

CORE LOGGING DATABASES

Gemcom's PC-XPLOR Databases comprise tables which are divided into rows (ranges) and columns (fields). Each table contains specific information about the drill hole. Curragh's diamond drill hole data base contains the following tables:

Table 1 - Header:

Hole # , collar survey, hole length and miscellaneous information (core size, date logged etc).

Table 2 - Surveys. (all dip tests)

Depth, dip azimuth

Table 3 - Lithology:

Depth down hole ("from" and "to"; rock codes, description

Table 4 - Assays:

Depth down hole ("from" and "to"); interval length; core recovery; sample number; rock type; rock code; s.g. assays.

Table 5 - Structures:

Complete definition, in terms of down hole distance(s) core angle(s) of structural elements in drill core. The quantity of data recorded will depend on the purpose for which the hole was drilled.

Table 7 - Geotech:

All geotechnical information including core recovery, R.Q.D., weathering, and comments. Joint number and joint frequency may also be recorded where extra detail is required, as should point load tests if they are done.

Table 8 - Samples:

This table is for samples taken for research purposes, and is not frequently used during routine core logging.

The above tables should be used for all deposits on Curragh's Faro property. A complete example of a drill hole database, actually the one for Vangorda, is attached (Appendix "A"). Note that "fields" in individual tables should be in the same relative position for all deposit databases.

\*\*\* VANGORDA - Drill Hole Database \*\*\*  
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 PRINTOUT OF DATABASE STRUCTURE INFORMATION  
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Database Filename : F:\VANGORDA\VANGORDA.B5A  
 Table Number : 1  
 Table Name : HEADER  
 Number of Fields : 12

Field name	Code	Mark	Type	Minimum	Maximum	Default
HOLE-ID	1:1	Optional	String		8	
LOCATION	1:2	Optional	Local			
(X-COORD)	1:2:1		Real	-1.0	20000.0	-1.0
(Y-COORD)	1:2:2		Real	-1.0	20000.0	-1.0
(Z-COORD)	1:2:3		Real	-1.0	1350.0	-1.0
LENGTH	1:3	Optional	Real	-1.0	4000.0	-1.0
UTM COLLAR	1:4	Optional	UTM			
(X-COORD)	1:4:1		Real	-1.0	600000.0	-1.0
(Y-COORD)	1:4:2		Real	-1.0	910000.0	-1.0
(Z-COORD)	1:4:3		Real	-1.0	1350.0	-1.0
TYPE	1:5	Optional	String		6	DDH
SECTION	1:6	Optional	String		15	
CORE SIZE	1:7	Optional	String		10	NG
GEOLOGIST	1:8	Optional	String		10	
LOG DATE	1:9	Optional	Integer	-1	999999	-1
RECORD	1:10	Optional	Integer	-1	999	-1
CORE LOTN	1:11	Optional	String		20	SRUM
COMMENTS	1:12	Optional	String		100	

Table Number : 2  
 Table Name : SURVEYS  
 Number of Fields : 5

Field name	Code	Mark	Type	Minimum	Maximum	Default
DISTANCE	2:1	Optional	Real	.0	4000.0	.0
DIP	2:2	Optional	Real	-90.0	90.0	-90.0
AZIMUTH	2:3	Optional	Real	.0	360.0	.0
UTMAZIMUTH	2:4	Optional	Real	.0	360.0	.0
METHOD	2:5	Optional	String		20	AT 0

\*\*\* VANGORDA - Drill Hole Database \*\*\*

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Table Number : 3  
 Table Name : LITHOLOGY  
 Number of Fields : 6

Field name	Code	Mark	Type	Minimum	Maximum	Default
FROM	3:1	Optional	Real	-1.0	4000.0	-1.0
TG	3:2	Optional	Real	-1.0	4000.0	-1.0
UNIT	3:3	Optional	String		8	
DESCRIPTION	3:4	Optional	String		50	
COMMENTS	3:5	Optional	String		50	
ROCK CODE	3:6	Optional	Integer	-1	999	-1

Table Number : 4  
 Table Name : ASSAYS  
 Number of Fields : 29

Field name	Code	Mark	Type	Minimum	Maximum	Default
FROM	4:1	Optional	Real	-1.0	4000.0	-1.0
TO	4:2	Optional	Real	-1.0	4000.0	-1.0
INTERVAL	4:3	Optional	Real	-1.0	4000.0	-1.0
RECOVERY	4:4	Optional	Real	-1.0	4000.0	-1.0
RECOVERY %	4:5	Optional	Integer	-1	100	-1
SAMPLE #	4:6	Optional	Integer	-1	999999	-1
ROCK TYPE	4:7	Optional	String		8	
ROCK CODE	4:8	Optional	Integer	-1	999	-1
SS-PULP	4:9	Optional	Real	-1.00	10.00	-1.00
SS-WR	4:10	Optional	Real	-1.00	10.00	-1.00
PB+ZN %	4:11	Optional	Real	-1.00	100.00	-1.00
PB %	4:12	Optional	Real	-1.00	100.00	-1.00
ZN %	4:13	Optional	Real	-1.00	100.00	-1.00
ZN RATIO	4:14	Optional	Real	-1.00	1.00	-1.00
AG S/T(AA)	4:15	Optional	Real	-1.0	1000.0	-1.0
AG S/T(FA)	4:16	Optional	Real	-1.0	1000.0	-1.0
AU S/T	4:17	Optional	Real	-1.00	500.00	-1.00
PB+PY %	4:18	Optional	Real	-1.00	100.00	-1.00
PB %	4:19	Optional	Real	-1.00	100.00	-1.00
PY %	4:20	Optional	Real	-1.00	100.00	-1.00
BAC %	4:21	Optional	Real	-1.00	100.00	-1.00
BA %	4:22	Optional	Real	-1.00	100.00	-1.00
CL %	4:23	Optional	Real	-1.00	20.00	-1.00
FE %	4:24	Optional	Real	-1.00	100.00	-1.00
AS %	4:25	Optional	Real	-1.00	10.00	-1.00
MN %	4:26	Optional	Real	-1.00	10.00	-1.00
OXIDATION	4:27	Optional	Integer	-1	100	-1
OXIDE PB %	4:28	Optional	Real	-1.00	100.00	-1.00
OXIDE ZN %	4:29	Optional	Real	-1.00	100.00	-1.00

\*\*\* VANGORDA - Drill Hole Database \*\*\*  
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Table Number : 5  
 Table Name : STRUCTURES  
 Number of Fields : 23

Field name	Code	Mark	Type	Minimum	Maximum	Default
DISTANCE	5:1	Optional	Real	-1.0	4000.0	-1.0
SYMMETRY	5:2	Optional	String		5	
FEATRE-RFE	5:3	Optional	String		5	PS2
DEFN-RFE	5:4	Optional	Integer	-1	10	2
DIP-RFE	5:5	Optional	Integer	-1	90	-1
DIR-RFE	5:6	Optional	Integer	-1	360	220
PLOT-RFE	5:7	Optional	Logical			FALSE
FEATURE-A	5:8	Optional	String		5	
DEFN-A	5:9	Optional	Integer	-1	10	-1
DIP-A	5:10	Optional	Integer	-1	90	-1
DIR-A	5:11	Optional	Integer	-1	360	-1
PLOT-A	5:12	Optional	Logical			TRUE
FEATRE-B	5:13	Optional	String		5	
DEFN-B	5:14	Optional	Integer	-1	10	-1
DIP-B	5:15	Optional	Integer	-1	90	-1
DIR-B	5:16	Optional	Integer	-1	360	-1
PLOT-B	5:17	Optional	Logical			TRUE
FEATRE-C	5:18	Optional	String		5	
DEFN-C	5:19	Optional	Integer	-1	10	-1
DIP-C	5:20	Optional	Integer	-1	90	-1
DIR-C	5:21	Optional	Integer	-1	360	-1
PLOT-C	5:22	Optional	Logical			TRUE
COMMENTS	5:23	Optional	String		100	

Table Number : 6  
 Table Name : FAULTS  
 Number of Fields : 11

Field name	Code	Mark	Type	Minimum	Maximum	Default
FROM	6:1	Optional	Real	-1.0	4000.0	-1.0
TO	6:2	Optional	Real	-1.0	4000.0	-1.0
FEATURE	6:3	Optional	String		10	
RECOVERY	6:4	Optional	String		10	
DIP-UPPER	6:5	Optional	Integer	-1	99	-1
DIR-UPPER	6:6	Optional	Integer	-1	999	-1
DIP-INTRNL	6:7	Optional	Integer	-1	99	-1
DIR-INTRNL	6:8	Optional	Integer	-1	999	-1
DIP-LOWER	6:9	Optional	Integer	-1	99	-1
DIR-LOWER	6:10	Optional	Integer	-1	999	-1
COMMENTS	6:11	Optional	String		50	

\*\*\* VANGORDA - Drill Hole Database \*\*\*

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Table Number : 7  
 Table Name : SEDTECH  
 Number of Fields : 13

Field name	Code	Mark	Type	Minimum	Maximum	Default
FROM	7:1	Optional	Real	-1.0	4000.0	-1.0
TD	7:2	Optional	Real	-1.0	4000.0	-1.0
INTERVAL	7:3	Optional	Real	-1.0	500.0	-1.0
RECOVERY	7:4	Optional	Real	-1.0	100.0	-1.0
RECOVERY %	7:5	Optional	Integer	-1	100	-1
RSD	7:6	Optional	Real	-1.0	100.0	-1.0
RSD %	7:7	Optional	Integer	-1	100	-1
BREAKAGE	7:8	Optional	Integer	-1	15	-1
WEATHERING	7:9	Optional	String		5	
JOINT #	7:10	Optional	Integer	-1	100	-1
JOINT FREQ	7:11	Optional	Real	-1.00	100.00	-1.00
CORE SIZE	7:12	Optional	String		5	NG
COMMENTS	7:13	Optional	String		50	

Table Number : 8  
 Table Name : SAMPLES  
 Number of Fields : 7

Field name	Code	Mark	Type	Minimum	Maximum	Default
FROM	8:1	Optional	Real	-1.0	4000.0	-1.0
TD	8:2	Optional	Real	-1.0	4000.0	-1.0
UNIT	8:3	Optional	String		8	
ROCK CODE	8:4	Optional	Integer	-1	999	-1
DEPT	8:5	Optional	String		20	
PURPOSE	8:6	Optional	String		100	
DATE	8:7	Optional	Integer	-1	999999	-1

### 3. PAGE CAMC1981-E-1 OF DIAMOND DRILL CORE LOGS

Information to be collected for each drill-hole starts with the summary field sheet which outlines the location, inclination, and other general information for a particular drill-hole. This first sheet is for the information of the geologist and is not entered into the computer DDH data base. The summary field sheet for the diamond drill-hole should be kept up to date as the hole progresses. An example of a completed sheet is shown on page 6 .

#### 3.1 Drill-Hole Identification - Naming the Drill-Hole

The name for a drill-hole is composed of up to seven (7) alphanumeric characters. Intermixed alphabetic letters, numbers and even symbols may be used. The current Cyprus Anvil usage reserves the first character for Department, the second for Project, the next two characters for the year in which the hole was drilled, another character to denote the deposit and two more characters for the number (in the year) of the hole. An example from the Cirque deposit drilling program in 1979 is: "EG79C14" (Exploration-Gataga-1979-Cirque-Hole No. 14). Any 1981 Feasibility and Development holes could be labelled "FG81C02". This drill-hole identification is used for all data collected from this hole and is recorded on every page of the drill log. Codes for all 1981 projects are listed in Appendix III.

