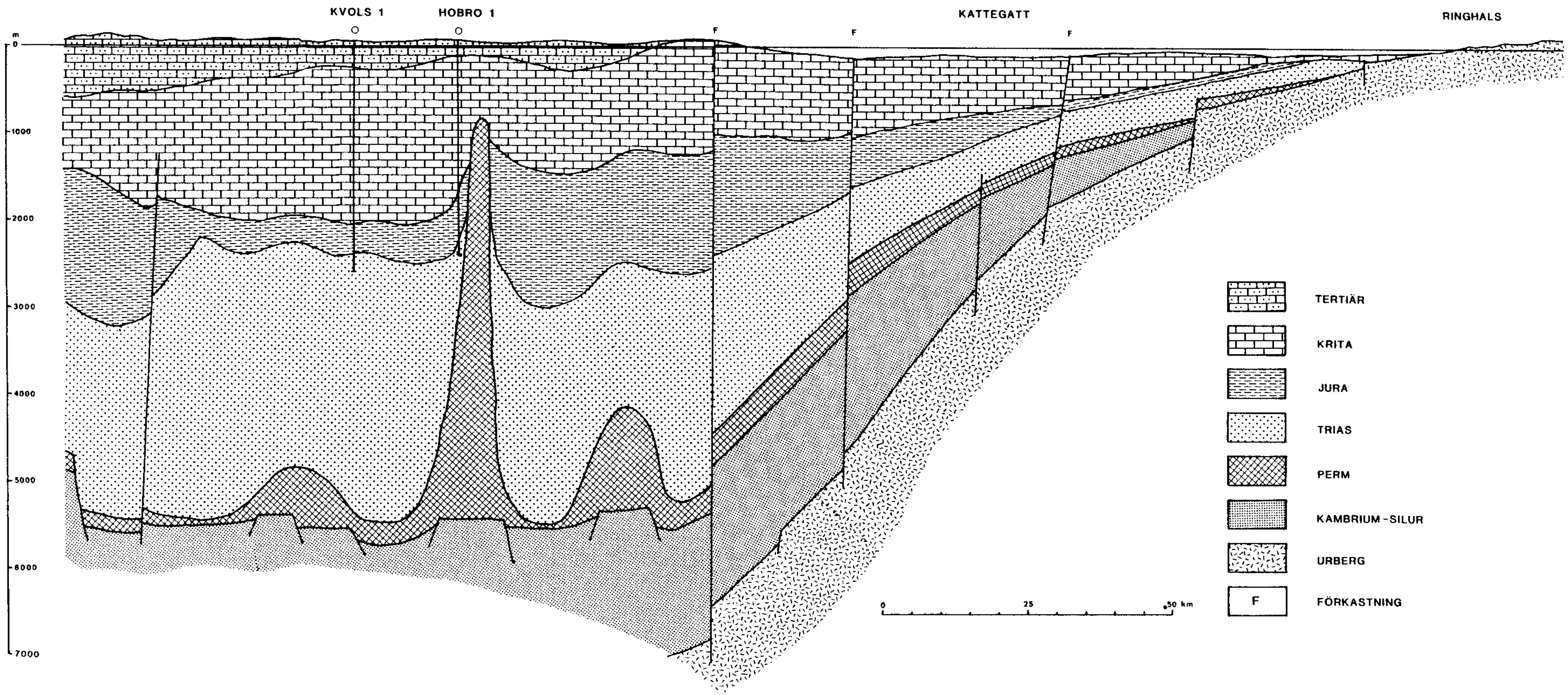


Profil E
K Larsson 1987
ØRSLEV 1
MØN
FALSTERBOREV 1
LJUNG-HUSEN 1
ESKILSTORP 1
ROMELE-HORSTEN
F
TERTIÄR
KRITA
JURA
TRIAS
PERM
KARBON
KAMBRO-SILUR
URBERG
FÖRKASTNING
m
0
1000
2000
3000
4000
5000
0
25


