SKB

TECHNICAL REPORT

91-01

Description of geological data in SKB Database GEOTAB Version 2

Stefan Sehlstedt, Tomas Stark
SGAB, Luleå

January 1991

SVENSK KÄRNBRÄNSLEHANTERING AB
SWEDISH NUCLEAR FUEL AND WASTE MANAGEMENT CO

BOX 5864 S-102 48 STOCKHOLM

TEL 08-665 28 00 TELEX 13108 SKB S
TELEFAX 08-661 57 19

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Information on SKB technical reports from 1977-1978 (TR 121), 1979 (TR 79-28), 1980 (TR 80-26), 1981 (TR 81-17), 1982 (TR 82-28), 1983 (TR 83-77), 1984 (TR 85-01), 1985 (TR 85-20), 1986 (TR 86-31), 1987 (TR 87-33), 1988 (TR 88-32) and 1989 (TR 89-40) is available through SKB.

SWEDISH GEOLOGICAL CO
Division of Engineering Geology
Client: SKB

REPORT
ID-no: IRAP 90085
Date: 1991-01-24

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1 INTRODUCTION

Since 1977 the Swedish Nuclear Fuel and Waste Management Co, SKB, has been performing a research and development programme for final disposal of spent nuclear fuel. The purpose of the programme is to aquire knowledge and data of radioactive waste. Measurements for the characterisation of geological, geophysical, hydrogeological and hydrochemical conditions are performed in specific site investigations as well as for geoscientific projects.

Large data volumes have been produced since the start of the programme, both raw data and results. During the years these data were stored in various formats by the different institutions and companies that performed the investigations. It was therefore decided that all data from the research and development programme should be gathered in a database. The database, called GEOTAB, is a relational database. It is based on a concept from Mimer Information Systems, and have been further developed by Ergodata. The hardware is a Vax 750 computer located at KRAB (Kraftverksbolagens Redovisningsavdelning AB) in Stockholm.

The database comprises six main groups of data volumes. These are:

- Background information
- Geological data
- Geophysical data
- Hydrogeological and meteorological data
- Hydrochemical data
- Tracer tests

In the database, background information from the investigations and results are stored on-line on the VAX 750, while raw data are either stored on-line or on magnetic tapes.

This report deals with geological data and describes the dataflow from the measurements at the sites to the result tables in the database. All of the geological investigations were carried out by the Swedish Geological Survey, before 820701, and by Swedish Geological Co, SGAB, after that date.

The geological investigations have been divided into three categories, and each category is stored separately in the database. They are:

- Surface Fractures
- Core Mapping
- Chemical Analyses

At SGU/SGAB the geological data were stored on-line on a PRIME 750 mini computer, on microcomputer floppy disks or in filed paper protocols. During 1987 the data files were transferred from SGAB to datafiles on the VAX computer. The data from the protocols were punched to data files either on the PRIME (before the transfer) or on the VAX. The flyleafs (tables containing background data) were also punched, transferred and loaded into the database.

In the following chapters the data flow of each of the three geological information categories are described separately.

2 SURFACE FRACTURES

Two different methods to collect surface fracture data has been used by SKB. In the GEOTAB database data is stored in two methods:

- SFRACT (data collected by SGAB)
- OFRAC (data collected by VIAK)

Data collected by SGAB is described below.

2.1 SURFACE FRACTURES COLLECTED BY SGAB

When studying the qualities of the bedrock at the SKB study sites, information about small fractures in outcrops have been systematically collected. More than 10 sites spread all over Sweden have been investigated. Investigations done after 1981 at the study sites Fjällveden, Gideå and Kamlunge have been stored in a fracture database at the Swedish Geological Co and further processed with computer programs. For earlier study sites such as Sternö, Kynnefjäll, Finnsjön, Svartboberget, Taavinunnanen, Gunnarsdjupträsk, Kärkejaure and Vittangi, information is only available as hand-written forms.

See Figure 2.6 for a description of the surface fractures dataflow.

2.1.1 Acquisition of surface fracture data

The spatial distribution of fractures measured when performing a linesampling survey on an outcrop gives the frequency of all fractures crossing a scan-line (see Figures 2.1 and 2.2). It gives information of anomalous fracturing, but the number is often strongly biased (Tirén 1986).

The method used for representing fracture information in the SKB study site program is based on a proposal (Ahlbom 1980) using an orthogonal configuration of two sampling lines (Figure 2.3). The fracture number is here defined as the frequency of intersections between the fractures and the sampling lines irrespectively of the orientation of the fractures. This method has a relatively good reproducibility and is rather fast operating (Tirén 1986 and Ahlbom 1980).

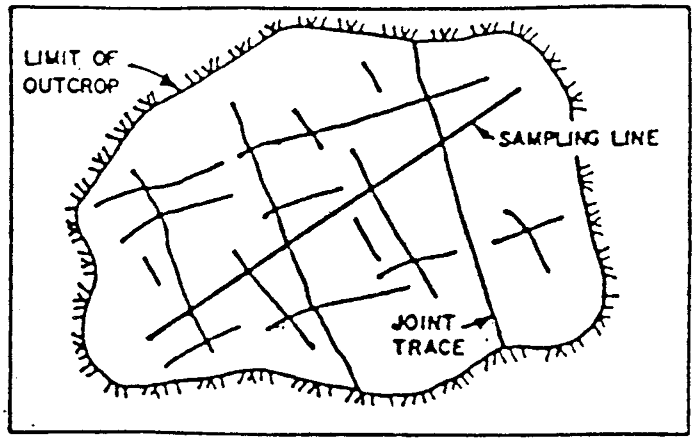

Figure 2.1 Intersections of joints with outcrop in plan view. Note that longer joint traces have a higher probability of intersecting sampling line than do shorter traces. (Beacher 1983)

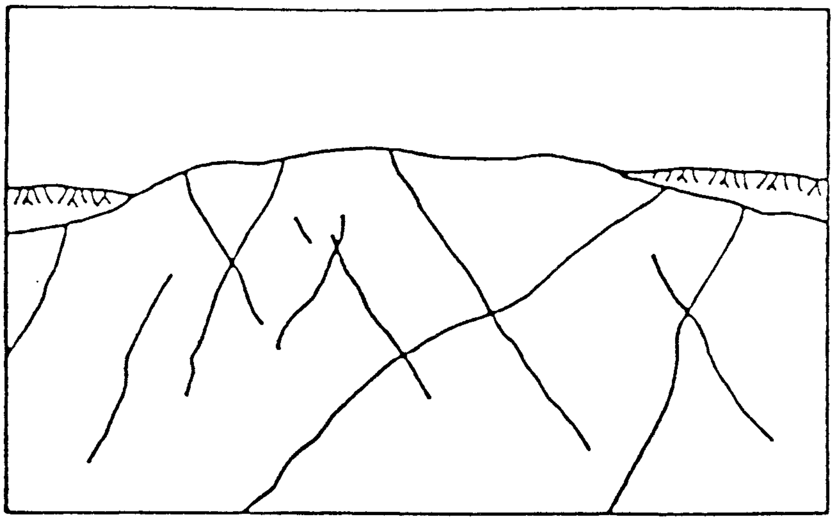

Figure 2.2 Profile view of joints intersecting an outcrop. Note that larger joints have a proportionately greater possibility of striking outcrop than do small joints. (Beacher 1983)

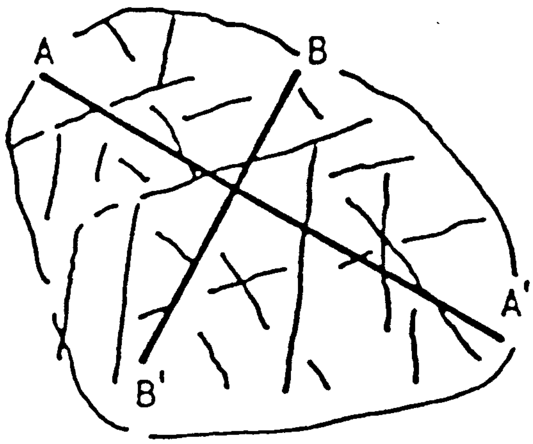

Figure 2.3. Sampling line configuration on an outcrop.

Sampled data is written on forms (see Appendices A-1 to A-5), and later punched and stored into a MIMER database on the PRIME mini computer at SGAB in Luleå.

The forms contain the following information:

<u>Area information</u>

- Area code
- Map sheet number
- Area name
- Y RAK coordinate
- X RAK coordinate

<u>Measuring cross data</u>

- Area code
- Cross number
- Y RAK coordinate
- X RAK coordinate
- Sampling line A
  - orientation
  - length (in meters)
- Sampling line B
  - orientation
  - length (in meters)
- Rock code (see Appendix C-2)

Fracture data

- Area code
- Cross number
- Sampling line (A or B)
- Order number
- Strike
- Dip
- Number of fractures
- Type of fracture (open, sealed, closed or combinations of these)
- Width (in mm)
- Length (in meters)
- Character, minerals (see Appendix C-1)

Structural data

- Area code
- Cross number
- Order number
- Element (eq lineation, axial plane etc)
- Strike
- Dip

Comments

- Area code
- Cross number
- Order number
- Comment text

2.1.2 Processing of surface fracture data

A fracture analysis program including features such as:

- Fracture grouping
- Fracture frequency calculation
- Gefüge diagram
- Rosette diagram
- Parameter discrimination
- Dip/fracture plot

has been used for the processing of surface fracture data. Figure 2.4 is a flow chart for the Fracture Analysis System. Figure 2.5 shows an example of rosette diagrams generated with the Fracture Analysis System.

2.1.3 Evaluation of surface fracture data

Processed surface fracture information has been used during the initial characterization of rock qualities of study site areas within the SKB study site program (eg Ahlbom et al 1980, Tirén et al 1981).

2.1.4 Surface fracture data in GEOTAB

Surface fracture data are stored in the following GEOTAB tables:

Flyleaf and background information

SFRACTF1	Area information; date, mapping crew, responsible person, references
SFRACTF2	Comments
SFRACTF3	Measuring crosses; orientation and length
ACROSS	Measuring crosses; RAK X and Y coordinates

Data

SFRD	Rock type
SFRDD	Fractures; profile, orientation, dip, type, width, length, characteristics
SFRND	Fractures; number of fractures, length, characteristics
SFRSD	Structural data; orientation, dip, element

Lexicons

SFLE	Element codes lexicon	(see Appendix C-4)
FLR	Rock codes lexicon	(see Appendix C-2)
FLM	Mineral codes lexicon	(see Appendix C-1)
SFLF	Fracture codes lexicon	(see Appendix C-4)
SFLP	Profile codes lexicon	(see Appendix C-4)

