NGU Report 97.100

Instructions for the systematisation of geological data and compilation of the registration form for the Ore Data Base.

NGU
Norges geologiske undersøkelse
Geological Survey of Norway

Geological Survey of Norway
P.O.Box 3006 - Lade
N-7002 Trondheim, Norway
Tel.: 47 73 90 40 11
Telefax 47 73 92 16 20

REPORT

Report no.: 97.100	ISSN 0800-3416	Grading: Open

Title:
Instructions for the systematisation of geological data and compilation of the registration form for the Ore Data Base.

Authors: Peter M. Ihlen, Leif Furuhaug, Peter Padget and Jan Sverre Sandstad		Client: NGU	
County:		Commune:	
Map-sheet name (M=1:250.000)		Map-sheet no. and -name (M=1:50.000)	
Deposit name and grid-reference:		Number of pages: 60 Price (NOK): 350,- Map enclosures:	
Fieldwork carried out:	Date of report: 17.06.1997	Project no.: 2702.00	Person responsible: Morten Often

Summary:

This report provides guidance for systematisation of geological data from the individual deposits to be stored in the Ore Data Base. This is built on NGUs former data base FORIBA (i.e. ore deposits registered in the Mineral Deposit Archive at NGU) which contained deposit numbers given by Foslie and Paulsen.

The instruction is derived from the screen pictures to the database, and describes all fields which can be filled out. Options are given for most of the fields. These option lists are to be updated as texts and explanations are improved during the work with the database. Therefore new editions of this report will come whenever it is considered necessary. This is 2nd edition. The first edition was published in May 1993 and was at that time written as a common instruction for the Ore-, Industrial mineral- og Natural Stone database.

In order to get the database as unanimous as possible, it is necessary that all who are collecting data strictly follow these instructions. It is of special importance that one is aware of the fields which have option lists, because it is only options from these lists which can be stored in the database.

Keywords: Ore geology	Ore deposit	Data base
Instruction	Scientific report	

CONTENTS

FIGURES

APPENDIX

1. BACKGROUND AND PURPOSE

Data concerning Norway's ore deposits are distributed in various publications, reports and maps (the NGU series and "Bergarkivet"), as well as with individual ore geologists. The data are very different in regards to quality and type. The need for more consistent information about the deposits of the country has been expressed by NGU's own staff, prospecting companies and county administrations. The increasing number of analyses of samples taken from the deposits has created a need for systematisation. Collectively, the data bases concerning Norway´s ores, industrial minerals and natural stones will increase our knowledge about them as well as improving the possibility of evaluating their economic potential and creating new ideas for further exploration. The data bases should therefore be of help to both scientists, prospectors, areal planners and public.

The subject data base, the Ore Register, was first assembled by Harald Karlstrøm in the ore section at NGU. The data base has been further developed by the Data Service Group at NGU (Morland 1993) in association with the Mineral Resource Group, and lately a Windows-based version has been developed. It is based on reviews given by Foslie (1925) and Poulsen (1958) and on the data base FORIBA (Ore deposits in the Mineral Deposit Archive at NGU). The data in the latter base are mainly taken from old and inaccurate maps. The occurrences must therefore be re-examined and their co-ordinates determined correctly. In addition, much more detailed information is required than is present in the old reports.

The data base contains basic geological and technical information for each deposit. In addition, detailed information regarding the mineralisation is obtainable on different displays. One of the major changes in this new version of the data base, apart from adapting a new standard for identification numbering, is that detailed information also can be given for localities/minor prospects associated an ore deposit. The professional groups have determined, after internal discussions, what type information that should be included. In addition, it is possible to include, as free text, important information about the deposit or locality/minor prospect which is not suitable for display screens but which helps to link up the tabular reviews.

This report provides guidance for systematisation of the data concerning the deposits. It is a revised edition of an earlier report (Furuhaug 1993).

The data base is connected to the reference archives at NGU. It is arranged in tabular reviews which in the future can be connected to other subject data bases at NGU.

When constructing the data base importance was placed on user-friendliness so that the addition of data is simple and can be performed without special data knowledge. The addition

of data is not time consuming if geologists have already systematised the data.
Geologists must do this themselves rather than engage less qualified extra personnel.

Out of consideration for foreign prospecting companies in Norway and NGU's activities abroad a need for an English language version has become evident. Therefore, all information which is registered is open and must be written in English. Option list exists for most of the entries both in Norwegian and English. Only the free text and rock and sample descriptions had to be written in both languages to make the data base bi-linguistic. A discussion is in progress regarding how much of the data base should be accessible for the public, for example on Internet. So far the principle has been that the data base should not contain restricted information.

1.1 Quality control

The purpose of subject data bases like this is to store information homogeneously, that is to say the entries are the same for all deposits. This is often difficult as the data are assembled by many different persons who do not necessarily comprehend everything in the same way or emphasise the same features. Regardless how respected and able the persons are who assemble the data there are many entries which will be understood differently or even misunderstood. **It is therefore absolutely necessary to achieve a good result, that this guidance be carefully read and followed when entering data.**

Even though forms (e.g. appendix 1) are completed conscientiously, faults and omissions will occur which are difficult to detect and the data entered will always reflect the capacity of the person who has done the job.

All data should therefore be controlled to ensure acceptable quality before being sent to interested users. The project leader is responsible for this at all times. There are of course limits to how careful this can be done. Field observations (co-ordinates, minerals, rocks etc.) must be accepted as entered and hence are the responsibility of the recorder. The person responsible for the quality must concentrate on the following:

1. That enough field observations have been made
2. That information in the different displays is not contradictory but probable
3. That the free text is understandable and contains the items mentioned in chapter 2.10

Quality control is most easily performed by reading quickly through the tables and then concentrating on the free text. Make sure that the free text gives a clear picture of the deposit, especially regarding the type, mineralogy, morphology, size and orientation. All data covered by chapters 2.2-2.7 in the tabular reviews should be mentioned and put together in a rational way. If a locality/minor prospect is described in the free text its number or name should be given and **not its co-ordinates**. Make especially sure that the co-ordinates for the main deposit are not repeated. It is also possible and recommended to give localities/minor prospects their separate free text.

Even though quality control is limited to office work it is a big job which the project leader alone cannot manage. The whole working group must make contributions to keep it up to date. If the quality controller in charge considers the data inadequate or incorrect they should be returned to the recorder for revision.

2. CONTENTS OF THE DATA BASE

The remaining part of the report will deal with the data which must be registered for a deposit in the course of field work. The procedure for entering and searching and how the data base functions technically will be described later.

New field report forms for the data base are being made, the last version of these forms are shown in appendix 1 (Norwegian edition). These **are filled in for each deposit as soon as possible** after the investigation. The forms will have the same headings as the displays. In order that the data base shall function as planned it is very important that the data introduced are uniform, that is to say, that all persons concerned with collecting data comprehend the different headings in the same way. **Everyone who fills in the forms must therefore read the instructions for each heading closely and follow them.**

Options exist for many of the headings which shall be filled in. These are as comprehensive as possible and cover the needs which so far (time of printing) have emerged but there is a constant need to add new ones. To avoid anarchic tendencies, the project leader is responsible for approving, updating and maintaining order in these options. The need for new options should be submitted in writing to the project leader. If, in the course of a year, changes occur, this report will be updated before the field season so that all persons surveying deposits in the field can collect data and fill in the forms in a correct manner.

NB! In cases where options exist, only these can be entered into the data base. It is therefore very important that those concerned with filling in the forms are informed about the options and follow them.

In the following, each sub-chapter corresponds to a heading in the forms and a display in the data base. The figures (Fig. 1, 2, 21-27) are copied from the screen.

2.1 General information

General information about identification numbers, location, type, investigations and the registration is included. When registering the data in the data base, this display also contain the links to the other displays where detailed information is entered.

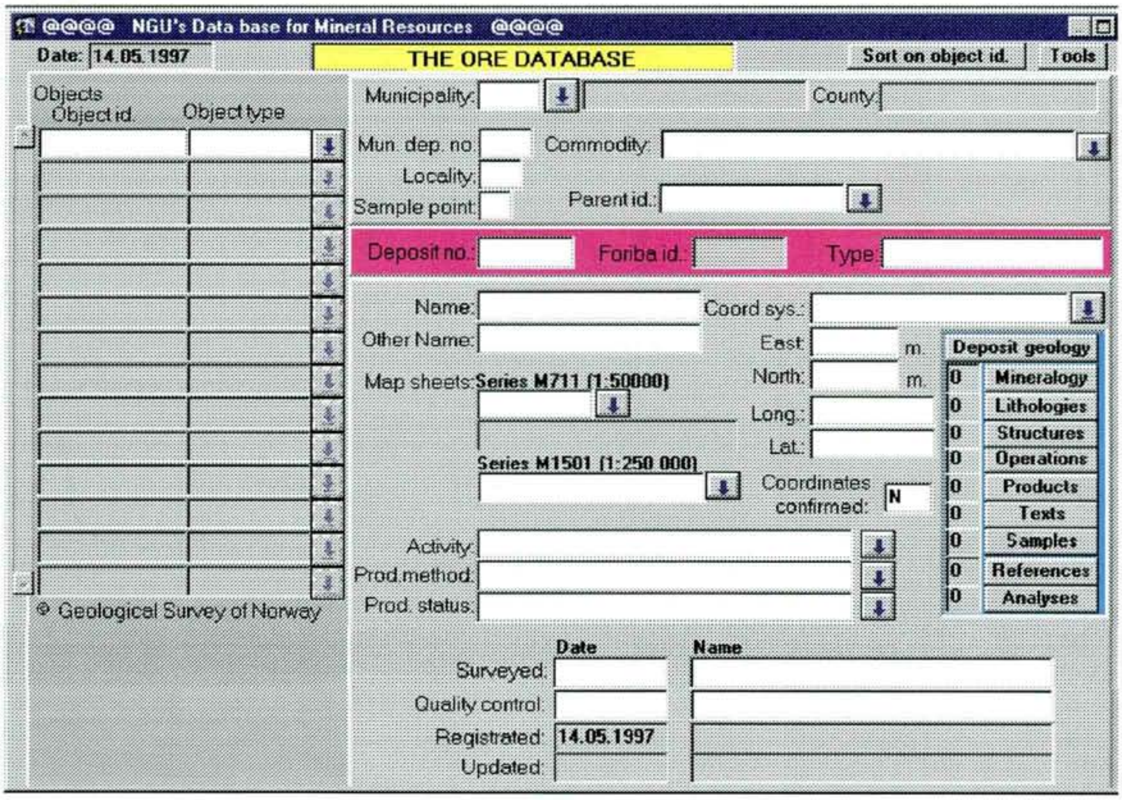

Figure 1. General information.

Objects

Object id.

This is a registration number with 11 digits according to the standard SOSI-format applied at NGU for all the databases of mineral resources. It is comprised of four sets of digits (e.g. 1601,012,02,01). The first four digits are the number of the municipality (e.g. Trondheim 1601) hosting the deposit, the next three digits are the deposit number within the municipality (e.g. deposit number 12), the next two digits are a locality number within a deposit or represent a minor prospect of similar type as the main deposit, and the last two digits are the number of a sample point associated either with an ore deposit or locality/minor prospect. This registration number is automatically filled in from other fields in this first screen.

Object type

Four types of objects can be registered.

OPTIONS:

```
Area with Ore Deposits
Ore Deposit
Locality/minor prospect
Sample point
```

Area with ore deposits: This first option give the opportunity to assemble ore deposits within an ore province. Only Free text and References can be added to this object type.
Ore deposit: The option for the main ore deposits.
Locality/minor prospect: Many smaller prospects often occur in the neighbourhood of larger deposits. If they are of the same type and are connected to the described deposit they should be recorded here and ***not*** **described as a separate ore deposit. Drill hole and shaft/adit opening** of the deposit to be shown here. Additional detailed information, including *Free text* can be added to this object, except details under the heading *Deposit geology (Ch. 2.2).*
Sample point: A sample point is always linked to a deposit or locality/minor prospect but do not necessarily have the same co-ordinates. This option is used for registration of **sample points which have other co-ordinates than the ore deposit or locality/minor prospect**. Several samples may have the same sample point. Further description for registration of samples is given in chapter 2.11.

Municipality

Number of relevant municipality. The name of the relevant municipality is automatically listed as well as the name of the county in the same record.

Municipality deposit number

Deposit number in the municipality. It is automatically given the lowest number not in use if other deposits have been recorded in the same municipality earlier. If not, you write 1 here.

Locality

If the registration is a locality or a minor prospect associated with an ore deposit (see object type) it is automatically given the lowest number not in use.

Sample point

If the registration is a sample either within a deposit or locality/minor prospect, it is automatically given the lowest number not in use.

County

Name and number (in parentheses) of the county where the deposit is situated.

Parent id.

This number consists of the 11 digits as the object id. For a locality/minor prospect the number refers to the number of the deposit it is associated with. For a sample point the number refers to the number of the deposit or locality/minor prospect it is associated with. The number is filled in automatically.

Commodity

The different deposit *types* (see below) are grouped in commodities. This is useful in different search operations and in plots.

OPTIONS:

```
Precious metals (Au, Ag, PGE)
Ferrous metals (Fe, Mn, Ti)
Ferroalloys (Cr, Ni, Co, V, Mo, W)
Base metals (Cu, Zn, Pb, Fe sulphides, As, Sb, Bi, Sn)
Energy metals (U,Th)
Special metals (Nb, Ta, Be, Li, Sc, REE)
Other metals
```

Deposit no.

The registration number of the deposit has two letters and four digits. The two letters indicate the county and the four digits the consecutive number of the deposit. The counties have the following letters:

ØS: Østfold	TE: Telemark	ST: Sør-Trøndelag
AK: Akershus	AA: Aust-Agder	NT: Nord-Trøndelag
OS: Oslo	VA: Vest-Agder	NO: Nordland
HE: Hedmark	RO: Rogaland	TR: Troms
OP: Oppland	HO: Hordaland	FI: Finnmark
BU: Buskerud	SF: Sogn og Fjordane	SV: Svalbard
VE: Vestfold	MR: Møre og Romsdal	KO: Kola

Examples : TR0007 denotes deposit number 7 located in Troms county, and
NT0124 denotes deposit number 124 in Nord-Trøndelag.

Foriba id.:

The registration number of the deposit in FORIBA (see also chapter 1.1). This is kept for references to old reports and maps.

Type

All elements, economically speaking, must be stated here, the most important first. For example, *Cu Zn Pb* where *Cu* is the dominant element and *Zn* and *Pb* also occur but in lesser amounts. It is also necessary to register occurrences of pyrite and/or pyrrhotite in massive sulphide deposits even though these are not currently of economic value. The word Fe-sulphide is written here. The need to use this word is because pyrite/pyrrhotite constitute the main bulk of the ore minerals in these deposits. The metals to be listed must of course be determined according to which are considered the most important from an economic point of view. Generally speaking, however, metals which exceed 0.1% in ore samples should be included. In the case of noble metals the lower limits are as follows: 1g/t for Au, 1g/t for PGE and 100g/t for Ag, and preferentially when values in two or more samples exceed these levels.

Name

This is the name most commonly used for the deposit. The same name **cannot** be used for several deposits which are described separately. In cases where the deposit is relatively insignificant and nameless, the name closest to the deposit on the 1:50000 map is used. Alternatively, a name in use can be chosen even though this particular name is not shown on the topographic map.

Other name

Many deposits have several names. Only one name in addition to the most usual name can be registered her. This must **not** be the name of an insignificant prospect registered under the deposit in question. Such names should be registered under "Locality/Minor Prospect".

Co-ordinate system

The correct UTM-zone (is written on the 1:50 000 maps) and datum have to be registered.

OPTIONS:

```
UTM-Zone 31 - EUREF89/WGS84        UTM-Zone 31 - ED50
UTM-Zone 32 - EUREF89/WGS84        UTM-Zone 32 - ED50
UTM-Zone 33 - EUREF89/WGS84        UTM-Zone 33 - ED50
UTM-Zone 34 - EUREF89/WGS84        UTM-Zone 34 - ED50
UTM-Zone 35 - EUREF89/WGS84        UTM-Zone 35 - ED50
UTM-Zone 36 - EUREF89/WGS84        UTM-Zone 36 - ED50
```

Until now all co-ordinates registered at NGU are based on the datum ED50, but:
NB! After 1st of January 1997 all co-ordinates must be based on EUREF89/ WGS84.
The Mapping Authority (Statens Kartverk) has for some years produced maps based on a new datum (EUREF89/WGS84) which represent a more accurate projection. A consequence of this is that the UTM-net **(printed in blue on new maps)** is somewhat displaced in relation to the situation on **older maps where the UTM-net is printed in black** (ED50). The whole

country is now covered with these new maps, and it therefore is decided that all co-ordinates registered after 1st of January 1997 shall be based on the EUREF89/WGS84 datum. At the same date all earlier registered co-ordinates in ED50 datum are to be converted (not implemented at the time of printing of this report) so all co-ordinates registered in our databases are uniform and referring to the same datum. **It is important that everyone who are registering co-ordinates are aware of the different projections and are concentrated when doing this work, otherwise there easily will be much disorder.**

East and North

The co-ordinates are shown in meters, 6 digits for east and 7 for north co-ordinates. The degree of precision which can be achieved is dependent on orientation ability and the scale of the map. GPS readings are to be preferred in areas with difficulties of orientation and few topographic markers. The main rule must be that all persons surveying deposits must be sure as regards position and must record the co-ordinates as exactly as possible. All other data about a deposit are useless if the co-ordinates are incorrectly recorded so that the deposit can no longer be found. If the deposit is located in an open pit of significant size or a large mineralised outcrop the co-ordinates recorded are for the centre of the open pit or the **centre of the outcrop.**

Longitude and Latitude

We are here given the opportunity to register the location of the object in degrees, minutes and seconds. This must be done in areas where maps with UTM co-ordinates are not available, until now actual at Kola. If we in the future are going to register deposits at Svalbard, we also have to use this system. The UTM co-ordinates for all the objects will be transformed to this uniform co-ordinate system to be used i.e. in production of maps.