CYPRUS ANVIL MINING CORPORATION

Page 1 of 24

DIAMOND DRILL CORE LOG

Date: July/81

Hole Number: EG 81C 11

Reference Fabric Orientation Diagram:

Project: GATAGA

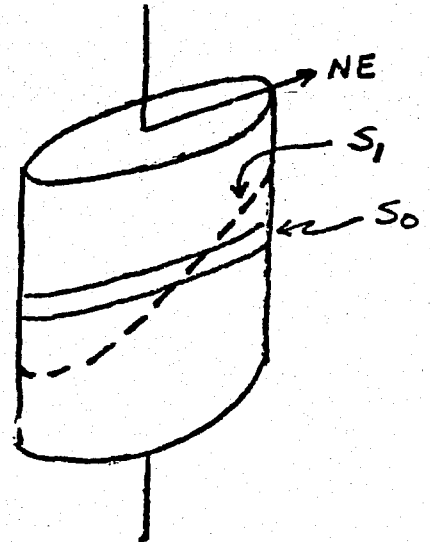
Location: Cirque Backside

Claim: CIRQUE # 4

Terr. Plane Co-ords.: 6,374,645.6 N

371,931.0 E

Grid Co-ords: SECTION 283+50N



Inclination: -80° towards 050°

All symmetry determinations looking

Elevation: 1719.57m.

NW with S1 dipping

Total Depth: 770.2m

SW with dip azimuth 220°

Purpose: Test adit site and potential of Earn Gp. on backside

Reason hole Terminated: Intersected footwall Silurian Siltstone

Logged by: VZS, CWJ, LCP, WJR

Date(s) Logged: July 17-30/81

Drilling Contractor: J.T. Thomas 44#4

Size	CORE From	To	Collar Cased and Capped:
<u>CASING</u>	<u>0.0</u>	<u>12.2</u>	<u>No</u>
<u>NA</u>	<u>12.2</u>	<u>770.2</u>	

Hole Cemented: No

Steel down hole: No

Started: July 13/81 Completed: July 30/81

#### 4. PAGE CAMC1981-E-2 OF LOGS: LOCATION, SURVEYS, COMMENTS

Field sheet CAMC1981-E-2 is the first computer-coded page of the drill logs. This sheet contains general information with T, R, and C subfiles. A completed example is illustrated on page 11 of this manual. This sheet includes the name and geographic location of the drill-hole (T-subfile). In addition it lists the necessary down-hole survey points (R-subfile) which allow for calculation of the three-dimensional position of any down-hole observation. Space at the bottom of the sheet is provided for general comments concerning the drill-hole (C-subfile).

##### 4.1 Type "T" Data (Drill-Hole Name and Location Data)

This data record is the drill-hole header and must always be the first computer record of the set of data for a drill-hole. The record contains the drill-hole identifier, collar elevation, collar coordinates and the system of measurement (feet or metres). The data format is as follows:

col 1	--	card code -- "T"
col 2-8	--	drill-hole identifier of 1-7 alphanumeric characters (see page 5). All other data for this drill-hole must have this identifier or they will be rejected.
col 10-16	--	collar elevation
col 17-24	--	collar northing coordinate (generally UTM coordinates)
col 25-32	--	collar easting coordinate (generally UTM coordinates)
col 34-39	--	units of measurement for the depths and coordinates. FEET or METRES, <u>if left blank metres are assumed</u>
col 41-42	--	R.F.E. - reference fabric element - for symmetry determination, e.g. S1, S2. (this will be explained in Section 6).

NOTE: Col 10-16, 17-24, 25-32 and 41-42 must be entered. If not available, dummy values should be input. e.g. zeros.

When the data are entered all alphanumeric field are left justified in their fields while the numeric fields (elevation and coordinates) are right justified with the decimal implied at the end of the field if it is not entered with the data.

#### 4.2 : Type "R" Data (Down-Hole Survey Data)

This record is used to enter survey data measured at intervals down the drill-hole. The survey data (Figure 4.2.1) consist of the borehole azimuth, relative to true North; and the borehole inclination entered as a zenith angle defined as follows:

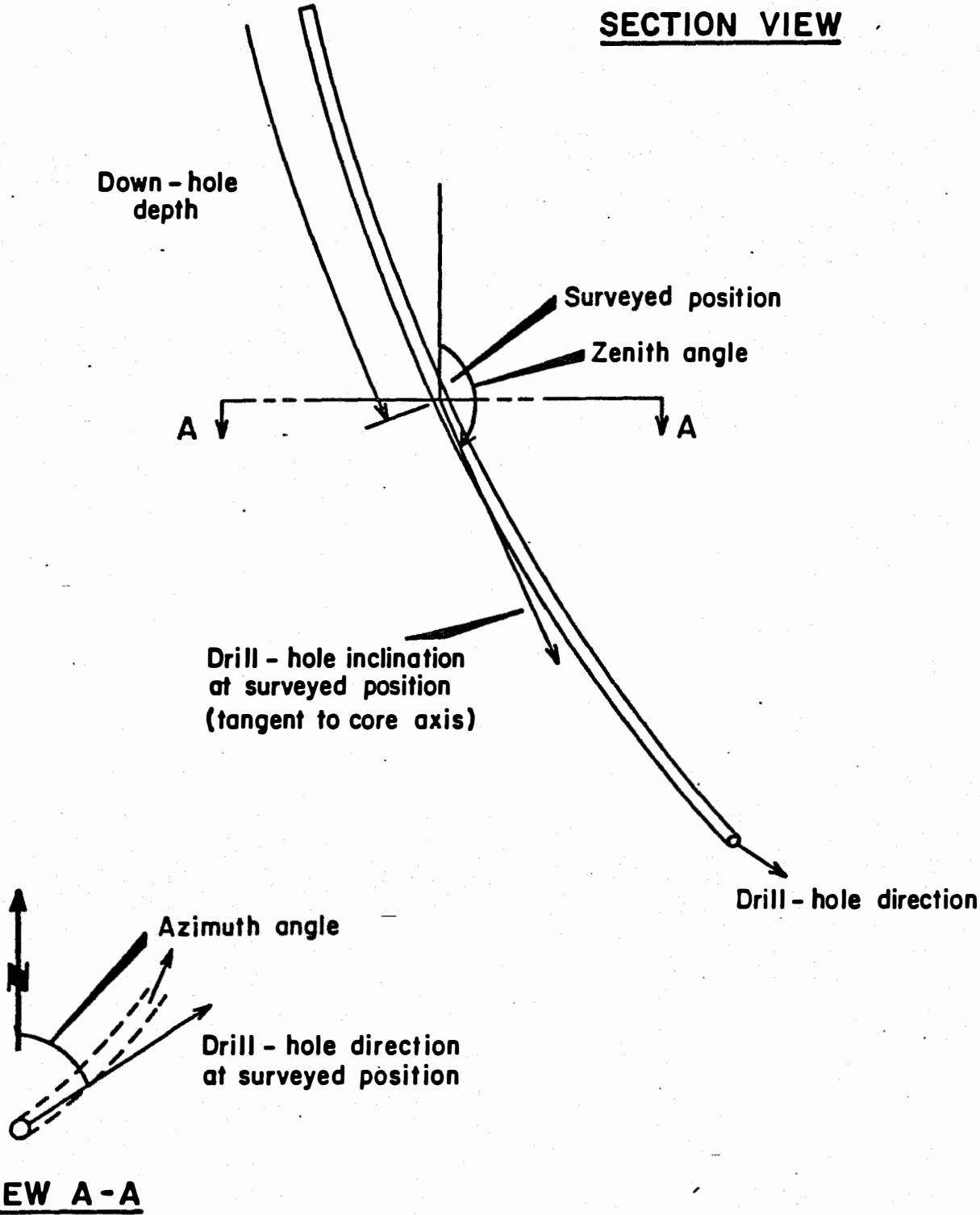
- 0 vertically upwards
- 90 horizontal
- 180 vertically downwards

All angles are measured in decimal degrees.

NOTE: At least one survey record must be present in the set of data for a borehole giving the azimuth and inclination at the collar. (Unless the hole is inclined, these are normally 0 and 180 degrees, respectively). No values for the collar azimuth is needed if the zenith angle is 0° or 180°.

Entries of "R" data are made in the following format (see example on page 11):

- col 1        -- card code -- "R"
- col 2-8     -- drill-hole identifier; this must be the same as on the type "T" header record
- col 10-14   -- depth at which the measurement was - entered as an integer in units of 0.1 metres (feet) i.e. 02500 = 250.0.



**Figure 4.2:1** DEFINITION OF DOWN - HOLE SURVEY ANGLES

- col 22-26 -- the drill-hole inclination measured at the depth and entered as a zenith angle as defined above. The angle is in terms of decimal degrees and must be entered to the nearest 0.1 degree. (see Figure 4.2.1)
- col 28-32 -- the drill-hole azimuth measured at the depth. This angle is measured clockwise from true north. The angle is measured in decimal degrees and is entered the same as the inclination.
- col 35-36 -- optional comment field - available for any comment concerning the reliability of a particular measurement.

Note that the survey point at a depth of 91.4 metres on page 11 has been listed as 'suspect'. Because the field geologist has decided that this reading is bogus, he has drawn a line through this measurement. Consequently the reading will not be entered into the data base. Alternatively, he could have interpolated values for the zenith and azimuth angles and noted in the R-comments field that they were "guestimates". This alternate approach is illustrated in the lower part of the R- subfile field.

#### 4.3 Type "C" Data (Comments)

This record is used to store comments about the drill-hole. C-subfile data may be used only on this field sheet in columns indicated. The format of the record is as follows:

- col 1 -- card code -- "C"
- col 2-8 -- drill-hole identifier - this must be the same as the type "T" header record.
- col 10-51 -- comment text field. This may contain any explanatory notes the geologist cares to add to the quantitative data pertaining to the drill-hole.



## REVISED ROCK CODES

The attached core logging guide is the result of extensive consultations between geologists at the mine and at the Whitehorse Office. It is designed around a simpler concept of stratigraphy and lithology than previously, and the dual lithostatigraphic/computer code systems have been replaced by a single rock coding system. Alphabetic mineral descriptors have replaced the old numeric ones, and they are used in a consistent fashion without direct reference to either the lithology or the stratigraphy.

It has been possible to simplify the previous lithostratigraphic coding system because a more perfect understanding of the geological structure of the Faro area has been developed over recent years, and the relationships between rock types better defined. The new rock descriptions are specifically designed by Lee Pigage to adequately distinguish the known stratigraphic subdivisions of the area, and drill core lithology ~~must be described in terms of one of his specified rock types.~~ Some care must be taken in doing this, and Lee's notes on rock types, and the stratigraphic columns which are included later in this manual will help. It is particularly important to note whether or not phyllites and schists are calcareous, as this is one of the prime ways of distinguishing schists and phyllites of the Vangorda Formation (calcareous) and those of the Mt. Mye Formation (non calcareous).