Profil F
ÅBENRÅ 1
RINGE 1
SLAGELSE 1
BARSEBÄCK 1
NORREVÅNG 1
m
0
1000
2000
3000
4000
F
TERTIÄR
KRITA
JURA
TRIAS
PERM
KAMBRIUM - SILUR
URBERG
FÖRKASTNING
0
25
50 km
K Larsson 1987

Pl. 39

Profil G

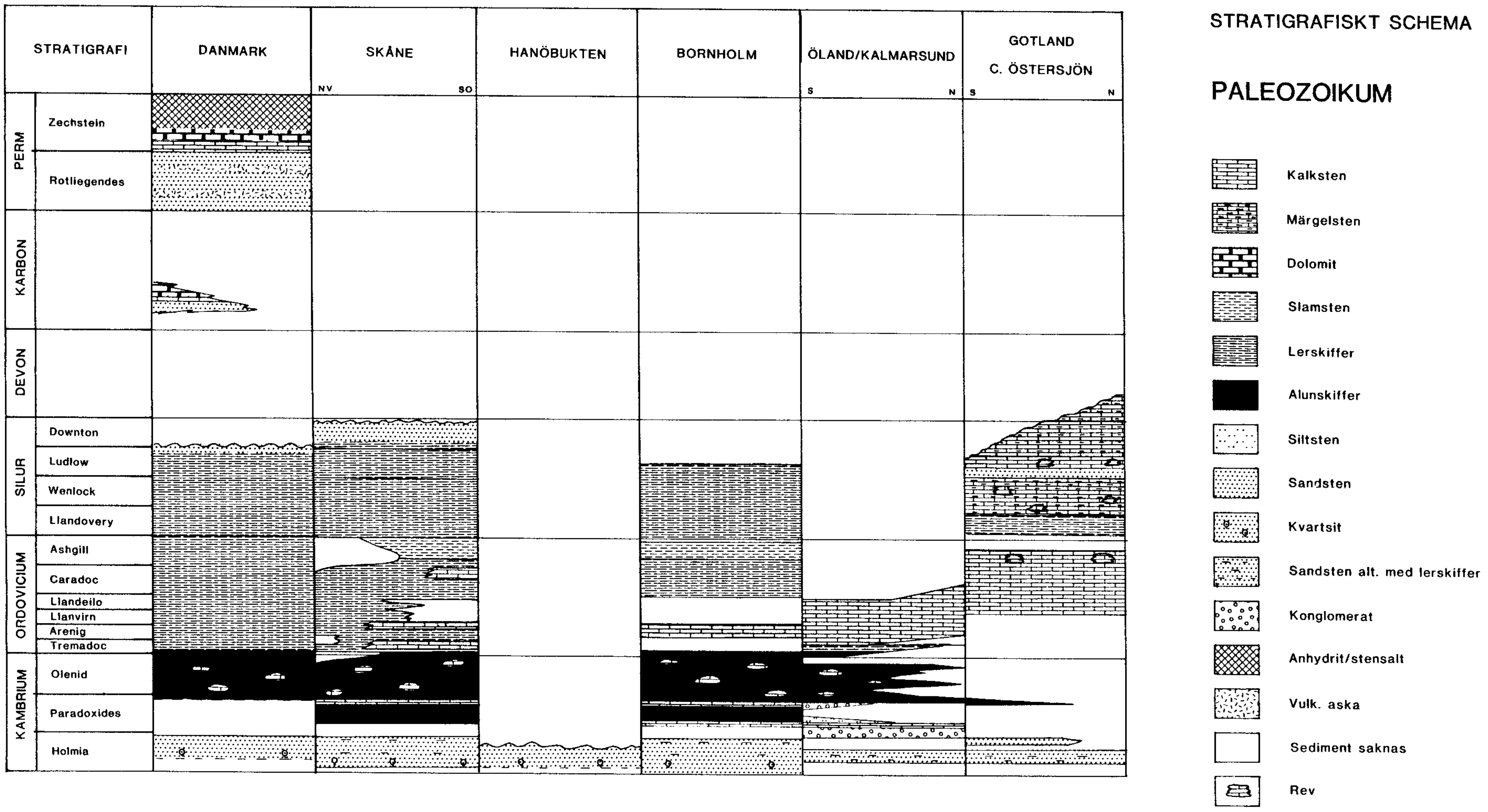


K Larsson 1987

Pl. 40

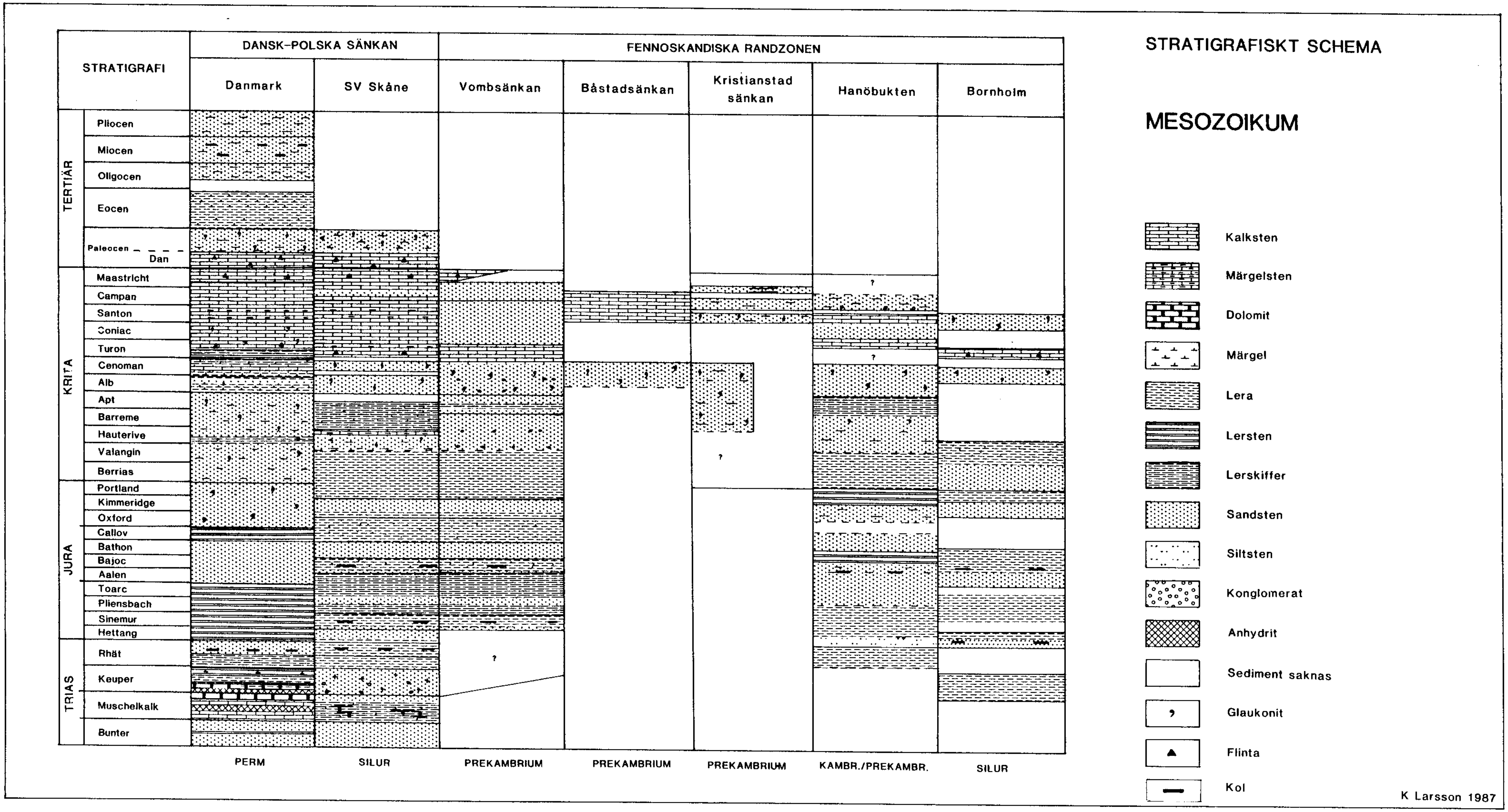
STRATIGRAFISKT SCHEMA

PALEOZOIKUM



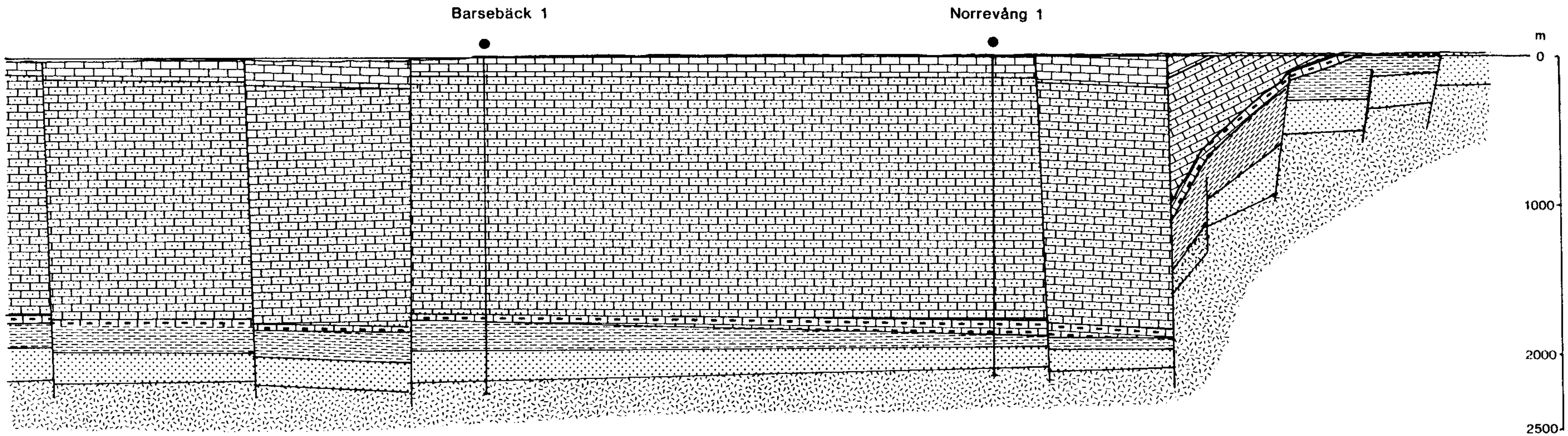