Co-ordinates confirmed

Yes means that the deposit has been found and the co-ordinates confirmed. If a deposit cannot be found it can nevertheless be desirable to keep it in the data base (The NGU's Mineral Deposit Archive and old registration maps) but one must here write **No**. Further information is obviously not relevant for registration of such a deposit **but one writes in the free text that an attempt was made to survey the deposit, without result.** Indicate also the time used in the search and the extent of the area searched by place names or co-ordinates of the outermost points.

Map sheets: Series M711 (1:50 000) and Series M1501 (1:250 000)

Name and number and name of relevant maps, respectively.

Activity
The activity level in a deposit are to be described here.

OPTIONS:

```
Exploration
Pitting (incl. trenching and shallow excavation)
Test mining
Mining
```

Production status
Shall give information about the deposit's production at the time of registration.

OPTIONS:

```
Disused, closed
Not yet active
Periodically active
Active
```

Production method
Used for deposits in current or former production.

OPTIONS:

```
Underground mining
Open pit mining
Open pit and underground mining
```

Surveyed
This shows the date of surveying and the person responsible. In cases where the deposit has been surveyed several times the survey which has supplied the most important information should be recorded.

Quality control
This heading is filled in when the data entered have been subjected to a quality check and approved.

Registered
This is not filled in the field but when the information is fed into the data base.

Updated
If there is done any changes after registration, date and name are automatically registered.

2.2 Deposit geology

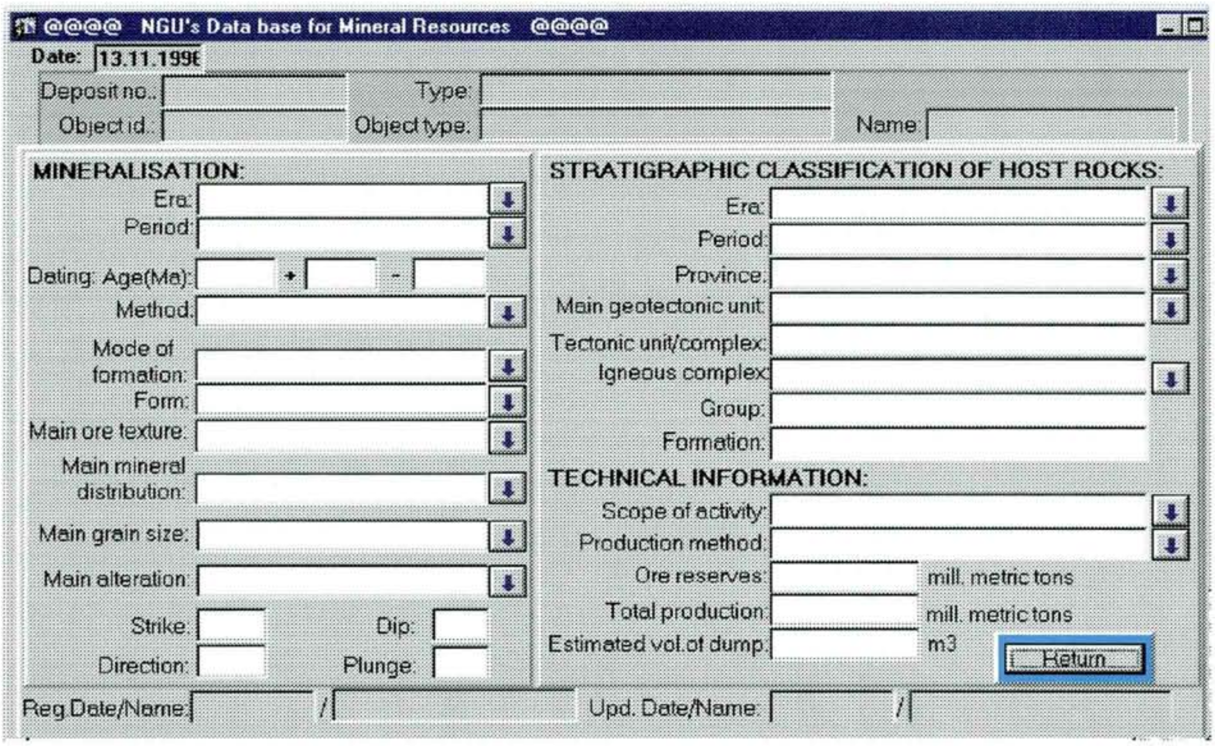

Figure 2. Description of mineralisation, stratigraphic classification of host rock and technical information.

The two first headings show the presumed age of the deposit. The first title: 'Era' will in most cases be easy to fill in but 'Period' can be more difficult. In cases where the period is determined the era is obvious and both titles should be filled in. Here it is important that the person filling in the form keeps to approved ages, if not it should be left open. **When the data are to be recorded in the data base there is no room for other ages than those shown below.** The geologic timescale is compiled by Gradstein & Ogg (1996).

Era

OPTIONS:

Cenozoic	0 - 65
Mesozoic	65 - 248
Paleozoic	248 - 545
Proterozoic	545 - 2500
Archean	2500 - 4000

Period

OPTIONS:

Quaternary	0 - 1.8
Tertiary	1.8 - 65
Cretaceous	65 - 142
Jurassic	142 - 206
Triassic	206 - 248
Permian	248 - 290
Carboniferous	290 - 354
Devonian	354 - 417
Silurian	417 - 443
Ordovician	443 - 495
Cambrian	495 - 545
Neoproterozoic	545 -1000
Mesoproterozoic	1000 -1600
Paleoproterozoic	1600 -2500
Archean	2500 -4000

Dating, Age (Ma) and Method

If the deposit has been age dated radiometrically the exact age (in mill. years) and method should be indicated. In addition a reference to a publication/source where the age determination is described must be cited under 'references'(2.12.). Even if this heading is filled in the two previous headings must also be filled in (for possible search reasons). Option list for age dating method is listed.

OPTIONS:

Ar40/Ar39	Pb/Pb
Fission Track	Rb/Sr
K/Ar	Sm/Nd
Marker fossils	U/Pb
Os/Re	U/Th

Mode of formation

OPTIONS:

Chemical sediment	Pegmatite formation
Clastic sediment	Porphyry-type
Collapse breccia	Replacement/Metasomatism
Diagenetic formation	Sedex
Hydrothermal breccia	Shear zone formation
Hydrothermal vein	Skarn formation
Intrusive breccia/diatreme	Stockwork formation
Metamorphic formation	Unknown
Orthomagmatic formation	Volcex

Form

Assumed form of mineralisation.

OPTIONS:

```
Cigar                                Lens
Cone (e.g. stringer zone)            Pipe (e.g. intrusive breccia)
Irregular                            Plate
Layer                                Ruler
```

Main ore texture

Many different textures can be present in one and the same deposit. The most dominant and typical ore texture should be recorded so as to avoid going down to the ore type level in the description of the deposit. If other types exist mention should be made of these in the free text.

OPTIONS:

```
                                     Fracture filling
Banded                               Pore space filling
Breccia cement                       Porphyroblastic
Cataclastic                          Structureless
Cavity filling                       Vein network
Foliated
```

Main mineral distribution

Same comments as for ore texture.

OPTIONS:

```
Massive (>50 % ore minerals)
Semi-massive (20-50 % ore minerals)
Disseminated (<20 % ore minerals; scattered, even distribution in rock)
Irregular (scattered, uneven distribution in rock)
```

Main grain size

Same comments as for ore texture.

OPTIONS:

```
Fine grained   (< 1 mm)
Medium grained (1-3 mm)
Coarse grained (> 3 mm)
Very unevenly grained
```

Main alteration

Means wall rock alteration. Otherwise same comments as for ore texture.

OPTIONS:

```
None                                    K-silicate alteration
Adularia alteration                     Monomineralic alteration
Albitisation                            Muscovitisation
Biotitisation                           Others
Calc-silicate alteration                Phyllic alteration
Carbonate alteration                    Propylitic alteration
Carbonatisation                         Pyritisation
Chloritisation                          Scapolitisation
Clay alteration                         Sericitisation
Epidotisation                           Silicification
Greisen (Li,-B-and/or F-rich            Skarn formation
minerals)                               Topaz alteration
K-feldspar alteration                   Tourmalinisation
```

Strike and Dip

The strike of the ore body is defined as the direction it has when the ore dips to the right. For example, if the direction is east/west the strike will be 90 degrees if the ore body falls to the south and 270 degrees if it dips to the north. 360° scale to be used.

Direction and Plunge

This is to be filled in if the ore body has a known axis. 360° scale to be used.

2.3 Stratigraphic classification of host rock

The host rock(s) of the deposit should here be placed in the stratigraphic or tectono-stratigraphic units the country rocks are subdivided into. The two first headings indicate the formation age of the lithological unit in which the deposit occurs. The possibilities of classification are the same as described for chapter 2.2. Mineralisation.

Era

OPTIONS:

Cenozoic	0 - 65
Mesozoic	65 - 248
Paleozoic	248 - 545
Proterozoic	545 - 2500
Archean	2500 - 4000

Period

OPTIONS:

Quaternary	0 - 1.8
Tertiary	1.8 - 65
Cretaceous	65 - 142
Jurassic	142 - 206
Triassic	206 - 248
Permian	248 - 290
Carboniferous	290 - 354
Devonian	354 - 417
Silurian	417 - 443
Ordovician	443 - 495
Cambrian	495 - 545
Neoproterozoic	545 -1000
Mesoproterozoic	1000 -1600
Paleoproterozoic	1600 -2500
Archean	2500 -4000

In many areas the age of the deposit and its host rock is very different from the age of the enclosing wall and country rocks. This situation is often encountered among deposits hosted by igneous dykes and intrusive bodies like some of the Permian vein deposits which are hosted by diabase dykes in the Kongsberg area. Many geologists would have classified these as part of the Oslo Region (province) and the Kongsberg Block (main geotectonic unit according to recent subdivision of the Oslo Paleorift). This classification would not be useful if the vein deposit instead was hosted by the Proterozoic gneisses. Then the host rock would be part of the South Norwegian basement province and the Kongsberg Complex (main geotectonic unit).

To avoid confusion and to make searches easier as well as facilitate the communication with other data bases at NGU in the future, Norway's bedrocks containing ore deposits are divided into several formal and *informal* (italicised in the options) provinces and principal geotectonic units. One important principal for a simple stratigraphic classification is that the host rocks can only be part of one unit at the different levels of the stratigraphic hierarchy which is independent of the age of the ore deposits. The host rocks are classified according to their location in relation to the subdivision depicted in Fig. 3-20 and options given for the two uppermost units in the stratigraphic hierarchy.

Alluvial gold deposits and bog ores of iron and manganese occur in Quaternary sediments which are not subdivided into provinces, principal units etc. Such deposits are cited only as Cenozoic (under Era) and Quaternary (under Period) in the stratigraphic classification.

Province

The options below indicate the provinces which Norwegian bedrock is divided into, formally or *informally* (see Fig. 3-4). The basement provinces include dominantly Archean to Mesoproterozoic rocks. Those rocks which are affected by the Caledonian activity or occurring inside horsts, tectonic windows and nappes in the Caledonian belt are classified as part of the Caledonian Basement Province. The only exception is the crystalline basement exposed in the lowland below the nappes in the Ryfylke-Hardangervidda area, i.e. south-east of the Hardangerfjord. It is regarded as part of the South Norwegian Basement Province. The Barents Sea Region is a province composed mainly of Neoproterozoic sedimentary rocks deformed during the Baikalian orogeny. The Caledonian province or the Caledonides comprise rocks deformed under the Caledonian orogeny including the Devonian Old Red Sandstone basins and the autochthonous sedimentary rocks of the *Platform Supergroup* outside the Oslo Region. The Oslo Region include Permian sedimentary and igneous rocks inside the central graben system as well as Early Paleozoic rocks in the immediately surrounding areas. The latter rocks are included to avoid confusion since a high number of Permian deposits occur in the contact zone between Permian granites and Early Paleozoic sedimentary rocks and frequently in both.

OPTIONS:

Oslo Region
Caledonides
Barents Sea Region
Caledonian Basement Province
East Norwegian Basement Province
South Norwegian Basement Province
Troms-Finnmark Basement Province

a)

b)

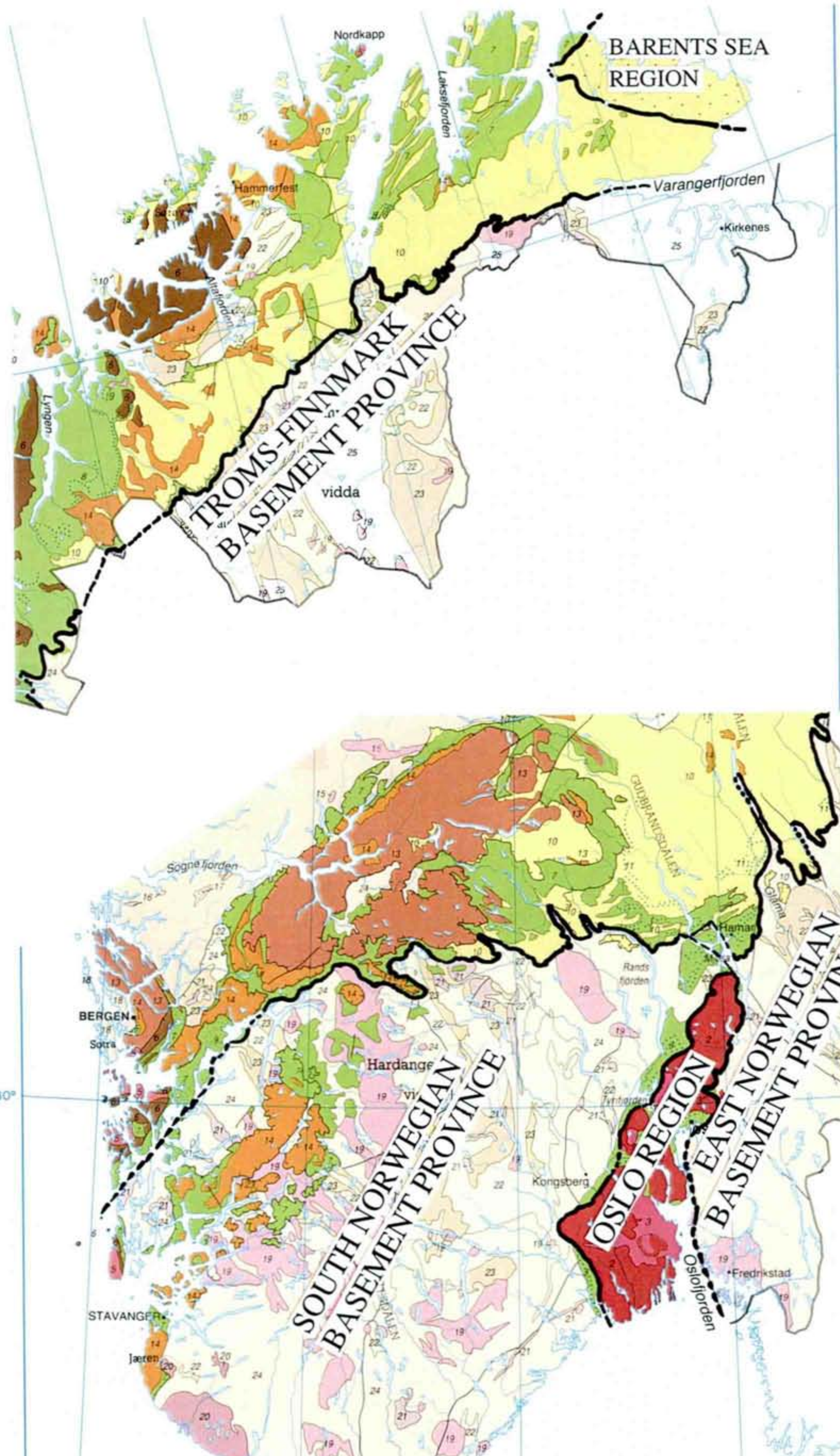

Figure 3. Provinces a) in Troms and Finnmark and b) in South Norway, except the Caledonides and the Caledonian Basement Province.

Main geotectonic unit

The Norwegian bedrock can be divided into a number of regional main units of tectonic (nappe complexes) or lithological/stratigraphic nature (principal complexes/supergroups). The main geotectonic units which are defined for use in the data base are shown on the maps of the counties (Figs. 4-20).

The main units include fault-defined areas such as the Akershus Graben and the Vestfold - Ringerike Graben in the Oslo Region, supergroups of volcanic and/or sedimentary rocks (e.g. the Telemark supergroup), greenstone belts with varying contents of other supracrustals (e.g. the Karasjok greenstone belt), major complexes consisting of para-and orthogneisses together with undeformed intrusions (e.g. Agder Complex) and nappe complexes in the Caledonides (e.g. Hardangerfjord Nappe Complex). In the OPTIONS the nappe series to which the nappe complexes belong are shown in parenthesis and are abbreviated as follows: UmA = uppermost nappe series, UA = upper nappe series, MA = middle nappe series and LA = lower nappe series. AU/PAU = autochthonous or parautochthonous units.

Names and extent of the different main units (see listings and figures) are taken from publications, bedrock maps at scales of 1:250000 and 1:50000 and after consultations with bedrock geologists at the Geological Survey. To achieve the best possible subdivision of the bedrock into its main units it has been necessary to introduce a number of new, informal names. These are shown in italics in the OPTIONS. These are only shown temporarily for principal units in which deposits are known to be present. **In border zones it is especially important to consult bedrock maps where boundaries are accurately shown before assigning a deposit to a definite unit.**

The term "greenstone belt" is preferred to supergroup since the former are often so deformed as to make it impossible to unravel the original stratigraphy. In the Polmak- and Pasvik Greenstone Belt it is, however, possible to use the term Petsamo Supergroup. Alternatively, greenstone belt could have been replaced by complex or greenstone complex. The Precambrian crystalline rocks constituting the Caledonian Basement Province represent in most cases allochthonous and parautochthonous units which form a natural part of the Caledonian tectonostratigraphy, especially those forming nappes. Archean to Mesoproterozoic rocks forming (or forming part of) well-defined nappe units will, therefore, be classified according to the name of the nappe complex they occur within. E.g. the deposits in the Paleoproterozoic rocks of the Nasafjell window will have the Gargatis Nappe Complex as main geotectonic unit, whereas similar rocks in the Espedalen valley hosting Ni-Cu deposits will have the Jotun Nappe Complex as the main geotectonic unit. Precambrian crystalline rocks of more uncertain tectonostratigraphic position such as those occurring inside "basement" windows and culminations as well as forming horst structures are classified as complexes or greenstone belts. Their name is kept according previous usage for windows and culminations, i.e. Grong-Olden window changes to Grong Olden Complex, Tysfjord culmination to Tysfjord Complex and Alta-Kvænangen window to Alta Kvænangen Greenstone Belt as the main geotectonic units.