Dave Tenney

July 30/90

ROCK CODE SUMMARY

ATTACHMENT # 1

QUARTZITES:

- |   |       |                                      |
|---|-------|--------------------------------------|
| 2 | 4A    | Ribbon banded carbonaceous quartzite |
| 3 | 4C/4D | Pyritic quartzite (<30% pyrite)      |

SULPHIDES:

- |   |             |  |
|---|-------------|--|
| 4 | 4EC/4E1/4C3 | Semi-massive siliceous pyritic sulphides sulphides (30-60% pyrite) |
| 5 | 4E/4F       | Massive pyritic sulphides (60-100% pyrite)                         |
| 6 | 4K          | Massive pyritic sulphides with clasts of dolomite/ankerite         |
| 7 | 4G          | Baritic pyrite sulphides (> 10% barite)                            |
| 8 | 4H          | Pyrrhotitic sulphides  |
| 9 | 4J          | Nonpyritic sulphides & oxides - pyrite poor                        |

METASEDIMENTS:

- |    |             |   |
|----|-------------|---|
| 20 | 3G          | Noncalcareous, muscovite-chlorite, medium grey phyllite                                       |
| 22 | 1C/1CD/1D   | Noncalcareous, biotite-muscovite-quartz ± staurolite ± andalusite ± garnet ± fibrolite schist |
| 30 | 5A/5G/3E/1E | Carbonaceous phyllite/schist  |
| 32 | 5E/3F/1G    | Marble ± calc-silicate bands  |
| 33 | 1B          | Skarn and "silicated" marble  |
| 36 | 3D          | Calc-silicate   |
| 40 | 5B          | Calcareous, silvery grey, muscovite-chlorite phyllite   |

META-IGNEOUS ROCKS:

44	5C/3C/1F	Metabasite, poorly foliated greenstone with relict igneous texture
45	5C/3C/1F	Pyroxenite -commonly serpentized - with relict bastites
46	5C/3C/1F	Amphibolite - bluish green hornblende - plagioclase - quartz amphibolite
47	5D/3B/1H	Chloritic phyllite/schist. pale olive green

ALTERED ROCKS: - (DOMINANTLY METASEDIMENTS)

52	4L0	Muscovite > chlorite - quartz phyllite/schist - very pale cream to white
54	4L6	Chlorite > muscovite-quartz phyllite/schist - pale green

CRETACEOUS INTRUSIVES:

60	10Q	Quartz vein- - white bull quartz vein
61	10AB	Anvil Batholith - Mt Mye phase of Anvil plutonic suite. Muscovite - biotite granite
65	10C	Pegmatite
66	-	Aplite
68	10E	Hornblende-biotite quartz diorite - massive and unfoliated
69	10F	Smokey quartz - feldspar porphyry - massive and unfoliated

META-IGNEOUS ROCKS:

44	5C/3C/1F	Metabasite, poorly foliated greenstone with relict igneous texture
45	5C/3C/1F	Pyroxenite - commonly serpentized - with relict bastites
46	5C/3C/1F	Amphibolite - bluish green hornblende - plagioclase - quartz amphibolite
47	5D/3B/1H	Chloritic phyllite/schist. pale olive green

ALTERED ROCKS: - (DOMINANTLY METASEDIMENTS)

52	4L0	Muscovite > chlorite - quartz phyllite/schist - very pale cream to white
54	4L6	Chlorite > muscovite-quartz phyllite/schist - pale green

CRETACEOUS INTRUSIVES:

60	10Q	Quartz vein - - white bull quartz vein
61	10AB	Anvil Batholith - Mt Mye phase of Anvil plutonic suite. Muscovite - biotite granite
65	10C	Pegmatite
66	-	Aplite
68	10E	Hornblende-biotite quartz diorite - massive and unfoliated
69 massive	10F	Smokey quartz - feldspar porphyry - and unfoliated

**FAULT ROCK:**

To be used only if parent cannot be identified - use rarely!

72	Gouge
74	Tectonic breccia
76	Mylonite

**OVERBURDEN:**

82	Unclassified - general
84	Triconed - no recovery
86	Till - silt -sand
88	Ferricrete
99	Air

MINERAL IDENTIFIERS

CARBONATES:

c	calcite
k	ankerite
v	carbonate - non specific
w	dolomite

MICAS: (LAYER SILICATES)

b	biotite
j	fuchsite
l	chlorite
m	muscovite
s	sericite
t	talc

FELDSPARS - QUARTZ

f	feldspar
q	quartz (fine-grained)
o	kaolinite (clay minerals)
p	potash feldspar
Q	quartz (vein)

CALC-SILICATES

a	actinolite
e	epidote
h	hornblende
i	diopside

ALUMINO-SILICATES/PELITE MINERALS

d	andalusite
n	garnet
r	fibrolite
u	staurolite
z	chloritoid

OXIDES/SULPHIDES/SULPHATES

A	Arsenopyrite
B	Barite
C	Chalcopyrite
G	Galena
L	Limonite (iron oxides)
M	Magnetite
P	Pyrite
R	Pyrrhotite
Z	Sphalerite

OTHER

g	carbon
x	noncalcareous

ROCK TEXTURES

ATTACHMENT # 3

+	equigranular
!	foliated
=	laminated/banded/ribbon-banded
>	coarse-grained
^	medium-grained
<	<u>fine-grained</u>
\	clotted
*	porphyroblastic (buckshot)
%	porphyritic
#	interstitial
@	porous
:	weathered
~	fault gouge - ie. mud-more than broken core
x	fault breccia (tectonic)
?	mylonite
"	altered
-	"stringered"
.	"spotted"

ATTACHMENT # 4

GRADE

N	=	no sphalerite or galena	(N = none)
W	=	1 - 3% PbS/ZnS	(W = waste)
L	=	3 - 5%	(L = low grade)
H	=	5 - 10%	(H = high grade)
V	=	10% +	(V = very high grade)

ATTACHMENT # 5

ROCK CODE CONSTRUCTION

ROCK #: MINERAL IDENTIFIERS: TEXTURE: GRADE

NOTES:

- 1) The most abundant rock type comes first if the rock is a hybrid.
- 2) Parentheses are used to separate subordinate rock types.
- 3) Textural codes are appended after the mineral identifier(s).
- 4) Baritic ore ("7") must contain more than 10% barite. If barite content is less than 10% use the appropriate rock code ( Not "7") with the mineral identifier for barite ("B").
- 5) Pyritic quartzite is assumed to have no more than 30% pyrite.
- 6) The grade descriptor for zero grade (i.e. N) may be omitted.
- 7) Mineral identifiers when more than one are used are in order of abundance.
- 8) Beware of redundancies when using mineral identifiers (eg. chloritic phyllite is "47", not "47|"; though possibly the latter could be used for a rock containing extraordinarily large amount of chlorite). In general, characteristics which are normally found in a rock type should not be indicated by a mineral or textural identifier.
- 9) Not all four parts of the rock code construction shown above are necessarily used. Rock number alone is mandatory. It must be accompanied by a grade descriptor if the rock is a sulphide (ie. rock units 4-9)

ATTACHMENT #6

EXAMPLES

<u>Proposed Code</u>	<u>Old Code</u>	
5Z#H	(2E4)	Massive sulphides with over 80% pyrite and heavy sphalerite in a ratio zinc to lead of greater than 1 1/2:1. Texture is network and combined lead/zinc grade is between 5 and 10%.
2ZW	(2A4)	Ribbon banded graphitic quartzite with up to 3% zinc (in sphalerite). < 30% iron sulphides are present by definition.
3/W	(2D)	Quartzite with up to 30% pyrite, and a combined zinc/lead grade of up to 3% in the usual ratio.
5</15/L	(80)	Massive fine grained pyrite with bands of metabasite. Sphalerite and galena are present in usual ratio of 1 1/2:1, and combined lead/zinc grade is between 3 and 5%.
31oY<	(10H9)	Kaolinized granite waste with fine grained pyrite.
3/17/L	(2D1H)	Base metal bearing quartzite with less than 30% pyrite mixed with chloritic phyllite. Combined lead/zinc grade is 3 to 5%. Quartzite constitutes more than 50% of rock.
17/3/L	(1H2D)	As above, but choritic phyllite constitutes more than 50% of rock.

a actinolite

b biotite

c calcite

d andalusite

e epidote

f feldspar

g graphite

h hornblende

i diopside

j fuchsite

k ankerite

l chlorite

m muscovite

n garnet

o kaolinite (clay minerals)

p potash Feldspar

q quartz (fine grained)

r fibrolite

s sericite

t talc

u staurolite

v carbonate (non-specific)

w dolomite

x non calcareous

z chloritoid

A Arsenopyrite

B Barytes

C Chalcopyrite

G Galena

L Limonite (iron oxides)

M Magnetite

Q Quartz (vein)

R Pyrrhotite

Y Pyrite

Z Sphalerite

ORE TYPES

- 2 (4A) Ribbon-banded, carbonaceous quartzite
- Dark grey finely banded quartzite with alternating interbands of light grey to white quartz - sulphides. Banding on a scale of 2mm-2cm. Sulphides pyrite & sphalerite (reddish) ± galena.
- Hard - nail or knife leaves metal on surface S2 surfaces are dark grey to black and typically mark the fingers.
- Typically has a well developed microlithon texture.
- If pyrite content > 30% then call it pyritic 2
- 3 (4C/4D) Slightly pyritic quartzite
- Pale grey to creamy white, generally noncalcareous quartzite.
- Contains thin ribbons and band of sulphides-pyrite, sphalerite, galena
- Hard - nail or knife leaves metal on surface. Typically sulphide bands show microlithon texture
- S2 surfaces are pale grey with discontinuous streaks of muscovite. Typically leaves no mark on fingers.
- Full gradation exists between 2 and 3. If S2 surfaces are medium grey -i.e. slightly to moderately carbonaceous the rock should be called carbonaceous 3 (and NOT 2!)
- If pyrite content > 30% then call it pyritic 3.
- 4 (4EC) Siliceous pyritic sulphides - semi-massive sulphides
- Intermediate rock type which is typically logged either as pyritic 3 or siliceous 5

Brassy yellow, fine grained, noncalcareous, moderately hard pyrite.

Typically low grade.

Locally finely laminated with thin streaks and bands of fine grained magnetite

Contains diffuse bands and lenses of grey to white quartz. Quartz also disseminated in matrix- pyrite constitutes 30-60% of unit. Banding is on scale of 1cm to 10cm.

Locally may contain small clasts of dolomite.

5

(4E)

Pyritic massive sulphides

Brownish yellow, fine grained, moderately hard, pyrite with sulphides. Pyrite constitutes 60-100%

Diffuse banding parallel S2 with variations in sphalerite-galena content

Contains clots and lenses of carbonate (calcite, dolomite) and quartz.

Typically high grade.

Typically interbanded with 6 on a scale of cm to metres.

For up to 10% barite rock should be called baritic 5

6

(4K)

Pyritic massive sulphides with ankerite/dolomite

Similar to rock type 5 except it contains large ameboid belbs of flesh-coloured dolomite/ankerite

It should not be used for massive sulphides with disseminated matrix carbonate.

- 7 (4G) Baritic, massive pyritic sulphides
- Pyritic massive sulphides with > .10% barite visually.
- Brownish to purplish, banded to laminated pyritic sulphides with barite. Soft.
- "Burns Black" on cut surface as pyrite streak shows on soft barite.
- Typically high grade - sphalerite is honey coloured and can be overlooked.
- Typically magnetite-bearing.
- 8 (4H) Pyrrhotitic, massive sulphides
- Fine-grained, reddish bronze pyrrhotitic massive sulphides
- Magnetic because of pyrrhotite
- Moderately hard
- Generally moderate to high grade
- Strongly laminated deformation texture. Shows ductile flow textures around clasts of carbonate, white quartz, phyllite, metabasite
- Not a common rock on Vangorda Plateau - occurs mainly at margins of sulphide intersectons.
- 9 (4J) Nonpyritic massive sulphides
- Unusual, rare rock type
- Coarse to medium grained sphalerite-galena with porphyroblasts of magnetite and pyrite. May also contain ameboid porphyroblasts of carbonate and diffuse quartz bands or lenses
- Typically high grade - colour reddish brown to dark brown.

- 20 (3G) Noncalcareous muscovite-chlorite phyllite
- Moderately soft, noncalcareous, medium grey phyllite
- Well developed, pervasive S2 foliation. S2 surfaces silvery grey to steely grey. No readily visible individual micas.
- Homogeneous to poorly laminated or banded. Laminae defined by shades of grey variations—not by siltstones.
- 22 (1C/1CD/1D) Noncalcareous muscovite-biotite schist
- Moderately soft, noncalcareous, brownish grey schist
- Well developed, pervasive S2 soliation, S2 surfaces silvery with brownish biotite streaking. Individual mica flakes are visible.
- Some varieties are strongly compositionally banded with biotite-rich bands and quartz-rich bands
- May contain clots and bands of biotite-andalusite, staurolite, garnet.
- Coarser-grained than phyllite Typically brownish hue as biotite overshadows carbon.
- 30 (5A/5G/3E/1E) Carbonaceous phyllite/schist
- Dark grey to black, moderately soft, carbonaceous phyllite/schist.
- S2 surfaces are dark steely grey to black and typically mark the fingers.
- Locally will contain thin pale grey quartz + calcite + dolomite siltstone laminae/bands
- Locally will contain interbands of dark grey to black marble with thin white beaded calcite laminae.