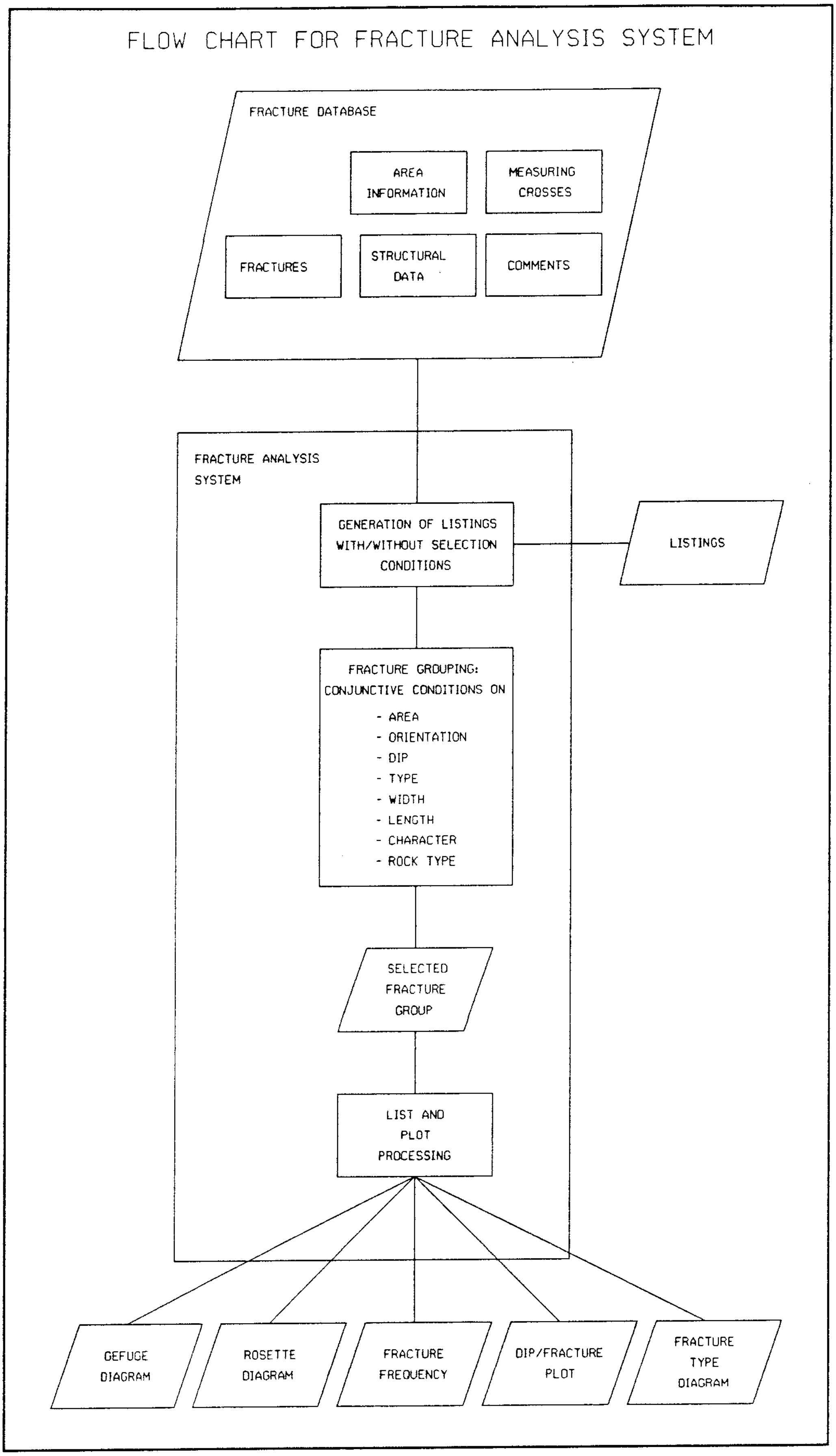

Figure 2.4 Flow chart for Fracture Analysis System

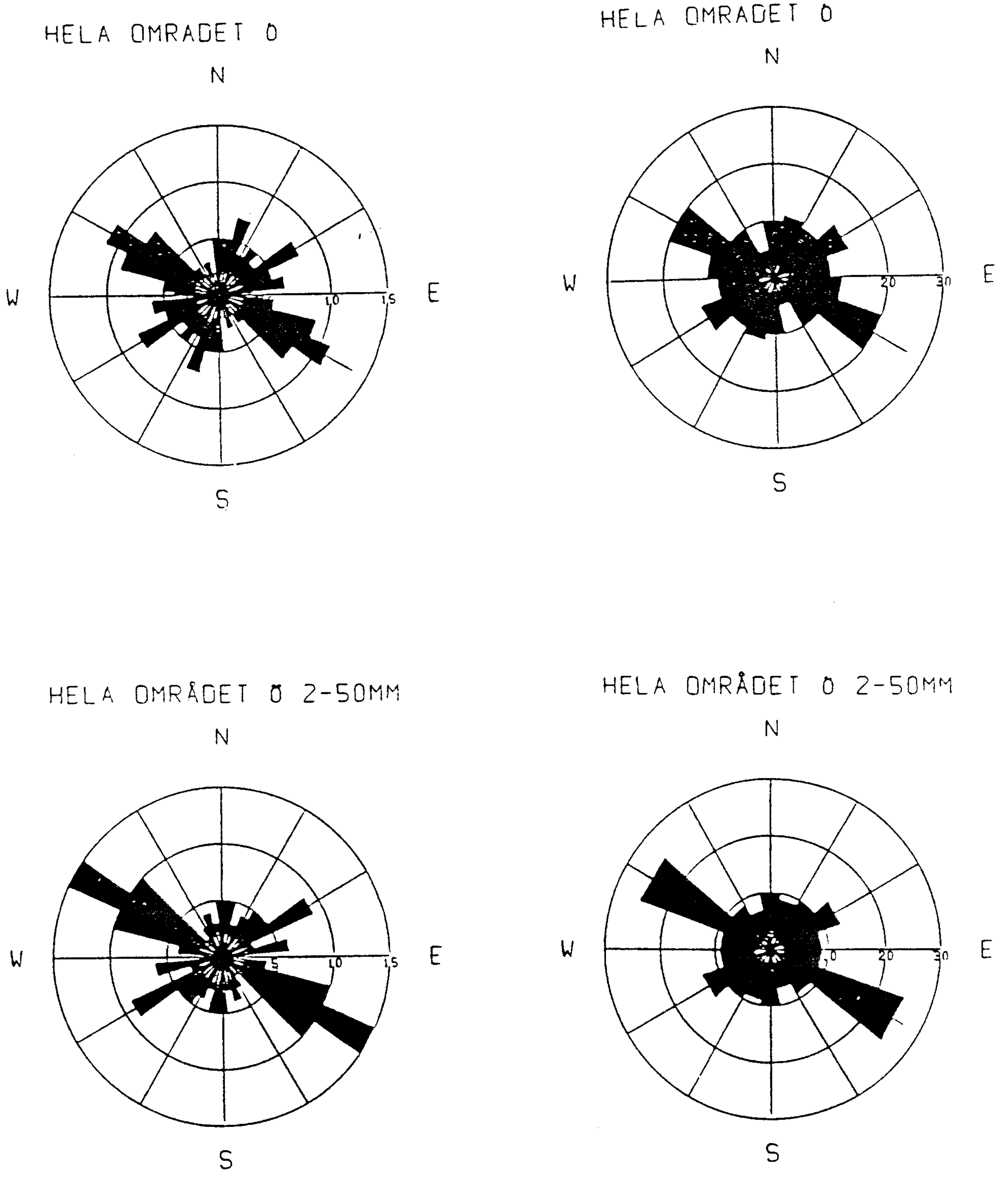

Figure 2.5 Example of generated rosette diagrams

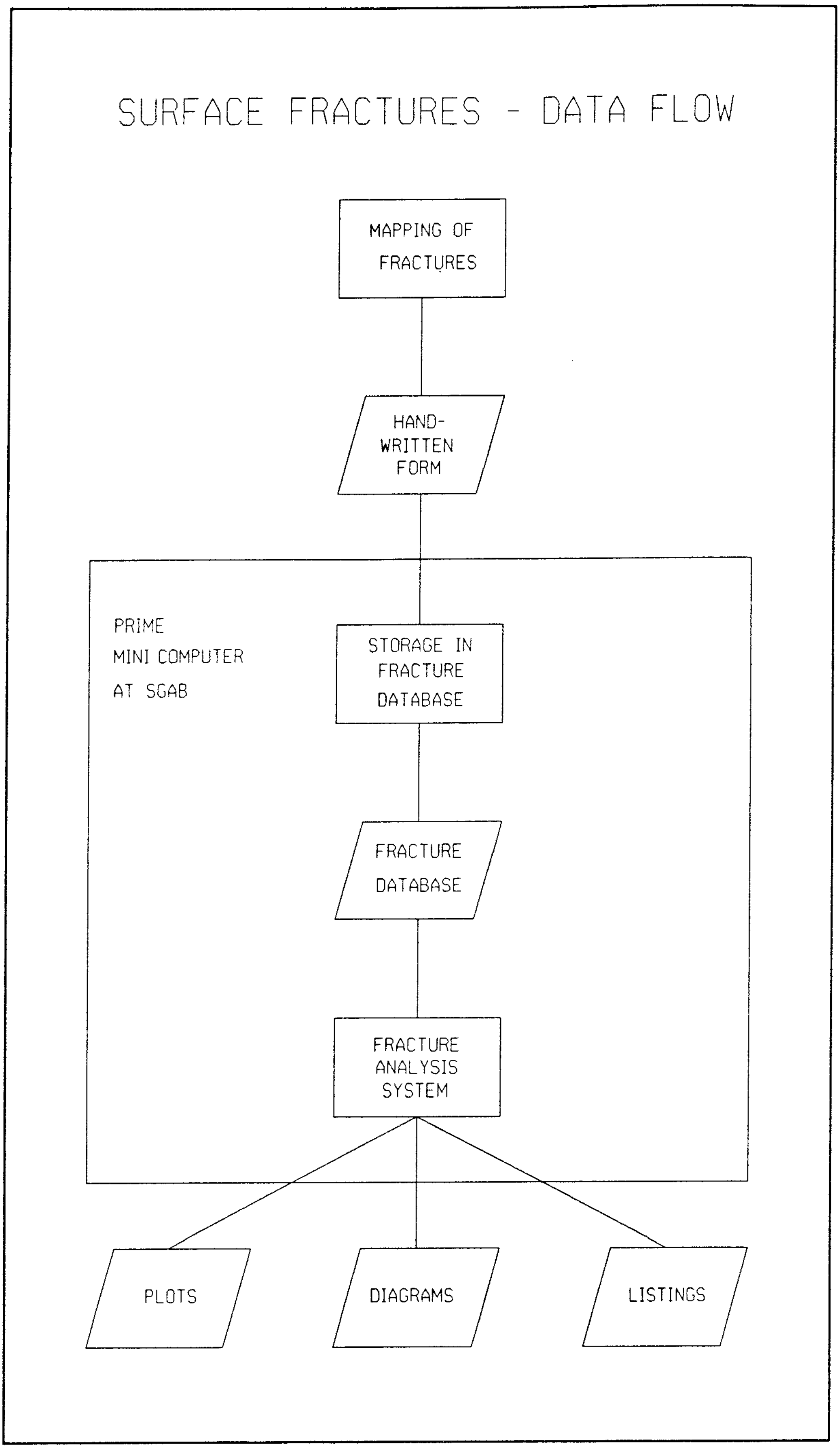

Figure 2.6 Surface Fractures - Data Flow

2.2 SURFACE FRACTURES COLLECTED BY VIAK

The surface fracture mapping conducted by VIAK is described below. The work is reported in SKB PR 25-87-05.

Among other preinvestigations a fracture mapping program was carried out before the establishment of the SKB Hard Rock Laboratory. The mapping was made on outcrops in the close area adjacent to Simpevarp as well as in the region between Oskarshamn and Västervik.

In Figure 2.7 the data flow of collected fractures is presented.

2.2.1 Acquisition of surface fracture data

The collection of data were carried out as a surface cell mapping. Each cell represents a circular outcrop, part of outcrop or road cut. The size of a cell was if possible chosen to give 100-150 fractures/cell. The fractures, exceeding 0.5 m in length, were measured on outcrops with areas ranging from 30 to 200 m2.

Sampled data is written on a form (see Appendix A-6) and later punched into a Lotus 1-2-3 table at VIAK in Göteborg.

The form contains the following information:

- Map code
- Square number
- Locality description
- Rocktype (dominating)
- Foliation
- Cell area (m2)
- Outcrop number
- Strike
- Dip
- Number of fractures
- Fracture fillings
- Length (dm)
- TGF (Truncation, Movement,Foliation)
- Notes

2.2.2 Processing of surface fracture data

Collected data were processed and presented in different ways. Fractures collected from outcrops was presented as follows:

- "Fingerprint diagrams"
- Rosette diagrams

Fractures collected from road cuts were presented as follows:

- Schmidt nets

or

- Rosette diagrams
- Dip rose diagrams

2.2.3 Evaluation of surface fracture data

Evaluation of collected data was reported in the following reports:

- regional data (SKB PR 25-87-05)
- data from Äspö island (SKB PR 25-88-10)

2.2.4 Surface fracture data in GEOTAB

To store the data in GEOTAB three tables was created. Efforts were made to get a data structure similar to other GEOTAB tables. To achieve this, a number of modifications of original data was made. Some of these were done by VIAK before delivery of data to SGAB:

- an areacode was added
- a fictive mapping date was added
- truncation codes for regional data and Äspö data was modified (codes used in the database is presented in Table 2.1).

Other changes was made by SGAB in dBase IV:

- TGF was splitted into three variables, Truncation, Movement and Foliation
- length was changed from dm to m to adapt to SI system
- mineral codes were changed to fit the codes in the Petro Core Mapping System
- rocktype codes were changed to fit the codes in the Petro Core Mapping System (in co-operation with SGU and VIAK)
- rocktype characteristics used in Petrocore were added (in co-operation with Kornfält, SGU)
- one variable, ALTER, was added for registration of oxidized fractures

The final dBase files (*.DBF) were transferred to the SKB Vax 750 and loaded into GEOTAB.

Surface fracture data are stored in the following GEOTAB tables:

Flyleaf and background information

OFRACF1 Mapping information; areacode, outcrop number, date, mapping crew, responsible person, company, reference

OFRACF2 Outcrop information; areacode, outcrop number, date, co-ordinates, rocktype and rocktype characteristics, area

Data

OFARCD	Areacode, outcrop number, fracture number, date, fracture characteristics, orientation, dip

Lexicons

FLM	Mineral codes lexicon (see Appendix C-1)
FLR	Rock codes lexicon (see Appendix C-2)
PCLRCOL	Rock colour lexicon (see Appendix C-7)
PCLRSTR	Rock structure lexicon (see Appendix C-7)
PCLRINT	Rock structure intensity lexicon (see Appendix C-7)
PCLRGRA	Rock grain size lexicon (see Appendix C-7)
PCLRTEX	Rock texture lexicon (see Appendix C-7)

Table 2.1 Truncation (intersection and termination) codes for fractures

0	Not intersected by any other fracture, both terminations visible
1	Intersected by one fracture and both terminations visible
2	Intersected by two or more fractures and both termination visible
3	Not intersected by any fracture, one visible termination, the other covered by soil
4	Not intersected by any fracture. Both terminations hidden.
5	As code 3 regarding terminations but intersected by one fracture
6	As code 3 regarding terminations but intersected by two or more fractures
7	As code 4 regarding terminations but intersected by one fracture
8	As code 4 regarding terminations but intersected by two or more fractures
9	The fracture terminates in one end in another fracture
10	The fracture terminates in both ends in other fractures
11	As code 9, but the other termination is hidden
9-11:	These codes are used for outcrop numbers lower than 140. Fracture intersections are not registered.

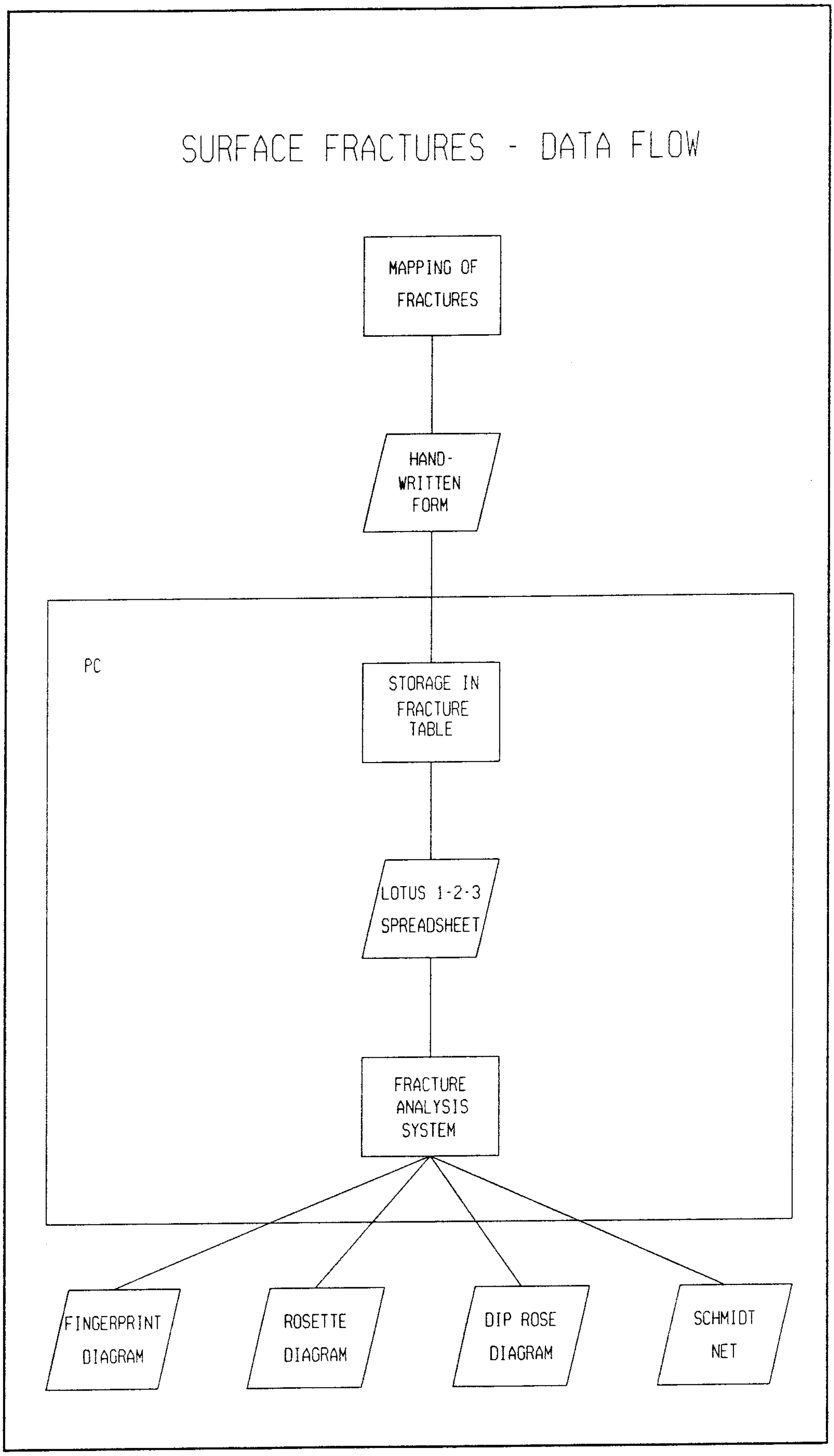

Figure 2.7 Surface fractures (VIAK) - Data Flow

3 CORE MAPPING

Core mapping has been performed at the following study sites:

-	Finnsjön	6 boreholes
-	Gallejaur	1 borehole
-	Gideå	13 boreholes
-	Kamlunge	16 boreholes
-	Klipperås	14 boreholes
-	Lansjärv	1 borehole
-	Laxemar	1 borehole
-	Taavinunnanen	1 borehole
-	Äspö	12 boreholes
-	Ävrö	1 borehole

The impact has been on fracture mapping, with a detailed mapping of single fractures, fracture zones and crushed zones. The rock mapping has been limited to rock type and angle to core axis.