The Western Gneiss Region or -complex in the list of OPTIONS contains infolded units of the Caledonian nappe series. These are shown on the bedrock map of Norway (1:1 million) as Caledonian Precambrian gneisses (numbered 172, 175 and 178) and augen gneisses (numbered 180). On published maps (e.g. Røros and Sveg 1:250000) and in publications (Krill 1985, Tucker 1986, Kollung 1990 and Robinson 1995) the allochthonous rock sequences are divided into nappe complexes. In Fig.13-15 they are designated UNCW (Undifferentiated Nappe Complexes in the Western gneiss region) The separate nappe units are made up of characteristic rock sequences which one must be familiar with to be able to place the deposits in their correct unit. It is therefore recommended that one should read Robinson (1995) and any other publication dealing with this subject.

The nappe complexes to which individual nappes belong are shown below. The complexes beneath and on the west side of the Trondheim Nappe Complex (which includes the Gula Nappe) are deliberately kept separate from the east side since the tectonostratigraphic correlation between them is still very uncertain. For this reason a number of new names have been introduced for the nappe complexes on the south-west side of the Trondheim fjord and under the Trondheim Nappe Complex. Nappes in the Western Gneiss Region are present in the following nappe complexes.

```
Trondheim Nappe Complex (UA)
- Støren Nappe
Blåhø-Surnadal Nappe Complex (UA) (- Seve)
- Blåhø Nappe            - Rinna Nappe
- Gangåsvatn Nappe       - Surna nappe
- Orkla Nappe
Tingvoll Nappe Complex (MA)
- Risberg Nappe (augen gneisses)
- Songa Nappe
- Sætra Nappe(quartzites)
```

Sunndal Nappe Complex (LA)
- not divided into nappes

In the Caledonides there are many imbricated units which have previously been designated as nappes. In some cases, where they have a large areal extent, they have been redesignated as nappe complexes, as for example, Synnfjell Nappe = Synnfjell Nappe Complex and Fortun Nappe = Fortun Nappe Complex. In addition new names have been invented for nappes previously unnamed, and imbricated sequences. In the area Tysfjord and Salten the Køli and Seve Nappe Complexes are intensely folded together and cannot be separated on figure 18.

They are therefore designated as Seve-Køli Nappe Complex, undifferentiated. On map sheets of the bedrock of the area they are, however, separated.

A relatively thin sequence of autochthonous sediments deposited in a shallow sea on the Fennoscandian platform overlies the basement rocks of the Caledonides. The sequence includes Neoproterozoic to Silurian deposits which have different stratigraphic signatures along the length of the mountain chain (e.g. The Dividals Group in Finnmark). This sequence is important in connection with the Pb-Zn deposits located in the marginal zone of the Caledonides. It is distinguished as a separate unit and termed the Platform Supergroup. The autochthonous sedimentary rocks which form parts of the Tanafjord - Varangerfjord region on the south side of the Trollfjord - Komagelv Fault are also included under the term Platform Supergroup, but not rocks of the Barents Sea Group on the north side. These form part of the Barents Sea Region. Cambro-Silurian rocks including alum shales in the Oslo Region belong to this supergroup since in this area it is difficult to define the border between thrust units belonging to the Os-Rø Nappe Complex (LA) and autochthonous units. The main geotectonic units in the Oslo Region are shown by their familiar names below.

OPTIONS:

<u>Oslo Region</u>

Akershus Graben, AG
Vestfold-Ringerrike Graben, VRG

<u>Caledonides</u>

Abisko Nappe Complex, ANC (MA)
Blåhø - Surna Nappe Complex, BSNC (UA)
Dalsfjord Nappe Complex, DNC (MA)
Evanger Nappe Complex, ENC (LA)
Formofoss Nappe Complex, FFNC (LA)
Fortun Nappe Complex, FNC (LA)
Gaissa Nappe Complex, GNC (LA)
Gargatis Nappe Complex, GGNC (LA/MA)
Granvin Nappe Complex, GVNC (LA)
Hardangerfjord Nappe Complex, HFNC (UA)
Hardangervidda Nappe Complex HVNC (MA)
Helgeland Nappe Complex, HNC (UmA)
Jotun Nappe Complex, JONC (MA)
Jær Nappe Complex, JNC (MA)
Kalak Nappe Complex, KNC (MA)
Kvitvola Nappe Complex, KVNC (LA)
Køli Nappe Complex, KLNC (UA)
Laksefjord Nappe Complex, LFNC (MA)
Lindås Nappe Complex, LNC (MA)
Lyngen Nappe Complex, LYNC (UA)
Magerøy Nappe Complex, MNC (UA)
Narvik Nappe Complex, NANC (UA)

Niingen Nappe Complex, NNC (UmA)
Nordfjord Complex NFC (LA)
Ofoten Nappe Complex, ONC (UA)
Os - Rø Nappe Complex, ORNC (LA)
Platform Supergroup, PSG (AU/PAU)
Rauta Nappe Complex, RANC (LA)
Reisa Nappe Complex, RSNC (LA)
Remsklepp Nappe Complex, RKNC (MA)
Ryfylke Nappe Complex, RYNC (LA)
Rødingsfjell Nappe Complex, RFNC (UmA)
Røros Nappe Complex, RNC (UA)
Särv - Offerdal Nappe Complex, SONC (MA)
Seve Nappe Complex, SNC (UA)
Seve - Køli Nappe Complex, undiff., SKNC (UA)
Solund Basin, SB
Stavfjord Nappe Complex, SFNC (UA)
Sunndal Nappe Complex, SUNNC (LA)
Synnfjell Nappe Complex, SYNC (LA)
Tingvoll Nappe Complex, TVNC (MA)
Tromsø Nappe Complex, TMNC (UmA)
Trondheim Nappe Complex TNC (Ua)
Vossa Nappe Complex, VNC (MA)

Barents Sea Region

Not subdivided into principal units or supergroups.

Caledonian Basement Province

Alta - Kvænangen Greenstone Belt, AKGB (AU/PAU)
Altenes Greenstone Belt, ALGB (AU/PAU)
Bardu Complex, BAC (AU/PAU)
Beito Complex, BOC (AU/PAU)
Borgund Complex, BGC (AU/PAU)
Brattskarv Complex, BSC (AU/PAU)
Dalsfjord Nappe Complex, DNC (MA)
Formofoss Nappe Complex, FFNC (LA)
Gargatis Nappe Complex, GGNC (LA/MA)
Grong-Olden Complex, GOC (AU/PAU)
Hardangervidda Nappe Complex, HVNC (MA)
Jotun Nappe Complex, JONC (MA)
Kalak Nappe Complex, KNC (MA)
Komagfjord - Repparfjord Greenstone Belt, KRGB (AU/PAU)
Laksefjord Nappe Complex, LFNC (MA)
Lindås Nappe Complex, LNC (MA)
Lofoten-Vesterålen Complex, LVC (AU/PAU)
Nordfjord Nappe Complex, NFC (LA)
Rauta Nappe Complex, RANC (LA)
Remsklepp Nappe Complex, RKNC (LA)
Ringvassøy Greenstone Belt, RGB (AU/PAU)
Rishaugfjell Complex RHC (AU/PAU)
Rombak Complex, ROC (AU/PAU)

Skardøra Complex, SKDC (AU/PAU)
Spekdal Complex, SDC (AU/PAU)
Sunndal Nappe Complex, SUNNC (LA)
Svartis-Rødøy Complex, SRC (AU/PAU) (incl. Laksådal window)
Tingvoll Nappe Complex, TVNC (MA)
Trollheimen Complex, THC (AU/PAU)
Tysfjord Complex, TFC (AU/PAU)
Tømmerås Complex, TMC (AU/PAU)
Vestrand Complex, VRC (AU/PAU)
West-Troms Complex, WTC (AU/PAU)
Western Gneiss Region, WGR (AU/PAU)
Øygard Complex, ØGC (AU/PAU)

East Norwegian Basement Province

Romerike Complex, RC
Solør Complex, SC
Trysil Complex, TC
Østfold Complex, ØC

South Norwegian Basement Province

Agder Complex, AC
Bamble Complex, BC
Kongsberg Complex, KC
Randsfjord Complex, RFC
Setesdal-Hallingdal Complex, SHC
Sperillen Complex, SPC
Telemark Super Group, TSG

Troms-Finnmark Basement Province

Altevann Complex, AVC
Baisvarri Complex, BVC
Cier'te Greenstone Belt, CGB
Jergol Complex, JC
Karasjok Greenstone Belt, KGB
Kautokeino Greenstone Belt, KKGB
Krokfjell Complex, KFC
Leavvajohka Complex LC
Polmak-Pasvik Greenstone Belt, PPGB
Raiseatnu Complex, RAC
Sørvaranger Complex, SVC
Tanaelv Complex, TEC

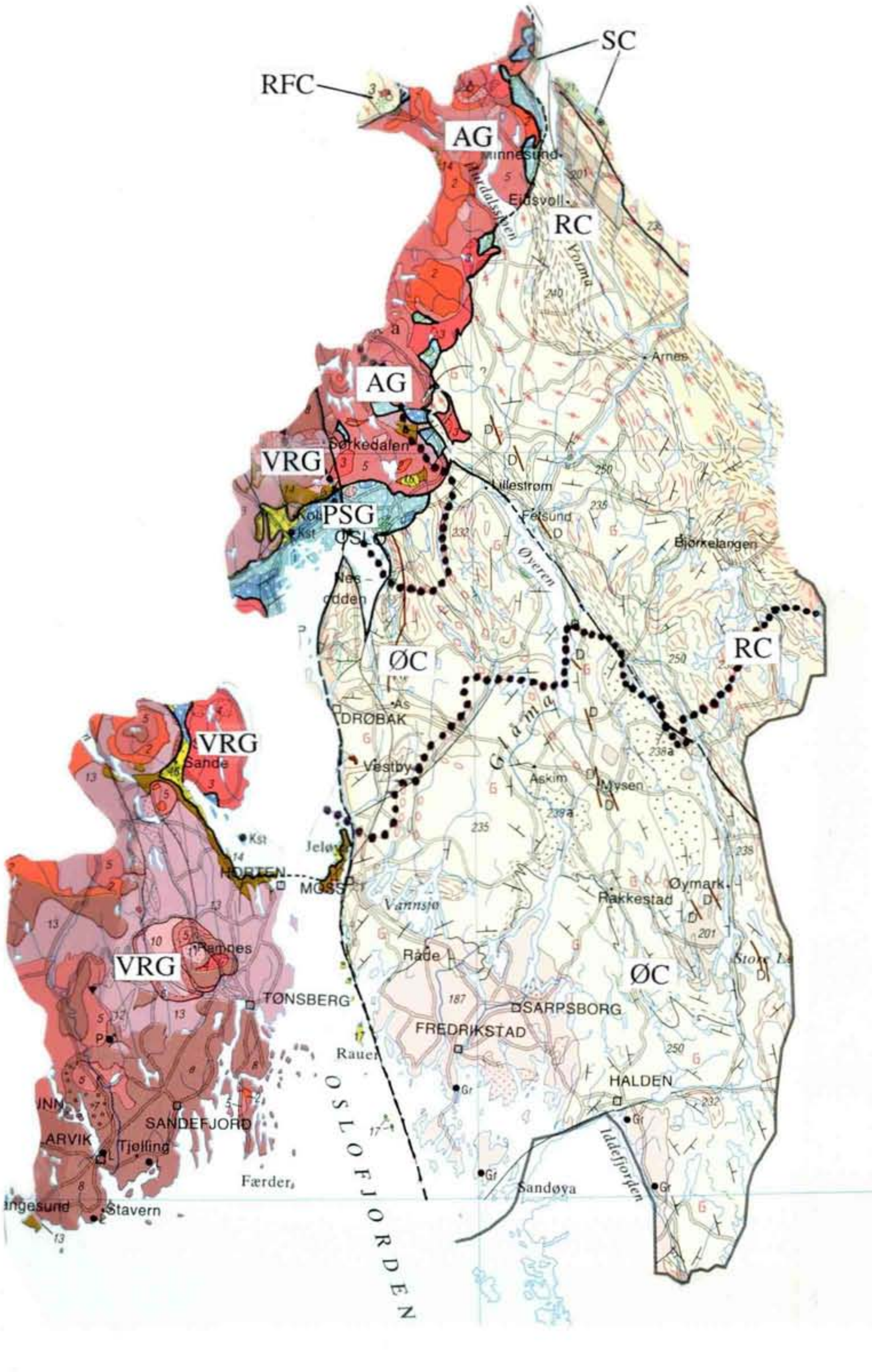

Figure 4. Principal geotectonic units in the counties of Akershus, Oslo, Vestfold and Østfold.

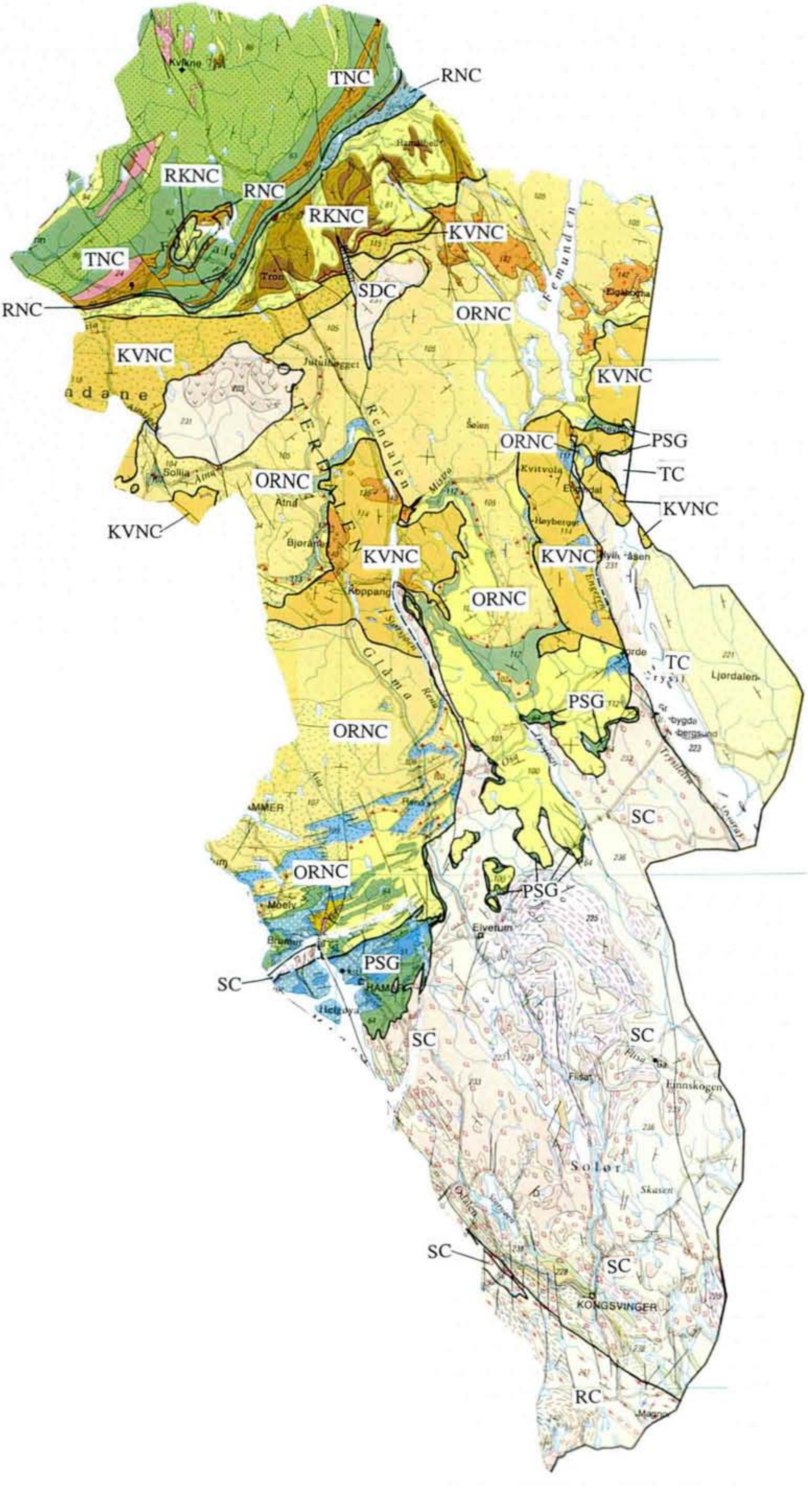

Figure 5. Principal geotectonic units in the county of Hedmark.