Should not be used for only moderately carbonaceous phyllite/schist. S2 surfaces should be dark and mark fingers.

Siltstone bands should be noted. Carbonates (if present) should be noted.

32

(5E/3F/  
1G/1B)

Marble and silicated marble

Medium crystalline, medium to pale grey calcite marble.

May locally be very fine grained with mylonite texture.

Typically contains thin bands of pale to dark green calc-silicate and/or dark brown biotitic silicates.

Silicate bands are commonly boudinaged.

May contain coarser skarn textures.

On Vangorda Plateau this is shut down rock

Locally will be carbonaceous dark grey to black with thin laminae of white, beaded calcite defining S2.

36

(3D)

Calc-Silicate

Hard, noncalcareous to slightly calcareous, prominently striped pale green calc-silicate and dark brown biotitic pelite. Banding typically on a scale 1-10cm. Proportions of biotite and calc-silicate vary greatly.

Unit is fine-grained. Non calcareous schist (110) are typically coarser grained.

40

(5B0)

Silvery grey to pale grey, moderately soft, muscovite-chlorite phyllite.

Contains thin pale grey to off-white quartz-carbonate (calcite or dolomite) siltstone laminae to bands. Siltstones give core an overall calcareous aspect. Siltstones are 1-5cm thick.

S2 surfaces are silvery grey. Darker S2 surfaces should be logged as carbonaceous.

Typically S2 foliation defined by crenulation cleavage-microlithons.

Typically contains scattered, isolated pyrite/pyrrhotite porphyroblasts.

44 (5C/3C  
1F)

Metabasite

Poorly foliated, dark green, noncalcareous to slightly calcareous, chloritic metabasite.

Typically relict igneous texture with grey to white altered plagioclase.

Moderately hard to hard

Altered variants are typically strongly foliated with anastomosing chloritic streaks in a grey carbonate matrix. May contain streaks or bands of bright green "fuchsite" This variant has been called zebra rock.

45 (5C/3C  
1F)

Pyroxenite

Poorly foliated, dark green, noncalcareous to slightly calcareous, chloritic metabasite.

Typically serpentized and therefore slightly magnetic. Relict igneous textures show pyroxene "bastites".

46 (5C/3C/  
1F)

Amphibolite

Foliated, dark green to bluish green, moderately hard hornblende amphibolite.

Commonly contains pale grey to white streaks parallel S2. Locally calcareous.

47

(5D/3B/  
1H)

Chloritic phyllite

Foliated, pale olive green, moderately soft, moderately calcareous, chloritic phyllite.

Locally diffusely banded with speckled off-white calcite ± quartz bands

Typicaly has thin white quartz-calcite veins parallel S2.

S2 surfaces are silvery pale green and have a slightly gritty texture.

Pervasive S2 foliation.

Marginal contacts with metasediments are sharp.

Altered variants are pale tan with streaks of muscovite on S2 surfaces. Carbonate is typically dolomite/ankerite. Commonly contains specks of bright green "fuchsite".

52

(4L)

White mica envelope-altered phyllite

Moderately soft, pale grey to off-white muscovite-quartz phyllite.

Generally sulphide-bearing with discontinuous streaks of pyrite or pyrrhotite ± sphalerite ± galena.

Locally may be siliceous = hard, that should be noted in modifiers.

Typically pervasively foliated - not microlithoned.

S2 surfaces are silvery white from fine muscovite.

Typically noncalcareous.

Represents highly altered metapelite.

- 54 (4L6) Slightly altered muscovite-chlorite phyllite.  
Moderately soft, pale creamy green, muscovite-chlorite phyllite.  
May be sulphide bearing with discontinuous pyrite or pyrrhotite streaks.  
Typically noncalcareous.  
Represents more slightly altered metapelite.
- 60 (10Q) Bull quartz vein  
Coarse grained, milky white, vein quartz.
- 61 (10AB) Anvil Batholith (biotite-muscovite granite)  
Equigranular to slightly foliated, biotite-muscovite, granite.  
Medium to coarse grained.  
May contain large K-feldspar megacrysts.  
Near Tie Fault will have S-C mylonite texture.
- 65 (10C) Pegmatite  
Coarse grained granite to pegmatite. Typically occurs as dykes in pelites or Anvil Batholith.  
Typically contains tourmaline.
- 66 - Aplite  
Fine-grained, "sugary-textured", creamy white K-feldspar-plagioclase-quartz granite/aplite.  
Typically unfoliated.  
Typically contains garnet and/or tourmaline.
- 68 (10E) Hornblende-biotite quartz diorite.  
Medium grained, equigranular, unfoliated, medium grey, hornblende-biotite quartz diorite.  
Marginal phase is fine-grained, brown, aphanitic matrix with scattered biotite and hornblende phenocrysts.  
May contain hornblende phenocrysts.

- 69 (10F) Smoky quartz-feldspar + biotite porphyry
- Pale cream, fine-grained granite with numerous phenocrysts of dark brown smoky quartz, biotite, white feldspar. Quartz phenocrysts are commonly euhedral.
- Very soft and punky when altered. Upon weathering typically breaks apart - contains swelling clays.
- Unfoliated - may contain banding and streaking which looks like flow banding texture.
- 82 (\*) Overburden - general
- Unspecified overburden
- 84 (\*) Overburden - Triconed
- Triconed - no recovery
- 86 (\*) Overburden - Till/Silt/Sand
- 88 (\*) Overburden - Ferricrete
- Rock fragments cemented by orange to brownish fine grained hematite/limonite/goethite iron oxides.22

8. PAGE CAMC1981-E-5 OF LOGS: ASSAY SAMPLES

8.1 Type "P" Data Sheet - Assay Log (Sample Location)

This field sheet is used to record the depth and sample number of specimens from the drill core that have been taken for assay. The sample is always taken over an interval denoted by the from-depth and the to-depth. The format of the logging sheet is shown below:

- col 1 -- card code "P"
- col 2-8 -- drill-hole identifier which must be the same as used on the header card (type "T") for this drill-hole
- col 10-14 -- from depth. This depth is recorded in units of 0.1 metres (feet) with the decimal point assumed between columns 13 and 14.
- col 16-20 -- to-depth. This depth is recorded in units of 0.1 metres (feet) with the decimal point assumed between columns 19 and 20.  
Both the from-depth and the to-depth must be present. The actual location of the sample is taken to be at the midpoint of the sample interval.
- col 22-26 -- sample number of the specimen sent for assaying. The assay results are recorded on a separate data card. The sample number is an integer value only. Steps have been taken to assure unique numbers for each property.
- col 28-30 -- Sample interval (i.e. difference between FROM and TO depths). This is recorded in units of 0.1 metres (feet) with the decimal point assumed between columns 29 and 30.
- col 32-34 -- recovered length of sample. This is recorded in units of 0.1 metres (feet) with the decimal point assumed between columns 33 and 34.

- col 36-40 -- lithostratigraphic code of the sample material (see chapter 5; appendices I, II).
- col 42 -- description. continued lithostratigraphic code modifiers and/or brief description of feature in the drill core. This field may also contain whole rock specific gravity measurements for the assay interval. Page 49 contains an example of measured specific gravities for the assay samples.



6. PAGE CAMC1981-E-4 OF LOGS: STRUCTURE

6.1 Type "S" Data Sheet (Geological Structure Data)

This field sheet is used to record structural observations from the drill core. As these data are often measurements, the observations are assumed to be at discrete points down the drill-hole. The depth of the observation is recorded in the "to-depth" field (col. 16-20). The different data that may be observed and recorded include orientation of any planar element ( $S_0$  bedding,  $S_1$  cleavage,  $S_2$  cleavage....) with respect to the core axis, symmetry information (vergence), type(s) of cleavage present, and stratigraphic facings--stratigraphic tops up or down the DDH.

Examples of the structural logging sheet are illustrated on pages 20 and 21. Page 20 is a typical example for the Gataga area; page 21 is an Anvil example. The format of the logging form is as follows:

- col 1        -- card code -- "S" or "\$"  
              "S" is used for data which is to be plotted on the drill-hole projections.  
              "\$" is used to enter observations in the DDH-data base which are not to be plotted on the drill hole projections.
- col 2-8     -- drill-hole name (identifier).  
              This must be the same as that used with the type "T" information).
- col 10-14  -- from depth of the observation.  
              This depth is recorded to the nearest 0.1 metre (foot) with the decimal point assumed between columns 13 and 14. It is used only for zone observations. With point observations it must be left blank.)

- col 16-20 -- to-depth of the observation.  
This depth must be present and is taken as the depth at which the observation was made. The depth is recorded in units of 0.1 metres (feet) with the decimal point assumed between columns 19 and 20.
- col 22-24 -- feature field.  
This field is used to insert descriptive information about the reference fabric element during the structural logging. It is not plotted. Permitted codes are PSn, CSn, and DDn; these are explained in Section 6.2.
- col 26 -- symmetry code  
The permitted symmetry codes are S, M, Z, E, and 3. These codes describe vergence relations for the reference fabric element and are defined in Section 6.3. The codes are plotted on the structural projection of the drill-hole. Symmetry may be either a zone or point observation. With point observations of symmetry the From-depth field is left blank. For zone observations both the From-and To- depth fields are completed in the log. If this field is blank it was not measured or observed.
- col 28-32 -- observation for the  $S_0$  plane as follows:  
col 28-29 angle to the core axis (0-90)  
col 30-32 dip-direction (0-360) with respect to the reference fabric element measured clockwise (see Fig. 6.4.2).
- col 34-38 -- observation for the  $S_1$  plane as follows:  
col 34-35 angle to the core axis (0-90)  
col 36-38 dip-direction (0-360). Where  $S_1$  is the reference fabric element the azimuth is inserted once at the top of the field sheet or where the azimuth changes. Where another planar feature is the reference fabric element, the dip-direction of  $S_1$  is measured clockwise with respect to the reference fabric element.
- col 40-44 -- observation for the  $S_2$  plane as follows:  
col 40-41 angle to the core axis (0-90)  
col 42-44 dip-direction (0-360). Where  $S_2$  is the reference fabric element the azimuth is inserted once at the top of the field sheet or where the azimuth changes.
- col 45 -- description  
This field is not entered into the computer drill-hole data base. It is available for any comments on measurements recorded in columns 28-44. It is also used to sketch minor folds noted in core. A useful feature recorded here for future reference is stratigraphic facings directions.

More detailed discussions of the features recorded on this sheet are presented in the following pages



## 6.2 Feature Codes (columns 22-24)

Permitted feature codes are PS<sub>n</sub>, CS<sub>n</sub>, and DD<sub>n</sub>. These are descriptive codes for the reference fabric element noted in the drill-core.

PS<sub>n</sub> where  $n = 1, 2, 3, \dots$

PS is a specific term referring to a pervasive fabric element such as pressure-solution striping, slaty cleavage, or schistosity. The n refers to the particular phase of deformation associated with the planar fabric element. Three criteria should be used to recognize this fabric:

- a) it is present in more than one rock type
- b) microlithon structures are not visible
- c) ideally there should be a transition from a crenulation cleavage to a closely spaced crenulation cleavage to a pervasive schistosity /cleavage.

PS<sub>2</sub>, therefore, refers to a pervasive S<sub>2</sub> schistosity or cleavage developed in the core.

CS<sub>n</sub> where  $n = 1, 2, 3, \dots$

CS refers to a well-developed crenulation schistosity/cleavage. As above, n delineates the deformation phase associated with the crenulation schistosity. CS<sub>1</sub> will only be rarely observed because generally the S<sub>1</sub> cleavage is pervasively developed. Again, this code refers only to the reference fabric element.

DDn where  $n = 1, 2, 3, \dots$

The term DD is used when the axis of a minor fold (microlithon) is parallel to the major axis of the reference fabric element in drill core. Again  $n$  refers to the deformation phase associated with the fold axis and the reference fabric element. With this special case, symmetry of the drill core is not readily determined visually. It must be identified with respect to fold plunge (i.e. S looking down plunge or Z looking up plunge.)

