Structural Logging

PURPOSE

To collect structural information from orientated core such as bedding, joint and fault planes.

SCOPE

This procedure applies to all geologists employed by or contracted to CuDeco Ltd.

ACTION

Measurements of a range of down hole structural features are carried out where oriented core is present. Bedding, cleavage, faults, foliation, fold axes, vein and breccia contacts are all measured. These structures are measured directly using the Core Orienting Frame and a Brunton compass, or as bedding angles (alpha), and the circumference angles (beta) which are measured with protractors. The confidence of a structural measurement that is referenced to the orientation line is determined by the number of orientation marks that align along that section of core. A single orientation mark is assigned as unreliable, two is probable and three or more is reliable. The reliability of the orientation marks should be recorded on the core by using different coloured pens or dashed lines for varying levels of reliability of orientation measurements.

The procedure to obtain the alpha and beta angle are as follows, using the convention set out in Barrett & Fuller Partner Notes (1995):

- Alpha Angle: This is the angle between the fracture plane and the core axis. Note that in a vertical hole, this angle is the complement of the true dip.

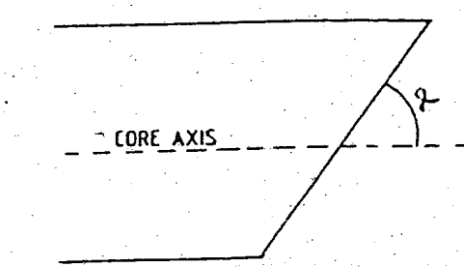

Diagram showing alpha angle relative to core axis

- Beta Angle. This is the angle between the apex of the fracture and the reference line. The reference line is defined as the line drawn on the core surface joining the <u>DOWNHOLE</u> apices of the bedding/structural feature traces on the core. The beta angle in measured in a CLOCKWISE direction from the reference line to the DOWNHOLE apex of the fracture, looking DOWN the hole.

Structural Logging

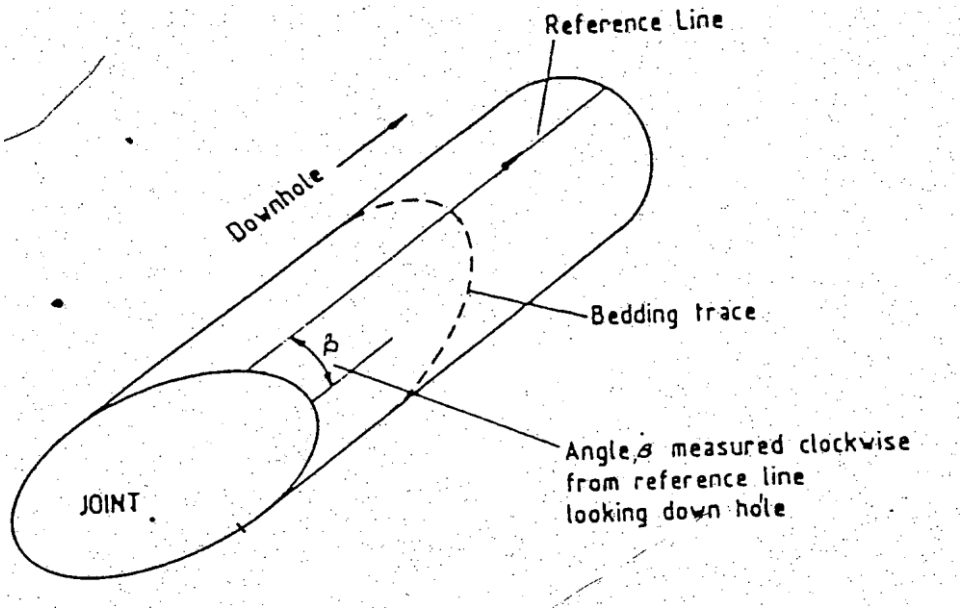

Figure 26. Diagram showing convention for measuring beta angle.

The angle is measured using a strip or a half core protractor, with length equal to the core circumference.

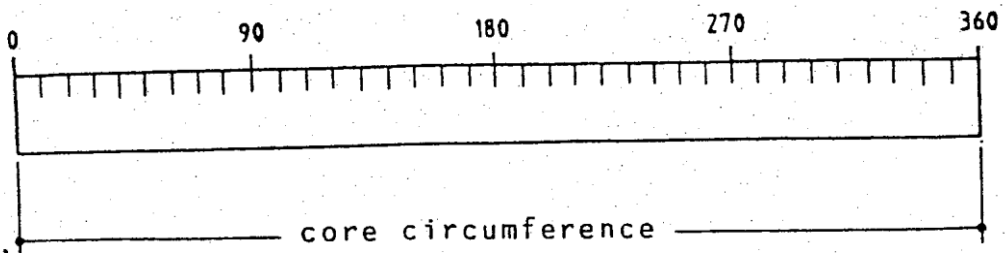

Diagram showing circumference protractor

The type of structure and its accompanying infill mineralisation is recorded as a code as displayed in Table 6 & 7 below. It is not necessary to populate the infill mineralisation field if there is no infill mineralisation.