Figure 6. Principal geotectonic units in the county of Oppland

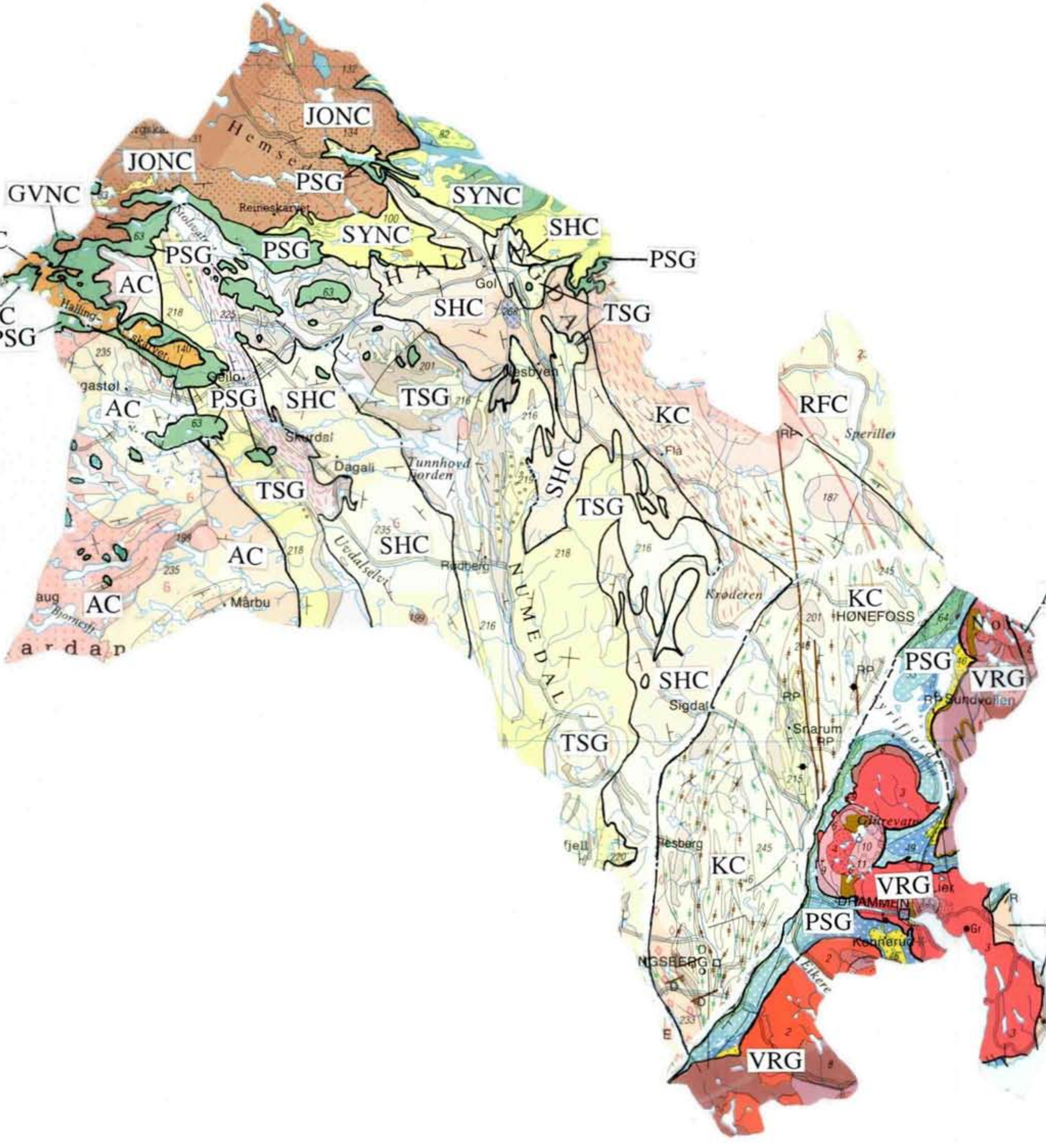

Figure 7. Principal geotectonic units in the county of Buskerud

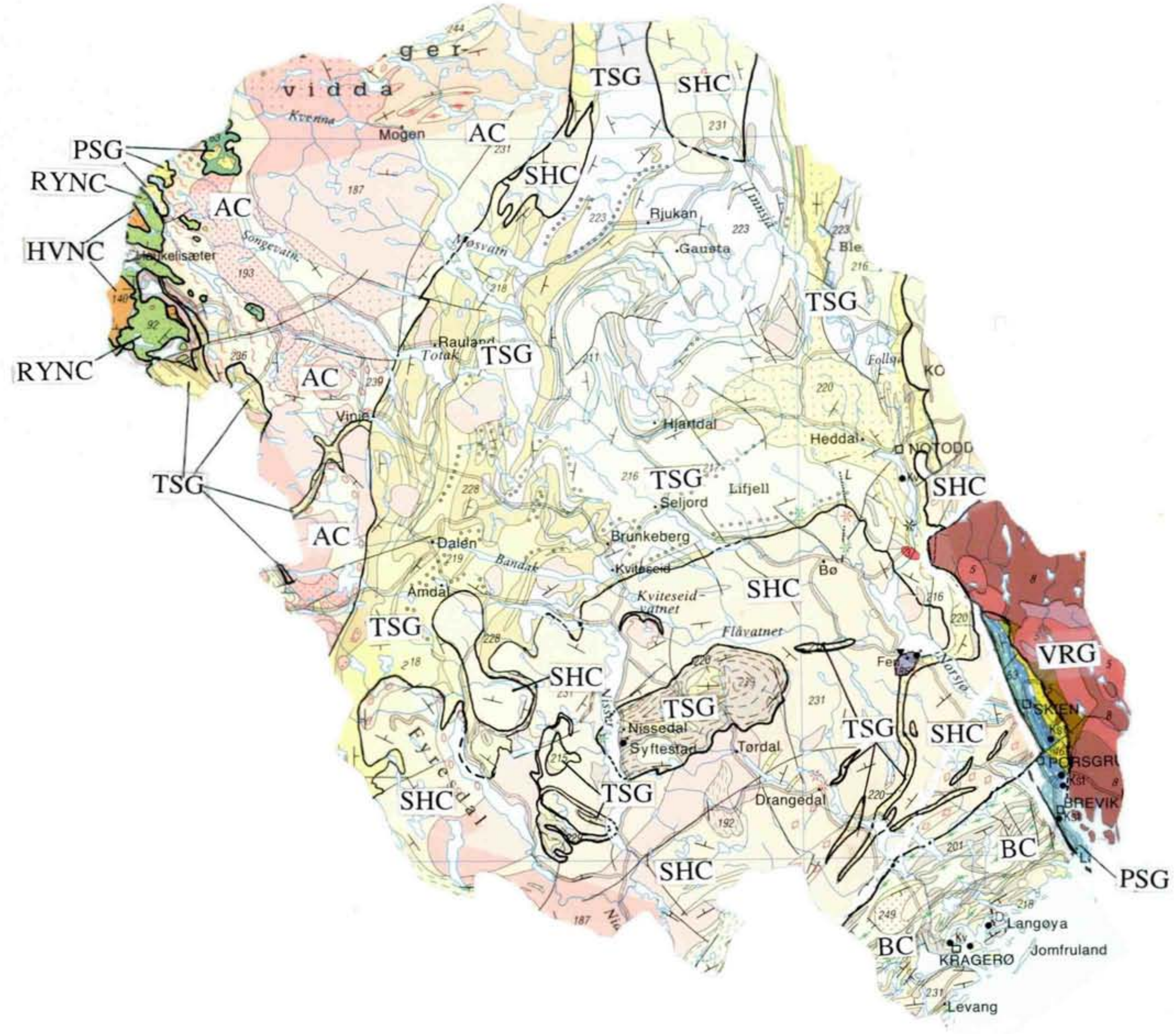

Figure 8. Principal geotectonic units in the county of Telemark

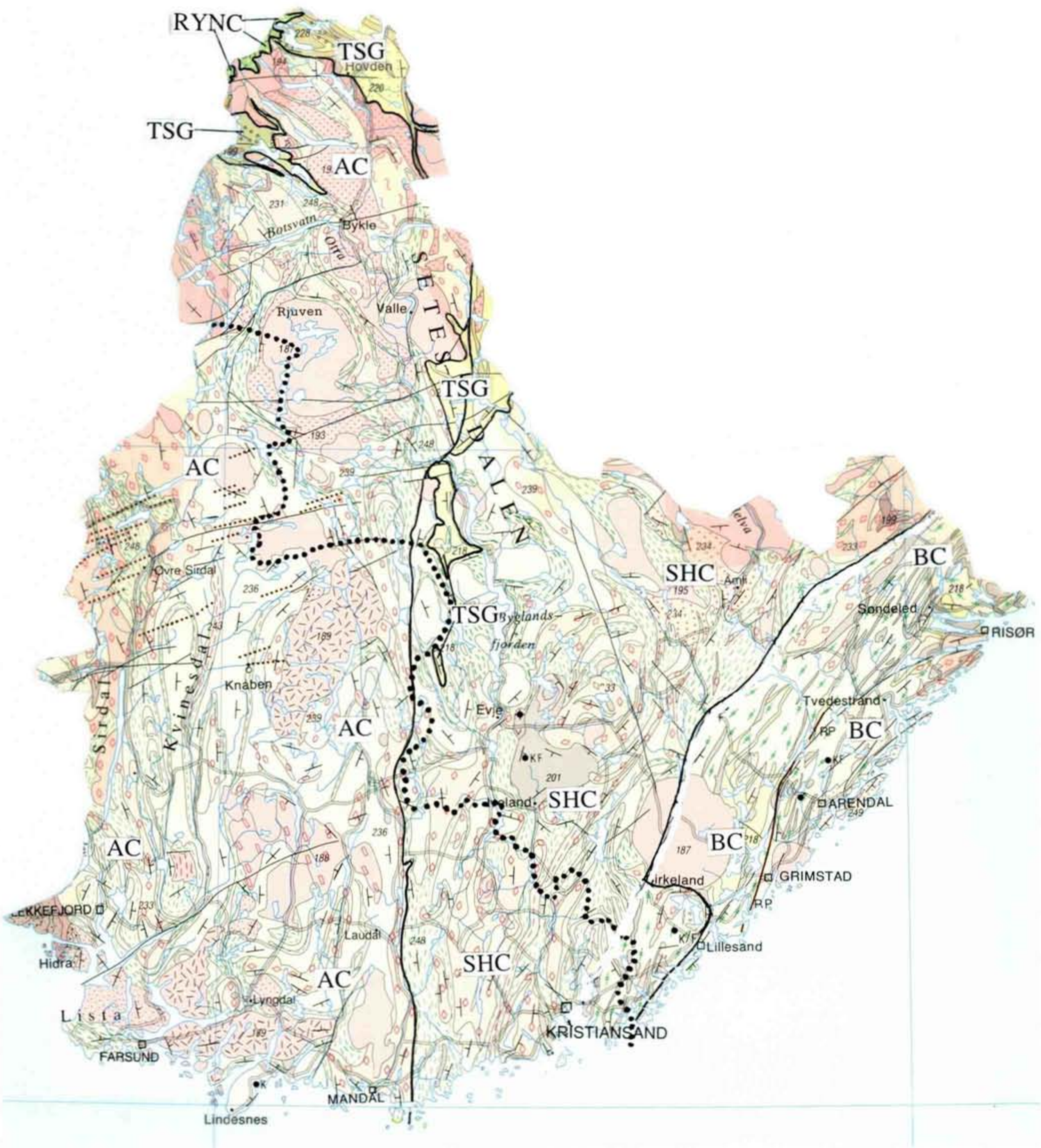

Figure 9. Principal geotectonic units in the counties of Aust- and Vest-Agder

Figure 10. Principal geotectonic units in the county of Rogaland

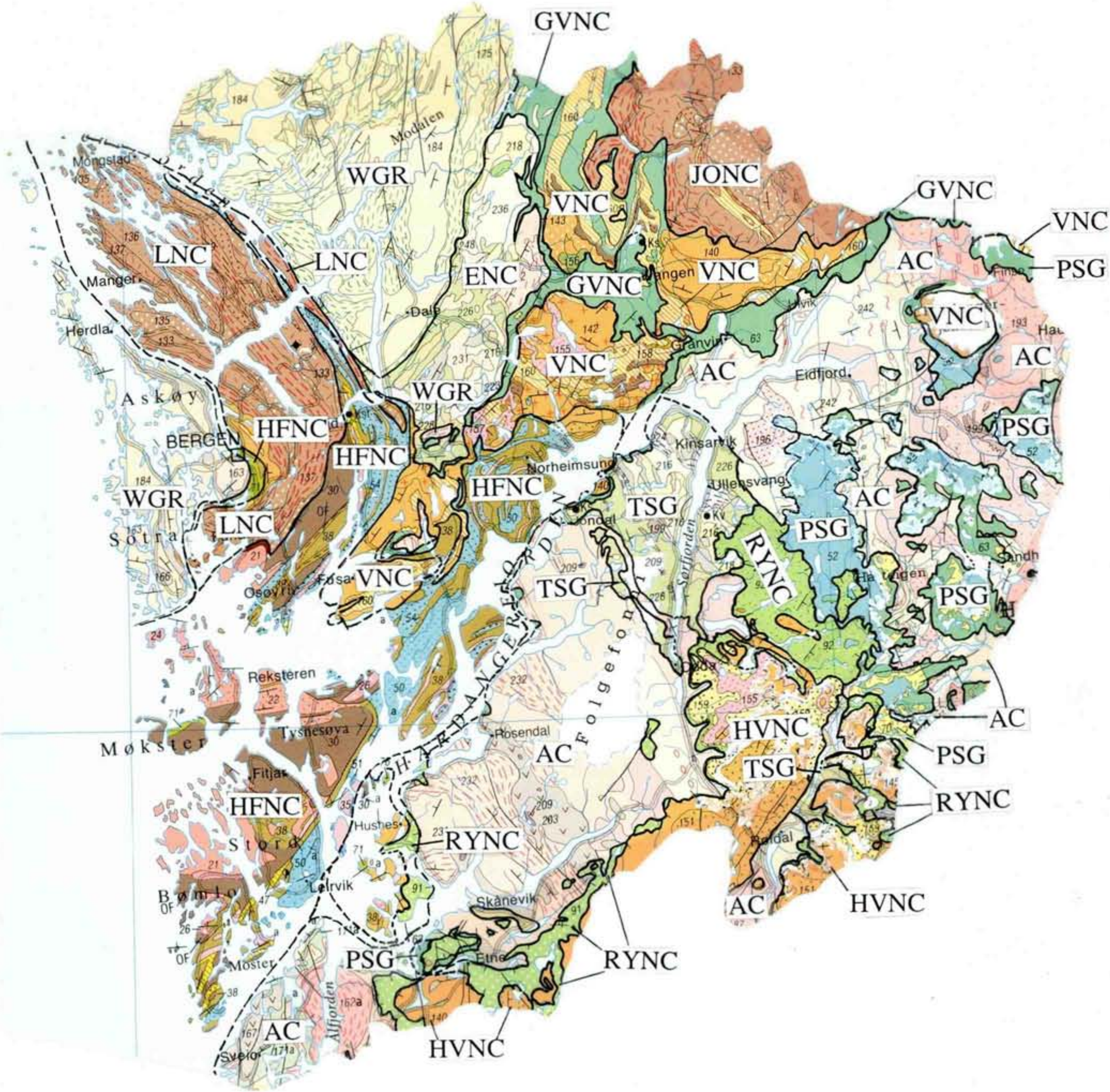

Figure 11. Principal geotectonic units in the county of Hordaland

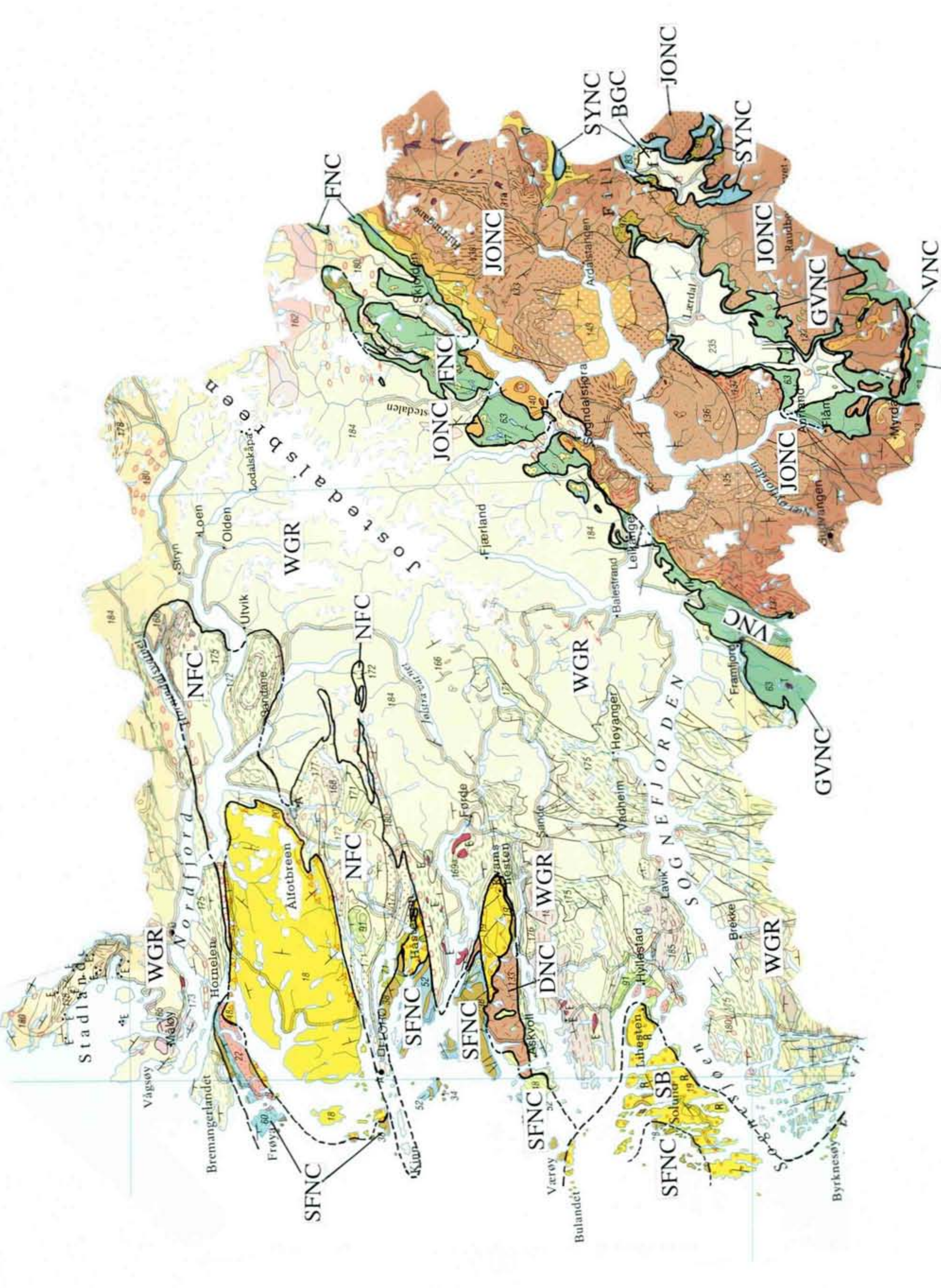