### 6.3 Symmetry Codes (column 26)

Symmetry codes refer to the angular relationship between the surface being folded and the reference fabric element axial planar cleavage of a fold. In both Anvil and Gataga areas folds are usually overturned. Figure 6.3.1 illustrates the symmetry relations between the folded surface and the axial plane cleavage (R.F.E.). The upright folded surface has Z-symmetry (note minor folds) and the S-limb has an overturned facing direction.

Permitted symmetry codes in column 26 are S, Z, M, E, and 3. Symmetry codes refer to angular relation between the reference fabric element (= axial plane cleavage) and the surface being folded. In Gataga these surfaces are  $S_1$  and  $S_0$  respectively. In Anvil the equivalent surfaces are usually  $S_2$  and  $S_1$ .

The codes often may be used as both point and zone observations. Point observations apply to a specific observation noted in core; in this case

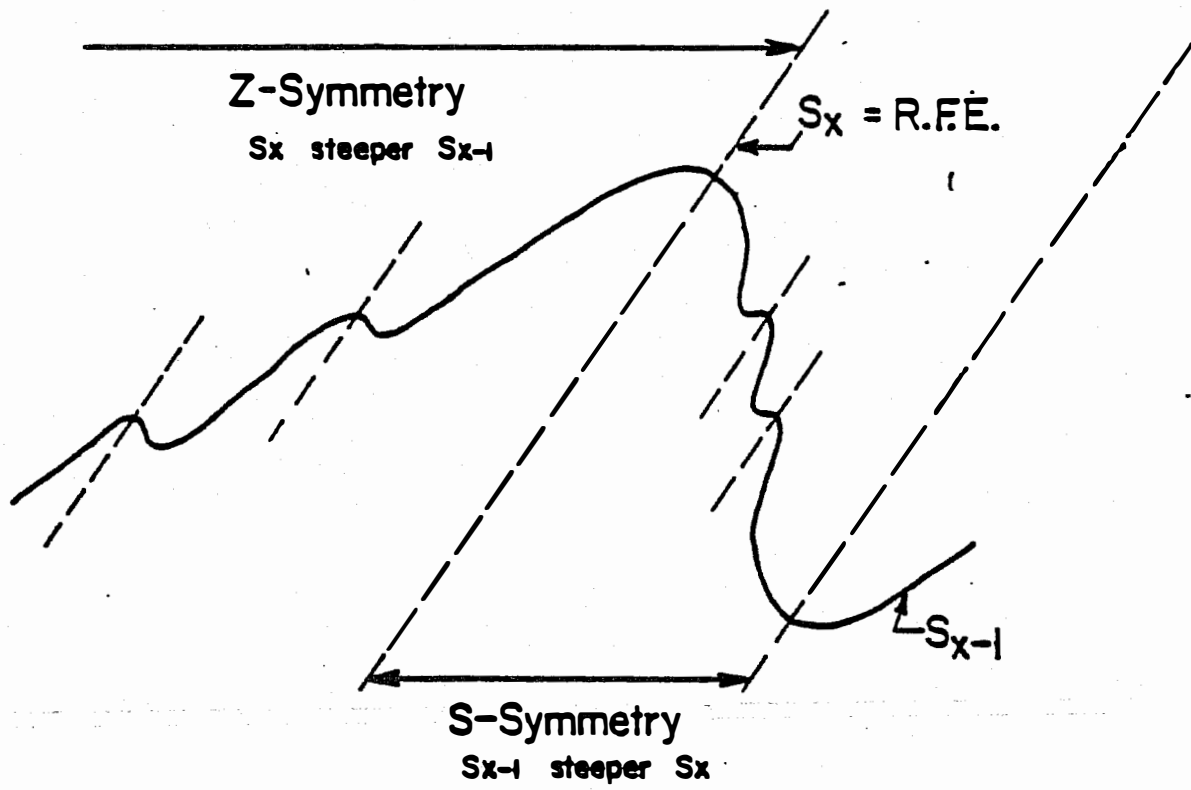
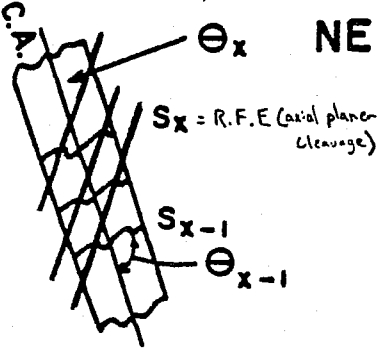
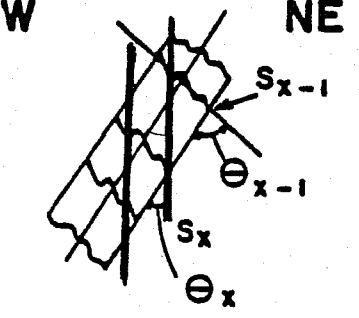
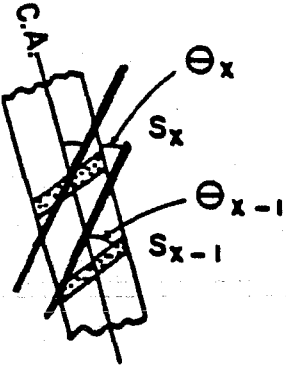
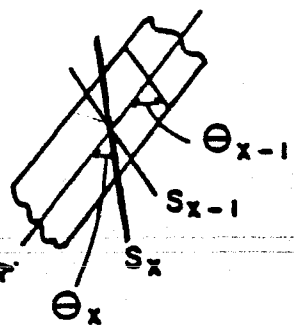
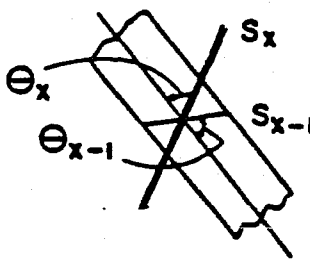
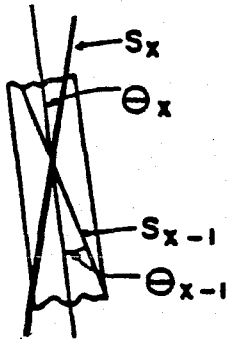
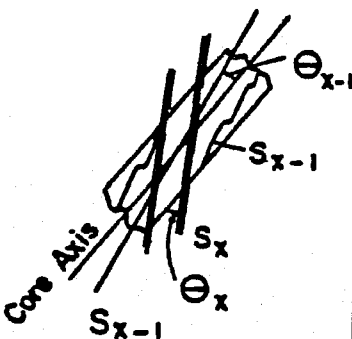
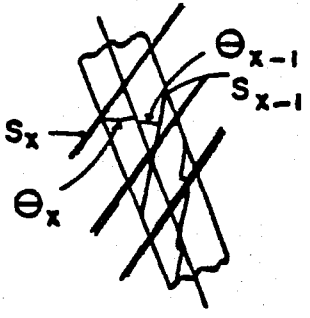


Figure 6.3.1 Fold Symmetry

only the To-depth field is completed in the field log (columns 16-20). In many cases, however, the symmetry code is valid for an entire interval of core; the zone with symmetry noted is indicated by completing both the from- and to-depths (columns 10-14 and 16-20). Figures 6.3.2 and 6.3.3 illustrate several examples of symmetry in core.

- 1) S and Z refer to observed S- or Z- symmetry in microlithons and minor folds (Figure 6.3.1). Both point and zone observations are allowed. For concordance in logging, symmetry should be determined with the core axis oriented in the appropriate drilling position. This obviously means that some symmetry observations will be incorrect because of uncertainties in core orientation. Symmetry interpretation must therefore be constantly interpreted with caution.
- 2) M refers to a zone of mixed symmetry usually implying a hinge zone of uncertain vergence. Typical examples include large hinge zones or short, steep limbs. Use of this symbol allows for uncertainty in locating symmetry changes over large zones. Both zone and point observations are allowed.
- 3) E and 3 are used for actually observed fold closures in the drill-core. As such they are point observations. These symbols also have implied symmetry changes associated with them. For E the zone above the symbol has implied S-symmetry and the zone below has Z-symmetry. For 3 the overlying zone has implied Z-symmetry and the underlying zone has S-symmetry.

Figure 6.3.2 Core Symmetry

Fabric Elements	"Z" Symmetry	"S" Symmetry
<p><math>\Theta_{X-1} &gt; \Theta_X</math> with minor folds</p> <p>Same dip azimuth dir.</p>	 <p><math>\Theta_X</math> NE</p> <p><math>S_x = R.F.E. (axial\ plane\ cleavage)</math></p> <p><math>S_{X-1}</math></p> <p><math>\Theta_{X-1}</math></p>	 <p>SW</p> <p>NE</p> <p><math>S_{X-1}</math></p> <p><math>\Theta_{X-1}</math></p> <p><math>S_x</math></p> <p><math>\Theta_X</math></p>
<p><math>\Theta_{X-1} &gt; \Theta_X</math></p> <p>Same dip azimuth dir.</p>	 <p><math>\Theta_X</math></p> <p><math>S_x</math></p> <p><math>\Theta_{X-1}</math></p> <p><math>S_{X-1}</math></p>	 <p><math>\Theta_{X-1}</math></p> <p><math>S_{X-1}</math></p> <p><math>S_x</math></p> <p><math>\Theta_X</math></p>
<p><math>\Theta_{X-1} = \Theta_X</math></p> <p>Opposite dip azimuth directions</p>	 <p><math>S_x</math></p> <p><math>\Theta_X</math></p> <p><math>S_{X-1}</math></p> <p><math>\Theta_{X-1}</math></p>	 <p><math>S_x</math></p> <p><math>\Theta_X</math></p> <p><math>S_{X-1}</math></p> <p><math>\Theta_{X-1}</math></p>
<p><math>\Theta_{X-1} &lt; \Theta_X</math></p> <p>Same dip azimuth dir.</p>	 <p><math>\Theta_{X-1}</math> NE</p> <p><math>S_{X-1}</math></p> <p><math>S_x</math></p> <p><math>\Theta_X</math></p> <p>Core Axis</p>	 <p><math>\Theta_{X-1}</math> SW</p> <p><math>S_{X-1}</math></p> <p><math>S_x</math></p> <p><math>\Theta_X</math></p>

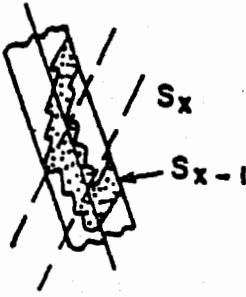
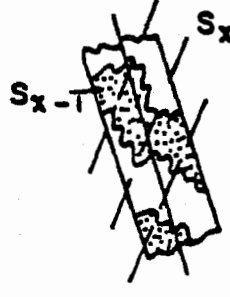