The core mapping data flow is described in Figure 3.1.

For a sample compilation of core mapping data for the Klipperås study site see (Egerth 1986).

3.1 ACQUISITION OF CORE MAPPING DATA

3.1.1 History

Before 1982 core mapping was registered on forms. A handdrawn corelog was produced for presentation of the mapped information.

In the beginning of 1982 SKB decided to develop a microcomputer based Core Mapping System to:

- rationalise the core mapping process
- automaticallly generate plotted "core logs"
- provide for further data processing by more strict codification of data

3.1.2 Data acquisition on forms

Before autumn 1982, acquisition of core mapping data was done on paper forms (see Appendix B-1) and presented as hand-drawn "core logs" showing fractures, fracture zones, crushed zones, rock type, fracture angles, minerals etc (see Appendix B-2).

3.1.3 Data acquisition with the Core Mapping System

The Core Mapping System was developed by SGAB, and implemented on an ABC800 microcomputer with dual 5 1/4" floppy disk drives and an attached Epson MX-100 matrix printer. The software was written in ABC BASIC and built around a commercial database system called

"Basregister 800 Version 1.4". The main functions of the Core Mapping System are:

- Fracture mapping
- Rock type mapping
- Plotting of "core log"
- Calculation of fracture frequencies
- Plotting of fracture frequencies
- Listing of rock zones
- Listing/editing of database records
- Miscellaneous data administrative functions, such as floppy disk formatting, backup routine etc

Version 1 of the system was used from autumn 1982. During 1985 Version 2 of the system was developed. Version 1 is completely in Swedish, whereas Version 2 is completely in English. In Version 2 some improvements were made, for example a more detailed mapping of fracture zones. The following chapters will describe Version 1 of the system, since nearly all investigated areas up to the date of this report are mapped with Version 1.

See (Stark 1983) for a user description of the Core Mapping System.

3.1.3.1 Fracture and rock type mapping

The following list comprises the main menu of the fracture and rock type mapping routine in the system:

1 - Fractures, coated
2 - Fracture zone
3 - Crushed zone
4 - Sealed fracture
5 - Fresh fracture
6 - Uptake
7 - Rock type
8 - Core loss
9 - Notes

The user enters a depth (rounded to nearest 5 cm), and then selects the choice from the main menu, consistent with the core observation. Some menu choices have sub-menus, some do not. All choices will be explained in the chapters below. All menu texts have been translated into english in this report, though they are in Swedish in the Core Mapping System Version 1.

<u>Fractures, coated</u>

The coated fractures menu has the following contents:

```
Number of fractures (1-99):
        Angles from (0-90):
                  to (0-90):
    Parallel foliation (Y/N):
                  Mineral 1:
```

Mineral 2:
Mineral 3:
Mineral 4:
Mineral 5:
Surface (V,S,O,P,L,M,Ö):

The surface character codes have the following meanings:

Table 3.1. Surface character codes

Swedish code		English code
V	Weathered	W
S	Smooth	S
O	Rough	R
P	Polished	P
L	Slickenside	L
M	Coated	C
Ö	Other	X

In Version 2 the surface character codes were translated to english equivalents (see Table 3.1). These english equivalents are also used consistently in the GEOTAB database, even if data acquisition was originally performed with Version 1 of the Core Mapping System.

Mineral codes used conform to the code dictionary defined by the Swedish Geological Survey (see Appendix C-1).

Fracture zone

Begins or Stops (B/S):
Coated or Fresh (C/F):
Number of parallel (0-99):
Angles from (0-99):
to (0-99):
Number of crossing (0-99):
Angles from (0-90):
to (0-90):
Parallel foliation (Y/N):
Mineral 1:
Mineral 2:
Mineral 3:
Mineral 4:
Mineral 5:
Surface (V,S,O,P,L,M,Ö):

Crushed zone

Begins or Stops (B/S):
Mineral 1:
Mineral 2:
Mineral 3:
Mineral 4:
Mineral 5:
Surface (V,S,O,P,L,M,Ö):

Sealed fracture

This choice has no sub-menu. The given depth will be marked to contain a sealed fracture.

Fresh fracture

This choice has no sub-menu. The given depth will be marked to contain a fresh fracture.

Uptake

This choice has no sub-menu. The given depth will be marked to contain a core uptake.

Rock type

Rock code:
Prefix code:
Angle:

Rock and prefix codes used conform to the code dictionary defined by the Swedish Geological Survey (see Appendix C-2 and C-3). The parameter "Angle" is the angle to the core axis in degrees.

Core loss

Begins or Stops (B/S):

The given begin and stop depths will be marked as core loss borders.

Notes

Note (max 20 chars):
Should the note be printed on the core log plot (Y/N):

Notes are maximised to 20 characters and may optionally be printed at the core log plot.

3.1.3.2 Listing/editing of database records

With the database system routines in "Basregister 800", all data records stored with the Core Mapping System may be listed and edited. Also searching for specific data may be performed, but is seldom used in practice since it is more convenient to incorporate frequent searches in specific application programs and routines (like for instance fracture frequency calculation). In general, there is also seldom much use for the editing facilities, since the Core Mapping procedure has built in data checking for inconsistencies and errors.

3.1.3.3 Miscellaneous data administrative functions

Included in the system are also routines for floppy disk formatting, backup of floppy disks and "Basregister 800" routines for "reparing" of databases that has been damaged due to floppy disk failures. Also included in the "Basregister 800" package, are routines for sorting database registers and for mathematical operations on database registers.

3.2 PRESENTATION OF CORE MAPPING DATA

3.2.1 Potting of core log

A core log plot may be produced with the system, comprising all information stored for the complete borehole core (see Appendix B-3). A description of the plot layout is also produced by the system (see Appendix B-4).

3.2.2 Plotting of fracture frequency

The calculated fracture frequencies may be plotted on an attached HP7475A pen plotter. This routine will be described in the "Data processing" chapter.

3.2.3 Listing of rock zones

A printout of rock sections may be generated with the system. This routine will be described in the "Data processing" chapter.

3.3 PROCESSING OF CORE MAPPING DATA

3.3.1 Calculation

3.3.1.1 Fracture frequency

A fracture frequency calculation routine is included in the Core Mapping System. The fracture frequency for coated fractures may be calculated, where selection conditions for minerals and/or angle to core interval, may be set by the user.

For example, the fracture frequency for all fractures coated with the mineral calcite and with an angle to core between 30 and 60 degrees may be calculated. The section length may be chosen by the user, but is usually set to 1 meter.

Since the fractures in a fracture zone are collectively registered, the fracture frequency calculation routine will "spread" the number of fractures in the zone at equal distances, and if angle selection conditions are set, the number of fractures in the registered angle interval at equal distances.

Example:
A fracture zone between depths 53.00 m and 54.70 m is registered to contain 8 fractures in the angle interval 30-45 degrees. These 8 fractures will be placed at equal distances in the angle interval (30, 32.14, 34.29, 36.43, 38.57, 40.71, 42.86 and 45 degrees). If an angle selection condition is set to the angle interval 40-60 degrees, only 3 of the 8 fractures will be included in the fracture frequency calculation (40.71, 42.86 and 45 degrees). These 3 fractures will be spread at equal distances in the depth interval 53.00-54.70 m (53.00, 53.85 and 54.70 m).

Crushed zones will have a pre-defined fracture frequency of 50 fractures per meter.

3.4 EVALUATION OF CORE MAPPING DATA

Core mapping data have been used to evaluate:

- the distribution of different rock types
- the location of fracture zones in the bedrock and their orientation
- the distribution of different minerals in the fracture zones and solid rock
- correlations to geophysical loggings
- alteration of fracture zones
- ground water flow
- water chemistry

By using computer based core mapping it has been possible to evaluate core mapping data in a more objective and systematic way, compared to solely manual methods.

3.5 CORE MAPPING DATA IN GEOTAB

Core mapping data are stored in the following GEOTAB tables:

<u>Flyleaf information</u>

CFRACTF1 Borehole information; date, mapping crew, responsible person, references
CFRACTF2 Borehole comments
CFRACTF3 Core mapping comments

Data

FRACTURE	Fractures; depth, angle interval, type, number of fractures
PARAFOL	Parallel foliation; depth
CRUSHZ	Crushed zones; depth
CLOSS	Core losses; depth
UPTAKE	Uptakes; depth
MINERAL	Minerals; depth, mineral code
CHARACTE	Fracture surface character; depth, character code
ROCK	Rock types; depth, prefix code, rock code, angle to core axis

Lexicons

CMLFT	Fracture type lexicon (see Appendix C-5)
CMLC	Fracture surface character lexicon (see Appendix C-5)
CMLPC	Prefix code lexicon (see Appendix C-3)
FLR	Rock code lexicon (see Appendix C-2)
FLM	Mineral code lexicon (see Appendix C-1)

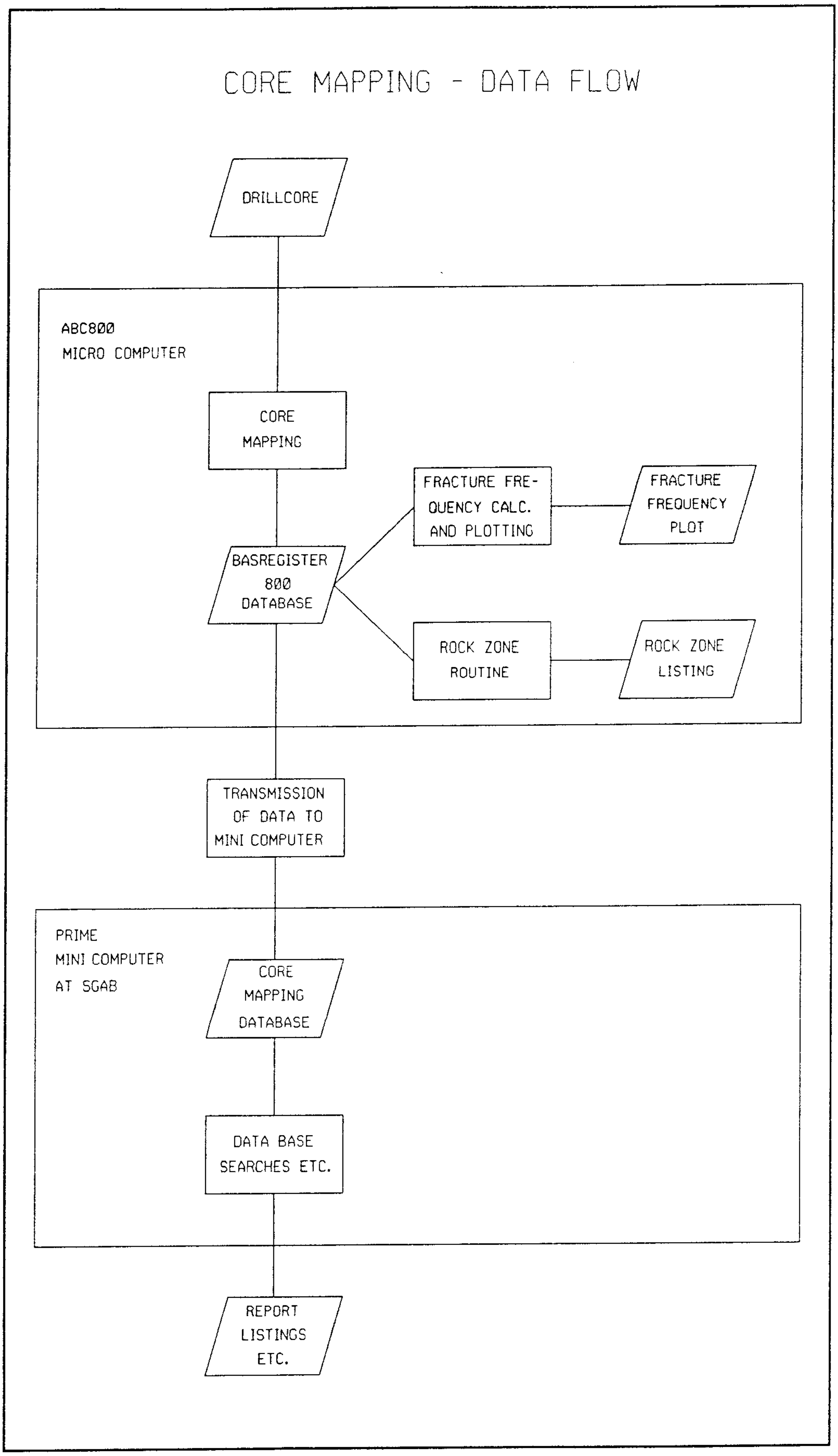

Figure 3.1 Core Mapping - Data Flow

4 CORE MAPPING 1988-

The core mapping data flow is described in Figure 4.1.

4.1 ACQUISITION OF CORE MAPPING DATA

4.1.1 History

The Core Mapping System on ABC 800 finally reached its limits. Since early 1988 a new PC data acquisition system have been in use.

4.1.2 Data acquisition with the Petro Core Mapping System

The Petro Core Mapping System was developed by Petro bloc AB, and implemented on a PC with 3.5" floppy disk drive and an attached HP 7475 pen plotter. The software was built around a commercial database system called "Dataflex". The main programs of the Petro Core Mapping System handle:

- Collection of data
- Presentation of data on lists or with printer graphics
- Calculation of joint frequencies and RQD
- Plotting of data on multicolour plots
- Drawing of stereographic projections of the orientation of joints in oriented cores

Version 1 of the system was used from early 1988.

See (Ludvig 1988) for a user description of the Petro Core Mapping System (version 1.11). Version 2 is now in use, but no manual is yet available.

4.1.3 Core mapping

The following list comprises the main features mapped in the system. Each number is a so called variable.

The user enters upper and lower section length, a variable number and codes consistent with the core observation. All codes will be explained in the chapters below.

