

HARZA-EBASCO

Susitna Joint Venture
Document Number

53

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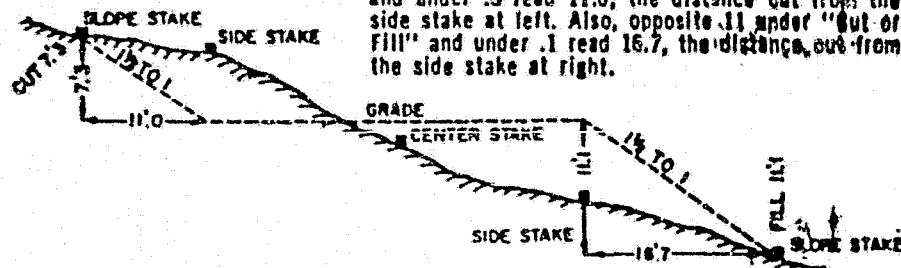
AAI FIELD BOOKS, GEOLOGY

10L 2/3

DIST. FROM SIDE STAKES FOR CROSS-SECTIONING

Roadway of any Width. Side Slopes 1½ to 1.

In the figure below: opposite 7 under "Cut or Fill" and under .3 read 11.0, the distance cut from the side stake at left. Also, opposite .11 under "Cut or Fill" and under .1 read 16.7, the distance cut from the side stake at right.



Cut or Fill	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	Cut or Fill
	Distance out from Side or Shoulder Stake										
0	0.0	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	0
1	1.5	1.7	1.8	2.0	2.1	2.3	2.4	2.6	2.7	2.9	1
2	3.0	3.2	3.3	3.5	3.6	3.8	3.9	4.1	4.2	4.4	2
3	4.5	4.7	4.8	5.0	5.1	5.3	5.4	5.6	5.7	5.9	3
4	6.0	6.2	6.3	6.5	6.6	6.8	6.9	7.1	7.2	7.4	4
5	7.5	7.7	7.8	8.0	8.1	8.3	8.4	8.6	8.7	8.9	5
6	9.0	9.2	9.3	9.5	9.6	9.8	9.9	10.1	10.2	10.4	6
7	10.5	10.7	10.8	11.0	11.1	11.3	11.4	11.6	11.7	11.9	7
8	12.0	12.2	12.3	12.5	12.6	12.8	12.9	13.1	13.2	13.4	8
9	13.5	13.7	13.8	14.0	14.1	14.3	14.4	14.6	14.7	14.9	9
10	15.0	15.2	15.3	15.5	15.6	15.8	15.9	16.1	16.2	16.4	10
11	16.5	16.7	16.8	17.0	17.1	17.3	17.4	17.6	17.7	17.9	11
12	18.0	18.2	18.3	18.5	18.6	18.8	18.9	19.1	19.2	19.4	12
13	19.5	19.7	19.8	20.0	20.1	20.3	20.4	20.6	20.7	20.9	13
14	21.0	21.2	21.3	21.5	21.6	21.8	21.9	22.1	22.2	22.4	14
15	22.5	22.7	22.8	23.0	23.1	23.3	23.4	23.6	23.7	23.9	15
16	24.0	24.2	24.3	24.5	24.6	24.8	24.9	25.1	25.2	25.4	16
17	25.5	25.7	25.8	26.0	26.1	26.3	26.4	26.6	26.7	26.9	17
18	27.0	27.2	27.3	27.5	27.6	27.8	27.9	28.1	28.2	28.4	18
19	28.5	28.7	28.8	29.0	29.1	29.3	29.4	29.6	29.7	29.9	19
20	30.0	30.2	30.3	30.5	30.6	30.8	30.9	31.1	31.2	31.4	20
21	31.5	31.7	31.8	32.0	32.1	32.3	32.4	32.6	32.7	32.9	21
22	33.0	33.2	33.3	33.5	33.6	33.8	33.9	34.1	34.2	34.4	22
23	34.5	34.7	34.8	35.0	35.1	35.3	35.4	35.6	35.7	35.9	23
24	36.0	36.2	36.3	36.5	36.6	36.8	36.9	37.1	37.2	37.4	24
25	37.5	37.7	37.8	38.0	38.1	38.3	38.4	38.6	38.7	38.9	25
26	39.0	39.2	39.3	39.5	39.6	39.8	39.9	40.1	40.2	40.4	26
27	40.5	40.7	40.8	41.0	41.1	41.3	41.4	41.6	41.7	41.9	27
28	42.0	42.2	42.3	42.5	42.6	42.8	42.9	43.1	43.2	43.4	28
29	43.5	43.7	43.8	44.0	44.1	44.3	44.4	44.6	44.7	44.9	29
30	45.0	45.2	45.3	45.5	45.6	45.8	45.9	46.1	46.2	46.4	30
31	46.5	46.7	46.8	47.0	47.1	47.3	47.4	47.6	47.7	47.9	31
32	48.0	48.2	48.3	48.5	48.6	48.8	48.9	49.1	49.2	49.4	32
33	49.5	49.7	49.8	50.0	50.1	50.3	50.4	50.6	50.7	50.9	33
34	51.0	51.2	51.3	51.5	51.6	51.8	51.9	52.1	52.2	52.4	34
35	52.5	52.7	52.8	53.0	53.1	53.3	53.4	53.6	53.7	53.9	35
36	54.0	54.2	54.3	54.5	54.6	54.8	54.9	55.1	55.2	55.4	36
37	55.5	55.7	55.8	56.0	56.1	56.3	56.4	56.6	56.7	56.9	37
38	57.0	57.2	57.3	57.5	57.6	57.8	57.9	58.1	58.2	58.4	38
39	58.5	58.7	58.8	59.0	59.1	59.3	59.4	59.6	59.7	59.9	39
40	60.0	60.2	60.3	60.5	60.6	60.8	60.9	61.1	61.2	61.4	40

Book 9
Camp (907) 733-2450
Wainwright 277-8131

AAE 2207 Seward Rd
Anchorage AK 99053

Alyeska Air
15th east
left at Merrill Field rd
on Bldg on left

205 = 626

121 out call

203 747-2255

Anchorage Office 270-4888



The paper in this book is made of 50% high grade rag stock with a WATER RESISTING surface sizing.

KEUFFEL & ESSER CO.

May 18, 1981 Monday

Leave Buffalo 10:10 AM

Arrive Anchorage 2 PM

Went to AAI office and spoke with Jim Gill about mapping program. Gave me a copy of WCC report.

5/19/81 Tuesday

AM in AAI office with M Breen

PM bought field gear and went to core warehouse

DH-10 (COE)

Checked Corps' shear at approx 40-50, 80, 108-110 and 130 ft. General agreement with AAI calls, but more conservative in case of core loss and/or broken core fragments called shear. Lithologic calls agree.

DH-28 (COE)

disagreement bet. AAI
and COE on lithology bet.
58.3 + 120.4 (Rhyolite vs
cc. basaltic porphyry)

5/20/81

7 AM. left La Air Service to
High Lake Lodge then to Camp.
After lunch David Canyon
M Bruner + J. Hinson begin
mapping on north bank from
BH-2.