Figure 12. Principal geotectonic units in the county of Sogn and Fjordane

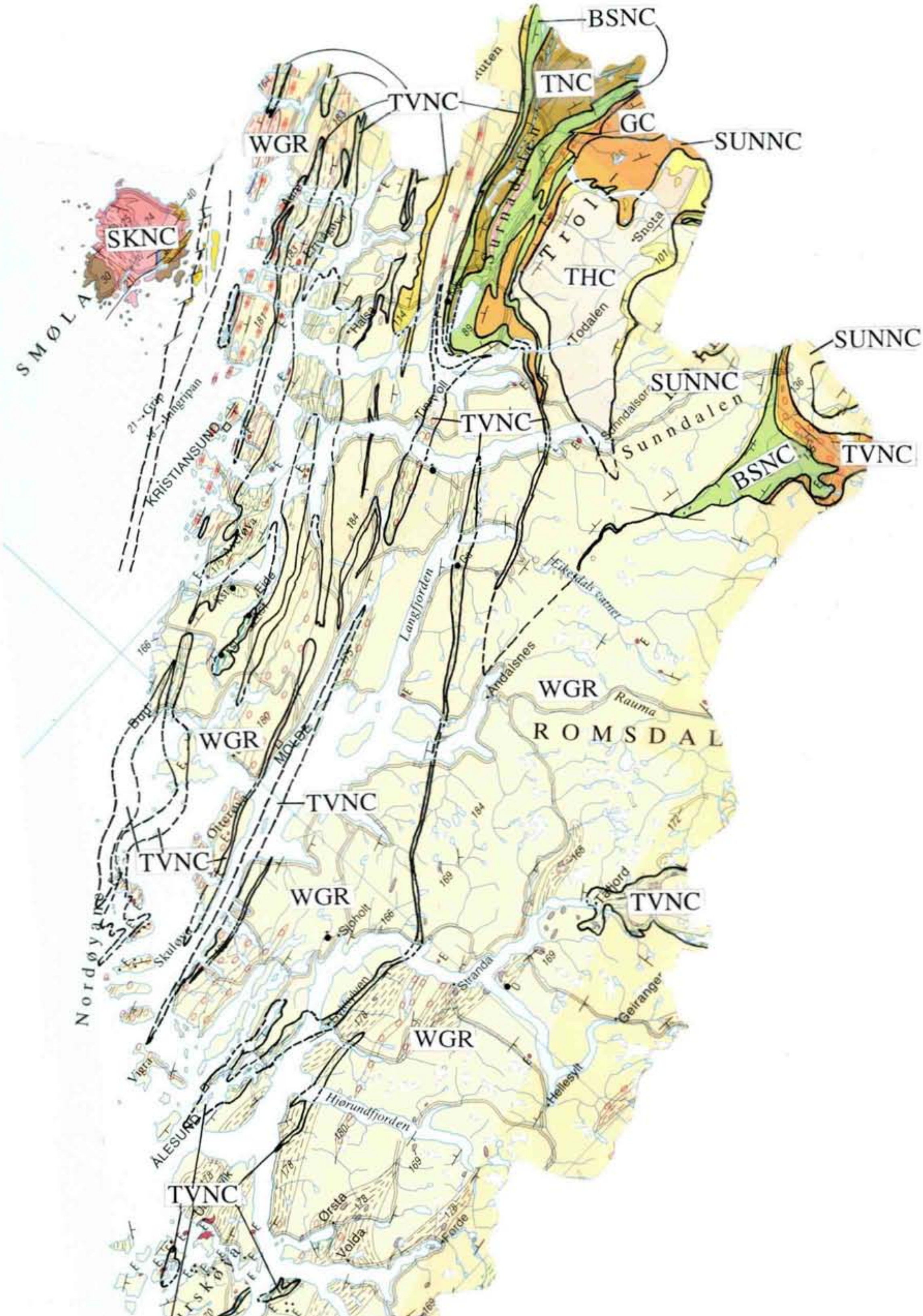

Figure 13. Principal geotectonic units in the county of Møre and Romsdal

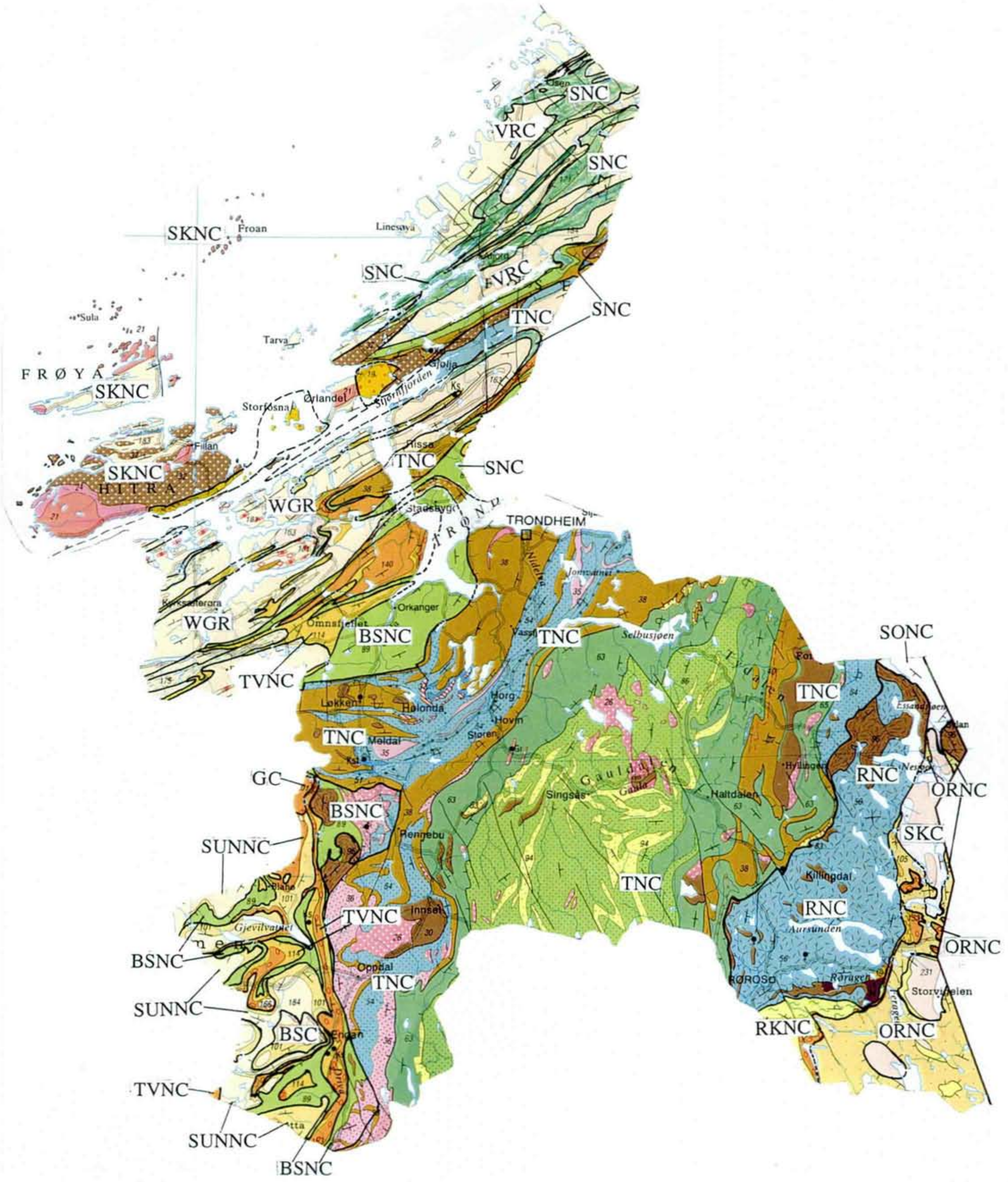

Figure 14. Principal geotectonic units in the county of Sør-Trøndelag

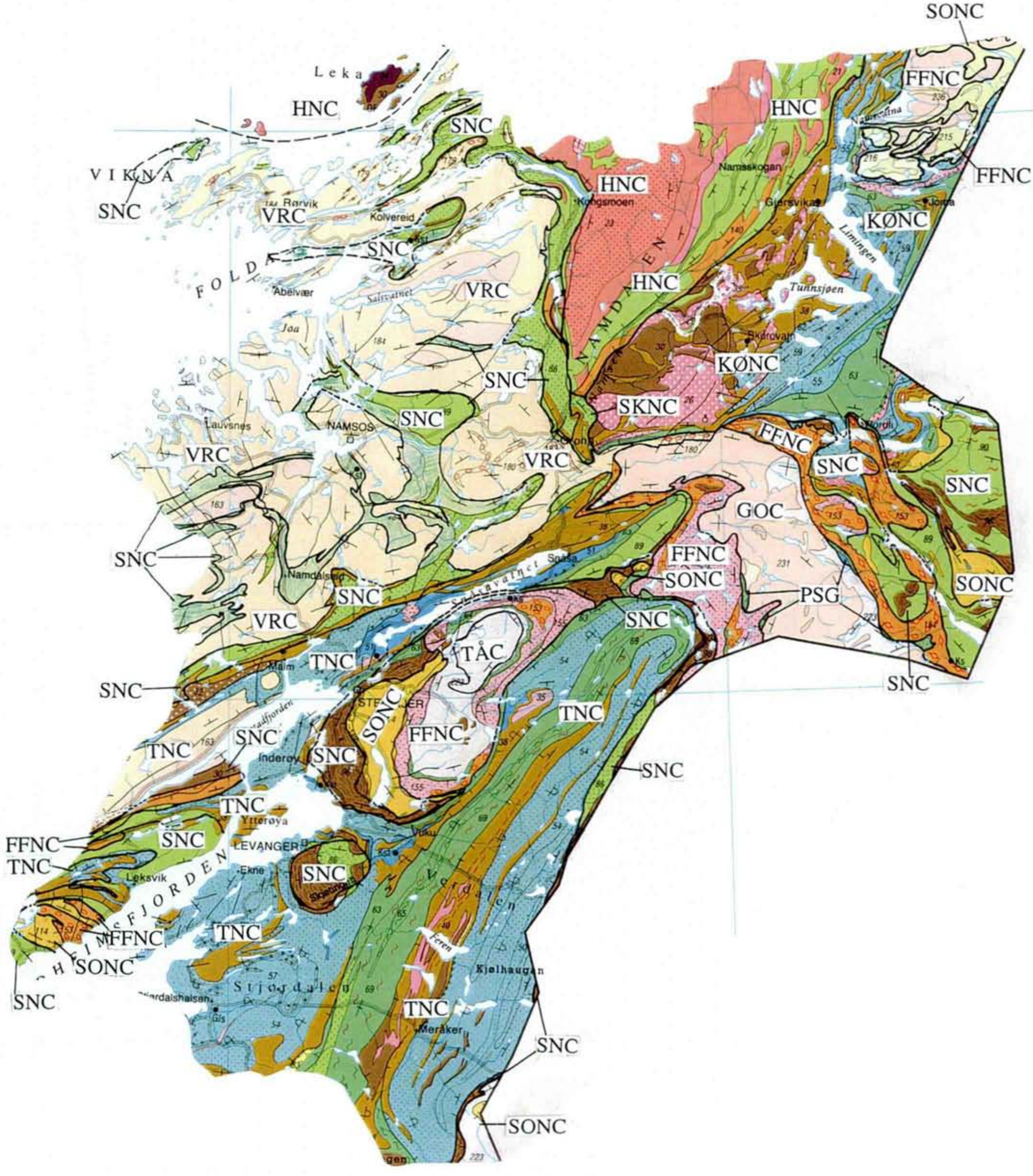

Figure 15. Principal geotectonic units in the county of Nord-Trøndelag

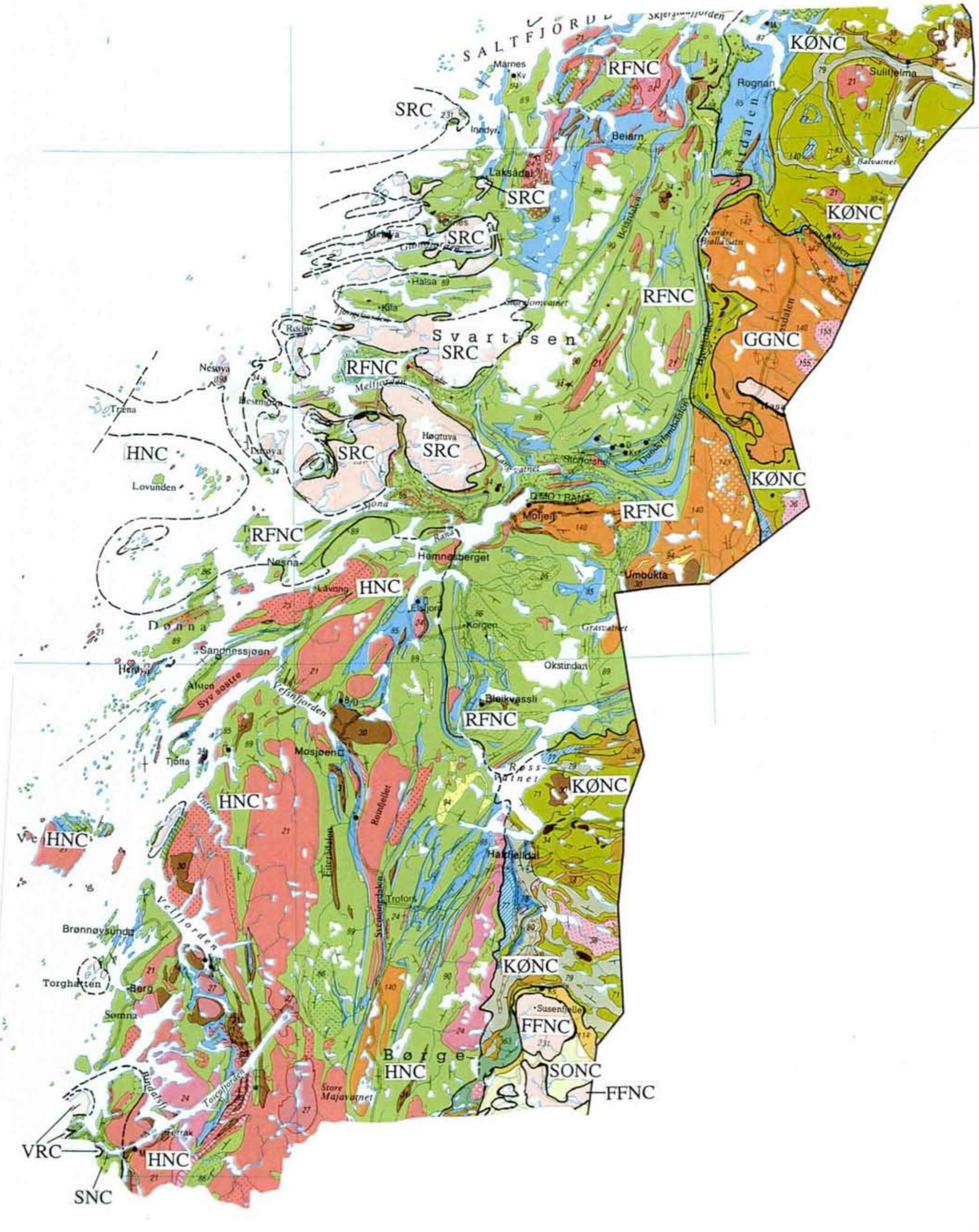

Figure 16. Principal geotectonic units in the southern part of the county of Nordland

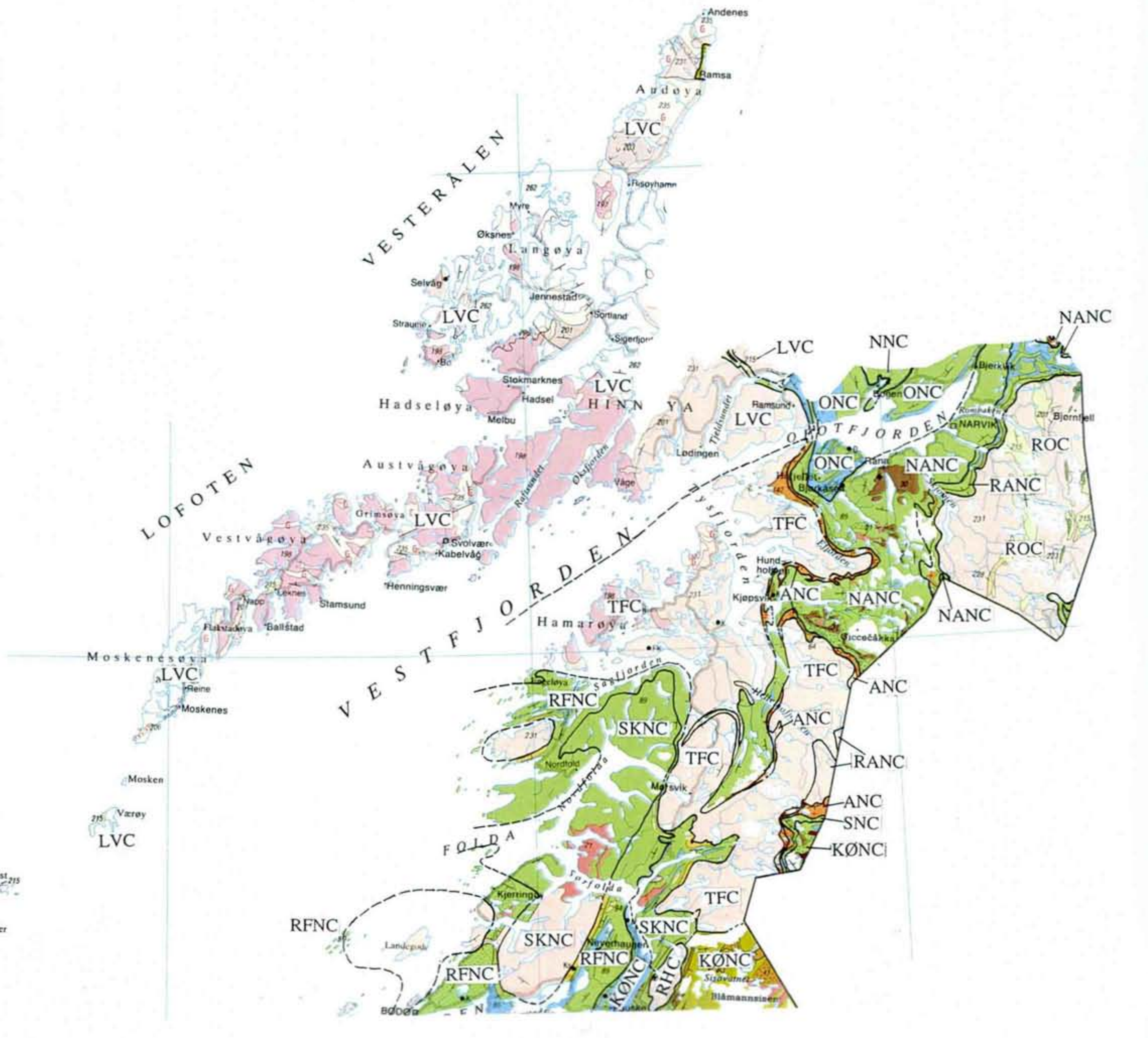

Figure 17. Principal geotectonic units in the northern part of the county of Nordland