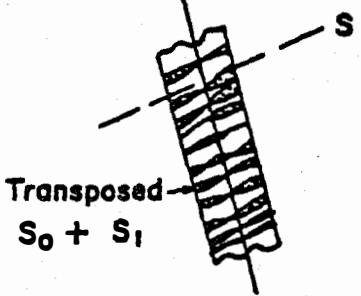
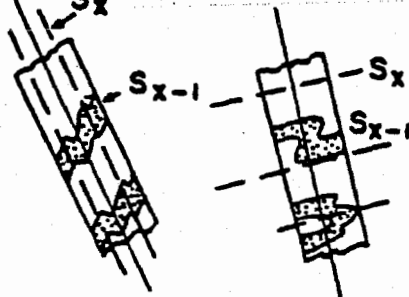
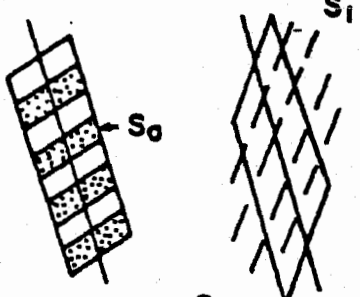
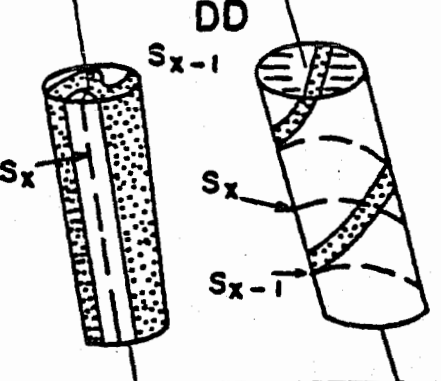
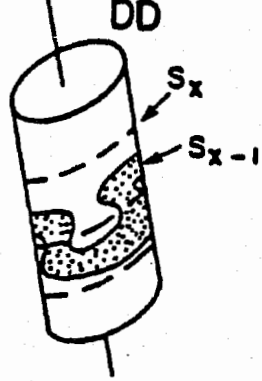
Fabric Elements	Symmetry Examples	Symmetry Examples
<p><math>S_x</math>; minor folds in <math>S_{x-1}</math></p>	<p>SW "E" NE</p> 	<p>SW M NE</p> 
<p><math>S_x</math>; minor folds in <math>S_{x-1}</math></p>	<p>"3"</p> 	<p>?</p>  <p>Transposed <math>S_0 + S_1</math></p>
<p><math>S_x, S_{x-1}</math></p>	<p>?</p> 	<p>?</p>  <p><math>S_1</math> not visible    <math>S_0</math> not visible</p>
<p>Dip azimuth direction <math>S_x \perp</math> dip azimuth direction <math>S_{x-1}</math></p>	<p>DD</p> 	<p>DD</p> 

Figure 6.3.3 Core Symmetry

#### 6.4 Sn Codes Where n = 0, 1, 2, ...

$S_n$  is a point observation of the orientation of a particular planar element with respect to the core axis.  $n$  describes the deformation phase associated with the S-surface being measured.  $S_0$  refers to primary sedimentary bedding,  $S_1$  refers to the axial plane cleavage formed during the first phase of deformation, etc.

$S_n$  surfaces can be divided into two major categories:

- 1) reference fabric element (R.F.E.) =  $S_x$  = axial plane cleavage
- 2) other planar surfaces =  $S_{x-i}$  where  $i = 1, 2, \dots, x$

In the following discussion these two types of surfaces will be discussed separately. Measurement of each surface is similar. In all calculations of orientations of the planar elements measured for a DDH, the R.F.E. ( $S_x$ ) is assumed to dip in a direction specified by the field geologist.

##### 6.4.1 $S_x$ = Reference Fabric Element

The R.F.E. is defined as the planar element which is developed throughout the core for a particular DDH and has a constant dip line azimuth (dip direction) in the area of the DDH. Because it is assumed to have a constant dip direction, the R.F.E. ( $S_x$  plane) should ideally be the axial plane cleavage for the latest deformation phase observed in drill core. In the Gataga area  $S_x$  is normally  $S_1$ ; in the Anvil area it is commonly  $S_2$ .

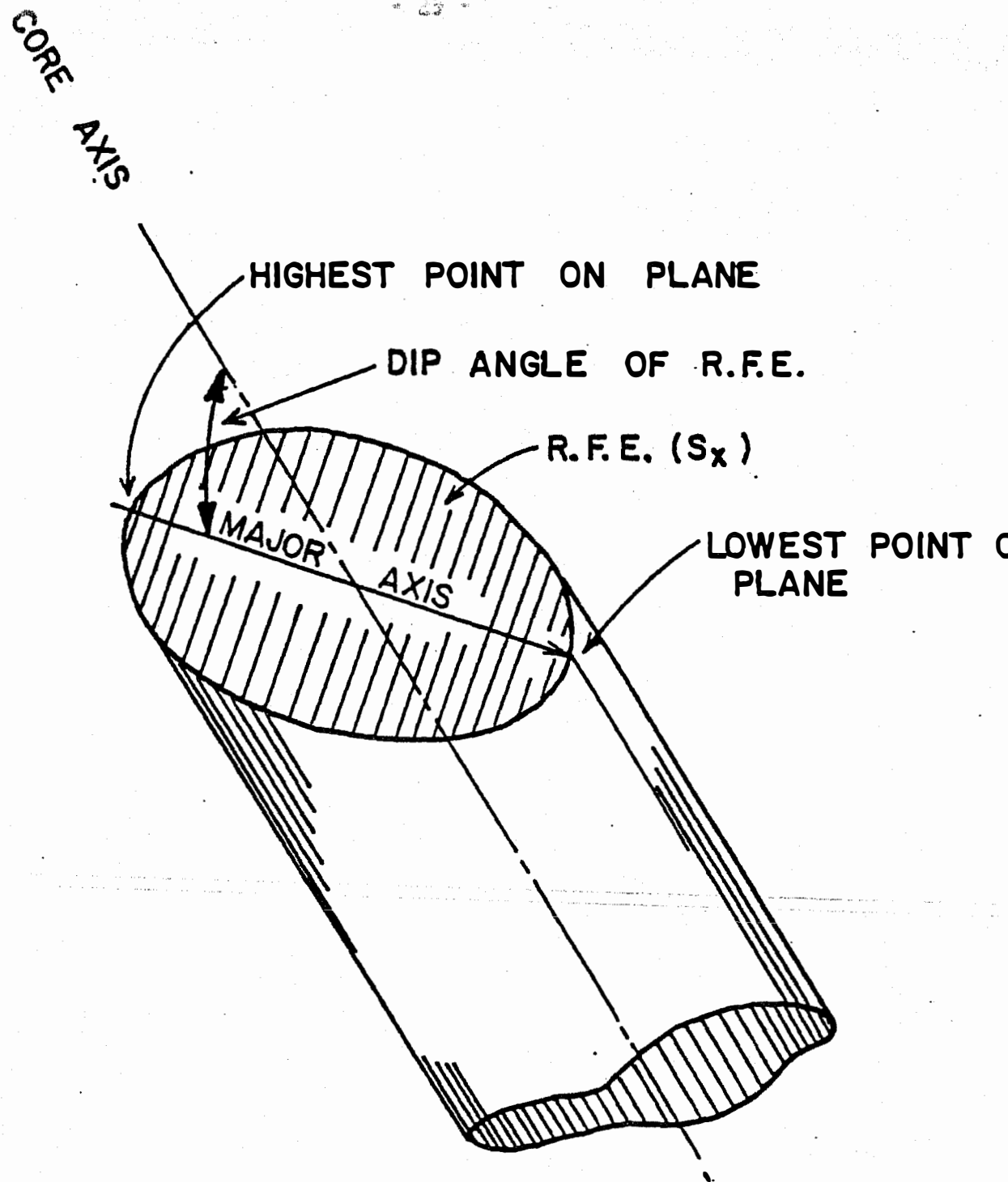


FIGURE 6.4.1 DIP ANGLE OF R.F.E.

The deformation cleavage (reference fabric element) for a particular DDH is specified in the "T" line of field sheet CAMC 1981-E-2 (columns 41-42). An example is illustrated on page 11.

Measurement of the R.F.E. plane in drill core is illustrated in Figure 6.4.1. The intersection of the R.F.E. plane with the core cylinder is commonly marked on the edge of the core using a grease pencil or felt marker. Because the R.F.E. in both Anvil and Gataga areas is a schistosity/cleavage, this line is often defined by the way the core breaks. The R.F.E. ( $S_x$ ) core intersection is a plane with an elliptical outline. The field geologist measures the angle between the lowermost point on this plane (major axis of the ellipse) and the core axis. This angle is readily measured using a contact goniometer or a protractor. It is recorded on the logging sheet (CAMC 1981-E-4) in the Dip columns of the appropriate deformation fabric (commonly  $S_1$  or  $S_2$ ).

The R.F.E. is assumed to have a constant dip direction (dip line azimuth) for the entire drill hole. It is determined by averaging measured dip directions of surface outcrops in the vicinity of the drill hole. The averaged dip line azimuth is recorded in the Direction columns of the appropriate deformation fabric (commonly  $S_1$  or  $S_2$ ). Since this direction is constant, it is commonly entered into the structural logs only on the first line of each page.

#### 6.4.2 Other Related Planes: $S_x-i$ ; $i = 1, 2, \dots, x$

The orientation of any other plane within the drill core is measured with respect to the core axis and the reference fabric element ( $S_x$  plane). Its orientation in true space can then be calculated since the orientations of the drill core and the R.F.E. are known and/or assumed.

Two measurements are made and recorded for  $S_x-i$ . These are illustrated in Fig. 6.4.2. To make the necessary measurement the core is conventionally held vertically with the direction of drilling being down. The lowest points on the planes representing  $S_x$  and  $S_x-i$  are identified and marked on the side of the core. The 'dip' field for  $S_x-i$  is measured with respect to the core axis in the same manner as done for the R.F.E. For the 'Direct' field the angular distance between the lowest point on the R.F.E. and the lowest point on the  $S_x-i$  plane is measured in a clockwise direction around the circumference of the drill core cylinder. This angle ranges from  $0^\circ$  to  $360^\circ$ . (If they dip in the opposite directions the measured angle is  $180^\circ$ .)

Locally in a drill-hole a later cleavage may become the dominant, pervasive planar fabric present. In Anvil, for example,  $S_4$  may be locally dominant with  $S_2$  being the folded planar element. In this situation the R.F.E. in the  $S_4$ -dominant area must be changed to  $S_4$ . An example of a series of structural measurements with the indicated change in R.F.E. is illustrated on page 21. Note that the description field (column 45-) is used to clearly outline the change in R.F.E. as well as denote that the three  $S_n$  fields (column 28-44) are being used for different deformation phases than those recorded in the rest of the drill-hole.