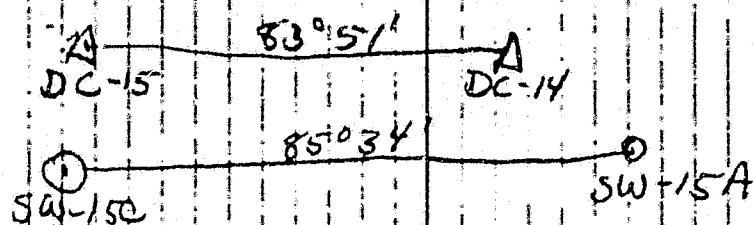
K White went to DH-17 to
observe drilling. Hole
oriented $353^\circ/45^\circ$ N
depth ~ 90 feet. R & M
inspector Jan
Returned to camp with K.
He asked to arrange
helicopter schedule + discuss
mapping program

Also checked location for

BH-5. Water level nearly
at base of cliffs. Best location
is on a bench approx 30-40
feet above river and north of
proposed location.

things to do at DC

- ① Check location of borehole BH-6
- ② " declination at DC



- ③ Check location of seismic line at
DC, extend to projection of BH-5
- ④ Gravel bar trench location,
trial mat.?
- ⑤ Map location of BH-5

5/21/81 Thursday

Devil Canyon K. White, M. Brown, J. Heinzon
Landed at BH-1 and began
traverse up slope then down stream
Notes in Book 8

~~Climbing~~ Visibility on steeper slopes
very low due to foliage

Upper slopes are step like
ie flat benches separating
vertical cliffs. Blocks are
pulling away from face along
NEW joint set

5/22/80

M. Bruen + J. Heinzen at D.C. AM

K. J. White at camp AM

11 AM K. White and C. Crawford

to Fort at Devil Canyon

Dug pits at location of
proposed tent trenches

TT-G1, G2 and G3

TT-G1

In old bulldozer cut
ground frozen ~ 1-2 ft
couldn't get beyond
slope wash

TT-G2 320° and 50 ft from TP-10

In old bulldozer cut

Top of slope 0-1.3' organics, roots etc

1.3-3' (2 ft) Silty sand,

uniform fine, 30-40%

slightly plastic fines, brown,

2" lenses of Sand, fine grained,

uniform, < 10% silt, gray

approx 40% of volume

40 ft down slope

Same material as above
but with cobbles to ~3 in.
ground ^{feet} below 1-2 ft.
layering appears parallel to
slope and may be slopewash
deposits found in soil 50' south of this test

TTG-3 2nd bulldozer cut, trench on side

0-2 organics

2-4.2 Sand, uniform, fine
grained, <10% silt, non plastic,
light brown, 0.1" layer at
3-2' of Sand, coarse to med grained,
<5% pebbles

4.2-5.8 Gravelly Sand, well graded.

base coarse to fine gravel to 12 in max,
most <3 in, <5% silt,
some decomposed granite
boulders 3"-1", gravel size
inc with depth

Photo K8-4

Down slope 2 1/5 vertical feet. 3 ft trench

Sand, uniform, fine,
<10% fine gravel, but none
to 3 in, also on slope boulders

to 3 ft

Checked declination using
Seismic line SW-15
line is $85^{\circ}34'$, using
declination of 28° east
we got on 85° orientation
on the line.

$\therefore$ Declination at
Devil Canyon = 28° east

5/23 Saturday Devil Canyon
M. Buena & H. Keinzon North Bank
C. Crawford & K. White South Bank

Marking location of
Seismic line SL-17
bearing 273° from 10 ft
north of cabin

Photo K8-5

Looking D/S from end of
SL 17

West end of line 600' west
of line SL 12
East end of line at intersection
of 273° line and N-S line from
BH-5 pad 200' down slope
below cabin

Flagging along route styled
pattern ~~at~~ ends of line

Start of traverse on N/E
(A) Corner of USBR Cabin to
east facing slope.

A to B 115' 270° 114'

B to C 112' 273° 95'

C to E (SL-17) 6' 273° 66'

SL-17 to D 57' 0° 10'

D-E 40' 340° 10'

D-DC 81-101 54' 328° 10'

E to F DC 1102 76' 320° 10'

F to G 42' 136° 10'

G to H 25.5' 50° 10'

H to I 30' 65° 23'

I to J (81-103) 20' 85° 14'

Station D
DC-81-100

Small outcrop 15' X 8', face 320°

Argillite / Graywacke, very thin
bedded, and sandy beds,
poorly developed foliation parallel
to bedding, minor folds,
SS/SE bedding
argillite is dark gray, graywacke
is light gray

Joints

① Major

320 / 86 SW parallel face of OC
planar, smooth to rough
spacing 1/2" to 2"

② Parallel bedding / foliation

SS/SE smooth, planar to
folding, spacing 1' to 3'

③ Minor

62 / 10 N planar to irregular, rough
spacing 1'-4'

J-K	58'	316	< 0	
K-L	44	315	< 0	
	DC-81-104			
G-M	64	156°	< 0	
	DC 81-105			
M-N	65'	158°	< 0	
N-O	60'	157°	< 0	
O-P	66'	180	= 0	
P-Q	21'	185°	< 0	
Q-K	61	223°	< 14 up slope 59°	
R-S	82.5	274	< 7 up	82
S-T	100'	275°	< 18° up	95
T-U	86'	285°	< 15° up	87
U-V	134.5'	345°	0	
V-A	35	236	0	

~~W-81~~
 DC-81-101 30' X 10' face parallel to NW joint
 Same as 100" lithology

Outcrop tagged
 Photo K8-5
 Major joint
~~137~~
 309 / 68-84° N
 spacing not known, joint
 parallel to face

Minor
 235 / 76 NW
 planar, smooth, some rough,
 spacing 6"
 not continuous

DC-81-102 (to corner of cliff)

40' X 15' face 338 // NW joint

Argillite / Graywacke
as 100 and 101

Joints

or massive with few joints

① minor set 11 or face

② 1:2/50 SE bedding plane. foliation
spacing 2' to 5' (and 6'-1')
smooth, planar

③ minor 330/5 W plane to irregular,
smooth
spacing 2'-8'

DC-81-103

20' X 15' NW face

Argillite / Graywacke as above
very thinly bedded, wedge(?) of
argillite. 5' wide, more FeOx
stained than surrounding.
Outcrop is more fractured than
above outcrops.

Joints

230 / 85 S, planar, smooth,
spacing 6 in

32 / 77 SE, planar, smooth,
spacing irregular, 6"-
3', or 1 ft

80 / 65° S Bedding plane
foliation, few, widely (3-4')
spaced joints parallel to
foliation.

DC-81-104

box 40 high at 330°

Argillite / Graywacke, very
thinly bedded

Joints

Major

315 / 85 SW Planar, smooth to rough
spacing 2" to 3' (ave 1")
some open to 3"

65 / 40 S

bedding / fol
planar, rough, some open to
spacing 1 1/2" to 4'

10/60 W planar, smooth
spacing 6" to 10' (avg 2')

DC-81-105

arg./Gwck
open joint

Major

211/75 S planar, rough
open to 6", spacing
2" to 10' av 3ft

Minor

320/0°

45/59° bedding plane/foliation
planar, smooth, 6" - 3'

Major

282/73 NW planar smooth
spacing 3 in - 2ft

At BH-7

Hole to 385 ft 7 PM

Crossed extension of NE trending
lineament along east facing
slope, no outcrops and
~~area in~~ slopes are gentler
area is overgrown

3/24/81 Sunday

K. White + C. Crawford

Traverse along east facing
slope on south bank

Starting point at SE corner (A)
of USBR Cabin. Start notes on
Traverse p 26

A SE corner of USBR cabin			
	distance	Az	dip
A to B	100'	160°	15°
B to C	100'	120°	14°
C to D	62'	80	0
D to E	100'	90°	0
E to F	77'	110°	15°
F to G	85'	130°	0
G to H	100'	120°	0
H to I	88'	136°	0
I to J	28'	117°	18°
DC 81-106			



aged
 DC-81-106
 30 X 40' h
 Sample
 320° orientation

Argillite dark gray
 iron staining on weathered surfaces
 foliation seen on weathered surface
 but fresh appears massive
 occasional beds of massive
 looking (with) non foliated
 up to 1', blocky jointing, often
 heavily stained to buff on
 weathered faces.