4.1.3.1 Description of variables and subvariables

Each variable is described with one or several subvariables. A complete description of variables and subvariables is found in Appendix D.

Table 4.1 Variables used in Petro Core.

1	Break
2	Natural fractures
3	Sealed fractures
4	Crush zones
5	Rock type
6	Structure
7	Alteration
8	Uptake
9	End of orientation
10	Orientation of fractures
11	Core loss
12	Box
18	Position
19	Drill method
103	Fracture orientation

4.2 PRESENTATION OF CORE MAPPING DATA

4.2.1 Multicolour plotting

A plot showing the core mapping along the borehole may be generated and plotted with an attached HP7475A pen plotter (see Appendix B-7). Any section, scale and configuration of variables may be choosen for the plot.

4.2.2 Listings and printer output

Three types of reports may be generated in the system:

- List of variables (Appendix D-1)
- List of core
- Printer graphics

The lists may be directed to the attached printer and/or on a disk file.

4.2.3 Stereographic projections

If fractures are orientated it is possible to present these fractures in stereographic projections of different types. Both Schmidt- and Wulf-net presentations are available (Appendix B-8).

4.3 PROCESSING OF CORE MAPPING DATA

4.3.1 Calculation

A fracture frequency calculation routine is included in the Petro Core Mapping System. The fracture frequency for coated fractures may be calculated, where selection conditions for minerals and/or angle to core interval, may be set by the user.

- Joints/m
- RQD

Crushed zones are defined by section limits and length of core pieces.

4.3 EVALUATION OF CORE MAPPING DATA

Core mapping data have been used to evaluate:

- the distribution of different rock types
- the location of fracture zones in the bedrock and their orientation
- the distribution of different minerals in the fracture zones and fractures
- correlations to geophysical loggings
- alteration of fracture zones
- water chemistry

By using computer based core mapping it has been possible to evaluate core mapping data in a more objective and systematic way, compared to solely manual methods.

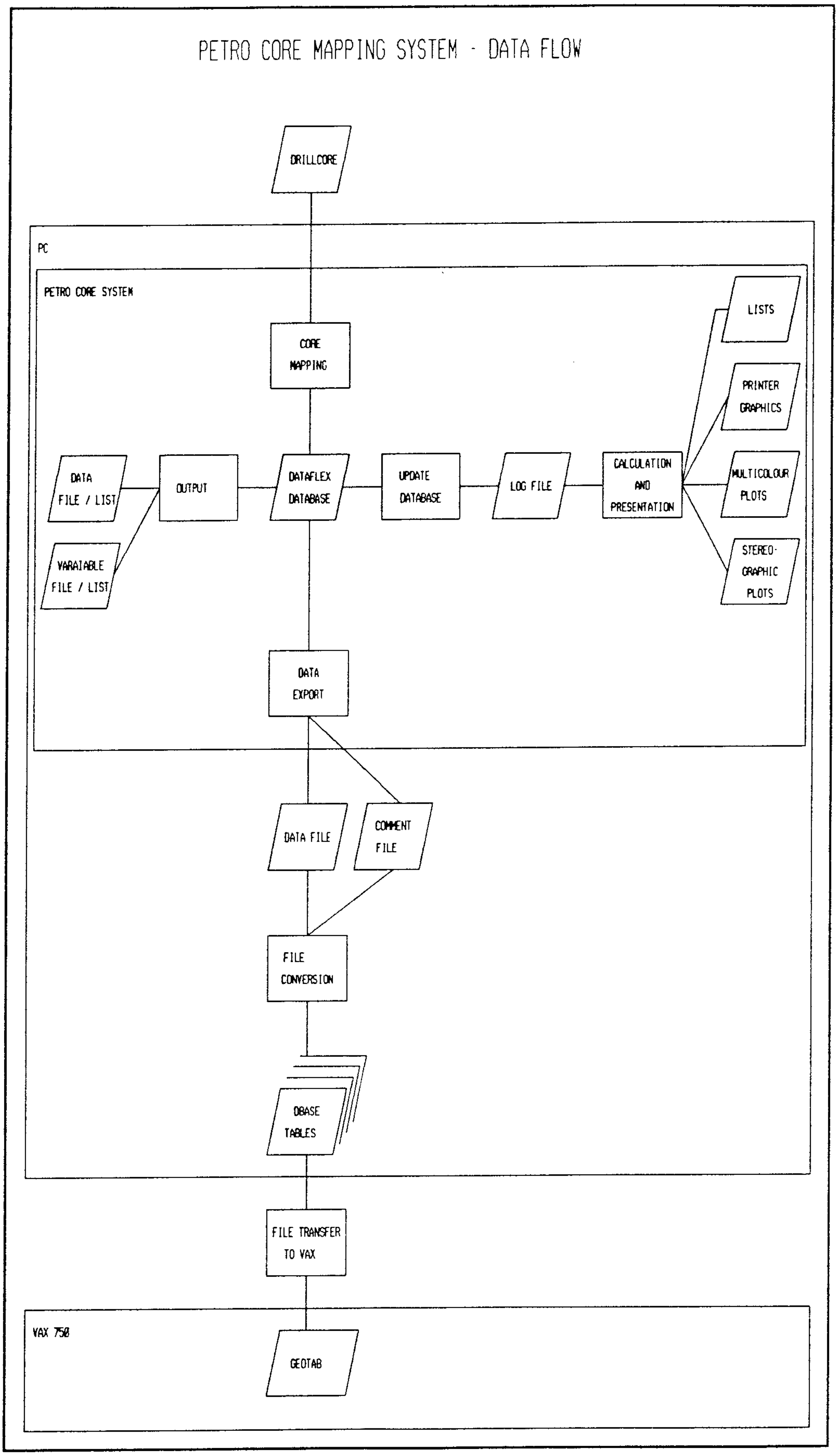

Figure 4.1 Petro Core Mapping - Data Flow

4.4 CORE MAPPING DATA IN GEOTAB

Core mapping data are stored in the following GEOTAB tables:

Flyleaf information

PCFRACF1	Borehole information; date, mapping crew, responsible person, references
PCFRACF2	Borehole comments
PCFRACF3	Core mapping comments

Data

ALTER	Alteration; from\to length, alteration code, intensity code
BREAK	Break; from\to length, break code
CORECOM	Core comment; from\to length, comment
COREREC	Core recovery; from\to length, recovery code, marked length, length difference
CORLOS	Core loss; from\to length, core loss code
CRUSH	Crushed zone;from\to length, piece length
ENDORI	End of orientation; from\to length, code, correction angle
FILL	Fracture filling; from\to length, observation variable
NJOINT	Natural joint; from\to length, fracture width
ROCKTYPE	Rocktype; from\to length, rock code, structure code, intensity code, grain size code, texture code
RORIANG	Orientation; from\to length, variable,alpha angle, beta angle, strike, dip, quality
ROUGHN	Roughness; from\to length, variable, fracture roughness
SJOINT	Sealed joint; from\to length, fracture width
SKIN	Fracture skin; from\to length, skin code
STRFEA	Structural feature; from\to length, structural feature code, structural feature intensity code
SURFACE	Fracture surface; from\to length, fracture surface code
VEIN	Vein; from\to length, rocktype code

Lexicons

PCLBREAK	Core break lexicon
PCLRCOL	Rock type colour lexicon
PCLRSTR	Rock type structure lexicon
PCLRINT	Rock type structure intensity lexicon
PCLRGRA	Rock type grain size lexicon
PCLRTEX	Rock type texture lexicon
PCLSTRU	Rock type structure lexicon
PCLSTRIN	Rock type structure intensity lexicon
PCLALTER	Alteration lexicon
PCLAINT	Alteration intensity lexicon
PCLRECOV	Core recovery lexicon
PCLEO	End of orientation lexicon
PCLOF	Oriented fractures lexicon

PCLCL	Core loss lexicon
PCLVAR	Variable lexicon
PCLROUGH	Fracture roughness lexicon
PCLSURF	Fracture surface lexicon
PCLSKIN	Fracture skin lexicon
FLR	Rock code lexicon (see Appendix C-2)
FLM	Mineral code lexicon (see Appendix C-1)

5 CHEMICAL ANALYSES

Analyses of rock and core samples have been performed to a minor extent within the SKB study site program. Analyses have been performed on samples from the Fjällveden, Gideå, Kamlunge, Klipperås, Svartboberget and Taavinunnanen study sites.

The chemical analyses data flow is described in Figure 5.1.

Petrophysical analyses of rock and core samples are described in the report "Description of geophysical data in SKB's database GEOTAB", which is being written parallel to this report.

5.1 ACQUISITION OF CHEMICAL ANALYSES DATA

Rock and core samples collected at the study sites have been sent to the laboratory at the Swedish Geological Co in Luleå, to be analyzed. Several different sample preparation, sample treatment and analyzing methods have been used, including:

Sample preparation

- Grinding in steel mill
- Grinding in tungsten carbide mill
- Grinding with additive in steel mill
- Grinding with additive in tungsten carbide mill

Sample treatment

- Grinding isoformation
- Dissolution after melting
- Total dissolution
- Total dissolution (HF, H_2SO_4)
- Acid leaching (HNO_3, HCL)
- Gas generation
- Melting

Analyzing method

- Atomic absorption
- Atomic absorption (flame emission)
- X-ray fluorescence analysis
- Jumbo spectrophotometry
- Spectrophotometry
- Spectrometry (colorimetry)
- Electrochemistry
- Gravimetry
- Titrimetry

Analyses have been stored in a MIMER database on the PRIME mini computer at SGAB in Luleå.

5.2 PROCESSING OF CHEMICAL ANALYSES DATA

Chemical analyses data has not been further processed, only listed in reports etc.

5.3 EVALUATION OF CHEMICAL ANALYSES DATA

The analyses data has been used for rock classification where manual methods have been insufficient, or to chemically confirm manual interpretations.

5.4 CHEMICAL ANALYSES DATA IN GEOTAB

Chemical analyses data is stored in the following GEOTAB tables:

Flyleaf information

ARCHEMF	Area information; date, mapping crew, responsible person, references
BRCHEMF	Borehole information; date, mapping crew, responsible person, references

Data

ARCHEMD1	Rock sample analyses; trace elements
ARCHEMD2	Rock sample analyses; main elements
ARCHEMD3	Rock sample analyses; oxide elements
ARCHEMD4	Rock sample analyses; remaining elements
BRCHEMD1	Core sample analyses; trace elements
BRCHEMD2	Core sample analyses; main elements
BRCHEMD3	Core sample analyses; oxide elements
BRCHEMD4	Core sample analyses; remaining elements

Lexicons

RCLAM	Analyzing method code lexicon (see Appendix C-6)
RCLST	Sample treatment code lexicon (see Appendix C-6)
RCLSP	Sample preparation code lexicon (see Appendix C-6)

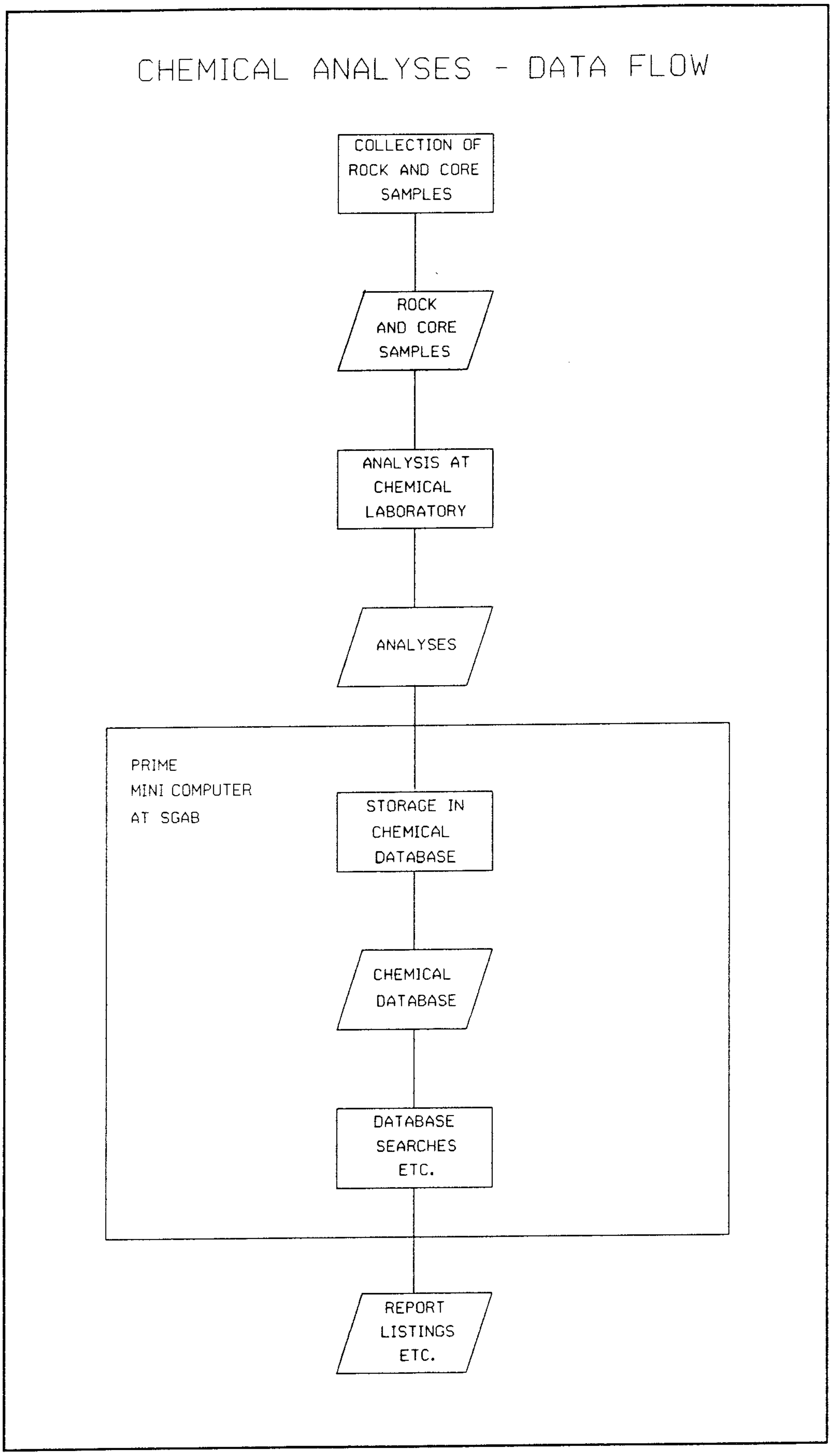

Figure 5.1 Chemical Analyses - Data Flow

6 ACKNOWLEDGEMENTS

Version 1

The author wishes to thank Bengt Gentzschein, Göran Nilsson, Stefan Sehlstedt and Sven Tirén for their help during the writing of this report.