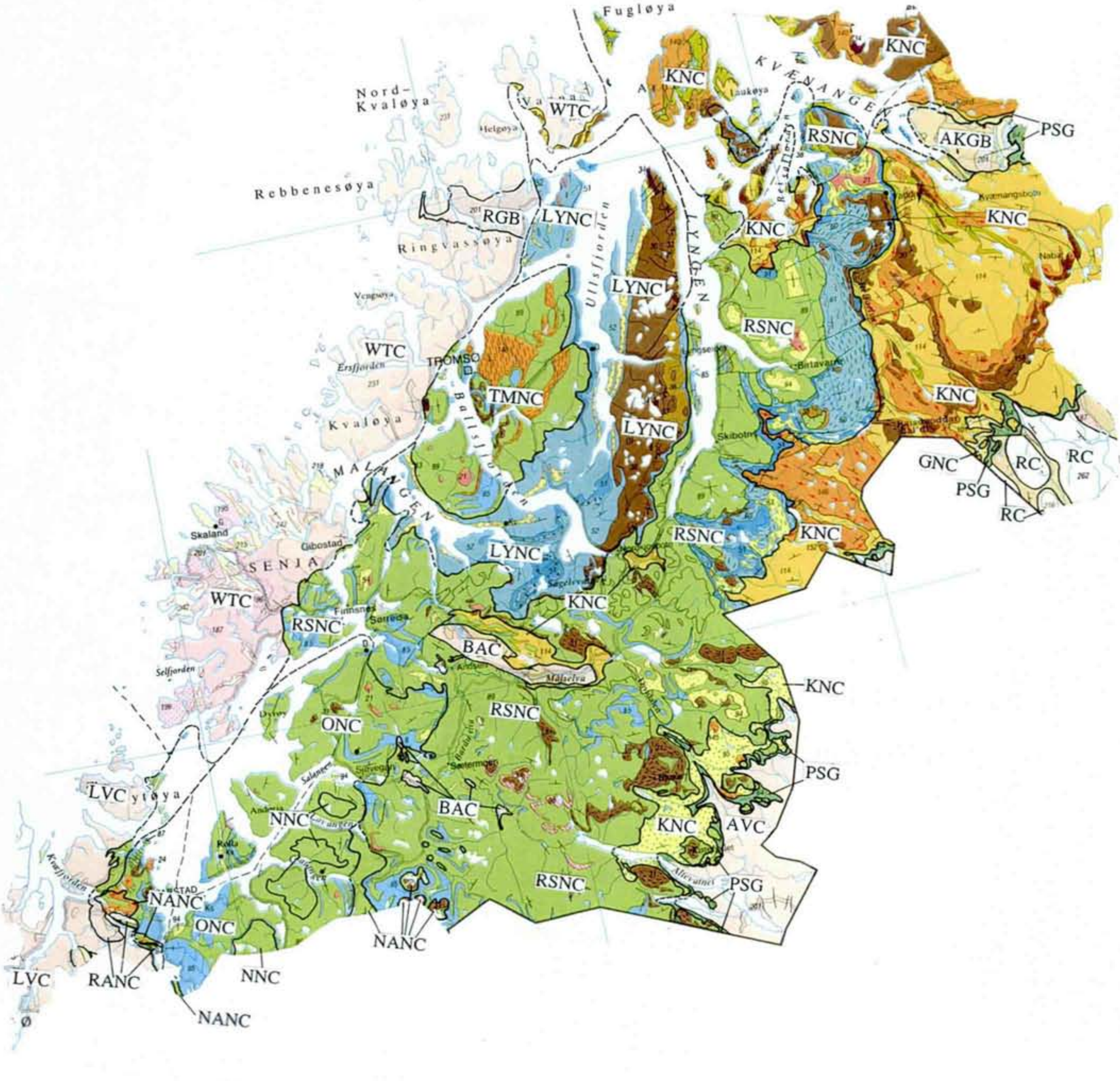

Figure 18. Principal geotectonic units in the county of Troms

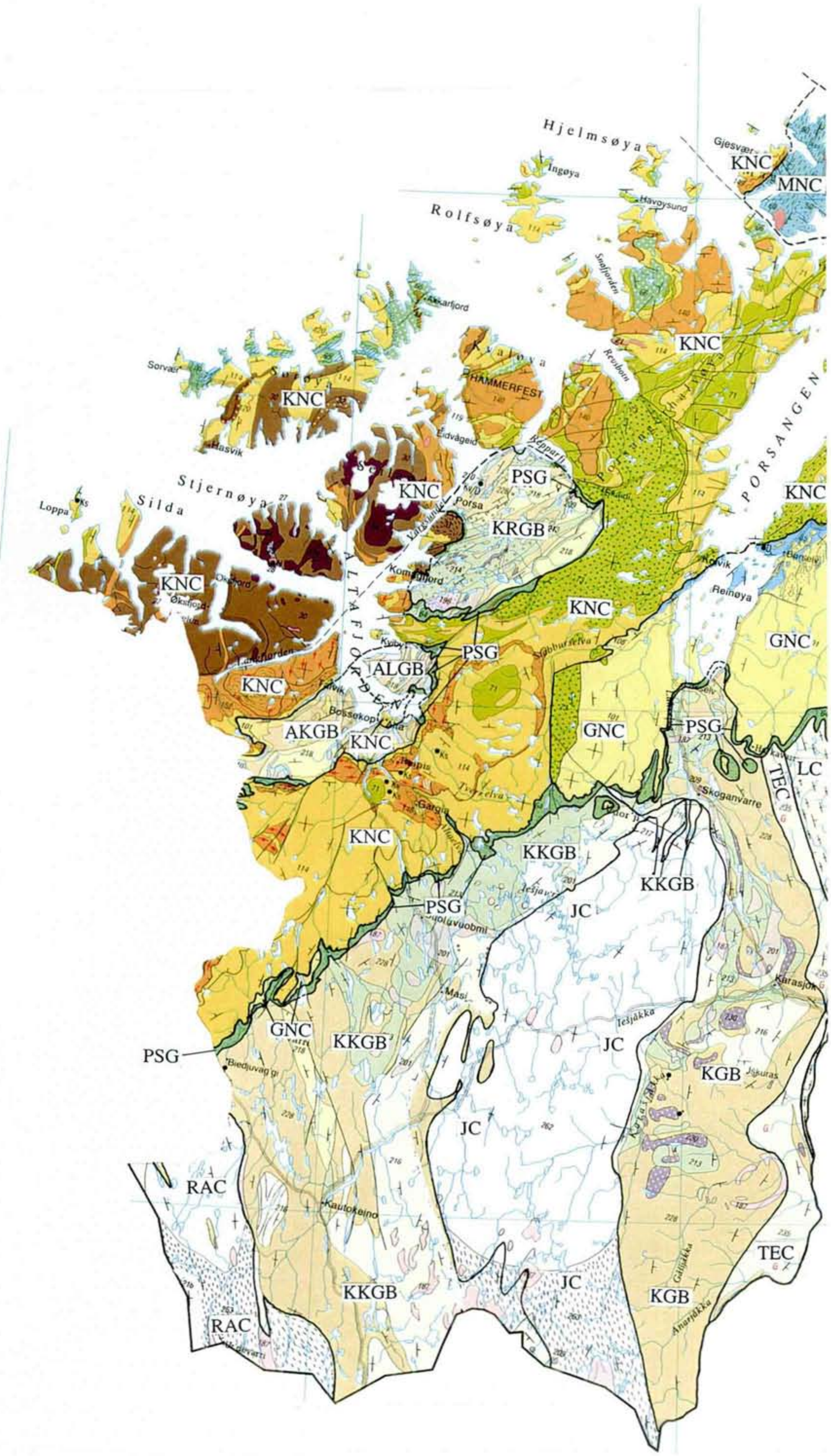

Figure 19. Principal geotectonic units in the western part of the county of Finnmark

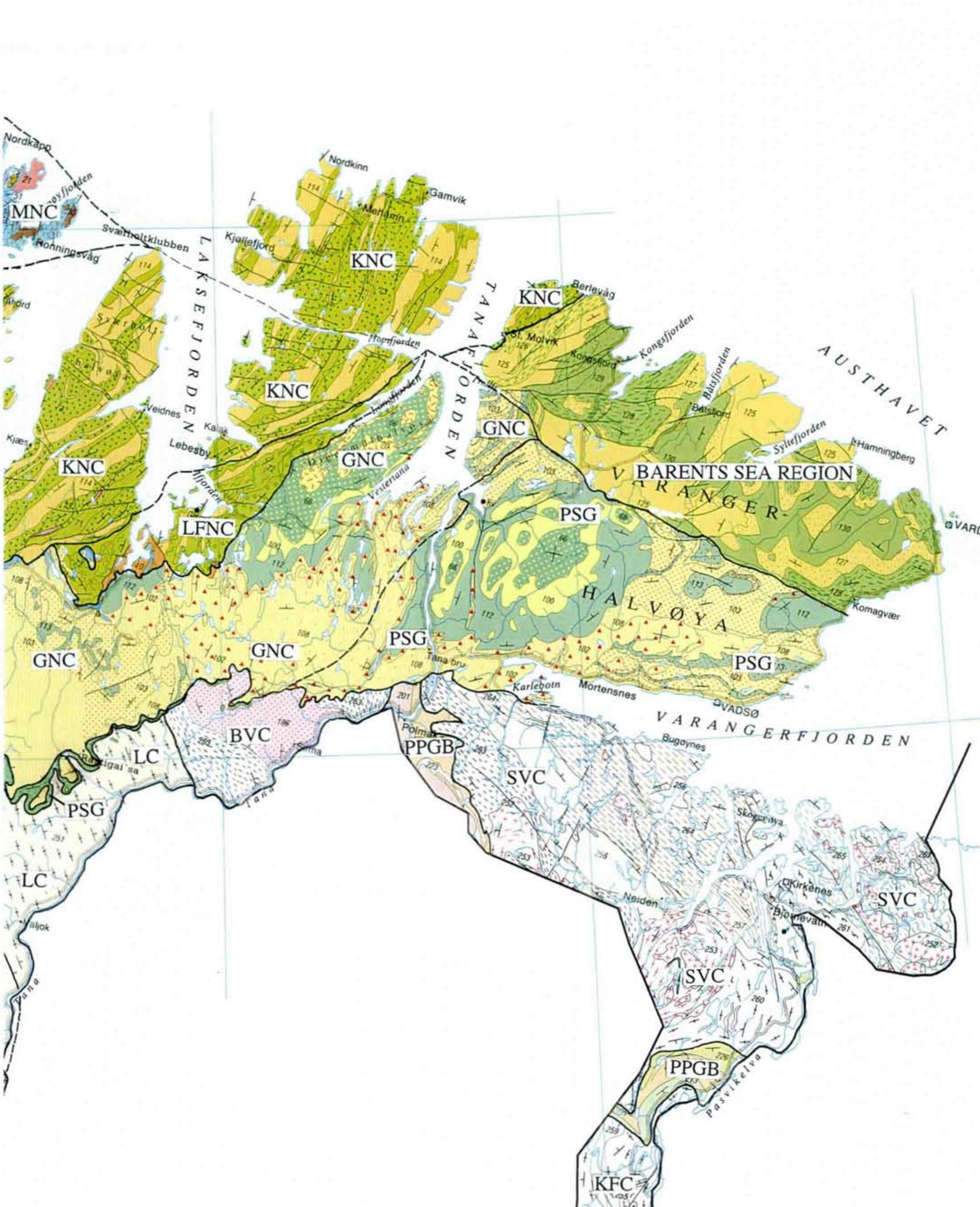

Figure 20. Principal geotectonic units in the eastern part of the county of Finnmark

Tectonic unit/ complex

The rocks belonging to many of the principal geotectonic units are subdivided into tectonic units and complexes which relate to the nappe units in the Caledonidian nappe complexes or gneiss complexes in the basement. In some of the nappe complexes occur rock units of Neoproterozoic to Paleozoic age which are not limited by thrust faults. These should not be termed nappe units but complexes, for example, the Geittind unit in the Helgeland Nappe Complex. This unit is termed the Geittind complex. In the Oslo area the calderas will be included as tectonic units. Formal names for the tectonic units or complexes must be taken from publications or bedrock maps of the area. If the main unit is not subdivided or composed of groups of formations no entry is necessary.

Igneous complex

The bedrock of Norway contains a number of large intrusive complexes which form parts of the main geotectonic units and part of the tectonic units and complexes. Examples of this are the Larvik - Skrim batholith in the Vestfold-Ringerike Graben in the Oslo Region, the Bindal batholith in the Helgeland Nappe Complex and the Egersund anorthosite complex in the Agder Complex. **The heading shall only be filled out in cases where the deposit or parts of it lie in an intrusion/ophiolite.** Many of the names below are informal *(italics)* as several of the igneous complexes which contain deposits have not yet been given formal names. Only the most important, that is to say those with known deposits, are included as yet but there will probably be a need to add others in the future. Ophiolite complexes occur in many places in the Caledonides and can be entered here as they contain many intrusive rocks.

OPTIONS:

```
Drammen Batholith (Permian)
Eiker Batholith (Permian)
Finnemarka Batholith (Permian)
Larvik-Skrim Batholith (Permian)
Nordmarka-Hurdal Batholith (Permian)
Råna Pluton  (Early Silurian)
Bindal Batholith (Late Ordovician)
Fen Carbonatite Complex (Late Ordovician)
Follafoss Pluton (Late Ordovician)
Møklevatn Pluton  (Late Ordovician)
Smøla-Hitra Batholith (Late Ordovician)
Sundhordland Batholith (Late Ordovician)
Gulfjell Ophiolite Complex (Early Ordovician)
Karmøy Ophiolite Complex (Early Ordovician)
Leka Ophiolite Complex (Early Ordovician)
Lykling Ophiolite Complex (Early Ordovician)
Lyng Ophiolite Complex (Early Ordovician)
Skorovas Complex (Early Ordovician)
Vassfjell Ophiolite Complex (Early Ordovician)
Vågå Ophiolite Complex (Early Ordovician)
Seiland Igneous Complex (Neoproterozoic)
```

Egersund Anorthosite Complex (Neoproterozoic)
Iddefjord Batholith (Neoproterozoic)
Evje Amphibolite Complex (Mesoproterozoic)
Lofoten Mangerite Complex (Paleoproterozoic)
Odal Batholith (Paleoproterozoic)
Todal Batholith (Paleoproterozoic)
Tysfjord-Rombak Batholith (Paleoproterozoic)
Värmland Batholith (Paleoproterozoic)
Neiden Granite (Archean)

Group and Formation

Sequences of surface rocks are divided into stratigraphic groups which are further subdivided into formations. Because of the large number of groups and formations which are known to exist, no OPTIONS are listed. Formal names for groups and/or formations must therefore be taken from geological bedrock maps or publications which cover the area of the deposit.

2.4 Technical information

Technical information directly related to the deposit is registered.

Scope of activity

This covers the classification of the various activities, the smallest being prospecting. If this is the case there is no visible work done, only a report or publication.

OPTIONS:

```
Prospecting (no sign of activities except drill holes)
Pitting (incl. trenching/shallow excavations)
Test mining (shaft/adit > 2 m's deep or length)
Mining (regular deliveries for beneficiation or smelting
        for more than 1 year).
```

Production method

Also if test mining or regular mining has taken place previously, the most important methods used should be recorded here.

OPTIONS:

```
Open pit mining
Open pit and underground mining (if both methods have been used)
Underground mining
```

Ore reserves in mill. metric tons

Proved ore reserves in mill. metric tonnes to be shown here. These must only be recorded if based on drillhole data or operational data.

Total production in mill. metric tons

Estimated total extraction of crude ore in mill. metric tonnes from the deposit during test mining or regular mining.

Estimated volume of dump in m^3

A rough estimate of the volume of the dump in m^3. In cases where the deposit consists of several prospects the total tip volume of these should be recorded.

2.5 Mineralogy

The minerals of a deposit are divided into two groups, ore minerals and gangue minerals. This subdivision is not always simple if one attempts to keep a clear difference between the two groups. A typical ore mineral in one deposit can be a gangue mineral in another (e.g. rutile). All ore minerals with a specific weights greater than 5,0 as well as minerals used in the production of metals are defined as ore minerals. All others are gangue minerals even though they can be economically important components in some ores.