Structure Code	Structure
AX	Axial Plane
AX1	Axial Plane Dipping
AX2	Axial Plane Vertical
AX3	Axial Plane Horizontal
BED	Bedding S0
BED1	Bedding Dipping
BED2	Bedding Vertical
BED21	Bedding (facing unknown)
BED3	Bedding Horizontal
BED4	Bedding Overturned

Structural Logging

Structure Code	Structure
BOUD	Bouding Axis
BX	Breccia Zone
CC	Crenulation Cleavage
CC12	Crenulation Cleavage Vertical
CC13	Crenulation Cleavage Horizontal
CLV1	Cleavage (first generation S1)
CLV101	Cleavage Dipping
CLV102	Cleavage Vertical
CLV103	Cleavage Horizontal
CLV2	Cleavage (second generation S2)
CT	Contact
DYK	Dyke
F	Fault
F1	Fault Dipping
F2	Fault Vertical
F3	Fault Horizontal
FB	Flow Banding
FH	Fold Hinge
FLD	Fold Axis
FOL	Foliation
FOL1	Foliation Dipping
FOL2	Foliation Vertical
FOL3	Foliation Horizontal
IGL	Igneous Layering
IGL1	Igneous Layering Dipping
IGL2	Igneous Layering Vertical
IGL3	Igneous Layering Horizontal
INT	Intersection Lineation
JT	Joint
JT1	Joint Dipping
JT2	Joint Vertical
JT3	Joint Horizontal
KINK	Kink Band
LIN	Lineation
ME	Mineral Elongation
MU	Mullion
MY	Mylonite Fabric
MYC	Mylonite Fabric C Plane
MYS	Mylonite Fabric S Plane
PC	Paleocurrent
SH	Shearing
SHD	Shearing Direction
SL	Slickenside
STCH	Stretching Lineation
VN	Vein
VNCB	Vein Carbonate
VNQZ	Vein Quartz
VNSU	Vein Sulphide

Structure Codes

Structural Logging

Code	Infill
AB	Albite
ACT	Actinolite
AG	Silver
ALSI	Aluminosilicate
ALU	Alunite
AMPH	Amphibole
AND	Andalusite
ANH	Anhydrite
ANK	Ankerite
AP	Apatite
APY	Arsenopyrite
ASOX	Oxidised Arsenopyrite
ATH	Anthophyllite
AU	Gold
AZ	Azurite
BN	Bornite
BRL	Beryl
BRT	Barite
BT	Biotite
CAL	Calcite
CARB	Carbonate
CC	Chalcocite
CCP	Chalcopyrite
CER	Cerrusite
CHDI	Chrome Diopside
CHR	Chromite
CHRY	Chrysocolla
CIN	Cinnabar
CL	Chlorite
CLAY	Clay
CLB	Columbite-Tantalite
CLC	Chalcedony
CLD	Chloritoid
COR	Corundum
CPX	Clinopyroxene
CRD	Cordierite
CST	Cassiterite
CU	Copper
CUM	Cummingtonite
CUOX	Oxidised Copper Minerals
CUP	Cuprite
CV	Covellite
DIOP	Diopside
DOL	Dolomite
DSP	Diaspore
DVD	Davidite
DYK	Dyke
ENG	Enargite

Code	Infill
GNT	Garnet
GP	Gypsum
GR	Graphite
GRU	Grunerite
GT	Goethite
HBL	Hornblende
HEM	Hematite
HL	Halite
ILL	Illite
ILM	Ilmenite
JAR	Jarosite
JSP	Jasper
KFS	K-Feldspar
KLN	Kaolinite
KY	Kyanite
LAU	Laumontite
LCX	Leucoxene
LMN	Limonite
LPD	Lepidolite
MAL	Malachite
MGHM	Maghemite
MGS	Magnesite
MGT	Magnetite
MICA	Mica
MLL	Millerite
MNOX	Manganese Oxides
MNT	Montmorillonite(Smectite)
MNZ	Monazite
MOL	Molybdenite
MS	Muscovite
NEO	Neotocite
NTN	Nontronite
OL	Olivine
OPL	Opal
OPS	Opaline Silica
OPX	Orthopyroxene
PBJ	Plumbojarosite
PBOX	Oxidised Lead Minerals
PCIL	Picro-ilmenite
PHL	Phlogobite
PL	Plagioclase
PN	Pentlandite
PO	Pyrrhotite
PRH	Prehnite
PRL	Pyrophyllite
PY	Pyrite
PY2	Pyrite (2)
PYOX	Oxidised Pyrite