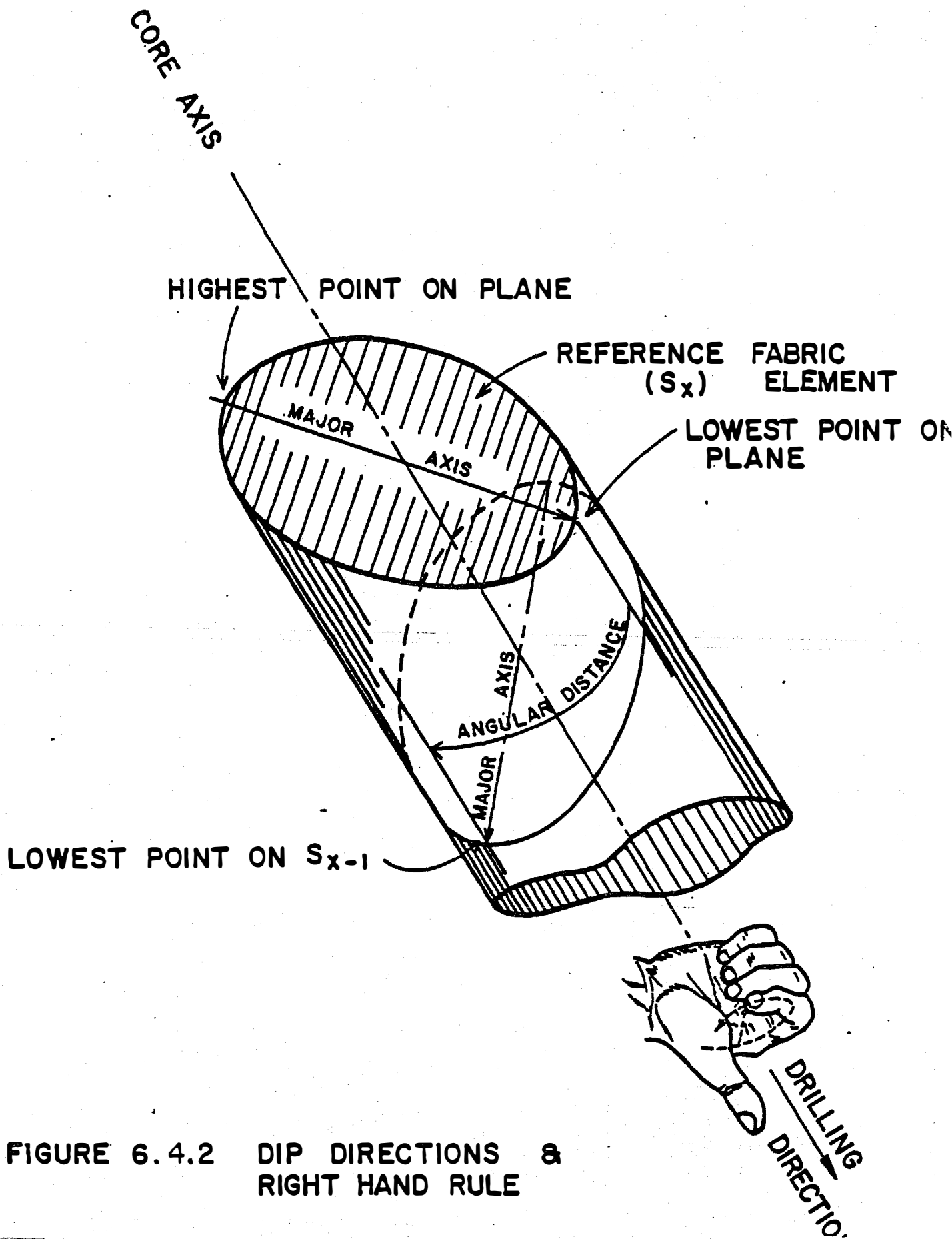


FIGURE 6.4.2 DIP DIRECTIONS & RIGHT HAND RULE

### 6.4.3 Other Related Planes $S_{x+i}$ , $i = 1, \dots, n$

Ideally, the R.F.E. should be the planar surface formed during the latest deformation event. All other measured planar elements in the drill-hole would be related to original sedimentary deposition or earlier deformation events. Pragmatically however, late deformation fabrics are often encountered as weakly or inconsistently developed planes in a particular drill hole. Since they are not pervasively developed, they do not form a suitable R.F.E.. In these particular cases it is practical to keep the R.F.E. as the latest pervasively developed planar feature and to measure these later planes with respect to this R.F.E. surface. These later planes are then plotted in projection as  $S_{x+1}$  surfaces in a separate drill-hole structural plot.

An example of this situation is present in some Gataga drillholes. The typical R.F.E. is  $S_1$ . Locally  $S_1$  is disrupted by a weakly to strongly developed  $S_2$  crenulation cleavage. In most cases the  $S_2$  cleavage does not significantly fold the earlier  $S_1$  cleavage. In this situation it is practical to measure  $S_2$  with respect to  $S_1$ . A separate structural plot for these drillholes contains only  $S_2$  ( $S_{x+1}$ ) and  $S_1$  ( $S_x$ -RFE) planes in the plane of the projection.

## 6.5 Structural Logging - scale considerations and problems with field logging

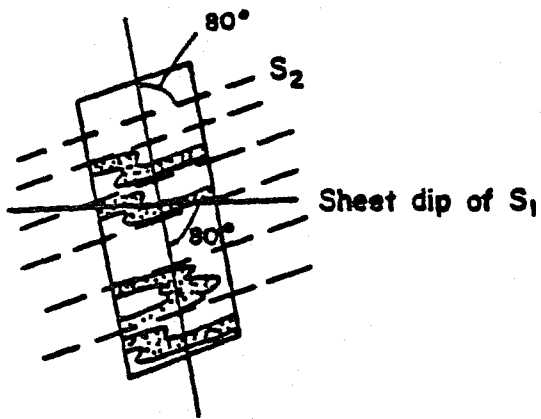
Structural information from the field logs is typically displayed on a down-hole projection of the drillhole. Obviously the density of structural readings while logging core is related to the scale used when projecting the drillhole data. If structural observations are done at intervals too close for the scale of the plot, the plotted structures overlap and are difficult to properly interpret.

Previous experience has dictated a practical density for structural observations while logging drill core. For readily legible structural plots the following distance between structural readings is suggested:

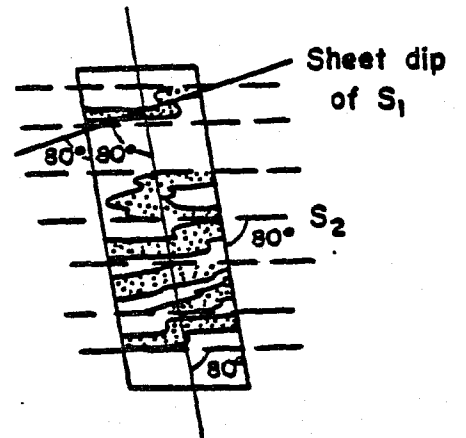
PLOTTING SCALE	STRUCTURE MEASUREMENT EVERY
1:1000 (1"=83.3')	3-6 metres
1:6000 (1"=500')	18-36 metres
1:1200 (1"=100')	6 metres (20 feet)

Symmetry determinations are often difficult to impossible to determine from drill core when the RFE is at an angle of  $70-90^{\circ}$  to the core axis. This situation is aptly illustrated in Fig.6.5.1. The RFE ( $S_2$ ) is almost normal to the drill core axis. Two solutions for  $S_1$  and  $S_2$  are often possible with  $S_2$  dipping in the same direction for each solution. These solutions typically

FIGURE 6.5.1



"Z" POSSIBILITY



"S" POSSIBILITY

have an opposing sense of vergence. In this situation independent stratigraphic facing indicators are needed to arrive at a unique symmetry solution.

In the Anvil area the  $S_2$  (RFE) cleavage is typically at a high angle to the core axis for surface exploration drillholes. Therefore appropriate symmetry determinations are often difficult to impossible to delineate. This problem is further compounded because the RFE is subhorizontal and is often locally warped to gentle SW and NE dips by later deformation phases. It is often better to ignore symmetry determinations in this situation since they are suspect.

Finally it should be noted that the instructions for measuring the angular distance between the R.F.E. plane and  $S_{x-i}$  or  $S_{x+i}$  planes assumes that the drilling direction was "down" (drill-hole azimuth is between  $90^\circ$  and  $180^\circ$ ; see section 4.2). Similar rules are followed for measuring this angle on upward-directed drill-holes. To summarize, the angle between  $S_x$  and  $S_{x-i}$  or  $S_{x+i}$  planes is measured in a clockwise direction around the core circumference when the drill core is oriented so that the observer is looking along the core axis in the direction of drilling.

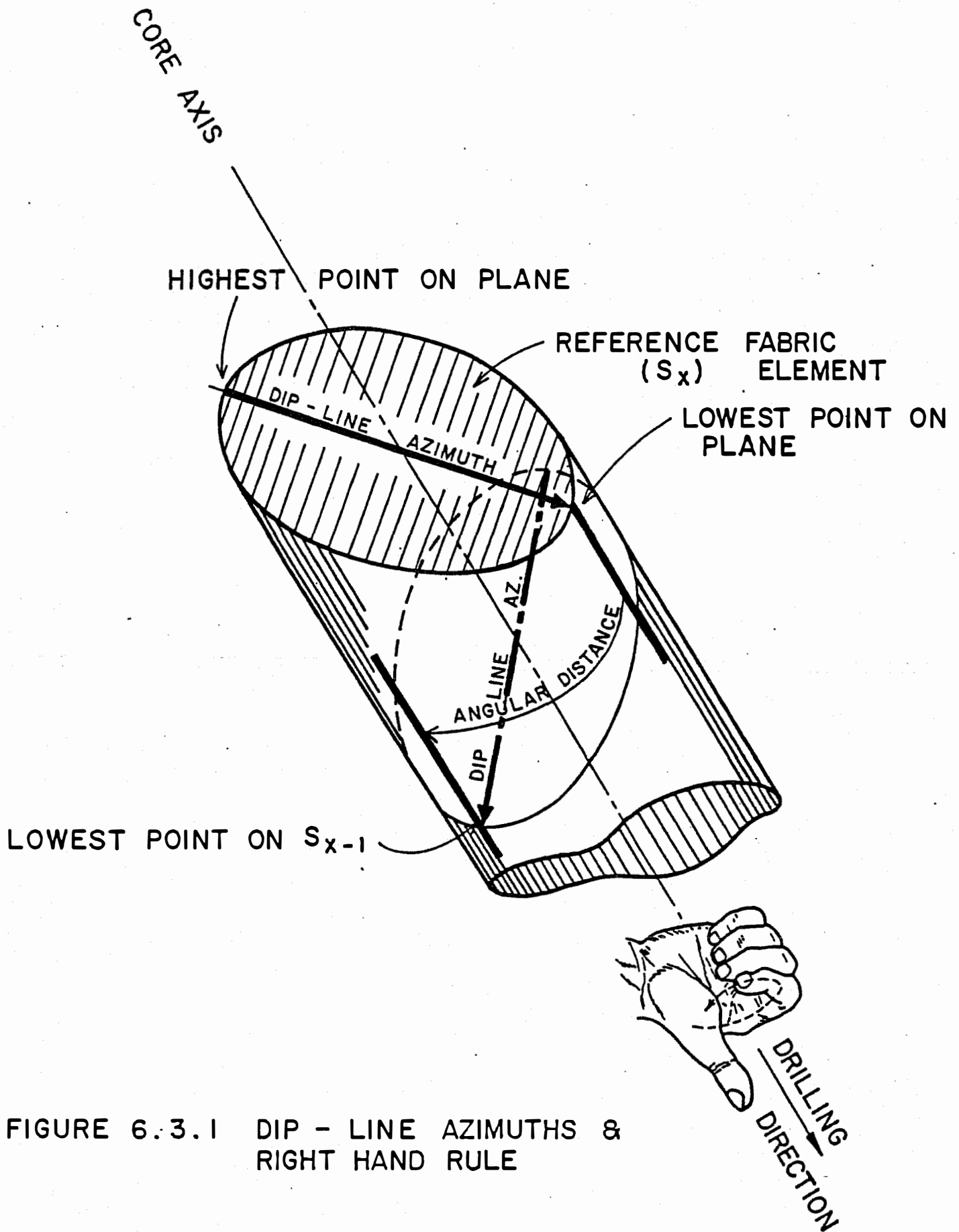
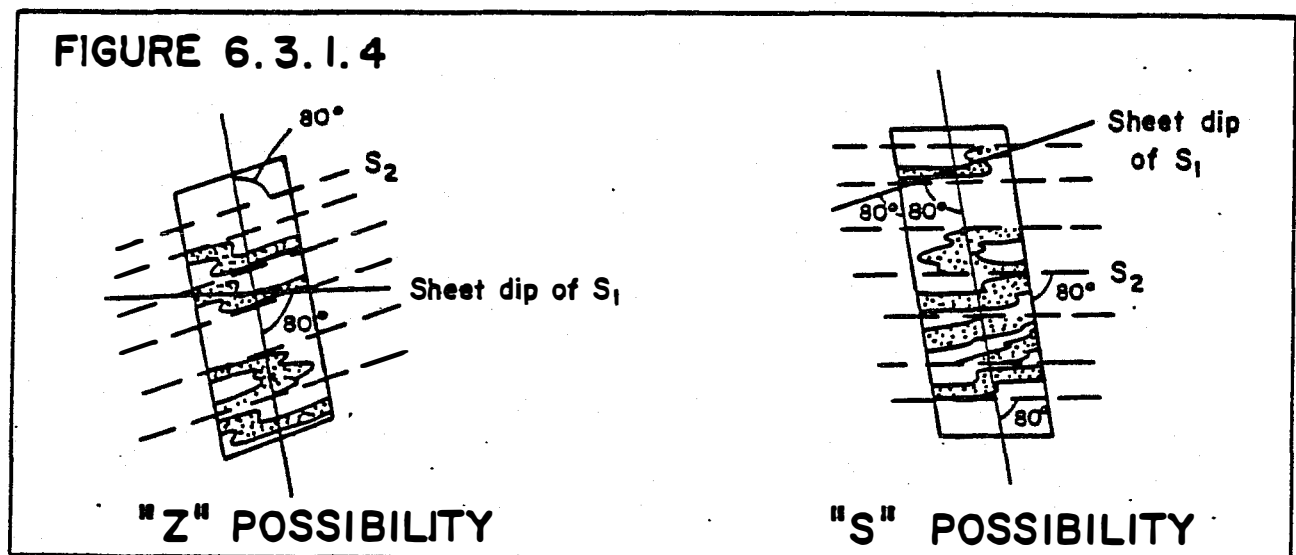


FIGURE 6.3.1 DIP - LINE AZIMUTHS & RIGHT HAND RULE

#### 6.3.1.4 Example 4 (Anvil District)

The same procedures as above are followed, except that  $S_2$  is the reference fabric element and  $S_1$  plays the role that  $S_0$  did in Gataga.  $S_0$  and  $S_1$  are mainly transposed or were originally very close to  $S_2$ .  $S_0$  is mainly preserved as microlithon structure (rock material between cleavage planes that is folded or kinked) in the plane of  $S_1$ . The microlithon structure and  $S_1$  are folded and kinked with axial plane  $S_2$ .  $S_2$  has a very gentle dip towards an azimuth of  $185^\circ$  but in about 30% of the area dips gently north. Therefore symmetry is often difficult to determine.