Tomas Stark
Luleå, April 1988

Version 2

The author wishes to thank Tomas Stark, Allan Stråhle and Lars O. Ericsson for their help during the revision of this report.

Stefan Sehlstedt
Luleå, November 1990

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HUVUDDATA

PT (1)	GDA (3)	OMR NR (7)	TOP (12)	OMRÅDETS NAMN (17)	Y (33)	X (40–46)
01	BDAD	0201	19JNV	GIDEÅ	1664100	7045300
		0202	19JNV	GIDEÅ	1663250	7045750
		0203	19JNV	GIDEÅ	1663300	7045100
		0204	19JNV	GIDEÅ	1664000	7044500
		0205	19JNV	GIDEÅ	1664350	7045950
		0206	19JNV	GULLMYRBERGET	1664500	7043800
		0207	19JNV	FAGERMYRBERGET	1663000	7046750
		0208	19JNV	SJÖBOTTBERGET	1659300	7044300
		0209	19JNV	FILLINGEN	1672400	7041000
		0210	19JNV	HÖVATTBERGET	1661850	7040200

APPENDIX A-2

Surface fracture form - Measuring cross data

MÄTKORSDATA

PT (1)	GDA (3)	OMR NR (7)	KORS NR (12)	Y-KOORD (16)	X-KOORD (23)	PROFIL A ORIENT (30)	PROFIL A LÄNGD (34)	PROFIL B ORIENT (39)	PROFIL B LÄNGD (43)	BERGART (48)
02	BDAD	201	1	1664095	7045320	N37W	15.0	N60E	9.5	MHA
		201	2	1664005	7045265	N78W	13.0	N25E	11.5	MHA
		201	3	1664130	7045265	N08E	14.0	N52W	10.0	MHA
		201	4	1664135	7045305	N90W	20.3	N06W	10.0	MHA
		201	5	1664155	7045370	N42E	24.5	N33W	12.0	MHA
		202	1	1663335	7046630	N22E	15.0	N62W	10.0	MHA
		202	2	1663225	7046825	N50E	27.0	N34W	13.6	MHA
		202	3	1663180	7046895	N80E	23.5	N20W	10.5	MHA
		202	4	1663215	7046705	N60E	17.8	N32W	10.2	MHA
		202	5	1663240	7046635	N26E	18.0	N65W	11.0	MHA
		203	1	1663330	7044935	N68E	16.1	N22W	9.6	MHA
		203	2	1663355	7045050	N28E	18.6	N62W	12.5	MHA
		203	3	1663320	7045105	N45E	15.5	N52W	15.8	MHA
		203	4	1663280	7045185	N10W	19.5	N82E	10.0	MHA, HSB
		203	5	1663240	7045195	N76E	27.0	N27W	22.7	MHA
		204	1	1663785	7044570	N28W	12.7	N58E	20.0	MHA
		204	2	1663720	7044410	N10E	17.4	N85E	8.5	MHA, MHB
		204	3	1664015	7044670	N62W	18.2	N45E	24.6	MHA
		204	4	1664060	7044615	N12E	40.7	N80W	14.8	MHA
		204	5	1664200	7044525	N04W	23.2	N88E	13.2	MHA
		205	1	1664395	7044800	N[illegible]E	16.7	N15W	[illegible]	[illegible]
		205	2	1664340	7044860	N85W	13.4	N08W	11.5	MHA
		205	3	1664390	7045010	N14E	17.4	N85W	16.2	MHA
		205	4	1664335	7045060	N12W	16.6	N72W	13.5	MHA
		205	5	1664290	7045075	N46E	32.9	N45W	9.5	MHA
		206	1	1664500	7043920	N14W	13.9	N78E	9.6	MHA
		206	2	1664460	7043800	N12E	46.4	N72W	14.0	MHA
		206	3	1664500	7043800	N10W	32.0	N80E	17.0	MHA
		206	4	1664480	7043680	N62E	21.4	N0[illegible]W	12.0	MHA
		206	5	1664400	7043800	N90E	17.5	N10E	13.0	MHA
		207	1	1663070	7046690	N46V	32.5	N47E	19.5	MHA

APPENDIX A-3

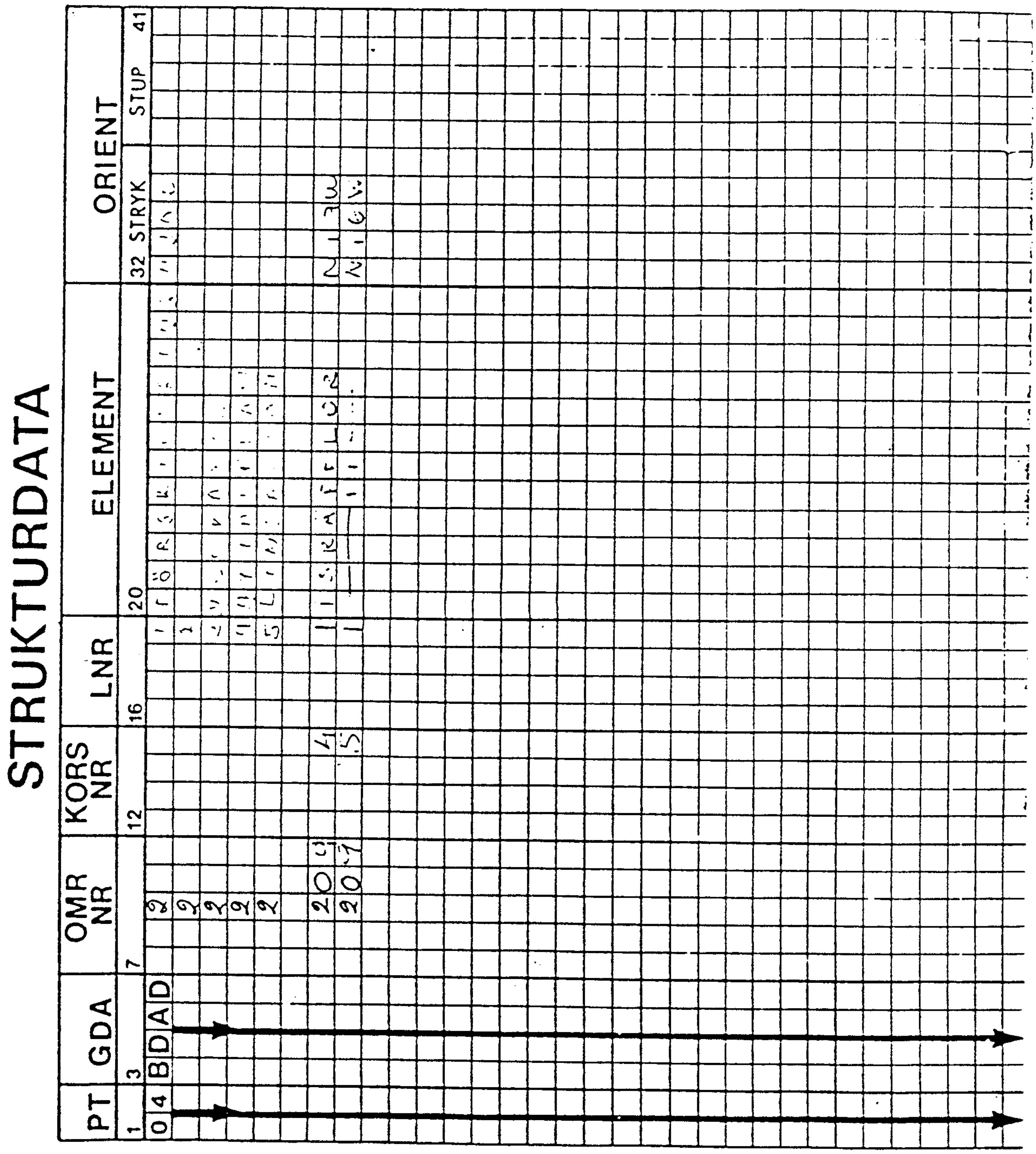
Surface fracture form - Fracture data

SPRICKDATA

PT	GDA	OMR NR	KORS NR	PROF	NR	STRY	STUP	ANT	TYP	BREDD (i mm)	LÄNGD (i m)	KARAKTÄR
1	3	7	12	16	17	21	25	29	32	35	39	43
03	BDAD	201	1	A	1	N26E	80S	1	Ö	1	0	
					2	N69W		2	L	1	1.5	QZ
					3	N73W		1	L	1	1.0	QZ
					4	N68W	70S	1	S	0	0	
					5	N56W	40S	1	Ö	2	0	
					6	N54E	90	1	L	1	0	
					7	N20E		1	S	1	0	
					8	N56E	80N	1	L	5	0	QZ, FSP
					9	EW	70N	1	Ö	2	0	
					10	N10E	90	1	S-Ö	0	0	
					11	N22E	90	1	S-Ö	0	0	
					12	N35E	70S	1	Ö	4	0	
					13	EW	85N	1	S-Ö	0	2.0	
					14	N55E	85S	2	S-Ö	0	0	
					15	N45E		1	S	0	1.0	
					16	N38E	20N	1	Ö	2	0	
					17	N67E	85S	1	S-Ö	0	1.5	
					18	N70E	60S	1	Ö	4	0	
					19	N62W	80N	1	L	1	1.5	
					20	N52E	90	2	S	0	1.0	
					21	N72E	85S	1	S-Ö	0	0.7	
					22	N58E	80N	2	S-Ö	0	0.5	
					23	N70E	75S	1	S-Ö	0	0.5	
					24	N32E		1	L	1	0	QZ-FSP
					25	N32E	90	1	Ö	3	0	
					26	N32E	70S	1	S-Ö	0	0	
					27	N76W	85N	1	S-Ö	0	1.2	
					28	N76W	90	1	Ö	1	0	
					29	N85W	90	1	Ö	3	0	
					30	N27E	90	1	HLL	0	0	
		201	1	B	1	N40W	60S	1	Ö	1	0	
					2	N75W	90	1	S	0	0	

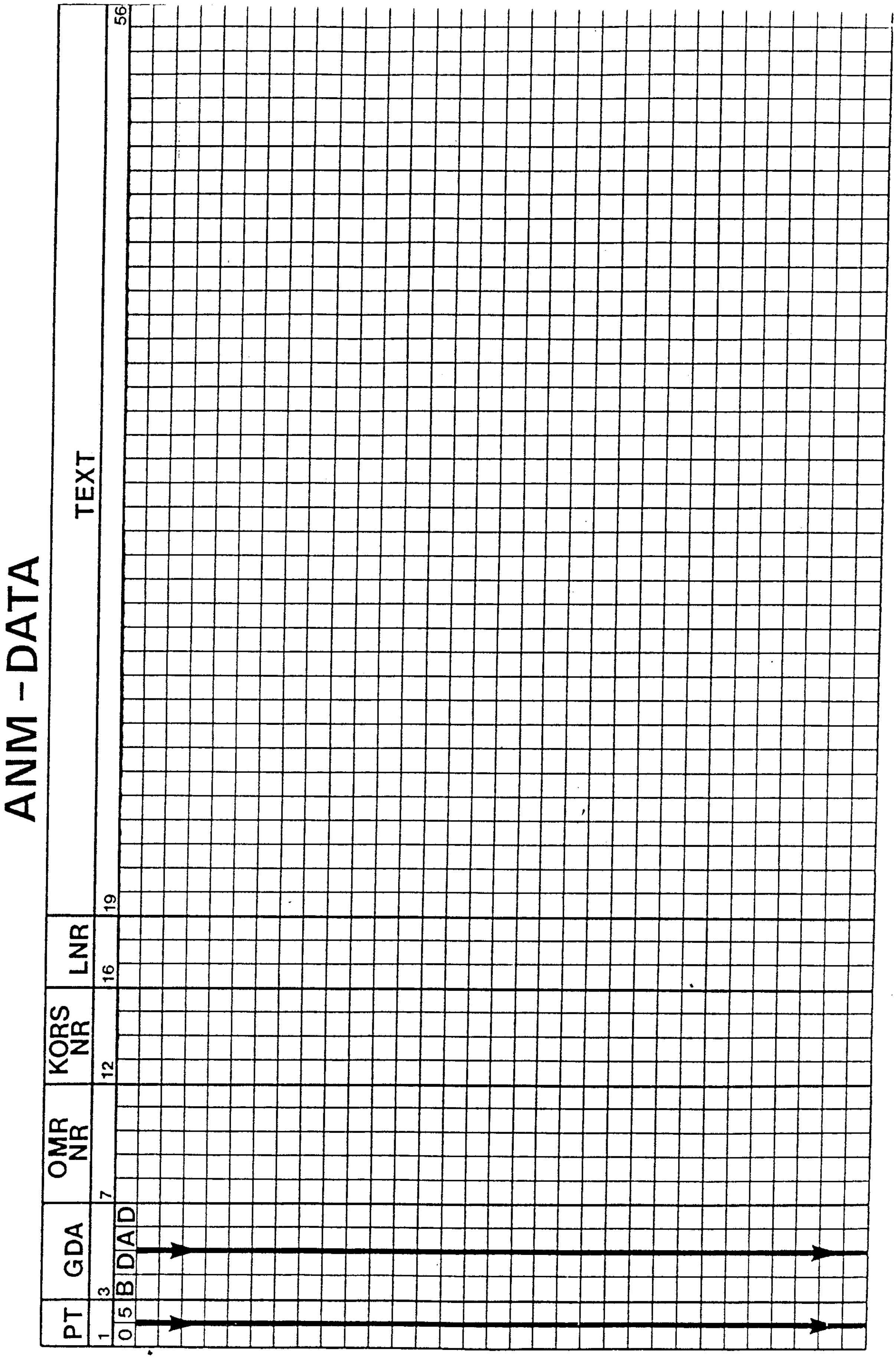
APPENDIX A-4

Surface fracture form - Structural data



APPENDIX A-5

Surface fracture form - Comments



APPENDIX A-6

Surface fracture form - VIAK

BESTÄLLARE: ______________________ SIDA: __

PROJEKT: ______________________ NR: ____________

TOPOKARTA: ____ ______________________ RUTA NR: ____________

LOKAL BESKRIVN: ______________________

BERGART: ______________________

FOLIATION: ______________________

HÄLLYTA M^2: ______________________ (MIN. 400 M^2)

VIAK AB

STRYKNING NXXW(E)	STUPNING XXW(E)	AN-TAL >1	SPRICKTYP, FYLLNAD XX	LÄNGD DM	TGF XXX	ÖVRIGT

HÄLLBESKRIVN.:

Fracture logging diagram

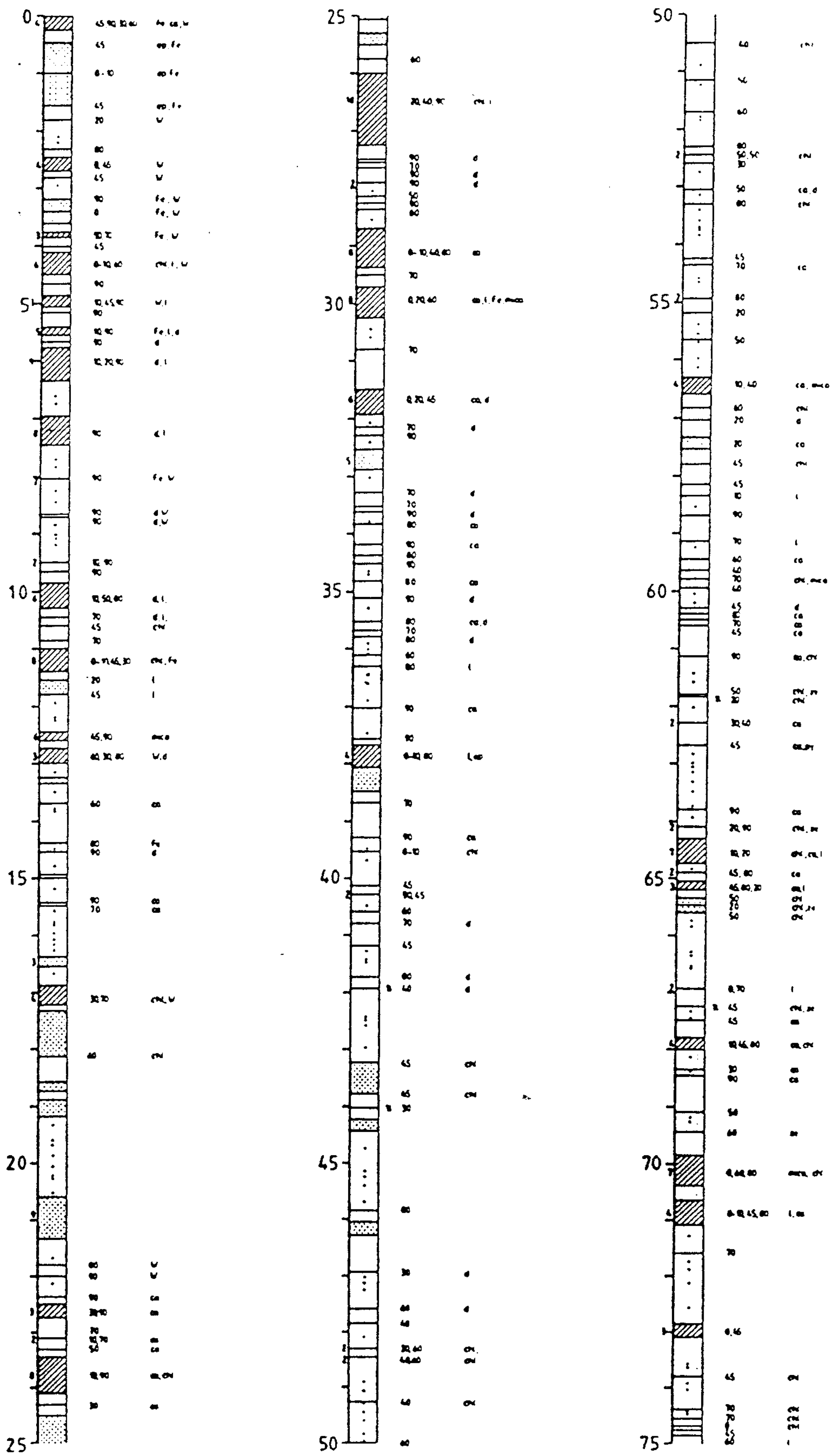
Depth (m) Uptake, U	Fracture type: individual (>10 cm dist.) Break: coated	fresh	No break: sealed	partly sealed	fracture indication	systems (<10 cm dist.) fracture zone (f.z.) = f.z. with fresh surfaces, f.z. with fresh and coated surfaces, crushed zone, gouge	number parallel crossing	Fracture character: coating: mineral thickness mm	weathered w, smooth s, rough r, polished p, partly polished p.p	angle to core axis	miscellaneous
00- 0,25	X					f2	4	Fe, ca	r w	45, 90, 30, 60	
0,45 – 1,55	X	X				f2 vertikalgående spricka mellan 0,45-1,30	3+14	E, Fe	r r	450-10, 90	U= 1,09
1.80	X							m	r w	20	
2.10		X							V	90	
U=2.19		X							r	70	
30	X							m	r	80	
2.45-.70	X	X				f2	4+2	m	r w	0, 45, 70	
80	X							m	r w	45	
95		X							r	95	
3.20-.60	X	X				f2 borrpressad längs vertikalgående spricka	2+6	Fe	r w	0, 90	
.75-.86						f2	3	Fe	r w	50, 70, 90	U= 3.86
4.00	X	X					1+1	m	r	45, 90	
.70-.50	X					f2	6	chl, l	w	0-10, 60	
65	X							m	r	90	
.85-.05	X							m, l	r w	10, 45 90	
5.15	X							m	r	90	
.40-.55	X					f2	5	Fe, l, d	r	10, 90	
5.65	X							grönaktig beläggning	V	90	
.75-6.35	X	X				f2	9+1	d, l	r	10, 20, 90	U= 6.09
.60		X							r	90	

APPENDIX B-1

Core mapping form

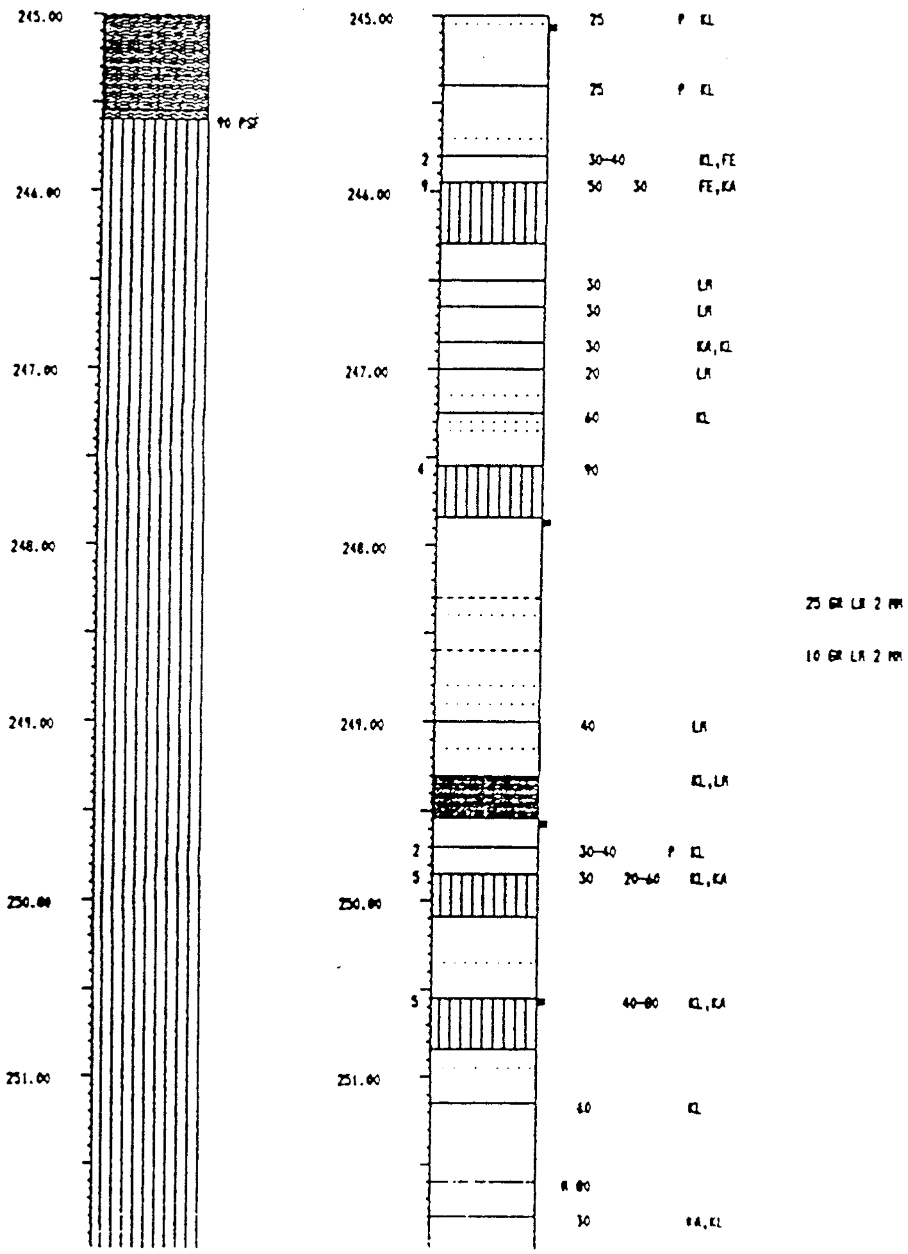
APPENDIX B-2

Hand drafted core log



APPENDIX B-3

Computer drafted core log



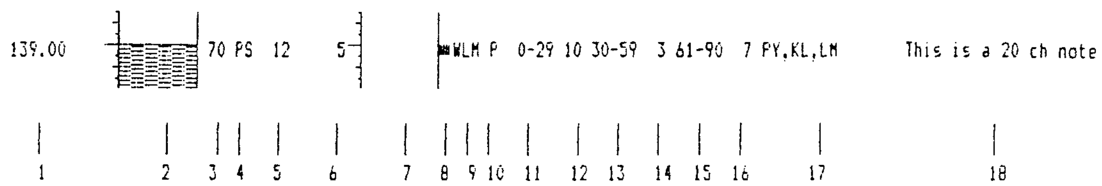
APPENDIX B-4

Plot description

Description

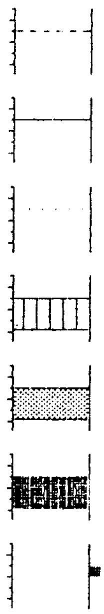
of plot symbols and codes

Rock mapping Fracture mapping



1 - Depth
2 - Rock classification
3 - Angle to core axis
4 - Code for rock type
5 - Prefix code for rock type
6 - Number of fractures
7 - Type of observation (see description below)
8 - Marking for core uptake
9 - Marking for weathered (V), slickenside (L) and coated (M) fractures
10 - Marking for parallel foliation
11 - Angle interval 1
12 - Number of fractures in interval 1
13 - Angle interval 2
14 - Number of fractures in interval 2
15 - Angle interval 3
16 - Number of fractures in interval 3
17 - Mineral codes
18 - Note

Type of observation



Sealed fracture

Coated fracture(s)