Joints
 major
 335/25 E to vert planar with rough
 surface, spacing 2"-2' (1')
 80/45 S bedding plane foliation
 planar to slightly curved,
 smooth
 spacing 2" to 4' (1-2')
 35/55 NW irregular, rough
 discontinuous

J 81-106 to	K (101)	74'	165	23	15
K to L		75'	134	0	
L to M		100'	132	0	
M to N		50	55	40	33
N to O	(109)	79'	152	0	
O - P		30	105	0	
continued		5/25			

DC-81-107 Along face of cliff
outcrop 30' X 30' X NW

Argillite as at 106 but with
a 10 ft thick bed of
quartzite (?), light gray, fine
grained

Sample DC-81-107 quartzite(?)

Photo K8-7 argillite / quartzite
contact

Joint

72 / 64 SE bedding foliation
planar, smooth, 2" - 4"
or 12 - 18"

80 / 45 N

planar to undulating, smooth
5 - 18" or 8", some open
to 0.5 in

DC-81-108

Fracture zone

15°/90

15 ft wide, joints v cl to
cl spaced, no evidence
of shearing

may be similar to
lake Creek ment like
joint spacing in core
of veins, ~~at~~ no orientation
could be taken

N sandy argillite, bedding
non-~~is~~ massive, very
f. bbb. appear stretched
50/50 SE bedding

sample

DC-81-109

Argillite dark gray

- massive (poorly developed foliation)
- minor sulfide mineralization along
minor joints, etc
- iron oxide on some joint surfaces
- quartz vein 2-4" wide
parallels bedding ~~thin~~

Sample 81-109-A Argillite
81-109-B Quartzite (?)

Joints

major 340/75E
planar smooth
spacing 2" to 2' (ave 6" 1')

70/55S bedding foliation
spacing 3"-4' (ave 2')
planar, smooth

minor 320/80NE planar irregular
smooth
spacing 1/2" to 18" (ave 12")
discontinuous

P-Q	48'	51	0	-
Q-R	77	141	0	-
Q-R outcrop DC-81-110				
R-S	51'	152°	0°	-
S-T	60'	170°	5°	-
T-U	68'	146°	10° down	67'
U-V	48'	146°	0	✓
V-W	61'	160°	28° up	✓
W-X	56'	128	5 down	✓
X-Y	82'	126°	24° down	15'
Y-Z	67'	138	25 down	15'
Z-AA	100'	46°	35° down gully	✓
AA-BB	53	130	10	✓

5/25/81 Monday
Continue yesterday's traverse
on east facing slope at
Devil Canyon Point P
C Crawford and K White

DC-81-110

77' x 50' NW face

Argillite, dark gray, becoming
phyllitic in places, ^{vertically} foliation
better developed in phyllite,
poorly developed in argillite
outcrop tends to be massive
with few joints, rock is
hard and competent.

2 Dikes (?) of light gray, felsic
material make up about 1/3 of outcrops
of exposure appear to be
parallel to foliation
15' and 20' wide
fine grained, jointing better developed in dike
Sample DC-8-110 "Dike" br. #1/c
NB. clasts of mangled arg found

BB-CC 35' 150° 0
end of traverse at Fracture zone

C west side + X-10

Joints

major 330/70E planar, smooth
spacing diff (11 to face) ~ 1'

20/60NW planar, smooth
spacing 1" to 18" (ave 12")
most prominent in dike
material

68/75 SE bedding plane foliation
spacing 6' to 10'

Photo K 8-8

Contact bet. aegillite + dike
hammer at contact
note more pronounced jointing in
dike

Tu dike (?) felsic 40 - 60' along traverse
parallel to foliation 70/40°

So. takes & is easily mapped as
pelite, parallel to bedding, may
have been sand beds in the
pelite and during metamorphism
have been welded.

with or without lack of
bedding. In contact, and no
fracturing, contact, and
large, white, margin. Large

1. At the ... trend of lakes
may be the result of fracture zones.
Several E-W trending fracture
zones parallel to that trend were mapped
on the N-S face east of
lakes.

DC-81-111

Argillite, dark gray, poorly
developed to non foliated,
well developed jointing, blocky
like, & felitic, light gray

Jointing
(68°/40 S, foliation, planar
blocky) semismooth, 4" to 5' or 1.5"

(45°/50 N, planar, smooth,
spacing 6" to 6ft, or 10 in
some open to 1/8 in.

140°/75° E, planar, smooth,
occ. rough, 6 in to 4ft or
1-1.5ft

X Possible fracture zone in deep gully
5°/90
10-35' wide filled and
overgrown but same trend
as those to the north on the
slope

DC-81-112

30' x 20' NW face

Argillite, dark gray, massive
to poorly foliated, FeOx stain
on joint surfaces, small quartz veins

Joints

map

330/60 E

planar, smooth

spacing 3" to 12" (ave 6")

70/50 S

foliation plane

planar, smooth

spacing 1" to 12" (ave

10/70 W

planar smooth

spacing 1" to 6"

CC Argillite
Fracture zone, cl-vcl sand
joints, some open
no orientation, see topo

DC-81-113 see topo, 10X10 NW
Argillite dark gray,
poorly foliated, thinly laminated
some massive layers

Joints

90/60 S, planar, rough,
minor lty veins, spacing
1-3', mostly 1', foliation

150/80W planar, semi-smooth
discontinuous, spacing 2-6"
av 3in

50/25N planar, smooth
discontinuous, 1-3'

DC-81-114 30 X 15 E-W

on ridge south of drill
site (OH-17) south of
triangular shaped swamp
on airphoto

Sandy Argillite, possibly
graywacke, fine grained,
medium grad, massive, with
interbeds of argillite, dark gray,
nearly phyllite, good foliation, beds 3-6"
Joint

Major

60/65 S, planar, smooth
spacing 4' - 2.5', or 12 in

160/70 E, planar, smooth,
8 in - 2 ft or 1 ft

Minor

150/40 E planar, smooth
only one on outcrop

278/55 bedding & foliation
planar, smooth, 6" - 2'

former ridge trending "EW" may be

due to quartzite layers being
more resistant

DC-81-115 see topo west of 114
Argillite, dark gray, beds
to 3 in, bedding 105/50 S

DC-81-116 see topo, above end of
SW seismic line
Argillite very thinly laminated
dark gray nearly phyllite
some "beds" weather out lighter
color, fresh = argillite + qtz (5%)

Tagged

Joints

major 80/50 S foliation
planar, smooth to sl. rough
spacing 1/2" to 12" (6")
some Fe staining, open to 6"

minor

325/75 E planar, smooth
spacing 2" to 6"
discontinuous

DC-81-117 on top, mapped in '80
south of west end of lake (BH-7)

Amphibolite, very thinly bedded and
foliated, ~~massive~~, interbedded
stale and sandy layers, dark
gray, outcrop has massive
appearance, < 0.1 in
ft. veins ^{ts} parallel to frac cleavage

Joint

345/80 E possible frac cleavage
zones of spacing $\frac{1}{2}$ " overall $\frac{1}{2}$ " to 2"
(ave 6")

80/60 S foliation
planar, smooth to sl. rough
spacing 4" to 3' (12")
some open to 6"

330/vert smooth, planar
open $\frac{1}{4}$ "
spacing ? lot

Geology
9/15/20
J. J. L.