K Larsson 1987

Pl. 41


STRATIGRAFISKT SCHEMA
MESOZOIKUM
STRATIGRAFI
DANSK-POLSKA SÄNKAN
FENNOSKANDISKA RANDZONEN
Danmark
SV Skåne
Vombsänkan
Båstadsänkan
Kristianstad sänkan
Hanöbukten
Bornholm
TERTIÄR
Pliocen
Miocen
Oligocen
Eocen
Paleocen
Dan
KRITA
Maastricht
Campan
Santon
Coniac
Turon
Cenoman
Alb
Apt
Barreme
Hauterive
Valangin
Berrias
JURA
Portland
Kimmeridge
Oxford
Callov
Bathon
Bajoc
Aalen
Toarc
Pliensbach
Sinemur
Hettang
TRIAS
Rhät
Keuper
Muschelkalk
Bunter
PERM
SILUR
PREKAMBRIUM
PREKAMBRIUM
PREKAMBRIUM
KAMBR./PREKAMBR.
SILUR
Kalksten
Märgelsten
Dolomit
Märgel
Lera
Lersten
Lerskiffer
Sandsten
Siltsten
Konglomerat
Anhydrit
Sediment saknas
Glaukonit
Flinta
Kol
K Larsson 1987

Pl. 42

Profil H



TERTIÄR (Dan)
Kalksten m. flinta.