Fresh fracture

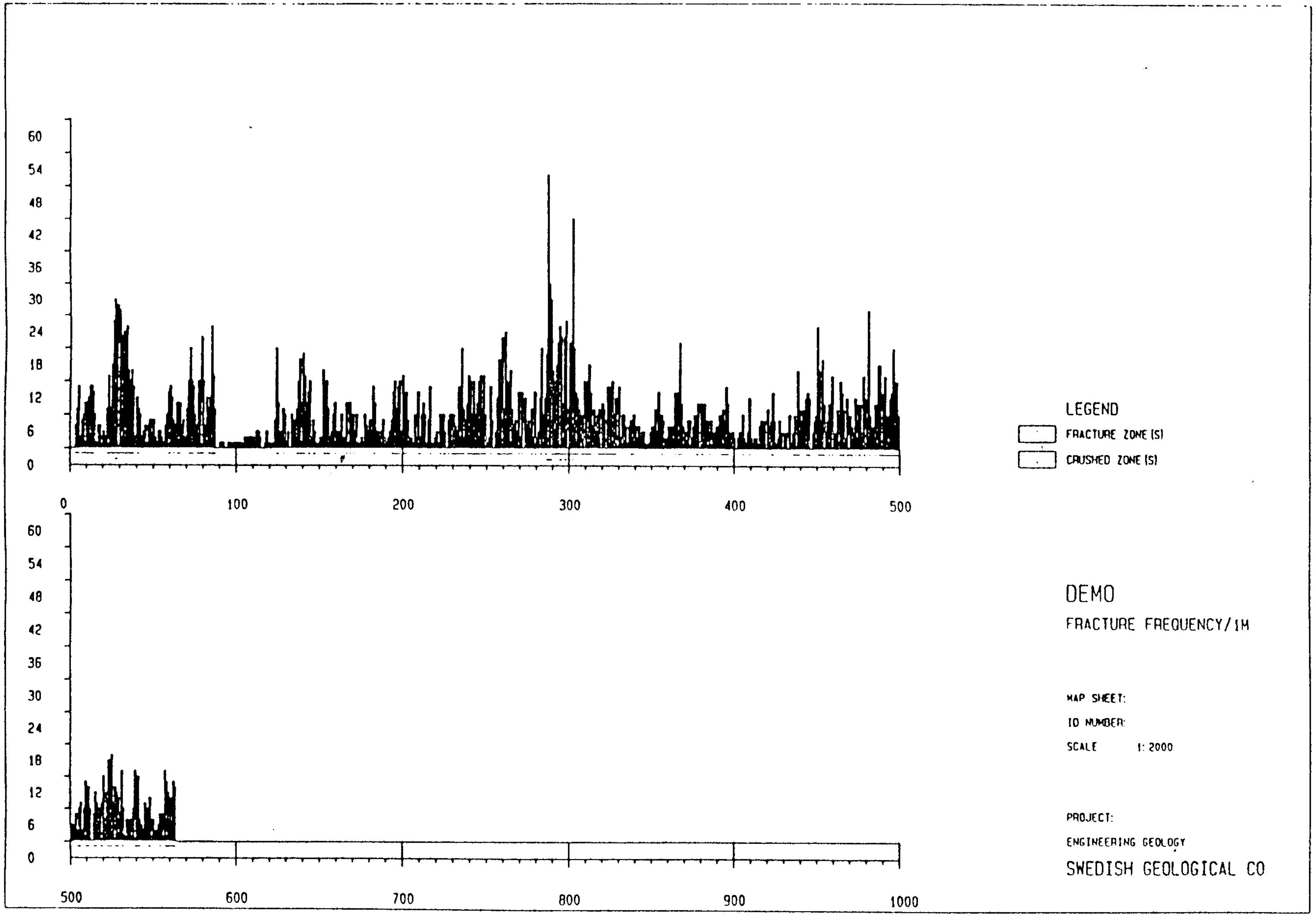
Fracture zone

Crushed zone

Core loss

Core uptake

Fracture frequency plot



APPENDIX B-6

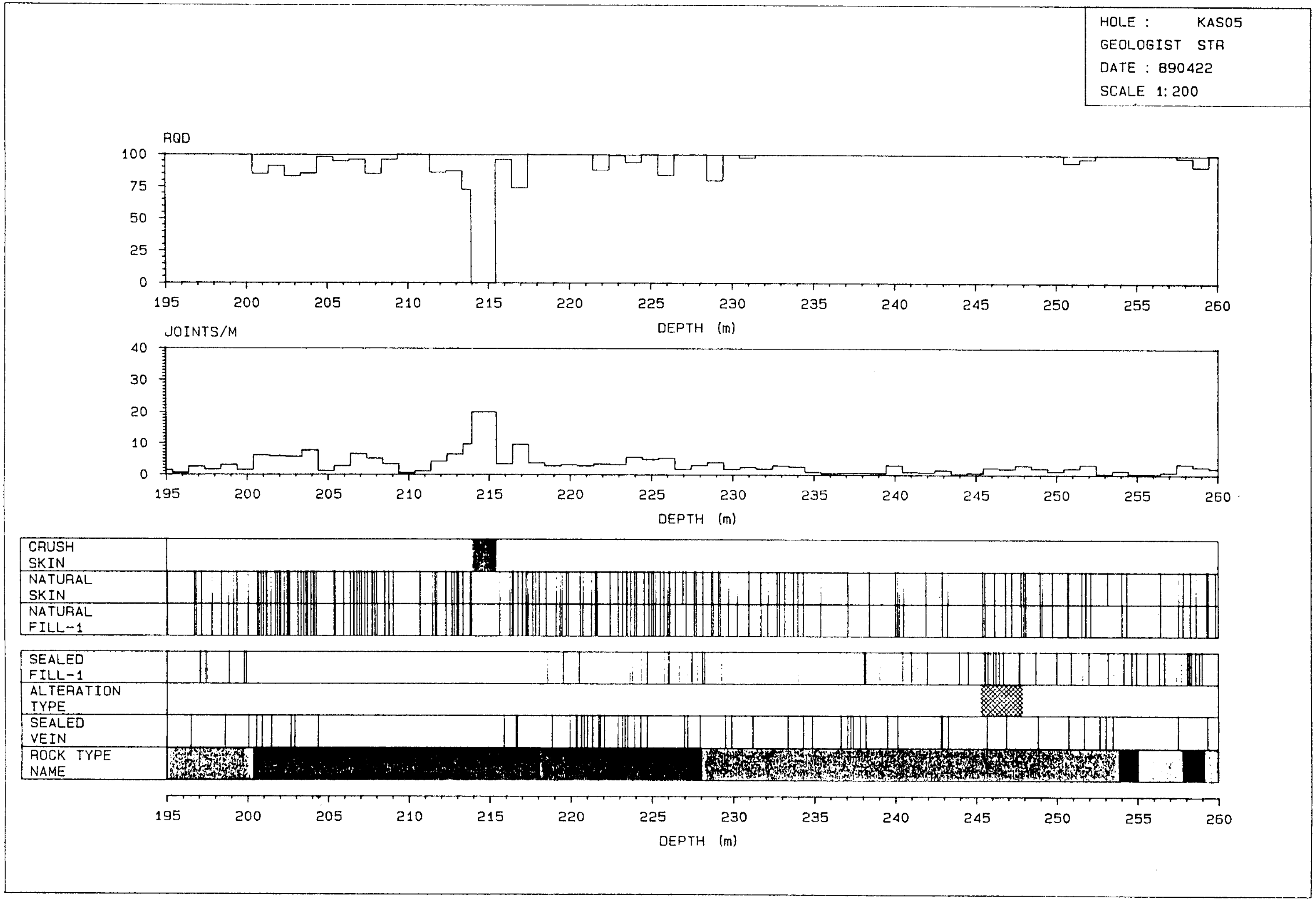
Listing of rock codes

Borehole

Rock zones

From	To	Rock code
3.70	71.15	PSE
71.15	71.95	MMB
71.95	75.10	PSE
75.10	79.80	MMB
79.80	85.00	PSE
85.00	86.40	MMB
86.40	140.60	PSE
140.60	143.90	MMB
143.90	153.40	PSE
153.40	155.80	MMB
155.80	167.35	PSE
167.35	169.25	MMB
169.25	170.20	PSE
170.20	187.00	MMB
187.00	192.70	PSE
192.70	193.65	MMB
193.65	218.15	PSE
218.15	219.85	HSC
219.85	223.00	PSE
223.00	223.65	HSC
223.65	228.90	PSE
228.90	229.05	HSC
229.05	234.05	PSE
234.05	236.10	MMB
236.10	236.65	PSE
236.65	236.75	MMB
236.75	249.10	PSE
249.10	250.10	HSC
250.10	283.85	PSE
283.85	289.00	MMB
289.00	308.00	PSE
308.00	309.15	MMB
309.15	316.40	PSE
316.40	317.90	MMB
317.90	318.75	PSE
318.75	325.25	MMB
325.25	343.25	PSE
343.25	344.60	HSC
344.60	345.60	PSE
345.60	345.85	MMB
345.85	390.90	PSE
390.90	391.25	MMB
391.25	409.10	PSE
409.10	409.80	MMB
409.80	421.20	PSE
421.20	421.75	MMB
421.75	443.95	PSE
443.95	444.60	MMB
444.60	449.90	PSE
449.90	460.00	VS
460.00	462.70	PSE
462.70	464.00	MMB
464.00	464.50	PSE
464.50	470.55	MMB
470.55	473.40	VS
473.40	473.70	MMB
473.70	478.00	VS

APPENDIX B-7

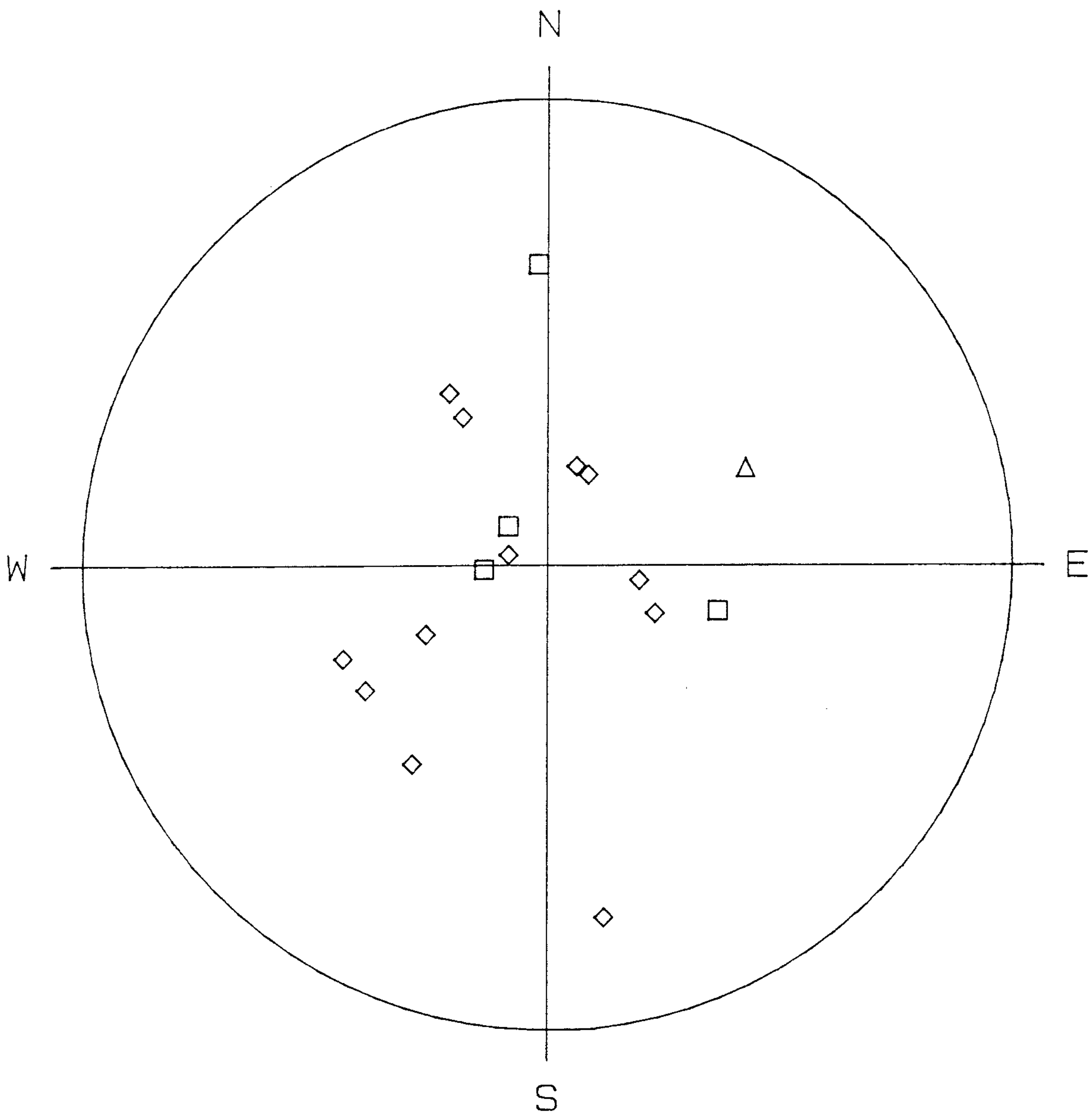


Multicolour plot from Petro Core Mapping System

APPENDIX B-8

Schmidt net plot from Petro Core Mapping System

SCHMIDT NET	BORE HOLE: KAS02
LOWER HEMISPHERE POLE POINTS DEPTH (m): 200.00 -535.00 NO. OF JOINTS: 17	WATERCONDUCTIVE FRACTURES IN ROCK TYPES 900831



APPENDIX C-1 (1)

Mineral code dictionary
GEOTAB table FLM

AD	Andalusite
AK	Arsenopyrite
AM	Amphibole
AP	Apatite
AZ	Azurite
BA	Baryte
BG	Galena
BI	Biotite
BR	Bornite
CM	Clay minerals
DI	Diopside
DL	Dolomite
EP	Epidote
FE	Iron oxide
FL	Fluorite
FM	Dark minerals
GA	Garnet
GL	Mica
GR	Graphite
HB	Hornblende
HM	Hematite
IL	Ilmenite
KA	Calcite
KB	Carbonate
KG	Cuprite
KK	Chalcopyrite
KL	Chlorite
KN	Caolinite
KR	Chromite
KS	Cassiterite
KY	Kyanite
LA	Laumontite
LI	Olivine
LM	Light minerals
MA	Malachite
MG	Magnetite
MI	Microcline
MK	Pyrrhotite
ML	Molybdenite
MT	Magnesite
MU	Muscovite
NE	Nepheline
PE	Pentlandite
PK	Opaque minerals
PL	Plagioclase
PR	Prenhite
PT	Pseudotachylyte
PX	Pyroxene
PY	Pyrite
QZ	Quartz
RF	Red feldspar
RU	"Rust" minerals
SC	Scheelite
SE	Serpentine

APPENDIX C-1 (2)

SF	Feldspars
SI	Sillimanite
SK	Scapolite
ST	Sericite
SU	Sulphides
TA	Talc
TI	Titanite
TR	Tremolite
TU	Tourmaline
UM	Uranipherous mineral
VF	White/grey feldspar
WL	Wollastonite
WT	Wolframite
ZB	Sphalerite
ZE	Zeolite
XX	Unknown mineral

APPENDIX C-2 (1)

Rock code dictionary

GEOTAB table FLR

BGT	Indeterminable rock
D	Various rocks
DB	Mafic rock
DBA	Basite (mafite)
DI	Intermediate rock
DS	Acid rock
DSA	Felsite
DSC	Ore quartzite
DSB	Leptite
DX	Volcanite and/or sediment
DY	Volcanite or plutonite
DZ	Xenolite
H	Hypabyssal rock
HB	Mafic hypabyssal rock
HBA	Porphyritic gabbro
HBB	Diabase
HBC	Olivine diabase
HBD	Lamprophyre
HF	Foidbearing hypabyssal rocks
HI	Intermediate hypabyssal rock
HIA	Porphyritic syenite
HIB	Porphyritic diorite
HS	Acid hypabyssal rock
HSA	Porphyritic granite
HSB	Pegmatite
HSC	Aplite
HSD	Granite-vein
HSE	Quartz-vein
HU	Ultra-mafic hypabyssal rock
HUA	Lamprophyre
HUB	Kimberlite
M	Metamorphic rock
MHB	Veined gneiss
MHC	High-grade metamorphic mica schist
MH	High-grade metamorphic rock
MHA	Migmattite MHG Glassy quartzite
MHE	Charnochite
MHF	Granulite
MHD	High-grade metamorphic amphibolite
MHH	Eclogite
MKB	Hornfels
MKA	Skarn
MKH	Crystalline limestone
MK	Contact metamorphic rock (tectite)
MLC	Slate
MLD	Low-grade metamorphic phyllite
ML	Low-grade metamorphic rock
MLA	Soapstone
MLB	Greenschist
MMA	Medium-grade metamorphic phyllite
MME	Medium-grade metamorphic mica schist
MMF	Graphite schist
MM	Medium-grade metamorphic rock

APPENDIX C-2 (2)

MMG	Quartzite
MMB	Greenstone
MMD	Medium-grade metamorphic amphibolite
MT	Regional metamorphic rock (tectonites)
MTA	Mylonite
MTB	Tectonic breccia
MTC	Tectonite
P	Plutonite
PB	Mafic plutonite
PBA	Anorthosite
PBB	Gabbro
PBC	Leuco-gabbro
PBD	Anorthositic gabbro
PBE	Gabbroic anorthosite
PBF	Mela-gabbro
PBG	Troctolite
PBH	Olivine gabbro
PBI	Gabbronorite
PBJ	Norite
PBK	Clinopyroxene norite
PBL	Orthopyroxene gabbro
PBM	Hornblende gabbro
PF	Foidbearing plutonites
PFA	Foidbearing alkali feldspar syenite
PFB	Foidbearing syenite
PFC	Foidbearing monzonite
PFD	Foidbearing monzodiorite
PFE	Foidbearing monzogabbro
PFF	Foidbearing diorite
PFG	Foidbearing gabbro
PFH	Foid syenite (nepheline syenite)
PFI	Foid monzosyenite (foid plagisyenite)
PFJ	Foid monzodiorite (essexite)
PFK	Foid monzogabbro
PFL	Foid diorite
PFM	Foid gabbro (theralite, teschenite)
PFN	Foidolite
PI	Intermediate plutonite
PIA	Alkali-feldspar syenite
PIB	Syenite
PIC	Monzonite
PID	Monzodiorite
PIE	Monzogabbro
PIF	Diorite
PS	Acid plutonite
PSA	Quartzolite
PSB	Quartzrich granitoids
PSC	Alkali-feldspar-granite
PSD	Alaskite
PSE	Granite
PSF	Granodiorite
PSG	Tonalite
PSH	Trondhjemite
PSI	Quartz-alkalifeldspar syenite
PSJ	Quartz syenite
PSK	Quartz monzonite
PSL	Quartz-monzo diorite
PSM	Quartz-monzo gabbro

APPENDIX C-2 (3)