5/26/81

Climbers at Devil Canyon
K White & C Crawford at Watana
plan to walk from camp to
Fins → Fingerbush →
camp

Declination (28° E)

Check extension of SL 6 + 7

Gully above W-81-1

Thinly diorite on both sides,
contact with the diorite porph.
on ridge between gully and
Fins, contact not exposed,
small, scattered outcrops

W-81-100

Contact between diorite porph
and Q dior. at eastern
major shear in Fins

Samples

W-81-100 A Dior Porph
(Formerly And Porph)
W-81-100 B Q. Dior

Joint

7780/605 planar, smooth,
spacing

Dio Payk 2"-4' go 1ft
open, possible slope failure
Q. Dio 3 ft closed

3740/505 planar to irregular,
rough

Spacing:

Dio Payk 1-2' open
Q. Dio 4-5' closed

Q Dio is massive

Set out seismic line trending
N45°E across Fins street
NE 300' from top of hill
SW to 450' from main shear
fully

Transverse from end of
Fing seismic line pt A

A-B	100	240°	0	
B-C	80	240	0	
C-D	100	222		
D-E	80	256	8° up	71
E-F	100	246°	0	
		Intersect SL-3, end point		
		95'	356	13 up
F-G	100	246	0	
G-H	100	200	0	
H-I	100	240	0	
I-J	100	256	0	
J-K	100	250	0	

W-81-101.54

62' along T-U

180° - 18° down

Large exposure 50 x 30
NW + EW faces

Dolomite, fine-med grnd,
greenish gray, 1/4 in red
with red, zones of red
minerals (red clay?)

Joints

Major

345/65E planar to sl cnd
smooth to sl rough
spacing 2"-3' or 6"

270/65N planar, smooth
spacing 3"-2'

Minor

275/35S planar smooth
spacing 1"-2', discontinuous

K-L 51 174° 16° down at 70'
Picture Panel SV

L-M 100 256° 8' tape level
F...ing SW-2 slope down

M-N 100 270° 0'
transverse along SW-2

N-O 100 270° 0'

O-P 100 270° 0'

P-Q 100 270° 0'

Q-R 100 270° 13 up
NO K-S

S-T 100 270° 5 up

T-U 100 270° 0'

into up at 100' along T-U

U-V 100 270° 9 up 81-102

turn to U

U-W 100 270° 20 up

From W 99' 0' 15' up to U-81-103

Fracture zone 8' wide,
1 closely spaced joints
bounded by two NW
trending open joints 1"-12"

Samples

W-81-101 A Dio

W-81-101 B Dio with red
minerals

W-81-102 50' x 20' high EW face

Dioite as at 101, rock is
gen massive

~3 ft bedded Dio breccia,
subangular frag to 6"
gen < 1", no orientation

Frac zone at west end
~3' wide, 335°

W-X	88	270	8° up	
	Small fully		trending	345°
	66	205	15° up	W-81-104 East
X-Y	100	270	15° down	17
Y-Z	100	270	0	
Z-AA	106	270	0	at PK nail DH 6, 8 I...

W-81-103 50' W x 30' H E-W face

Diorite, fine-med grnd,
greenish gray to green,
rock appears massive esp
although many tight jts,
discontinuous,

Felsic dikes (g dio incamp?)
light yellow, < 1 ft(?)
no orientation.

Poorly defined jts sets, no
prominent sets

Sample 81-103 Felsic dike

W-81-104 East

Diorite, green, med-fine
grnd.

Diorite

Major

340/80E planar, smooth,
sl. open in places.

Spacing 1"-2', or 6" face of outcrop

280/70 N planar, smooth,
6"-18" or 12"

Minor "

230°/80 N curved, rgh irreg
discont. spacing uncertain

47/35 S curved, rgh,
discont spacing 1"-5'

5/27/81

Climbers at Devil Canyon
K White + C. Crawford - Watson

Flew along Surtina from
Deadman to Townsend
checking outcrop areas
for future mapping

Spot checked Quarry A
for lithology, all
andesite or andesite porphyry
Where is Diorite?

Also checked next high
area down, it is also
volcanic prob. andesite

Returned to north bank
to pick up traverse
from 5/26

Large deviation to 25° E

From yeib-20 up traverse
 PAA-B 100' 270 0

B-C 100 270 0

C-D 100 270 0

D-E 100 270 0

E-F 100 270 0

F-G 100 270 0

G-H 90 270 0 W-8/-104

H-I 100 270 0

I-J 58 270 0 Intersection
 with SL-2

J-K 100 270 0

K-L 150 270 0

L-M 1 270 8 down

W-8/-104 tagged
 outcrop 20' x 10' # EW

Discrete, fine-mesh grain,
 greenish gray,
 moderately jointed,

major 350/80 E less prominent
 planar to sl. curved
 smooth
 spacing ave 2'

270/vert planar
 smooth to rough
 spacing 3'

minor 55/70 S planar smooth
 spacing 2' to 5'

365/30 SW planar, smooth
 spacing 6" to 18"
 discontinuous

M-N 98 270 0

N to outcrop 353 31 up

W-81-105

N-O 24 270 0 down
greenish gray druse

O-P 100 270 0

P-Q 100 270 0

Q to W-81-106
33' 242 150
110 154 30

Q-R 100 270 0

R-S 62 270 0

S-T 21 ²⁶⁵~~270~~ 30° down

T ~~107~~ 35 3110 30° up 107
51 290 0 length + trend
of 107

W-81-105
10 x 5 ft

Druse, light greenish gray,
fine-med grnd, massive,

Joints

32 / 40 E

planar - curved, smooth,
open in places to 1/2 in
spacing 8"-18"

76 / 86 S face of outcrop
curved, smooth,
spacing 1 ft

Minor

12 / 85 E

planar, smooth
avg sp 6"-1 ft

W-81-106 above fingerbuster
20 x 10'

Diorite, greenish gray,
med grnd, v. thin wtd ind,
rock fresh below wtd surface

Joints

Major

65/80 SE

planar to irregular

smooth to rough

spacing 4" to 12" (as 6")

some open 1/2"

Minor

315/40 SW

planar, smooth

spacing 1' to 2' <

300/78 NE

planar, smooth

spacing 1' to 2'

325/50 NE

sl. curved, rough

spacing 1" to 12" (as 6")

discontinuous

W-81-107

Quartzite (?), light gray
to buff, medium grained
altered with, fractured

Fracture zone, along
NW joints, shearing along
EW joints

Joints
major

05/85 W

sl. curved, smooth
spacing 12"

335/78 E

sl. curved, smooth
spacing 3" to 6"

80/80 S

parallels 18" wide
planar to irregular
shear: crushed rx to sand
size + clay, orange color

Fracture zones

- 345/vert E end of oc.
6' wide, V. closely spaced joints
- 345/vert W end
15' wide V. cl to closely spaced joints

Source E fracture K8-9

Sample

Excursion on D.C. rock types
Mafic dikes
ultramafic, feldspathoid,
olivine(?),
fractured, forms gullies,
some shearing associated

Feldic dikes & melted graywacke
beds

Sta + Leib Arch June 1
Merut June 2

Can Meet June 3

Sute June 4
+ Merut 4+5

2 tu, Leib Merut + Singh
at camp right of 4
4 - 11

From yesterday's traverse

1077 combined U-V	100	290	5 down	1077 combined well end
T-U	95	270	0	
U-V	40	270	13 down	
V-W	94'	270	35° down	7.1 Center of large gully, below well end of 1077
W-X	47	280	10° up	81-108
X-Y	28'	270	45 up	on SL
Y-Z	26	240	0	
Z-A	70	215	45 up	
A-B	21	280	20 up	back on Seismic line

W-81-107 Contd
Sta V to the east, outcrop
becomes less fractured,
massive, well defined
joints, rock is fresh &
hard, smooth face along 95/655
joint

Joints

Major

95/655 face weathered

pl - sl cr, some
spacing greater than 1 ft,

blocks falling away from face, horizontal joints?