ÖVRE KRITA (Maastricht-Santon)
Skrivkrita m. flinta,lös och fast sandsten, kongl.,lersten.

UNDRE KRITA
Sand- och siltsten,lersten,skiffer.

JURA och ÖVRE TRIAS (Rhät)
Omväxl. leror,lerstenar,lerjärnsten, sand o. sandsten m. kol.

ÖVRE TRIAS (Keuper)
Arkosiska ,brokiga sandstenar,konglomerat.

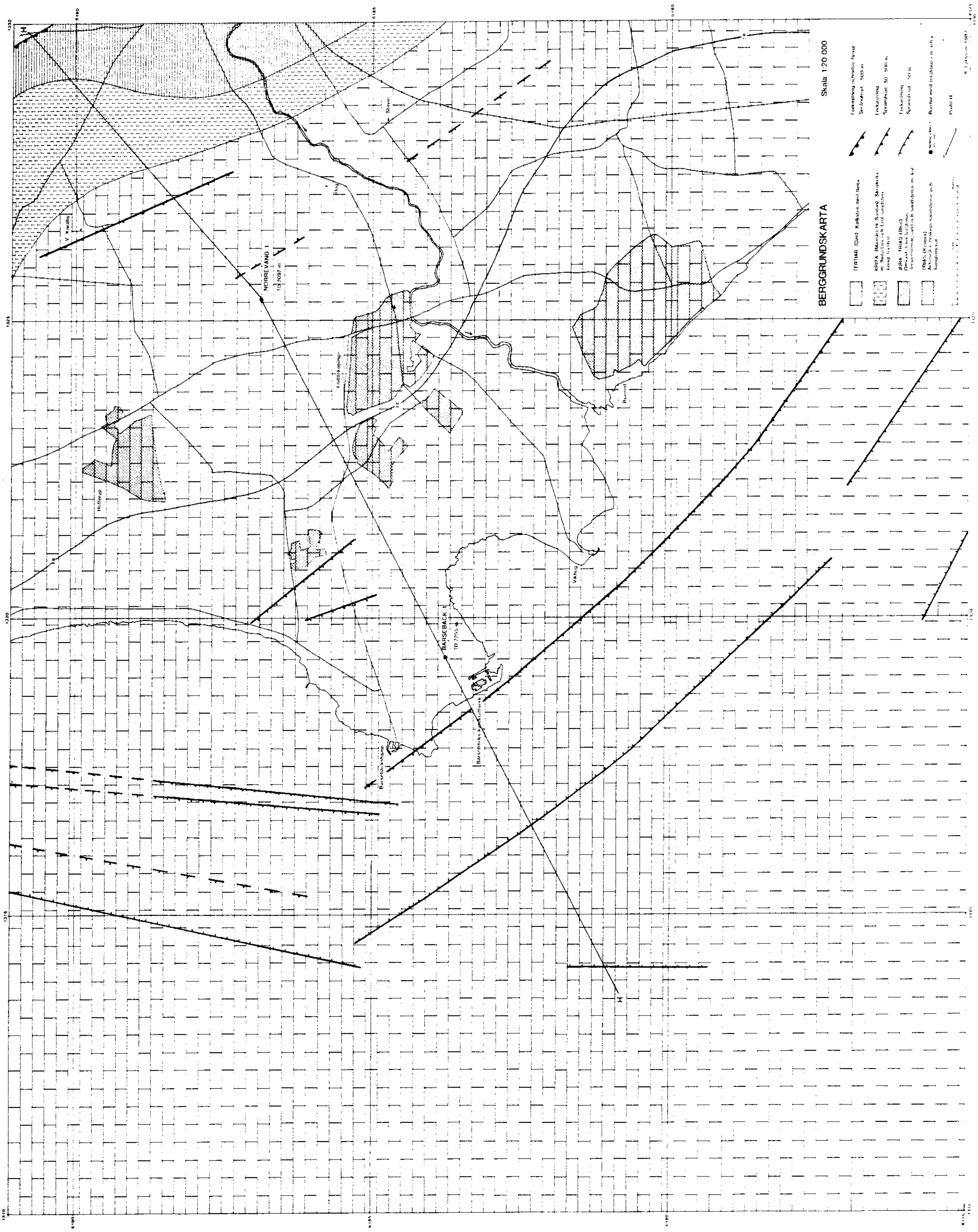
URBERG

0 1000 2000 m

K Larsson 1987

Pl. 43

Pl. 44



List of SKB reports

Annual Reports

1977–78
TR 121
KBS Technical Reports 1 – 120.
Summaries. Stockholm, May 1979.

1979
TR 79–28
The KBS Annual Report 1979.
KBS Technical Reports 79-01 – 79-27.
Summaries. Stockholm, March 1980.

1980
TR 80–26
The KBS Annual Report 1980.
KBS Technical Reports 80-01 – 80-25.
Summaries. Stockholm, March 1981.

1981
TR 81–17
The KBS Annual Report 1981.
KBS Technical Reports 81-01 – 81-16.
Summaries. Stockholm, April 1982.

1982
TR 82–28
The KBS Annual Report 1982.
KBS Technical Reports 82-01 – 82-27.
Summaries. Stockholm, July 1983.

1983
TR 83–77
The KBS Annual Report 1983.
KBS Technical Reports 83-01 – 83-76
Summaries. Stockholm, June 1984.

1984
TR 85–01
Annual Research and Development Report 1984
Including Summaries of Technical Reports Issued during 1984. (Technical Reports 84-01–84-19)
Stockholm June 1985.

1985
TR 85-20
Annual Research and Development Report 1985
Including Summaries of Technical Reports Issued during 1985. (Technical Reports 85-01-85-19)
Stockholm May 1986.

1986
TR86-31
SKB Annual Report 1986
Including Summaries of Technical Reports Issued during 1986
Stockholm, May 1987

Technical Reports

1987

TR 87-01