PSN	Quartz diorite
PSO	Quartz gabbro
PSP	Quartz norite
PSR	Quartz anorthosite
PSS	Grey granodiorite
PST	Pink granodiorite
PSU	Red granodiorite
PSV	Red young granite
PU	Ultra-mafic plutonite
PUA	Peridotite
PUB	Dunite
PUC	Pyroxene peridotite
PUD	Harzburgite
PUE	Lherzolite
PUF	Wherlite
PUG	Pyroxene-hornblende peridotite
PUH	Hornblende peridotite
PUI	Pyroxenite
PUJ	Olivine pyroxenite
PUK	Olivine orthopyroxenite
PUL	Olivine websterite
PUM	Olivine clinopyroxenite
PUN	Olivine-hornblende-pyroxenite
PUO	Orthopyroxenite
PUP	Websterite
PUR	Clinopyroxenite
PUS	Hornblende pyroxenite
PUT	Hornblendite
PUU	Olivine hornblendite
PUV	Olivine-pyroxene hornblendite
PUX	Pyroxene hornblendite
PUY	Perknite
PUZ	Serpentinite
S	Sedimentary rock
SA	Sandstone (arenite)
SAA	Quartz sandstone (quartz arenite)
SAB	Arkose
SAC	Lithic sandstone (subgreywacke)
SE	Evaporite
SK	Carbonaceous rock
SKA	Limestone
SKB	Calcareous sandstone
SKC	Marl
SKD	Dolomite
SKE	Magnesite
SL	Argillite
SLA	Argillitic greywacke
SLB	Siltstone
SLC	Claystone (mudstone)
SLD	Shale
SLE	Alum shale
SN	Nonclastic sediment
SNA	Chert
SNB	Flint
SNC	Jaspilite
SND	Quartz ore
SOI	Soil

APPENDIX C-2 (4)

SR	Conglomerate and breccia
SRA	Orthoconglomerate
SRB	Monogenetic conglomerate (oligomictic conglomerate)
SRC	Polygenetic conglomerate (petromictic conglomerate)
SRD	Paraconglomerate (diamictite)
SRE	Tillite
SRF	Sedimentary breccia
SW	Wacke
SWA	Quartzwacke
SWB	Feldspathic greywacke
SWC	Lithic greywacke
V	Volcanite
VB	Mafic volcanite
VBA	Basalt
VBB	Olivine basalt
VBT	Tuffite
VF	Foid volcanite
VFA	Phonolite
VFB	Tephritic phonolite
VFC	Phonolitic tephrite
VFD	Tephrite
VFE	Phonolitic foidite
VFF	Tephritic foidite
VFG	Foidite
VFT	Tuffite
VI	Intermediate volcanite
VIA	Intermediate lava: alkali trachyte
VIB	Intermediate lava: trachyte
VIC	Intermediate lava: latite
VID	Intermediate lava: latite andesite
VIE	Intermediate lava: latite basalt
VIF	Intermediate lava: andesite
VIH	Intermediate tuff: alkali trachyte
VII	Intermediate tuff: trachyte
VIJ	Intermediate tuff: latite
VIK	Intermediate tuff: latite andesite
VIL	Intermediate tuff: latite basalt
VIM	Intermediate tuff: andesite
VIT	Tuffite
VS	Acid volcanite rock
VSA	Acid lava: alkali rhyolite
VSB	Acid lava: rhyolite
VSC	Acid lava: rhyodacite (quartzlatite)
VSD	Acid lava: dacite
VSE	Acid lava: quartz andesite
VSH	Acid tuff: alkali rhyolite
VSI	Acid tuff: rhyolite
VSJ	Acid tuff: rhyodacite (quartz latite)
VSK	Acid tuff: dacite
VSL	Acid tuff: quartz andesite
VST	Tuffite
VU	Ultra-mafic volcanite
VUA	Picrite
XXX	Ore

APPENDIX C-3

Prefix rock code dictionary

GEOTAB table CMLPC

11	Pegmatite as veins and dykes
12	With undetermined fragments
13	With partly assimilated fragments
14	With inhomogenities
15	Altered to granite
16	Altered to sericite
17	Altered to chlorite
18	Altered to skarn
19	Altered to quartz
20	Altered to gneiss
21	Altered to veined gneiss
22	Hydrothermal alterations
23	Altered to albitite
24	Altered to scapolite
25	Altered to epidote
26	Altered to serpentine
27	Recrystallized
28	Tectonized

APPENDIX C-4

GEOTAB table SFLE - Element codes lexicon

AC	Axial plane foliation
AP	Axial plane
F	Fold axis
L	Lineation
S	Foliation
SL	Mineral lineation, rodding

GEOTAB table SFLF - Fracture codes lexicon

C	Closed
CO	Closed - open
CS	Closed - sealed
O	Open
OC	Open - closed
OS	Open - sealed
S	Sealed
SC	Sealed - closed
SO	Sealed - open

GEOTAB table SFLP - Profile codes lexicon

A	Profile A
B	Profile B

GEOTAB table CMLFT - Fracture type codes lexicon

C	Coated
F	Fresh
S	Sealed

GEOTAB table CMLC - Fracture surface character codes lexicon

C	Coated
L	Slickenside
P	Polished
R	Rough
S	Smooth
W	Weathered
X	Other

APPENDIX C-5

GEOTAB table RCLAM - Analyzing method codes lexicon

A	Atomic absorption
E	Electrochemistry
F	Spectrophotometry
G	Gravimetry
J	Jumbo spectrophotometry
K	Gamma spectrometry
N	Neutron activation
R	X-ray fluorescence
S	Spectrometry (colorimetry)
T	Titrimetry
V	Atomic absorption (flame emission)

GEOTAB table RCLST - Sample treatment codes lexicon

A	Leaching with ascorbic acid - hydrogen peroxide
B	Leaching with bromine water (HBr)
L	Leaching with acid (HNO3, HCL)
M	Grinding information
T	Total dissolution
V	Total dissolution (HF, H2SO4)
X	Dissolution after melting

GEOTAB table RCLSP - Sample preparation codes lexicon

A	Grinding in agate mill
G	Grinding in jet mill
I	Ashing
J	Ashing with additive
S	Grinding in steel mill
T	grinding with additive in steel mill
V	Mineral separation, till samples
W	Grinding in tungsten carbide mill
X	Grinding with additive in tungsten carbide mill

APPENDIX C-6 (1)

Codes for rocktype and rocktype characteristics used in GEOTAB (same as in Petro Core Mapping System)

COLUMN	VARIABLE	CODE	CODE	
RCODE	NAME	102	HSB	PEGMATITE
		103	HSC	APLITE
		104	HSD	GRANITE VEIN
		105	HSE	QUARTZ VEIN
		122	MTA	MYLONITE
		123	MTB	BRECCIA
		124	MS	META SEDIMENT
		143	PSE	GRANITE
		145	PSF	GRANODIORITE
		146	PSG	TONALITE
		171	VB	BASIC VOLCANITE
		172	VI	INTERMEDIATE VOLCANITE
		173	VS	ACID VOLCANITE
RCCODE	COLOUR		101	WHITE
			102	GREY
			103	GREY-RED
			104	RED
			105	RED-BROWN
			106	PINK
			107	GREEN
			108	BLACK
			109	DARK
			110	BRIGHT
RSCODE	STRUCTURE		101	HOMOGENOUS
			102	SCHISTOSE
			103	GNEISSIC
			104	BANDED
			105	MYLONITIC
			106	BRECCIATED
			107	LAYERED
			108	TECTONIZED
RICODE	INTENSITY		101	FAINT
			102	WEAK
			103	MEDIUM
			104	STRONG
RGCODE	GRAINSIZE		101	APHANITIC
			102	FINE GRAINED
			103	MEDIUM GRAINED
			104	MEDIUM-COARSE GRAINED
			105	COARSE GRAINED
RTCODE	TEXTURE		101	EVEN GRAINED
			102	PORPHYRITIC
			103	AUGEN
			104	UNEVEN GRAINED

APPENDIX C-6 (2)

ALTER	ALTERATION	700	OXIDIZED
		701	CHLORITISIZED
		702	EPIDOTISIZED
		703	WEATHERED
		704	TECTONIZED
		705	SERICITISIZED
		706	MIAROLITIC

APPENDIX C-7

Fracture mineral codes used in Petro Core and GEOTAB.

FILL	MINERAL	
1	QZ	quartz
2	KL	chlorite
3	KA	calcite
4	EP	epidote
5	HM	hematite
6	PY	pyrite
7	PR	phrenite
8	LA	laumontite
9	ZE	zeolite
10	CY	
11	PT	pseudotachylyte
12	KK	chalcopyrite
13	BI	biotite
14	FE	iron
15	FL	fluorite
16	RF	red feldspar
17	SU	sulphides
18	VF	white/grey feldspar
19		
20	MU	muscovite
21	KN	caolinite
22	MK	pyrrhotite
23	WL	wollastonite
24	AM	amphibolite
	ZZ	no mineral (only in GEOTAB)
90		UNKNOWN

APPENDIX D-1 (1)

Variables and subvariables in the Petro Core Mapping System

Variable 1: Break

Sub1	BREAK	1111	BREAK

Variable 2: Natural fractures

Sub1	FILL-1	1-99	See FLM
Sub2	FILL-2	1-99	See FLM
Sub3	FILL-3	1-99	See FLM
Sub4	FILL-4	1-99	See FLM
Sub5	ROUGHNESS	1	PLANAR
		2	UNDULATING
		3	STEPPED
		4	IRREGULAR
Sub6	SURFACE	1	ROUGH
		2	SMOOTH
		3	SLICKENSIDE
Sub7	SKIN	1	WEATHERED
		2	DULL
		3	CAVITIES
		4	OPEN
Sub8	ALFA	5002	DEGREES
Sub9	BETA	5002	DEGREES
Sub10	WIDTH	5002	MM

Variable 3: Sealed fractures

Sub1	VEIN	100-500	See FLR
Sub2	FILL-1	1-99	See FLM
Sub3	FILL-2	1-99	See FLM
Sub4	FILL-3	1-99	See FLM
Sub7	SKIN	1	WEATHERED
		2	DULL
		3	CAVITIES
		4	OPEN
Sub8	ALFA	5002	DEGREES
Sub9	BETA	5002	DEGREES
Sub10	WIDTH	5002	MM

APPENDIX D-1 (2)

Variable 4: <u>Crush zone</u>

Sub1	FILL-1	1-99	See FLM
Sub2	FILL-2	1-99	See FLM
Sub3	FILL-3	1-99	See FLM
Sub4	FILL-4	1-99	See FLM
Sub5	ROUGHNESS	1	PLANAR
		2	UNDULATING
		3	STEPPED
		4	IRREGULAR
Sub6	SURFACE	1	ROUGH
		2	SMOOTH
		3	SLICKENSIDE
Sub7	SKIN	1	WEATHERED
		2	DULL
		3	CAVITIES
		4	OPEN
Sub8	ALFA	5002	DEGREES
Sub9	BETA	5002	DEGREES
Sub10	WIDTH	5002	MM

Variable 5: <u>Rocktype</u>

Sub1	TYPE	100-500	See FLR
Sub2	COLOUR	101	WHITE
		102	GREY
		103	GREY-RED
		104	RED
		105	RED-BROWN
		106	PINK
		107	GREEN
		108	BLACK
		109	DARK
		110	BRIGHT
Sub3	STRUCTURE	101	HOMOGENOUS
		102	SCHSTOISE
		103	GNEISSIC
		104	BANDED
		105	MYLONITIC
		106	BRECCIATED
		107	LAYERED
		108	TECTONIZED
Sub4	INTENSITY		101 FAINT
		102	WEAK
		103	MEDIUM
		104	STRONG
Sub5	GRAINSIZE	101	APHANITIC
		102	FINE GRAINED
		103	MEDIUM GRAINED
		104	MEDIUM-COARSE
		105	COARSE GRAINED
Sub6	TEXTURE	101	EVEN GRAINED
		102	PORPHYRITIC
		103	AUGEN
		104	UNEVEN GRAINED
Sub8	ALPHA	5005	DEGREES
Sub9	BETA	5005	DEGREES

APPENDIX D-1 (3)

Variable 6: Structure

Sub1	TYPE	600	HOMOGENOUS
		601	SCHISTOSE
		603	GNEISSIC
		604	BANDED
		605	MYLONITIC
		606	BRECCIATED
		607	LAYERED
Sub2	INTENSITY	600	FAINT
		601	WEAK
		602	MEDIUM
		603	STRONG
Sub8	ALPHA	5006	DEGREES
Sub9	BETA	5006	DEGREES

Variable 7: Alteration

Sub1	TYPE	700	OXIDIZED
		701	CHLORITISIZED
		702	EPIDOTISIZED
		703	WEATHERED
		704	TECTONIZED
		705	SERICITISIZED
		706	MIAROLITITIC
Sub2	INTENSITY	700	FAINT
		701	WEAK
		702	MEDIUM
		703	STRONG

Variable 8: Uptake

Sub1	UPTAKE	800	CORE RECOVERY
Sub2	MARKED	5008	M
Sub3	DIFF	5008	M

Variable 9: End of orientation

Sub1	ORIENTATION TYPE	900	RELATIVE ORIENTATION
		901	IRON ROD ORIENTATION
		902	TV ORIENTATION
		903	TELEVIEWER ORIENTATION
		904	IMPRESSION PACKER
		905	CRAELIUS INDENTER
		906	FICTIVE TV SECTION
Sub2	CORR ANGLE	5009	DEGREES
Sub3	LENGTH	5009	M

APPENDIX D-1 (4)

Variable 10: Orientation of fractures

Sub1	TYPE	1000	JOINT
		1001	VEIN
		1002	CONTACT
		1003	SCHISTOSITY
		1004	BIT SHARPENING
Sub2	INSTRUMENT	1000	TELEVIEWER
		1001	BOREHOLE TV
Sub7	COLOUR	1000	BLACK
		1001	WHITE
Sub8	ALPHA	5010	DEGREES
Sub9	BETA	5010	DEGREES
Sub10	APERTURE	5010	MM

Variable 11: Core loss

Sub1	TYPE	1100	SOFT FILLING
		1101	CRUSHED ZONE
		1102	VEIN
		1103	MECHANICAL
Sub2	MISS CORE	5011	M

Variable 12: Box

Sub1	BOX NUMBER	5012	NUMBER
Sub2	ROW	5012	NUMBER
Sub3	SHELF	5012	NUMBER

Variable 18: Position

Sub1	METHOD	1800	SURVEYING
		1801	DEVIATION MEASUREMENTS
Sub2	X	5018	X
Sub3	Y	5018	Y
Sub4	Z	5018	Z
Sub5	DIP	5018	DEGREES
Sub6	DIR	5018	DEGREES

Variable 19: Drill method

Sub1	METHOD	1900	CORE DRILLING
		1901	WIRE DRILLING
		1902	PERCUSSION DRILLING
		1903	BOOSTER DRILLING
		1904	ROTARY DRILLING
		1905	RAISE BORING
		1906	FULL FACE BORING

Variable 103: Fracture orientation

Sub1	DIP	5103	DIP
Sub2	STRIKE	5103	STRIKE

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