N-S/75W compl. to above

sl cr, slight
sp 3-5 ft

Minor

90/355

sl cr, rgl, open 1/6 - 1/2"

Sp 6" - 2' av 8 in

270/25N

pl, some, spacing 6" - 2.5'
av 12 in, discontinuous

B-C	100	210	10	down	18
C-D	100	210	30		87
D-E	100	210	20	at Survey "11"	
E-F	100	270	25	Marker A	
F-G	100	210	20	10' to Eriq "E" 51	
G-H	63	270	30		
H-I	100	270	0		
I-J	180	270	0		
J-K	100 115	210	0	to SL-1	
K-L	100	350	0	on SL-1	
L-M	100	350	25		
M-A	100	350	20		

W-81-108

outcrop at west side of gully

Andesite(?), dark gray, aphanitic to fine grained, few plagioclase phenocrysts

Sample

Joint

major

325/85 NE

planar to sl. curved

rough, spacing 1' to 2'

fracture zone (3' wide) parallel

70 / 63 S

planar, sl. rough

spacing 1' to 2'

minor

35/50 W

planar, smooth

spacing 2" to 5' (3')

N-Q	21	225	0	
P-Q	73	110		
L-O	113		25	
J-K	100	0	5	
P-Q	67	0	10 up	outcrop
Q-R	130	0	10 up	
K	100	0	7 up	
S-T	100	0	12 up	
T-U	100	0	5 up	
U-V	100	0	7 up	
V-W	100	0	0	

30' x 80' E-W road
 W-81-109 above gully at 107
 andesite/Ltite similar to rock
 at contact along river
 between diorite and and. porphyry
 green, aphanitic to fine
 grained, few plag
 phenocrysts

Joints
 Major

N-S/80E

pl, am, 1'-10' or 18"
 some small gullies some open

330/75W

pl, am - rgh, sp 3'

Minor

270/55S

irreg, rgh, discont
 1'-3' or 6"

Sample

W-81-110. ^{center} from 100' W of line
10-20' high

Andesite (?) dark green,
aphanitic, 70-80% plagioclase
phenocrysts to 1/4 in,
massive, outcrop has
blocky appearance with
several well defined
joint sets.

inclusions of quartz
monodent? diorite (?) subrounded to
subangular to 3 in
generally less than 1 inch
also metamorphosed or metamorphic
fragments

Sample

Joints

340/90 and 340/70

pl-co, sm-rgl, 1" to
10 ft av 2 ft

310/30E

right, in 19
g-lar 5-10

outcrop

outcrop forms a low
ridge on slope

W-81-111 15' east of line

same lithology as at 110

Joint
Map

310/90 fl - sm

50/15 N fl sm

spacing 6" - 2' or 1 ft

Minor

80/80SW

irreg rough
spacing 3 ft

Major Geology
Plotted
5/31 C

5/29

5
20

PM Check location of
BH-6 on river. original
location is very difficult
to reach. Move hole
w/s ~ 100ft to
gravel bar. hole to
be S 45° W $\angle$ 45°
and drilled into out massive
argillite outcrop; however,
some concern whether
hole will hit talus
pile behind this outcrop.

Went to BH-7. to discuss
pressure testing with dull

Crew

1 p. vi / ft above water table
0.5 p. vi / ft below " "

15 ft interval

Start traverse 2/5 from
USBR monument DC 17

A-B	24	165	0
B-C	100	250	0
C-D	100	250	0
D-E	100	247	12 down
E-F	100	180	0
F-G	70.3	270	10 down

DC-81-200

C-H	67	200	0
H-I	20	165	35 down

USBR Marker Walt

Point F gully, trace of face
is $250^{\circ}/55^{\circ}E$, overgrown
cannot tell if cleared.

DC-81-200 at survey marker
Walt
Argillite, dark gray,
some FEOX staining.

Joins

90/70 N.

spacing 4" to 2"
53 / vert (?) open 8"-12"

DC-81-201 at point I

Argillite, nearly phyllitic,
weak foliation, dark
gray, minor qtz veins

²⁰¹ I-J	66'	195	12 down
J-K	100	230	0
K-M	79	234	0

Joints
315/65 E plane + smooth
spacing 1" - 10"; av 6

165/25 N plane + smooth
spacing 4" - 18 in av 10

45/75 SE Foliation

Point V - open joint

DL 81 - 202

Sandy argillite, rim of canyon
~ 50 ft long, open joints + unstable
blocks, foliation poorly defined

240/45 S pl sm
10 open

150/85 N sm, pl open joints
6" - 15"

Open joint ~~parallel to~~
approx parallel with
foliation trend as at 201

166
180
345

M-N	61	210	15 up	59
N-O	100	268	0	
O-P	100	235	0	
P-Q	100	238	0	
Q-R	100	244	15	97
R-S	100	245	20	
S-T	75	210	10 down	70
T-U	56	137	15 up	DC-81-203

From pt O possible light
colored dike
330°/20° down at
west end of broad face
above cut see topo.

PTO cliff face 10°/90

DC-81-203 small outcrop
8 x 5' NW trending face
Argillite, dark gray
varies from massive to
foliated

30/80NW foliation
irregular, very close fol
as jointing 0"

U-V	53	156	25 up	90
V-W	67	165	10 down	45
W-X	34	158	15 down	45
from PT X				
X-Y	31	287	20 down	29
edge of DC-81-204				
backtracked + down slope from point X				
Y-Z				

DC-81-204 50' x 30' high
 Argillite, dark gray very
 weak foliation, no
 orientation, dark gray

Joints

550/80 E	planar, smooth to rough spacing 6" to 12' some open to 4"
NW/20 W	irregular, rough spacing 3' to 4'
35/70 SE	irregular, rough spacing 1' to 2'
70/75 NW	irregular, rough spacing 5'

Y-Z	71	155 ⁵⁰	5(?) to	
Z-AN	67	80°	30 up	EE
AABB	91	80°	0	leading
BB-CC	100	70	0	east along side of ridge above
CC-DD	92	70	0	small swamp/lake
DD-EE	77	22	0	
EE-FF	92	82	0	
FF-GG	100	75	0	
GG-HH	100	75	0	
HH-II	79	64	0	
II-JJ	75	349	0	
JJ-KK	100	45	0	

KK-ZL	79	42	0
LL-MM	92	29	0
NN-NN	100	38	0
NN-OO	100	112	0
OO-PP	100	65	0
PP-QQ	52	49	0
QQ-RR	82	102	0
RR-SS	100	97	15 down
SS-TT	100	100	15 down
TT-UU	21	94	0
UU-VV	95	96	0