The following figure shows a case in which there are two possible orientations of the core. This is because there is a high angle between the sub-horizontal reference fabric element ( $S_2$ ) and the near-vertical drill core axis. Both  $S_1$  and  $S_2$  dip toward  $185^\circ$  no matter how the core is oriented.



B.V.H. from previous experience and looking at core above thinks the structure is Z. The dip azimuths of  $S_1$  and  $S_2$  are opposite ( $180^\circ$ ). This would therefore be recorded as:

Core No.	From	To	Feature #	$S_0$		$S_1$		$S_2$		Description					
				Dip	Direct.	Dip	Direct.	Dip	Direct.						
1	10	14	16	20	22	24	26	28	32	34	38	40	44		
S				50	00		Z				80	180	80	185	

and plotted as:

"Z" possibility side

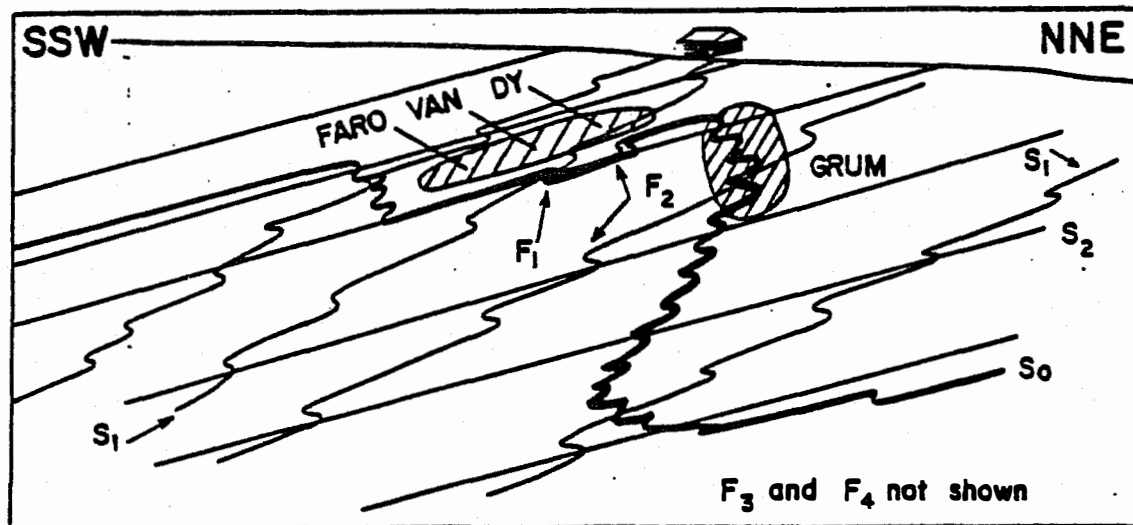
Z



"S" possibility side

Both options must be plotted because the R.F.E. dips nearly horizontally no matter how the core is oriented. But Z plotted beside the ticks reminds B.V.H. what he thought was the solution in the field.

In the Anvil District the deposits are mainly on the "Z" limb of a large-scale first-phase anticline.  $F_2$  has had the effect of pervasively flattening the first-phase structures, with  $S_2$  being close in orientation to  $S_0$  and  $S_1$ . The generalized fold pattern (for explanation see D.S.J.) looking WNW is:



7. PAGE CAMC1981-E-4' OF LOGS: FAULT SUBFILE ("F" - TYPE DATA)

7.1 Type "F" Data Sheet - Fault Subfile

Inspection of existing drill logs reveals a wealth of fault-related information under the "Description" field of the "L" and "S" subfiles. It is extremely useful to have this information in a separate "F" subfile which would be plotted in conjunction with the structural "S"-file.

Initial logging of the "F"-file was undertaken in the Anvil district during the 1982 field season. At present the "F" file is logged on the "S" structural field sheets. In most cases the "F" sheets were not completed in the field; rather they were filled out from the "L" and "S" files for a particular drill-hole.

An example of a modified "F" subfile log is shown on page 43. The format for the sheet is as follows:

col 1        -- card code -- "F"  
              This must be present for any data to be entered into  
              the data base

col 2-8     -- drill-hole name (identifier)  
              Name should correspond exactly to that used for the  
              "T"-type code

col 10-14  -- "from" depth of the fault zone  
              This depth is recorded to the nearest 0.1 metre (foot)  
              with the decimal point assumed between columns 13 and  
              14. It is used only for zone observations (i.e. where  
              the fault occurs over an interval in the drill-hole).  
              With a fault point observation (fault is less than 0.1  
              m thick) it must be left blank.

- col 16-20 -- "To" depth of the fault zone  
This depth must be present. For zone observations it is the lower limit of the fault interval. For point observations it is the depth at which the observation was made. The depth is recorded in units of 0.1 metre (feet) with the decimal point assumed between column 19 and 20.
- col 22-24 -- feature field  
This field is used to describe the type of discontinuity present. Table 7.1 contains the features recognized. The field is left justified. Modifiers are to be placed to the left of the feature to avoid confusion with the "recovery" field.
- col 26 -- recovery field  
Recoveries are tabulated in column 26. The conventions for this column are presented in Table 7.2.
- col 28-44 -- "orientation" fields  
Orientations of the fault zones are recorded in columns 28-44. Because they are planar observations, orientations are measured with respect to the S<sub>1</sub> (R.F.E.). Columns 28-32 are reserved for the upper<sup>x</sup> contact of the fault zone; columns 34-38 contain point observations within the fault zone; columns 40-44 are reserved for the fault orientation at the lower contact of the fault zone. If the fault zone is subparallel to the R.F.E. then this information is recorded by writing // R.F.E. in columns 28-32.
- col 45 -- "description" field  
This field is used for any further qualitative description of the fault interval.

7.2 Feature Field (columns 22-24)

Table 7.1 and 7.2 contains the different features and modifiers to be used in this field. Most of the terms are self-explanatory; a few warrant some additional description.

(AT)

Rec.

Structural Log

Date: \_\_\_\_\_ Logged By: \_\_\_\_\_

UPPER INTERVAL LOWER

Case	From	To	Feature	Dip			Description							
				<del>S<sub>0</sub></del> Direct	<del>S<sub>1</sub></del> Direct	<del>S<sub>2</sub></del> Direct								
	10	14	18	20	22	24	26	28	32	34	38	40	44	
F			64B R1											rubble
F			110901G											minor gauge
F	12	20	1240B1G											broken w/ minor gauge
F			12165G	3										gauge 30% recovery
F			14601G											minor gauge
F			14751G											" "
F	20	30	2206B											broken core
F	22	26	2280B											poker chippy core
F	23	20	2350B1G											poker chippy core/minor gauge
F	24	65	2515B1G											" " " " "
			2551G											gauge
F			2664G											"
F	28	55	2922B	5										broken core 50% recovery
F	29	22	2945R1G											rubble & gauge
F	29	45	30137B											broken core
F			3155B1G											gauge
F			3563G											gauge
F			4090G											"
F	40	90	4157B											broken core
F	41	88	4195X											brecciated
F	41	95	42107G	11	52									gauge (11 S <sub>2</sub> )
F	41	29	4320B											
F	44	45	4472B1RG											broken, rubble & gauge
F	51	100	51150G	0										gauge 15cm recovery
F	51	150	51170B											poor recovery
F	51	187	52100X											bx
F	52	100	52110G											gauge
F	52	1	5213B											broken core
F	52	15	5316B1RG											
F	61	81	6834R1											rubble
F	61	84	685R1											rubble
F	61	88	691092RG											50% rubble & gouge
F	71	30	733D?											
F	71	46	751072G											50% gauge
F	71	5107	7519X1F?									4.50.00		4A bxia!
F			757R1											rubble

Synonyms for broken core include blocky or fractured.

Rubble refers to pebbles or chips. It is considerably more broken than "poker chip" core.

Gouge obviously refers to mud and/or extremely broken core. It denotes brittle failure.

Sheared refers to core which has undergone recognizable strain but remains coherent. Typically it contains an anastomosing foliation which may or may not have associated slickensides.

Fault is a term with minimal constraints. Further it is not very descriptive. A more descriptive term should be used if at all possible.

Ductile breccia refers to a situation where there is a ductility contrast between minerals or interbanded rock units during deformation. It refers to augen of more competent minerals within a foliated matrix. In the Anvil area it would be most noticeable within the sulphide zones.

TABLE 7.1  
Fault Features

Main Feature		Degree
Broken core	= B	1 = weak, minor, slight(ly)
Rubble	= R	2 = moderate
Gouge	= G	3 = strong, largely, high(ly), very dominant(ly)
Sheared	= S	? = questionable
Fault	= F	
Brittle breccia	= X	
Ductile breccia	= D	
Quartz-calcite vein	= Q	
Joints	= J	
Poker chippy	= T	
Mislatch	= M	
Cave	= C	
No core	= N	
Poor recovery	= P	
No recovery	= NP	

TABLE 7.2

RECOVERIES

0	=	0 - 10 %
1	=	10 - 20 %
2	=	20 - 30 %
3	=	30 - 40 %
4	=	40 - 50 %
5	=	50 - 60 %
6	=	60 - 70 %
7	=	70 - 80 %
8	=	80 - 90 %
9	=	90 - 100%

9. PAGE CAMC1981-E-6 OF LOGS: RESEARCH SAMPLES

9.1 Type "H" Data Card-Research Sample Field Sheet

The sixth page of the drill logs is optional. It is used to record samples taken for research purposes: thin sections, palaeontology, etc. A suggested format, which allows computerization, is given below. H is suggested as the code.

9.2 Research Sample Logs

On the following two pages are examples of Research Sample and Thin Section logs that should be started for each sample while in the field. Later these pages will be collated into a registry of research orientated samples.

## REFERENCES

- Hall, B.V., Jefferson, C.W., Jennings, D.S., Kilby, D.B., Marlon-Lambert, J.R., and Pigage, L.C. 1981. Drill-hole data handling system (Short notes, for all geologists logging C.A.M.C. core). Cyprus Anvil Mining Corporation, May, 1981.
- Laing, W.P. 1977. Structural interpretation of drill core from folded and cleaved rocks. *Economic Geology* 72, 671-685.
- Marlon-Lambert, J.R. 1980. Drill-Hole Data Handling System - General System Notes. Cyprus Anvil Mining Corporation, July 15, 1980.
- Marlon-Lambert, J.R. 1983a. Diamond drill hole data base - User's manual. Cyprus Anvil Mining Corporation.
- Marlon-Lambert, J.R. 1983b. Diamond drill hole data base - Technical appendices. Cyprus Anvil Mining Corporation.