Radar measurements performed at the Klipperås study site
Seje Carlsten, Olle Olsson, Stefan Sehlstedt, Leif Stenberg
Swedish Geological Co, Uppsala/Luleå
February 1987

TR 87-02
Fuel rod D07/B15 from Ringhals 2 PWR: Source material for corrosion/leach tests in groundwater
Fuel rod/pellet characterization program part one
Roy Forsyth, Editor
Studsvik Energiteknik AB, Nyköping
March 1987

TR 87-03
Calculations on HYDROCOIN level 1 using the GWHRT flow model
Case 1 Transient flow of water from a borehole penetrating a confined aquifer
Case 3 Saturated-unsaturated flow through a layered sequence of sedimentary rocks
Case 4 Transient thermal convection in a saturated medium
Roger Thunvik, Royal Institute of Technology, Stockholm
March 1987

TR 87-04
Calculations on HYDROCOIN level 2, case 1 using the GWHRT flow model
Thermal convection and conduction around a field heat transfer experiment
Roger Thunvik
Royal Institute of Technology, Stockholm
March 1987

TR 87-05
Applications of stochastic models to solute transport in fractured rocks
Lynn W Gelhar
Massachusetts Institute of Technology
January 1987

TR 87-06
Some properties of a channeling model of fracture flow
Y W Tsang, C F Tsang, I Neretnieks
Royal Institute of Technology, Stockholm
December 1986

TR 87-07
Deep groundwater chemistry
Peter Wikberg, Karin Axelsen, Folke Fredlund
Royal Institute of Technology, Stockholm
June 1987

TR 87-08
An approach for evaluating the general and localized corrosion of carbon steel containers for nuclear waste disposal
GP March, KJ Taylor, SM Sharland, PW Tasker
Harwell Laboratory, Oxfordshire
June 1987