Seismic line at Y

DC-81-204

DC-81-205

205
DC-81-204

Argillite dark gray sl. foliated
α: 30' x 20' h
trace 65

major

320/65 E smooth, planar
spacing 6" to 12" (

05/ west planar, rough
spacing 2" to 12" (ave 6")

70/55 S foliation plane (?)
sl. curved, smooth to rough
spacing = ?, // face

DC-81-206

Arg as above

Joints

325/60 N planar, smooth
spacing 6" to 12" (

VY (205) to WW

47

105

WW - XX

49

63

14 down

46

XX - YY

85

75

BH -

4

end of traverse

filled traverse

5/3

was in " " 2.1 to 2.5

18

RM 01

lost - may get better

20/ 75W

planar, smooth to rough
to 12"

spacing

70/67S foliation (?)

planar, slightly rough to 3m
spacing 2" - 12"

Geology
3/20/2

map for geologic only

5, 1/81 Travertine

DA-89 PTA				
A-B	97'	100°	0°	
B-C	100	95°	0°	
C-D	100	95°	0°	
D-E	100	80	0	
E-F	25'	90°	35°	W-81-112

5/30/81
K White & C Crawford
at Watana, mapping
w/s from DH 89,
north bank

W-81-112
Outcrop 30' x 15' high
trend of face 30°, gen.
overgrown
Granodiorite, light gray,
20-30% quartz, mafic
10-20% m. with
kbl, sl-m. with, hard,
some sulphide str.

Joints

Major
25/65W com, sl cr
2" - 18" av 6"

110/70 S

irreg, spacing 3"-3',
av 2', small outcrop
hard to determine

F-G	73'	125°	15° down	"
G-H	98'	190	25° down	E-1
H-I	63'	95	< 5° down	
I-J	69'	82	45° down	W-81-113
J-K	65	100	20° down	W-81-114
K-L	69'	85	45° down	
L-M	59'	60°	45° down west edge of face zone W-81-115 across gully	
M-N	23	555		

290/10N down
or up 6"

Minor fourth set various
orientations

Sample W-81-112
Granodiorite

Joint pattern gives exposure
angular appearance

W-81-113 small overgrown outcrop
Granodiorite as at 112

W-81-114 small outcrop 30x5 hgt.
with surface, angular
face trends 100°

Quartz diorite (?) ~~is~~ light
greenish gray, medium grnd,
20-40% or less biotite
Hbl, ~ 10%, maybe
ol with

transition from

transition between granodiorite
at previous outcrop and
typical g. dio. at site

Joints

50/85 SE sl. curved, sl. rough
spacing 2" to 12"

N-S/40E irregular, rough
spacing 1' to 2'

100/vert planar, sl. rough
|| outcrop face

minor

310/80SW sl. curved, rough
discontinuous, spacing 1' to 3"

Fracture zone 6" to 1" wide

340/85E (NW set)
spacing of joints $\frac{1}{2}$ to 2'
mod weathered

M-N 25 355°

W 81-115

Fracture zone, deep (5-10')
gully, trend follows
major joint
320/70 W pl-sl rgh
spacing ~ 6"

22/20 S pl sm
sp 4" - 2" av 8"

Minor

245/60 N rgh, direct
sp. 1 ft open in places

190/70 S rgh, undulating
direct, 2" - 2"
av 4"

Gully is filled, no exposure in
bottom.

Diorite, dark green, med
grnd, 30-40% bio + Hbl(?)
rocks, dense, hard fresh
sl. withd

N-O	34'	110°	0	
O-P	36'	40°	0	small gully filled in
P-Q	25'	110	0	W-81-116
Q-R	24'	48°	0	
R-S	34'	76°	30	up across gully, Frac?
S-T	43'	45		W-81-117

sample W-81-115

W-81-116

Fracture zone, angular blocks, mixed outcrop and talus, open to various orientations, trend is 325° as at last outcrop mod with dio

W-81-117 small 4x6' on east side of gully

Discrete as at 115

Joints 230/70 NE sl. curved sl. rough, spacing abt 12"

15/75 E sl. curved to sl. rough spacing 2" to 12"

65/80 SE planar, smooth exposure spacing ~ 1'-2'

T-U	47	90		
U-V	46	84	0	W-81-118
V-W	36	106	0	
W-X	100'	90°	0	
X-Y	62'	50°	25°	up
Y-Z	75'	90°	0	
Z-A'	33'	134°	15	down
A'-B'	98'	85°	0	
B'-C'	97	80°		
C'-D'	100	80		
D'-E'	26'	70		W-81-117

(B1- con 4)

minor 225/20N planar, sl. rough
spacing 1' to 2'

W-81-118

Diorite as above

W-81-119 30 x 10' high

Quartz diorite, light gray,
10-20% qtz, fine-med grnd
10-20 biotite + Hbl

Outcrop is highly fractured
in places but is gen. massive.
Joints

320/45 E sl. curved, rough
spacing 2" to 1' discontinuous

320/75 E planar, rough
spacing 6" to 12"

40/vert planar, smooth
spacing 4" to 12"

(12) E' to F' 21 112°

E' - F' 93 80 10 C/K SL ?

F' - G' 40 640

31-119 con 4

280/705 irregular, rough
spacing 1" to 2" discontinuous

tugged outcrop

W-81-120
40' x 15'

Quartz diorite, med-fine
grind, light greenish
gray, ~10% gls
10-20% bio + Hbl
several well defined joints
fresh, hard,

South

50/20 N pl, sm
Sp 4" 18" or 6"
some open

G'-H'	76	80°	25 up	11
H'-I'	20'	50	40 up	12
I'-J'	100	90	0	
J'-K'	61	95	0	
K'-L'	50	133°	25 down	111
L'-M'	29'	70°	0°	W-81-121

61-120 Contd

30/90 irreg, am,
spacing 2.5' in

150/90 am pl
spacing 6" - 2.5'
face former

very small fracture zones
parallel to NE set, mod-
est width

W-81-120 Small 10x5'

Quartz Diorite, fine grnd,
~10% qtz, 20-30% bio & #61
fresh, hard light
greenish gray

Joints

40/90 pl, irreg
parallel to outcrop
some open to 1.5 in, probably
slumping

M'-N'	100	70°	10° down	"1"
N'-O'	56	50°	0	
O'-outcrop	33	317°	25° up	"1"
W 81-122				

contd

125/10 NE
 irreg semi smooth,
 up 2ft

130/75 E
 al cnd, some
 spacing 8 in

80/90 irreg, discont
 spacing 3ft

Sample

W 81-122 20' x 20', NE. a face

Quartz diorite at 123
 (1?)

Spines 320/75 E planar, sl. rough
 spacing 1' to 3', some open to 2"

45/vert planar sl. rough
 11 to face, spacing ~6" to 2"

(122)

P' top

58' 55°

Q'-R'

15' 42°

2'

edge of
shallow gully

1-122 con 4

Minot

275/30S irregular s. rough
spacing 2' to 3'

60/65SE irregular, discontinuous
s. rough, spacing > 6".