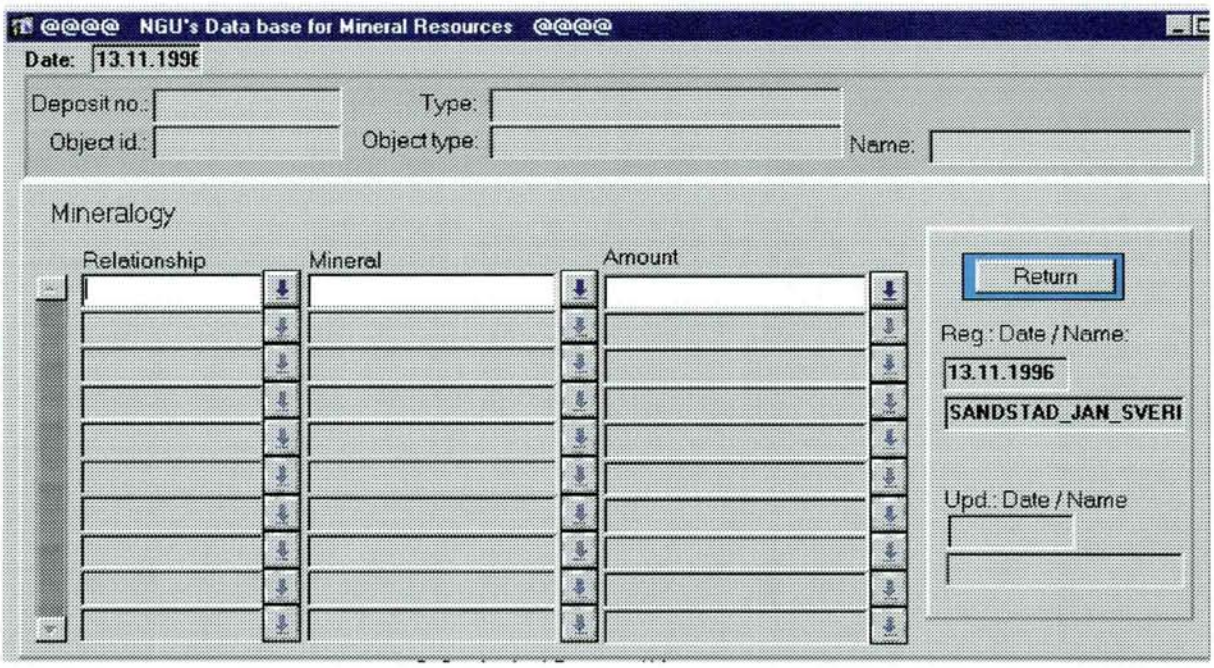

Figure. 21. Minerals of the deposit.

The number of minerals which can be fed in is not dependent on the number of lines in the form. The options shown below represent a selection of minerals. This selection has been enlarged as found necessary and further additions will be made in the future.

Relationship
Tells whether the mineral registered is an ore mineral or a gangue mineral.

Ore minerals

OPTIONS:

Altaite	Baddeleyite	Bismuth	Borovskite
Argentite	Barite	Bismuthinite	Boulangerite
Arsenopyrite	Berthierite	Bismutite	Bournonite
Azurite	Beryl	Bornite	Brannerite

Bravoite
Calaverite
Carrollite
Cassiterite
Cerussite
Chalcocite
Chalcopyrite
Chromite
Chrysocolla
Cobaltite
Cobalt pentlandite
Coloradoite
Columbite
Copper
Covellite
Cubanite
Danalite
Davidite
Digenite
Electrum
Euxenite
Fahlore
Fergusonite
Fluocerite
Gadolinite
Galena
Genthelvite
Gersdorffite
Glaucodot
Goethite
Gold
Hedleyite
Helvite
Hematite
Hemoilmenite
Hessite
Hoegtuvaite
Idaite
Ilmenite
Ilmenomagnetite
Jamesonite
Kainosite
Liebigite
Limonite
Linnaeite
Mackinawite
Magnetite
Malachite
Manganite
Marcasite
Melonite
Merenskyite
Millerite
Molybdenite
Monazite
Niccolite
Pentlandite
Phenakite
PGE-minerals
Pyrargyrite-group
Pyrite
Pyrochlore
Pyrolusite
Pyrrhotite
Rhodochrosite
Rutile
Samarskite
Scheelite
Siderite
Siegenite
Silver
Skutterudite
Sperrylite
Sphalerite
Stannite
Stibnite
Sudburyite
Sulpho-salts
Tellurobismuthite
Temagamite
Tennantite
Tenorite
Tetrahedrite
Thalenite
Thorite
Titanomagnetite
Ulvøspinel
Uraninite
Uranotile
Valleriite
Violarite
Wolframite
Xenotime
Yttrialite
Zircon

Gangue minerals

OPTIONS:

Actinolite
Aegirine
Albite
Allanite
Amazonite
Amphibole
Anatase
Andesine
Ankerite
Anthophyllite
Apatite
Asbestos
Barite
Biotite
Bytownite
Calcite
Carbonate
Chalcedony
Chlorite
Clinoamphibole
Clinozoisite
Cordierite
Corundum
Cummingtonite
Diopside
Dolomite
Enstatite
Epidote
Feldspar
Fluorspar
Fuchsite
Garnet
Graphite
Grunerite
Heulandite
Hoegtuvaite
Hornblende
Kyanite
Labradorite
Lepidolite
Magnesite
Mica
Microcline
Muscovite
Nepheline
Oligoclase
Olivine
Orthoclase
Plagioclase
Phlogopite
Potassic feldspar
Pyroxene
Quartz
Rhodochrosite
Rutile
Scapolite
Sericite
Serpentine
Siderite
Sillimanite
Spessartine
Spinel
Staurolite
Talc
Titanite
Topaz
Tourmaline
Tremolite
Vermiculite
Vesuvianite
Wollastonite
Zeolite
Zircon
Zoisite

Amount

The amount applies to both ore and gangue minerals.

OPTIONS:

```
Main mineral (>10%)
Subordinate mineral (1-10%)
Accessory mineral (<1%)
```

This percentage means parts of total ore or total gangue minerals. In this connection both ore and gangue minerals each will be 100 %.

2.6 Lithologies

The rock/rocks in which the mineralisation occurs (host rock) and/or which surrounds the mineralisation (wall rock) is to be registered here.

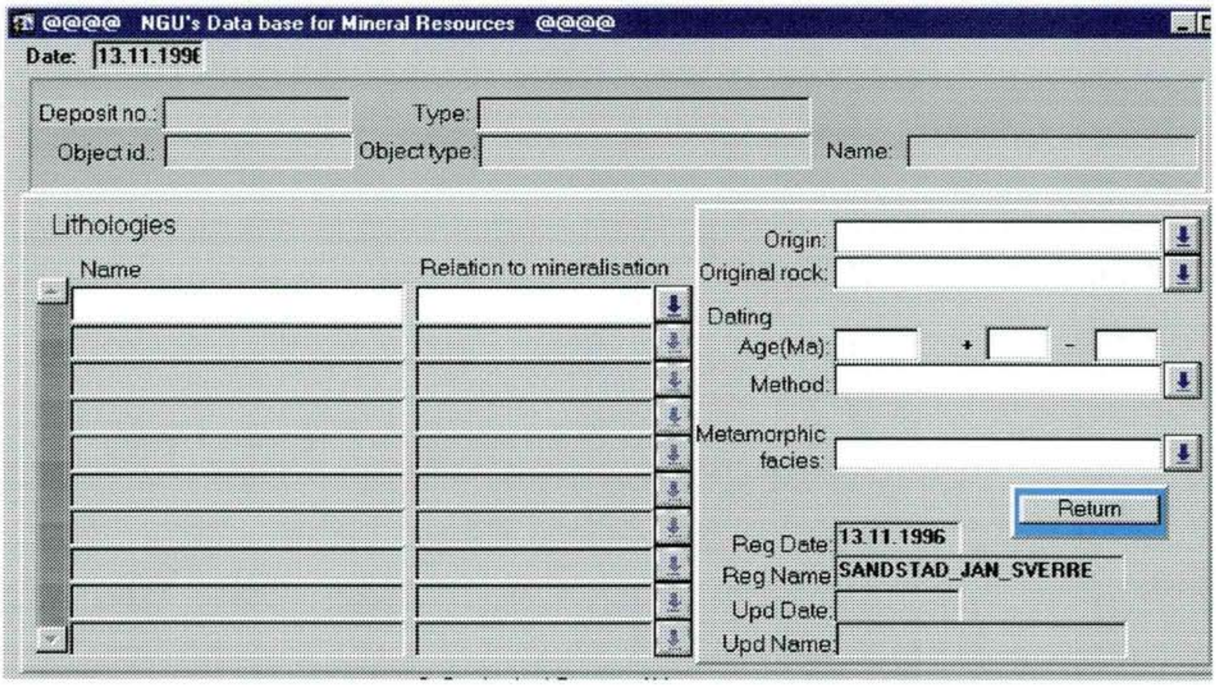

Figure 22. Registration of rocks.

Name

Formal and informal names of the rocks in which the deposit occurs are registered here. In order to achieve uniformity in naming of the rocks it is recommended that persons concerned with registrations to read Gjelle and Sigmond (1995). The part about metamorphic rocks is important regarding the use of the terms schist/phyllite and gneiss. In addition the hornblende-rich rocks of metamorphic origin are termed ultramafic amphibolite and not hornblendite which is a magmatic rock.

Relation to mineralisation

It is important to indicate whether the rock is a host rock or a wall rock.

Host rock: The rock in which the ore minerals occur.
Wall rock: The rock which encloses the host rock in the nearest neighbourhood.
(A deposit occurring in a great homogenous intrusive have no wall rock).

NB! Hydrothermal veins consisting of quartz etc. do **not** represent a host rock even though they contain younger veins of sulphide. In this case it is correct to record quartz as a gangue mineral (chapter 2.5.), while the host rock to the ore is the wall rock to the quartz vein. **Massive lenses and layers of sulphides and Fe-oxides have no host rock, only wall rocks.**

Origin

A general classification of the assumed origin of the registered rock.

OPTIONS:

```
Sedimentary
Extrusive
Intrusive
```

Original rock

The lithologies given in the option list below are taken from Gjelle and Sigmond (1995).

OPTIONS:

Sedimentary

```
Argillite
-bituminous argillite
-sandy argillite
Arkose
Bitumenite
Bentonite
Chert
Conglomerate (>2mm)
-sandy conglomerate
-muddy conglomerate
Diamictite
Dolomite
Evaporite
Exhalite
-siliceous rock (e.g.
 jasper, chert)
Limestone
-bituminous limestone
-dolomitic limestone
Marl
Sandstone (0.06-2 mm)
-arkosic sandstone
-conglomeratic
 sandstone
-quartz sandstone
-muddy sandstone
Sedimentary breccia
Siltstone (0.004-
          0.06mm)
Silty mudstone
-bituminous mudstone
-conglomeratic
 mudstone
Tillite
Tuffite
Wacke
-greywacke (dark
 wacke)
```

Extrusive

```
Andesite
-basaltic andesite
-olivine andesite
 (hawaiite)
Basalt
-alkaline basalt
-komatiitic basalt
-picrite
-tholeiitic basalt
Dacite
Keratophyre
Komatiite
Latite
Lehar
Leucitite
Melilite
-olivine melilite
Obsidian
Phonolite
Pyroclastics/tefra
-agglomerate (>64 mm)
-block breccia (>64
 mm)
-explosion breccia
 (pipe)
-ignimbrite
-lapilli rock
 (2-64 mm)
-lava breccia
-pillow breccia
-tuff
-tuffitic breccia
-volcanic breccia
Rhomb porphyry
Rhyodacite
Rhyolite
-alkali feldspar
 rhyolite
-peralkaline rhyolite
 (pantellerite)
Tefrite
Trachyte
-alkali feldspar
 trachyte
-peralkaline trachyte
Trachyandesite
-olivine
trachyandesite
(mugearite)
Trachybasalt
```

Intrusive
Anorthosite
-quartz anorthosite
-noritic anorthosite
Aplite
Carbonatite
-calcitic carbonatite (søvite)
-carbonatitic peridotite
-dolomitic carbonatite
-ferri-carbonatite (rauhaugite)
Damtjernite
Diorite
-quartz diorite
Dolerite
Dunite
Gabbro
-hornblende gabbro
-olivine gabbro
-pegmatitic gabbro
Granite
-alkali granite (peralkaline, ekerite)
-biotite granite
-granite pegmatite
-hornblende granite
-hypersthene granite (charnockite, farsundite)
-porphyry granite
Granodiorite
-hypersthene granodiorite (oppdalite)
Granophyre
Hornblendite
Ijolite
Jacupirangite
Kimberlite
Lamprophyre
Maenaite
Melteigite
Monzodiorite
Monzogabbro
Monzonite
-hypersthene monzonite (mangerite)
-quartz monzonite
-quartz hypersthene monzonite (quartz mangerite)
Norite
-anorthositic norite
-gabbro norite
-hornblende norite
-monzonorite (jotunite)
-olivine norite
Peridotite
Pyroxenite
Rhomb porphyry
Syenite
-alkaki syenite (peralkaline)
-alkali feldspar syenite
-hypersthene syenite
-nepheline syenite
-nepheline syenite pegmatite
-syenite pegmatite
-quartz syenite
Tonalite
-hypersthene tonalite (enderbite)
Troctolite
Trondhjemite

Dating, Age (Ma) and Method

If the rock has been age dated radiometrically the exact age (in mill. years) and method should be indicated. In addition a reference to a publication/source where the age determination is described must be cited under 'references'(2.12.). The list of methods is the same as for the mineralisation (Ch. 2.2).

OPTIONS:

Ar40/Ar39
Fission-track
K/Ar
Marker fossils
Os/Re
Pb/Pb
Rb/Sr
Sm/Nd
U/Pb
U/Th

Metamorphic facies

OPTIONS:

Unmetamorphosed
Zeolite
Greenschist
Amphibolite
Granulite
Eclogite
Contact *)

*)Contact metamorphic mineral parageneses must be proved before using contact as a designation. The presence of a deposit close to the contact of an intrusion is not sufficient to use the term contact as the grade of metamorphism.

2.7 Structures

Structures which either modify, control or otherwise are important to describe the deposit are registered here. Their relation to the ore and the deformation phase concerned are more clearly specified in the free text.

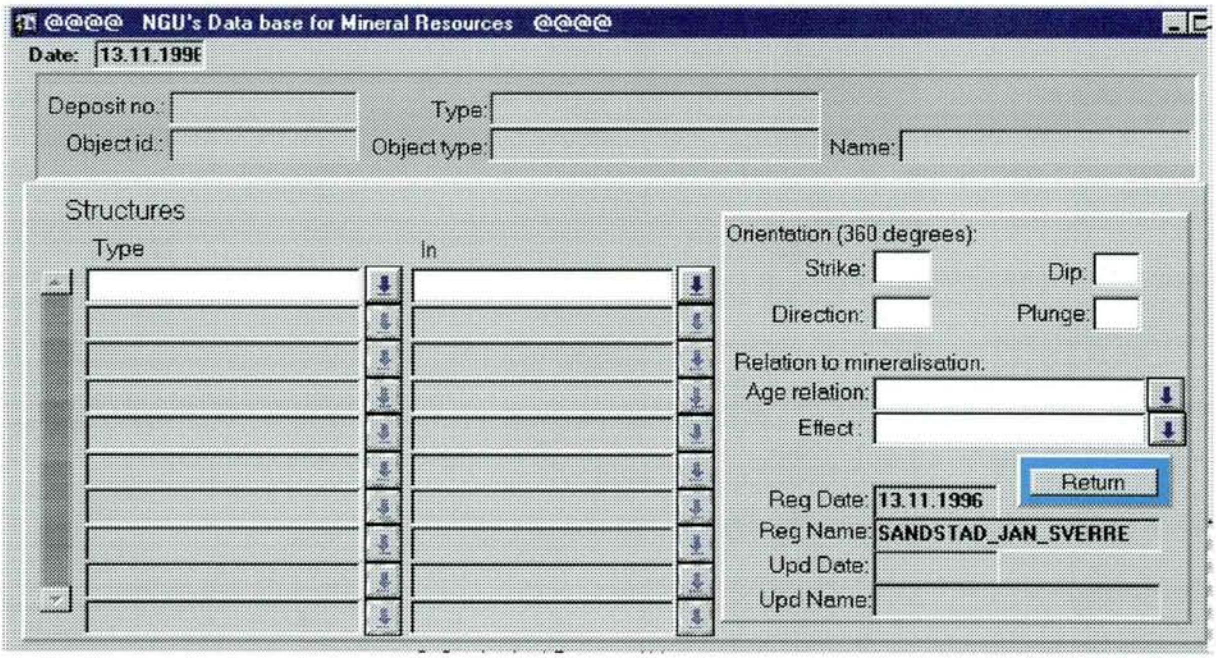

Figure 23. Registration of structures.

Type

OPTIONS:

```
Axial plane
Axial plane cleavage
Crenulation cleavage
Extensional lineation
Fault plane
Fold axis
Foliation
Fracture cleavage
Hydrothermal vein
Joint/Fracture
Mineral banding
Mineral lineation
Plane of brecciation (brittle shearing)
Primary layering
Rock contact
Schistosity
Shear plane (ductile shearing)
```

In

Register here if the structure occurs in the host rock or in the wall rock of the mineralisation.

Strike and Dip

Planar structures have a strike and dip. Measurement defined in the same way as for an ore body (Ch. 2.2.). **360° scale.**

Direction and Plunge

Linear structures have direction and plunge. **360° scale.**

Relation to mineralisation

The relative age of the structure and its effect on the mineralisation to be listed.

Age relation	*Effect*
OPTIONS:	OPTIONS:
`Pre - mineralisation`	`None`
`Syn - mineralisation`	`Modifies`
`Post - mineralisation`	`Controls`

2.8 Operations

All the activities of significance for the deposit is to be recorded here. Important events in the history of the deposit which do not fit into the table to be described in the free text.