TR 87-09
Piping and erosion phenomena in soft clay gels
Roland Pusch, Mikael Erlström,
Lennart Börgesson
Swedish Geological Co, Lund
May 1987

TR 87-10
Outline of models of water and gas flow through smectite clay buffers
Roland Pusch, Harald Hökmark,
Lennart Börgesson
Swedish Geological Co, Lund
June 1987

TR 87-11
Modelling of crustal rock mechanics for radioactive waste storage in Fennoscandia—Problem definition
Ove Stephansson
University of Luleå
May 1987

TR 87-12
Study of groundwater colloids and their ability to transport radionuclides
Kåre Tjus* and Peter Wikberg**
*Institute for Surface Chemistry, Stockholm
**Royal Institute of Technology, Inorganic Chemistry Stockholm
March 1987

TR 87-13
Shallow reflection seismic investigation of fracture zones in the Finnsjö area method evaluation
Trine Dahl-Jensen
Jonas Lindgren
University of Uppsala, Department of Geophysics
June 1987

TR 87-14
Combined interpretation of geophysical, geological, hydrological and radar investigations in the boreholes ST1 and ST2 at the Saltsjötunnel
Jan-Erik Andersson
Per Andersson
Seje Carlsten
Lars Falk
Olle Olsson
Allan Stråhle
Swedish Geological Co, Uppsala
1987-06-30

TR 87-15
Geochemical interpretation of groundwaters from Finnsjön, Sweden
Ignasi Puigdomènech[1]
Kirk Nordstrom[2]
[1]Royal Institute of Technology, Stockholm
[2]U S Geological Survey, Menlo Park, California
August 23, 1987

TR 87-16
Corrosion tests on spent PWR fuel in synthetic groundwater
R S Forsyth[1] and L O Werme[2]
[1]Studsvik Energiteknik AB, Nyköping, Sweden
[2]The Swedish Nuclear Fuel and Waste Management Co (SKB), Stockholm, Sweden
Stockholm, September 1987

TR 87-17
The July — September 1986 Skövde aftershock sequence
Conny Holmqvist
Rutger Wahlström
Seismological Department, Uppsala University
August 1987

TR 87-18
Calculation of gas migration in fractured rock
Roger Thunvik[1] and Carol Braester[2]
[1]Royal Institute of Technology
Stockholm, Sweden
[2]Israel Institute of Technology
Haifa, Israel
September 1987

TR 87-19

Calculation of gas migration in fractured rock – a continuum approach

Carol Braester[1] and Roger Thunvik[2]
[1]Israel Institute of Technology
Haifa, Israel
[2]Royal Institute of Technology
Stockholm, Sweden
September 1987

TR 87-20

Stability fields of smectites and illites as a function of temperature and chemical composition

Y Tardy, J Duplay and B Fritz
Centre de Sédimentologie et de Géochimie de la Surface (CNRS)
Institut de Géologie Université Louis Pasteur (ULP)
1 rue Blessig, F-67084 Strasbourg, France
April 1987

TR 87-21

Hydrochemical investigations in crystalline bedrock in relation to exesting hydraulic conditions: Klipperås test-site, Småland, Southern Sweden

John Smellie[1]
Nils-Åke Larsson[1]
Peter Wikberg[3]
Ignasi Puigdomènech[4]
Eva-Lena Tullborg[2]
[1]Swedisch Geological Company, Uppsala
[2]Swedisch Geological Company, Göteborg
[3]Royal Institute of Technology, Stockholm
[4]Studsvik Energiteknik AB, Nyköping
September 1987

TR 87-22

Radionuclide sorption on granitic drill core material

Trygve E Eriksen and Birgitta Locklund
The Royal Institute of Technology
Department of Nuclear Chemistry
Stockholm
November 1987

TR 87-23

Radionuclide co-precipitation

Jordi Bruno and Amaia Sandino
The Royal Institute of Technology
Department of Inorganic Chemistry
Stockholm
December 1987