Point Q. shallow gully may
align with one of
several gullies on
south bank
approx trend of 330°

Photo K8-12¹² looking
SE at large gullies on
south bank

Point R

Large boulders of
quartzite to 3-4
ft diameter

~~P-80~~
R'-S' 28 74° 20 down 21.
W-81-123

~~W-81-123~~
W-81-123 small outcrop,
10' x 5'

Quartz diorite, greenish
gray, ~ 10% qtz
30-40% mafic, locally
Hbl

Outcrop is fractured
along numerous joints
most blocks are loose,
possible fracture zone
Joints

325/90 pl, vein smooth
spacing 6"

40/555 rgh, irreg
Sp 2 ft

Minor

225/80 S, irreg, rgh
discont.
spacing av 6"

S'-T'	46'	55	0	
T'-U'	57'	65	15 down	5' W-81-124
U'-V'	38	105°	25 down	
V'-W'	36	25°	0	W-81-125

W-81-124
 Small outcrop 5' x 7' R
 surrounded by boulders

Quartz diorite out 123
 at head of small
 NW trending gully
 possible fracture
 zone

W-81-125
 at edge of large gully

Quartz Diorite fine-
 med grnd, 10-20% Qtz,
 20-30% biotite and
 Hbl (claritized) light gray
 to light greenish gray

Locality

305/65 SW planar, smooth to sl.
 rough, spacing 2" to 3"
 (ave 18")

W' to X'	32	29°	0	West edge of large, NW trending gully from zone?
X' - Y'	50'	47°	25° up	45
Y' - Z'	24'	105	0	east edge of gully
Z' - A''	40'	68°		
A'' - B''	44'	005	25° up	W-81-126

(cont)

280/50 N planar to sl. curved smooth, spacing 1/2" in fractured zone generally > 3'

355/20 W planar, smooth, spacing 1' to 2'

35/100 sl. curved, sl. rough spacing > 6"

W-81-126

Quartz diorite, fresh to mod. weath., same as 125 rock generally massive, few set small fracture zone along NW joints

joints 20/85 S up 5 ft

315/10 sm, irreg up 4" 10" or 8"

B" - C"	69'	32°	30°	up	5'
C" - D"	46'	30°	25°	up	west edge of gully
D" - E"	46'	305°	25°	up	
E" - F"	70'	350°	0°		
F" - G"	67'	20°	25°	up, east side of gully	W-81-27

W-81-26 contd

Minor

290/80 W. rgh, irreg, discont
sp 4" - 10' or ~ 2 ft

Point D" Edge of very deep
gully, probable
First fracture zone

Trend 295°

W-81-27

Quartz diorite / diorite,
mod. wldy, fine-med
grnd, outcrop is highly
frac.

Joints

45/85 NW

curved, irreg w/ rough
spacing 1" to 12"

305/vert

spacing

sl. curved, rough
ave 6"

G" to H"	78'	310°	30° up	1
H" - I"	51'	335°	25° up	42
I" - J"	51'	20°	30° up	114
J" - K"	100	60°	10° up	11
K" - L"	59'	65°	0 N. Edge of Fins gully	
L" - M"	49'	320°	15°	111
M" - N"	49'	355°	25°	1
N" - O"	100'	350°	30°	
O" - P"	56'	356°	25°	W-81-128 Edge of major Fins shear

(127 cont.)

310/75 SW planar to sl. curved
rough, spacing 6" to 3'

65/40 SE sl. curved, smooth
spacing 2" to 2' (avg 12")

Point L" Photo K8-12
Looking a/s
from Fins 13

W-81-128
outcrop at edge of main
Fins shear
30' x 7' h

Quartzite, sl with
med gray, ~10% gtz
20-30% bio + Hbl

P"-Q"	29"	250°	10°
Q"-R"	100	305°	25°
R"-S"	100	300°	20°
S"-T"	95'	310°	20°
T"-U"	94'	355°	0
U"-V"	66	10°	0

W-81-129

Joints

20/90 pl. - sm, spacing 6"

70/50S irreg, sm - rgh face of outcrop

110/55SW pl - sm, 2" - 1" av 4"

W-81-129 15' x 10' h, mostly vegetated top of Main Fins shear

Quartz Diolite(?) greenish gray, fine - med grnd, 20-30% bio, not sure of qty. content

Joints

48/80NW pl, sm, 6" - 18"

120/80W face of outcrop rgh, irreg, spacing? 2"?

V ⁿ -W ⁿ	100	60°	25° up	91
W ⁿ -X ⁿ	100	105	10° up	10
X ⁿ -A ^m	35	105	0	top of hill above Fire where seismic line well cross

high point on Topo map

Geology Plotted
5/31 C

Minor
225/60E, cut, on,
up 12" ?
205/35N, cut, discont
igh, up 8"

Summary
Lithology varies along
traverse mostly in the
amount of quartz

Plotted & Xeroxed
to here 5/31

5/31/81

June 1 1980 Rain
Work in Office in morning
PM K. White and C. Crawford
to Devil Canyon
location of BH-5
Quarry + borrow areas

at BH-5

~ 1013ft elevation, check
at BH-1(?)

BH-5 - B	18'	45°	0'	18'
B - C	64'	35°	18°	61'
C - D	65'	40°	25°	65'
D - E	28'	60°	10° down	28'
E - F	46'	350°	0	46'

at bridge

5330W + 205'

EL 1449 at BH 1

adjust to true el 1447' - 1415' = 35', change

el at BH-5 1013' - 35' = 978'

Up (flood) also Creek looking for
potential borrow areas, several
small terraces, some to have
boulder size fragments, no obvious
impossible source nearby

1013
35
978

Central quarry area
DC-81-300 on airphoto
Bio. Granodiorite, light gray,
massive, few well
defined joints, fine sand
jt. spacing 1-3 ft NW + NE trend,
Sample

DC-81-301 on airphoto
same as above, fresh to
sl. wtd, variable grain size fine - coarse
Sample
massive few well defined
joints spacing ~ 3 ft
NW + NE trend

Blasting will produce large blocks,

6/1/51

From D H 8, 9 (A) cut
A-B 53' 237° 0°

B-C 61' 265° 0°

C-D (130) 48' 270° 15° down

Chamber at D.C.
K. White and C. Crawford
at Watana

From D H 8, 9 downstream
to Fingert to
Volcanic, & water in latter

W-81-130 overgrown
outcrop, poor exposure
20 x 20

Diorite, greenish gray
fine to med grained, 10 to 20%
- mafic (prob. biotite)
fresh, hard

Joint:

4.5/75 W face of outc.

Plane sl. rough

spacing 12"

95/105 sl. curved, sl. rough
spacing ~ 1' to 2'

DLBC, to E

37'

280° 0

E-F

33'

260 20 down

W-81-131

-130 (cap. 4)

95/25S irregular, smooth
spacing 18"

Minor: 65/80 NW irregular, rough
spacing 2" to 18"
discontinuous

W-81-131 20 x 15'

Diorite, dark greenish grey,
less than 20% mafics (b.c.)
- med. grnd.

Felsic dike, 6", ~ 340°/90

Joints

30/90 pl, sm
spacing ~ 1 ft / 100 ft

110/75N pl, sm
spacing ~ 2.5 ft ?