Code	Infill
SCH	Scheelite
SCR	Scorodite
SD	Siderite
SERC	Sericite
SERP	Serpentine
SIL	Sillimanite
SMEC	Smectite
SMN	Smithsonite
SP	Sphalerite
SPN	Spinel
ST	Staurolite
STB	Stibnite
STN	Stannite
SU	Sulphur
SULP	Sulphide
TE	Tremolite
TIT	Titanite
TLC	Talc
TNR	Tenorite
TOUR	Tourmaline
TOZ	Topaz
TTH	Tetrahedrite-Tenantite
URN	Uraninite
UROX	Uranium Oxide Mineral
VES	Vesuvianite
VIO	Violarite
WO	Wollastonite
XP	Ex Pyrite
ZE	Zeolite
ZNOX	Oxidised Zinc Minerals
ZNW	Zinwaldite
ZRN	Zircon

Structural Logging

EP	Epidote		PYRX	Pyroxene
FCH	Chromian Muscovite		QZ	Quartz
FELD	Feldspar		QZCB	Quartz-carbonate mixture
FEOX	Iron Oxide		QZFS	Quartz-feldspar mixture
FL	Fluorite		RDS	Rhodochrosite
GBS	Gibbsite		RHD	Rhodonite
GHN	Gahnite		ROS	Roscolite
GLT	Glauconite		RT	Rutile
GN	Galena		S	Sulphur

Table 7: Mineral Infill Codes

Example Logging Sheets

Below are some hand written and spreadsheet versions of structural geology logs.

Terra Search for Cudeco STRUCTURE LOG Page

Hole ID:	LMDH009		Project: Rocklands					Date:	7/02/2007	Logged by:	SD Beams/S Newman
From	Struct_ID	Dip	Mag	Dip	Alpha	Beta	Width	Infill	Conf	Frequency	Comment
m			Strike	Quadrant			m	min	idence	m	
89.20	JT1	-35	136	SW	85				R		Chlorite coated joint with offset
89.30	VN	-55	46	SE	40		0.005	FELD	R		Vein Feldspar
89.42	VN	-40	38	SE	40		0.05		R		Vein quartz,feldspar,calcite,actinolite,pyrite
90.40	JT1	-13	110	NE	45			CL	R		Chlorite coated joint
90.50	VN	-24	123	SW	72		0.002	CAL	R		Vein red feldspar calcite
90.50	DYKE	-85	106	SW	45				R		Contact of fine grained basalt dyke
91.00	VN	-80	102	NE	40		0.005	CAL	R		Vein red feldspar calcite
92.00	VN	-90	30		2		0.002	CAL	R		Vein breccia,calcite red feldspar
92.30	DYKE	-45	90	S	75				U		Contact of fine grained basalt dyke
92.70	VN	-38	50	SE	47		0.003	PY	R		Vein red feldspar,quartz, pyrite
93.80	VN	-6	95	S	55		0.001	CAL	R	5	Vein red feldspar ,calcite,pyrite
94.92	VN	-82	132	SW	42		0.002	CAL	R	3	Vein red feldspar calcite, chalcopyrite
95.20	VN	-87	27	NW	15		0.015	CAL	R		Vein calcite,quartz,red feldspar, chalcopyrite
120.85	VN	-52	160	NE	20		0.005	CAL	R		Vein calcite,red feldspar,pyrite
121.20	JT1	-80	125	NE	22				R		Chlorite coated joint
121.30	VN	-85	117	SW	37		0.007	CAL	R		Vein, calcite, red feldspar, pyrite
121.58	JT1	-70	90	S	50		0.001	PY	R		Fracture filling pyrite,chalcopyrite,amphibole
121.58	LIN	-38	115						U		Mineral lineation pyrite, amphibole
121.70	DYKE	-35	115	NE	55				R		Dyke - bottom contact with dolerite
122.00	VN	-50	150	NE	10		0.012	QZ	R		Vein quartz,calcite,red feldspar
122.05	VN	-45	80	S	24		0.001	PY	R		Vein pyrite
129.90	VN	-50	152	NE	10		0.002	CCP	R		Fracture filling chalcopyrite
130.15	VN	-87	137	SW	28		0.1	PY	R		Vein pyrite,quartz,actinolite
131.20	JT1	-30	115	NE	22		0.001	FELD	R		Vein red feldspar,calcite, quartz
131.20	FOL1	-30	20						U		Mineral lineation amphibole
131.60	JT1	-13	40	SW	55		0.001	CAL	R		Vein, calcite, red feldspar, chlorite
131.80	VN	-42	165	NE	29		0.009	PY	R		Vein red feldspar,quartz,calcite,pyrite
132.25	VN	-90	135		42		0.001	FELD	R		Vein red feldspar,quartz,pyrite
132.85	VN	-85	15	SE	11		0.002	CAL	R		Vein red feldspar,calcite,quartz
133.10	VN	-73	165	SW	40		0.001	PY	R		Vein pyrite,quartz,calcite,red feldspar
134.80	JT1	-90	125		38		0.002	CAL	R		Vein calcite,chlorite,,red feldspar, quartz
135.10	VN	-18	100	N	50		0.006	CAL	R		Vein red feldspar,quartz,calcite,pyrite
135.90	VN	-25	83	N	46		0.01		R		Vein calcite,red feldspar,pyrite
140.90	VN	-80	130	SW	52		0.022	FELD	R		Vein red feldspar,calcite,pyrite
141.80	VN	-15	122	NE	43		0.02	FELD	R		Vein red feldspar,quartz,chlorite,calcite,amphibole
142.70	JT1	-85	115	NE	30		0.001	EP	R		Fracture coating epidote