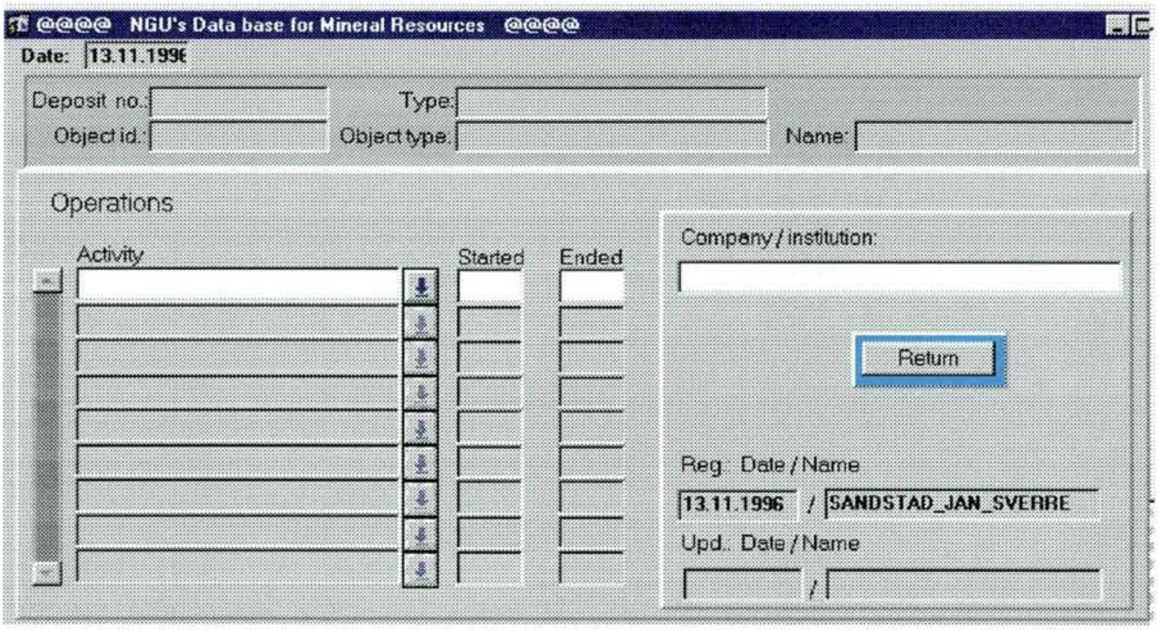

Figure 24. Production and investigation periods.

Activity

OPTIONS:

```
Core drilling                    Pitting
Geochemistry (sediments)         Regular production
Geology                          Sampling
Geophysics                       Test beneficiation
Inspection                       Test mining
```

Started and Ended

Year in which activity started and terminated. If the activity ceased the same year as it started the same year must be recorded.

Company/institution

The company/institution which carried out the investigation (or name of person) to be recorded here.

2.9 Products

Products are the metals which have economic significance for the deposit. The same elements shown under *type* in the first display (fig. 2) to be shown here, e.g. Cu, Au, Mo, etc.

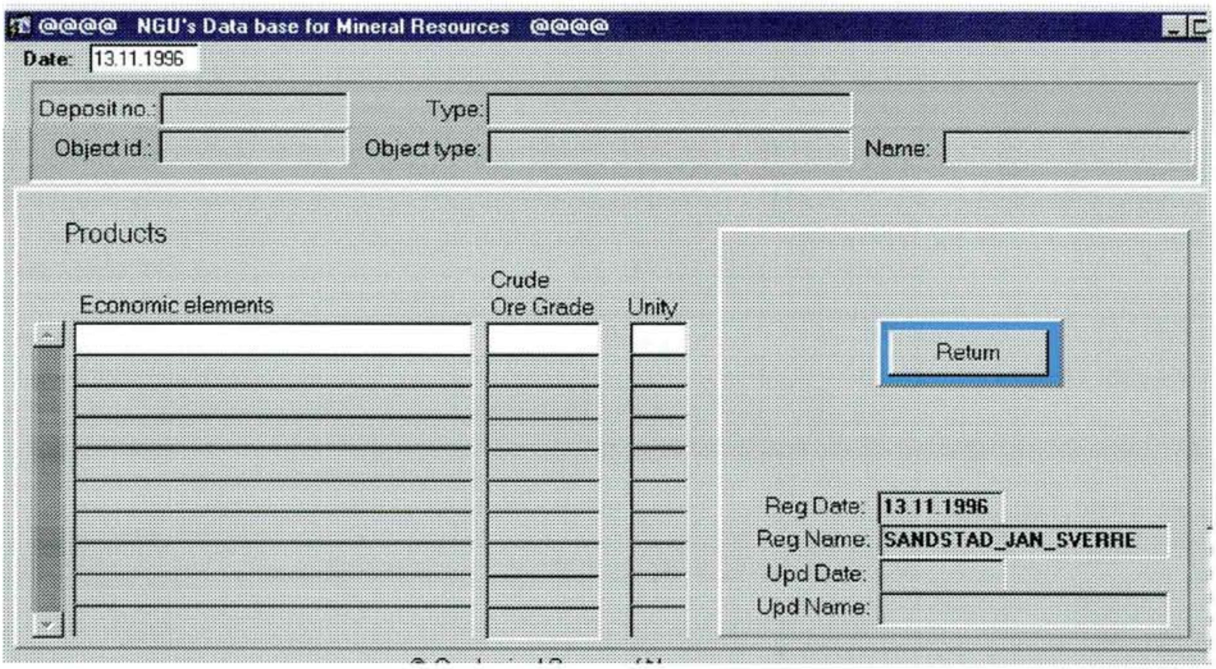

Figure 25. Registration of products and crude ore grade.

Economic elements

OPTIONS:

Ag	Fe-hem.	Pb	TiO_2
As	Fe-mag.	Pd	U
Au	Fe-total	PGE	V
Be	Mn	Pt	W
Co	MnO	REE	Y
Co (in pyrite	Mn-silicate	S	Zn
concentrate)	Mo	Sc	Zr
Cr	Nb	Sn	
Cu	Ni	Th	
Fe	P	Ti	

Crude ore grade

The crude ore grade shown here to be based on production results or an average of a large number of chemical analyses of samples from the deposit.

NB! The crude ore grade should neither be based on analyses of sampled material collected during ore registration nor by estimation.

Unity

Actual units are ppm, g/t and %.

2.10 Free text

The free text should unify the tabular material so that a complete description of the deposit is achieved. The text must be descriptive and should not include interpretations unless these are clearly indicated. The following features of a deposit should be amplified but not necessarily in the order shown below:

- Location, but without details unless the deposit is difficult to find.
- How the ore body is exploited/investigated (adits, incline shafts, open-pit, pitting etc.)
- Composition of the host and enveloping wall rocks, metamorphism (mineral association)
  and position in the local stratigraphy/tectonostratigraphy.
- Type of mineralisation, appearance, form, ore types, mineralogy, grain size, textural features, etc.
- Dimensions of the mineralisation, i.e. known length, breadth and possible extension downwards.
- Measured structures and their meaning in the tectonic and metallogenetic development, e.g. banding/foliation (S_0, S_1, S_2, S_3?), fold axes (F_1, F_2, F_3?) and lineation (L_1, L_2, L_3 ?).
- Other important features of the ore /mine, e.g. polluted areas, pollution in connection with drainage from mine openings, depositories and tips.

Free text can easily be too circumstantial and detailed. The important thing is to include information which is both **important** and **typical** for the deposit. It should be written in a **concentrated** form. Emphasis should be placed on good language. Free text is not meant to be a report but is more comparable to a resume about the deposit. Remember that this is a data base and not all detailed information about a deposit can be entered. Nor is it necessary to repeat what others have published previously, - this should be registered under references, and reference made in the free text to publications in the reference list.

2.11 Samples

In order to make an easy identification of samples taken from a deposit the following system has been developed:

> The samples are first given the same number as the deposit, then a full stop and finally two numbers. Example: NO0717.05. The number shows that this is sample no. 5 is collected from deposit no. 717 in **No**rdland.

This number system has functioned well and given a good picture of the sample collection at Løkken.

Samples collected must be related to a deposit or locality/minor prospect to be registered in the data base. A reference sample for all samples must be stored at Løkken. The co-ordinates of the samples are registered in the first screen; 'General information' after the option 'Sample point' have been selected for 'Object type' (see 2.1.). The rest of the registrations are made in a screen as shown below:

Figure 26. Registration and description of samples.

No.

This consists of two sets of figures. The first has two letters which indicate the county and four digits which is the number of the deposit, then, after the full stop, two further digits. The latter are for samples and are the only numbers which change for the deposit. Samples numbered 01 to 99 can be registered for each deposit.

It is most practical to give the samples only one number, in the manner described above. This is however not possible in all cases. If the sampled deposit is still not registered in the data base or its registration number is unknown, the samples must be given a temporary number (field number) until the deposit is registered and the final sample numbers can be given. All samplers are free to choose a system of field numbers but these are always temporary and are not to be registered in the data base.

Type
Sample type to be registered.

OPTIONS:

```
Bedrock sample
Core sample
Dump sample
```

NB! Loose blocks of uncertain origin are not acceptable as sample type and shall not be registered as analytical sample.

Stored
Name of place where the sample is stored.

Size
If you wish you estimate how heavy the sample is.

Sampler
Name of the person who collected the sample.

Description/remarks

This is the free text space in which the sample is described, for example, in terms of rock, grain size, specially high content of specific minerals etc. This must be written in a concentrated form but should also be intelligible for persons other than the sampler.

2.12 References

All types of references about a deposit (older reports, maps, publications etc.) are to be registered.

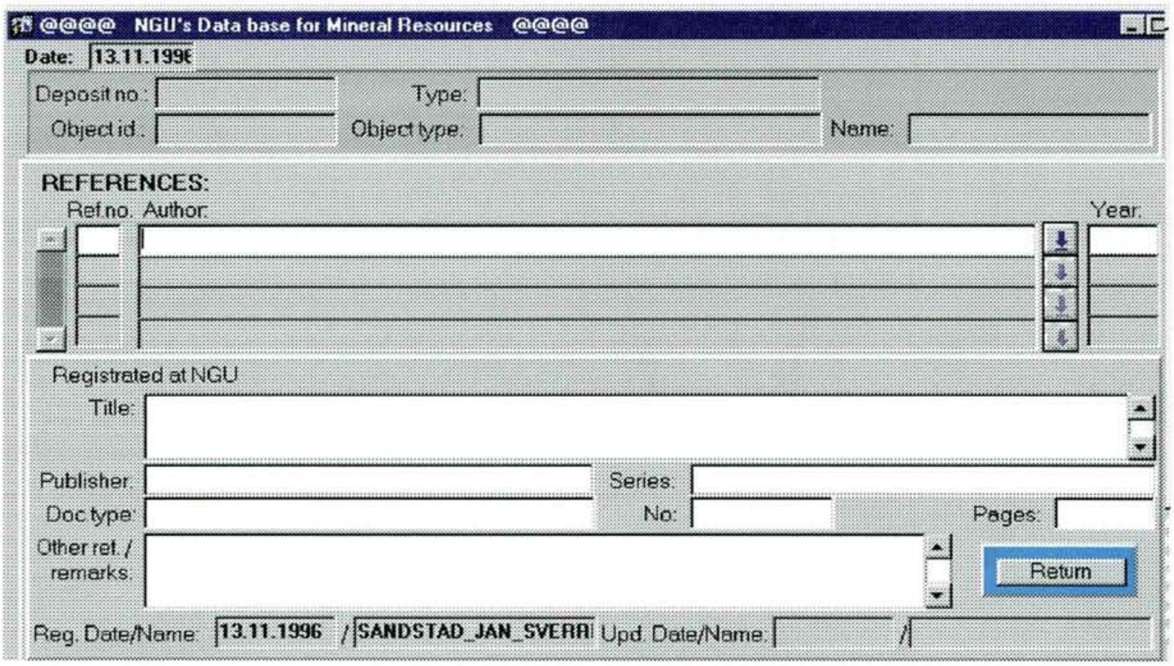

Figure 27. Registration of references.

Registered at NGU

The first part of the screen is used for references earlier registered at the Reference archive at NGU. Criterion's registering are, author, year of publishing, title, publisher, series, document type, volume number and number of pages. After entering certain search criteria a list with references is shown on the screen. When choosing the right report from this list all the options automatically are filled in.

Other references/remarks

If there is a reference which is not registered in NGU's reference archive, it is listed here. Reports in archives at quarries and mines in production usually are not registered at NGU, but still it is important that they are registered in the data base as they often contain important information about the deposits. When production stops these reports are transferred to the Directorate Of Mines.

In addition, comments to references can be recorded.

3. FINAL COMMENTS

This version of the Ore Data Base is based on 6-7 years experience with the collection and entering of data. The most important change from the previous version regarding the content of the data base is that the country is now subdivided into main geotectonic units with associated figures and options. It became evident that this was the only way to systematise the stratigraphic positioning of the deposits.

The content of the data base is now so well studied that only cosmetic changes should be necessary in the future. **Major changes must be very well founded** since this will cause much extra work bearing in mind how much has already been surveyed and entered. A new technical instruction user manual will be prepared for the Windows version of the data base.

4. LITERATURE

Furuhaug, L. 1993: Veiledning ved utfylling av feltskjema for Malm-, Industrimineral- og Natursteinsdatabasene, NGU internal report 93.012, pp 1-32.

Foslie, S. 1925: Syd-Norges gruver og malmforekomster. I. NGU 126, pp 1-89 + map.

Gjelle, S. & Sigmond, E.M.O. 1995: Bergartsklassifikasjon og kartsammenstilling. NGU Skrifter 113, 76 p. + plates.

Kollung, S. 1990: The Surna and Orkla nappes of the Surnadal-Orkdal district, southwestern Trondheim region. Nor. geol. unders. Bull. 418, pp 9-17.

Krill, A.G. 1985: Relationships between the Western Gneiss Region and the Trondheims Region: *Stockwerk*-tectonics reconsidered. *In* Gee, D.G. and Sturt, B.A. (eds), *The Caledonide orogen: Scandivavian and related areas.* J. Wiley & Sons, Chichester, pp 475-483.

Morland, E. & Grøvlen, Ø. 1992: Brukerveiledning for databaseapplikasjon for dokumentregistrering (Dok. 6811.16). NGU internal report 92.061, pp 1-29.

Morland, E. 1993: Brukerveiledning for Malmregisteret, Versjon 1.0 (Dok. 6811.23). NGU report 93.028, pp 1-54.

Poulsen, A.O. 1958: Norges gruver og malmforekomster. II. NGU 204, pp 1-101 + 2 maps.

Robinson, P. 1995: Extension of Trollheimen tectonostratigraphic sequence in deep synclines near Molde and Brattvåg, Western Gneiss Region, southern Norway. Nor. geol. tidskr. 75, pp 181-198.

Tucker, R.D. 1986: Geology of the Hemnefjord-Orkanger area, south-central Norway. Nor. geol. unders. Bull. 404, pp 1-21.

Registreringsskjema.

Forekomster i Malmdatabasen ved NGU.

1. Generelle opplysninger.

Forekomstnr.		Foriba id.	

Navn	
Annet navn	
Type	
UTM: Sone	
Øst	
Nord	
Bekreftet	
Kart 1:250 000 (navn)	
Kart 1:50 000 (nr.)	
Fylke	
Kommune	
Oppdatert	
Befart	

2. Mineraliseringen.

Tidsæra	
Periode	
Radiometrisk datering/metode	± ,
Antatt genese	
Form	
Dominerende malmtekstur	
Dominerende mineralfordeling	
Dominerende kornstørrelse	
Viktigste sidestensomvandling	
Strøk/fall (°)	/
Retning/stup (°)	/

3. Stratigrafisk klassifikasjon av vertsbergart.

Tidsæra	
Periode	
Provins	
Geologisk hovedenhet	
Tektonisk enhet/kompleks	
Intrusivkompleks	
Gruppe	
Formasjon	

4. Teknisk informasjon.

Virksomhetens omfang	
Driftsmetode	
Reserver	mill. tonn
Totalproduksjon	mill. tonn
Anslått tippvolum	m^3

5. Mineralogi.

Malmmineraler	Mengde	Malmmineraler	Mengde	Gangmineraler	Mengde	Gangmineraler	Mengde

Registreringsskjema.

Forekomster i Malmdatabasen ved NGU.

1. Generelle opplysninger.

Forekomstnr.		Foriba id.	
Navn			
Annet navn			
Type			
UTM: Sone			
Øst			
Nord			
Bekreftet			
Kart 1:250 000 (navn)			
Kart 1:50 000 (nr.)			
Fylke			
Kommune			
Oppdatert			
Befart			

2. Mineraliseringen.

Tidsæra	
Periode	
Radiometrisk datering/metode	± ,
Antatt genese	
Form	
Dominerende malmtekstur	
Dominerende mineralfordeling	
Dominerende kornstørrelse	
Viktigste sidestensomvandling	
Strøk/fall (°)	/
Retning/stup (°)	/

3. Stratigrafisk klassifikasjon av vertsbergart.

Tidsæra	
Periode	
Provins	
Geologisk hovedenhet	
Tektonisk enhet/kompleks	
Intrusivkompleks	
Gruppe	
Formasjon	

4. Teknisk informasjon.

Virksomhetens omfang	
Driftsmetode	
Reserver	mill. tonn
Totalproduksjon	mill. tonn
Anslått tippvolum	m^3

5. Mineralogi.

Malmmineraler	Mengde	Malmmineraler	Mengde	Gangmineraler	Mengde	Gangmineraler	Mengde

Forekomstnr. |_|_|_|_|_|_|

6. Litologi.

Bergart	V/S	Alder/metode	S/E/I	Tolket opprinnelse	Metamorfosegrad
		± ,			
		± ,			
		± ,			
		± ,			

7. Strukturer.

Strukturtype	V/S	Strøk/retning	Fall/stup	Aldersforhold til min.	Effekt på mineralisering

8.Produkter/råmalmgehalt.

Produkt	Råmalmgehalt

9. Drifts- og undersøkelsesperioder.

Virksomhet	Tidsrom	Selskap
	-	
	-	
	-	
	-	
	-	
	-	
	-	

10. Mindre skjerp.

Feltene 1, 4-9 og fritekst fylles ut på egne skjema når opplysningene er forskjellige i forhold til hovedforekomsten.

Nr.	Navn	Sone	UTM-øst (6 siffer)	UTM-nord (7 siffer)

Fritekst, prøveregistrering, og referanser skrives på baksiden av skjemaet eller på eget ark. Ved registrering av en prøve må det anmerkes om den skal knyttes til hovedforekomsten, et mindre skjerp eller registreres som eget prøvepunkt.