Structural Logging

Terra Search for Cudeco

STRUCTURE LOG

Page ..... of .....

Hole ID: LMDH09 | Project: | Date: | Logged by:

From m	To m	Struct_ID	Dip	Mag Strike	Dip Quadrant	Alpha	Beta	Width m	Infill min	Confidence	Preferred Reading	Frequency m	Intensity	Comment
156.1		BED1	15	070	NW	40								banded sediments
156.72		BED1	12	095	N	48								banded sediments
156.72		JT1	85	140	SW	50	26							hairline joint with differential alt.
156.67		JT1	8	140	NE	48	26							hairline joint
157		F1	70	010	W	25	70							Fault with offset
157.15		BED1	15	070	NW	40			CHL					banded sediments
157.3		JT1	78	135	SW	48	36							chlorite coated joint with intersection lineation
157.3		INT	5	330	(A2)									5 → 330 intersection lineation
158.7		BED1	22	105	NE	25								banded sediments
158.6		JT1	3	145	SW	60	34							chlorite coated joint
158.80		BED1	30	100	NE	20								banded sediments
158.85		JT1	10	142	NE	45	28							chlorite coated joint
160.38		VN1	80	110	SW	40								carbonate veins
163.88		FOL1	85	155	SW	35								~~Chlorite~~ - magnetite foliation
193.45		F1	85	072	NW	20								~~Fault~~ Hairline fault with offset
194.6		VN1	85N	085	N	45							Mode	~~Chlorite~~ - ~~calcite~~ quartz - sulphide vein (contact AMQS)
														~~Poss~~ Main sharp contact (sharp)
196.8		VN1	65	085	S	50								Chlorite - calcite vein AMQS
198		BED1	22	070	NW	30								banded sediments (possibly in situ)
197.9		VN2	90	122	~	30	40				✓			Calcite - chlorite - sulphide vein AMQS
198.95		VN1	84	125	NW	30 35								Chlorite - calcite - sulphide - feldspar vein AMQS
					SW									
210.8		VNCB	-84	130	~~SW~~	55	0.10	~~0.1~~	Amph			upper carb		chalcopyrite pyrite, amphibole, calcite, sharp contact
213.15		VNCB	-88	135	~~NE~~	32		0.58	Qu		← bot only			quartz, calcite, amph, pyrite, chalco, ~~[illegible]~~
216.8	215.07	VNCB	-84	125	NE	35	✓	0.27	Carb	Top				quartz, calcite, amph. ~~[illegible]~~, manganese
215.07		VNCB	-85	135	SW	47	✓	0.27	Carb	bot				quartz, calcite, amphibole, mang, pyrite, chalco.
215.88	X	VNCB	-87	130	NE	45		5.0				lower Carb		quartz, calcite amph. pyrite, chalco.
215.9		LIN.	014	~~195~~ 015										plunging 014 → 015 NE
219.07	✓	JT1	-74	130	SW	60		0.001	CHL					banded sediments.
219.6	X	JT1	-10	100	N	53		0.001	CHL					sediments, (sanded)
219.9	X	JT1	-24	130	NE	40		0.001	CHL					s/sediments, chlorite, calcite, amph.
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]					amphibole, calcite, red feldspar, pyrite

REASON FOR ISSUE

This is an updated version from the Rocklands Logging Kit.

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