45/30S pl - sl cr, sm
spacing 2" - 12", var 6"

F-G (132)	68"	275°	0
G-H (132)	54'	305°	0

} Co. ...
 } exposed

90/55N pl, sm, spacing 6" av
 Sample diorite A
 like B

Photo K8-14
 topped

W-81-132
 Similar to previous but
 more massive

B. 132
 210/155W face of m.c.
 planar, st. rough
 spacing ~ 5'
 facies detached block
 approx 5' ~ 6"

30/vent. ...
 spacing > 2'

335/70E planar, st. rough
 spacing ~ 5'

H(132) to I

30 288° 0

I-J

40' 305° 12° up "

J-K

68' 295° 0

K-L

80' 240 15° down 71
W-81-133

(cor)

100/305 phos, rough
spacing 2'-3'

thin, l. d. d. d. d. light yellow
color, no orientation

W-81-133 outcrop, along
NW trending ridge
Dipole, or above
margin, several well
defined joints

Joints

355/90 pl. d. d.
spacing 4"-3' or 18"
some open 1/2 in

120/80W am. pl.
typ. min. of 6 in to 2 ft

235/20N, irreg. rough
1 ft - 3 ft

(133)

L-M 72' 310' 35° up

M-N 60' 315' 35° up

N-O 60' 275' 0

OP 412' 280° 0°
it is a soil side of gully

W-81-134

Minor
110/15N

205/80W w-v-m
opening 1ft

W-81-134 west edge of
gully

Discrete dark greenish grey
thin grained, as above

Gully may be a fracture zone
some sections of wall
highly fractured and severely
weathered, friable

Joints

285/90 l. & rgh,
sp 2.5' span 3"

N-S/90 and, rgh
sp 3ft

P-Q 95' 265° 0
 at 20 ft. in a gully
 Q-R 73' 230° 15° 81-135 45
 (135')

90/80 S pl. sm. discontinuous
 ~ weathered 2 ft

Minor
 200/25 S discontinuous

W-81-135

Diorite, light greenish gray,
 med. grnd, coarser than
 previous outcrops, massive
 few well defined joints

Sample

Tand

225/62 N planar, smooth
 spacing 6" to 3' (one 18")
 some open 1/2"

345/65 E planar smooth
 spacing 1' to 2'

65/vert. w. curved, smooth
 spacing

R-S	32'	35°	25° up	
S-T	57'	115°	20° up	
T-U	35'	115°	0°	
U-V	37'	116°	15° down (136)	
V-W	61'	305°	25°	W-81-137

ENE/45N plane, 2420 ft
 sparse 8" to 18"

W-81-136
 west side of gully, deep
 trend is 155°, probable
 fracture zone, bottom
 is gray rock corner

Diorite, same as 135

Joint,
 N-S/90 irregular, some
 up 10"

210/-105 p.l. & m.
 up 6-10"

215/90 p.l. & m., also coal
 up 18"

(182)
 W-X 34' 280° 0 SL-2
 centerline
 X-Y 56' 260° 10' down
 Y-Z 37° 270 0 W-81-138
 W-81-138 from
 pt Z to B1

W-81-137 ^{opposed}
 pos. S.C.
 Diabase - med grained, light
 gray green.
 Diabase
 350' vert sl. curved sl. rough
 spacing 1" to 12" (see 12")
 55/55 NW sl. curved, smooth
 rough, spacing 2"
 245/80 S. Poros, sl. curved
 face of ac, approx spacing
 1"
 W-81-138 outcrop forming a
 small ridge E-W
 Diabase, fine-med grnd, light
 greenish gray, 10'-20'
 mafic, el to mod with
 possible thin dikes of andesite,

W-81-138 Contd

230/55E pl, sm,
spacing 6"-3"

270°/90 pl, sl. rgh,
sp. 3' some open 4"
shearing/fracturing
associated with this
set,

0/70W irreg, rgh
sp 12"

100/60N irreg, rgh
sp 2 ft

Shear. east and
270/60°N
slightly healed breccia,
less than 1 ft wide,
some small fractures
in outcrop

Z-A'	40'	265°	0
A'-B'	77'	280°	0
B'-C'	40'	335°	30° up
C'-D'	70'	290°	0
D'-E'	30'	290°	0
E' outcrop	13'	23°	
E'-F'	26'	280°	

W-81-139

F' to ... W-81-139
25' 20° 30 up

Went out, last 30 ft
shear, zone of fractured
rock, zone crushed rock
zone is poorly defined
earthenish
approx 300/30° N

Photo K8-15 close up
shear
K8-16 outcrop
tagged

W-81-139^{est} 30 x 15'
focal 315° and 280°
Degrade, light greenish gray,
fresh to old withd,

Joints
2/50 NW planar, smooth
opening 1" to 3" (ave 6")
most open 1/4" to 1/2"

315/vert o.c. face
planar, smooth
specimen?

34.75 E. Max to cl. curves,
 51.000 11
 51.000 > 2'

20/12 E. Max to irregular
 51.000
 51.000 2'

Continued in
 Book 11

CURVE TABLES

HOW TO USE CURVE TABLES

Table I. contains Tangents and External to a 1° curve. Tan. and Ext. to any other radius may be found nearly enough, by dividing the Tan. or Ext. opposite the given Central Angle by the given degree of curve.

To find Deg. of Curve, having the Central Angle and Tangent: Divide Tan. opposite the given Central Angle by the given Tangent.

To find Deg. of Curve, having the Central Angle and External: Divide Ext. opposite the given Central Angle by the given External.

To find Nat. Tan. and Nat. Ex. Sec. for any angle by Table I.: Tan. or Ext. of twice the given angle divided by the radius of a 1° curve will be the Nat. Tan. or Nat. Ex. Sec.

EXAMPLE

Wanted a Curve with an Ext. of about 12 ft. Angle of Intersection or I. P. = 23° 20' to the R. at Station 542+72.

Ext. in Tab. I opposite 23° 20' = 120.87
 $120.87 \div 12 = 10.07$. Say a 10° Curve.

Tan. in Tab. I opp. 23° 20' = 1183.1
 $1183.1 \div 10 = 118.31$.

Correction for A. 23° 20' for a 10° Cur. = 0.16
 $118.31 + 0.16 = 118.47$ = corrected Tangent.

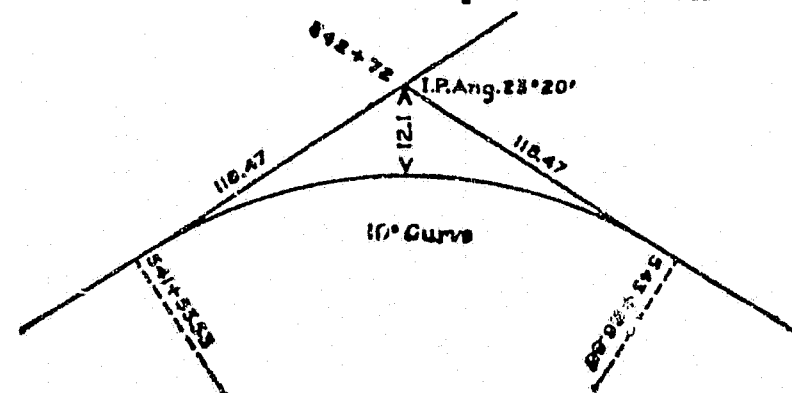
(If corrected Ext. is required find in same way)
 Ang. 23° 20' = 23.33° + 10 = 2.3333 = L. C.

2° 19½' = def. for sta.	542	I. P. = sta.	542+72
4° 49½' = " " "	+50	Tan. =	1 18.47
7° 19½' = " " "	543	B. C. = sta.	541+53.53
9° 49½' = " " "	+50	L. C. =	2 33.33
11° 40' = " " "	543+	E. C. = Sta.	543+86.86
	86.86		

$100 - 53.53 = 46.47 \times 3' \text{ (def. for 1 ft. of 10° Cur.)} = 139.41' =$
 $2° 19½' = \text{def. for sta. 542.}$

Def. for 50 ft. = 2° 30' for a 10° Curve.

Def. for 36.86 ft. = 1° 50½' for a 10° Curve.



AAI

EDEN
4. 11. 5
EXP. #10

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ACRIS REVIEW 46-49

LIST OF SAMPLES 149

STA 3 to 7
 Tr 10 93,
 4°-5° directly
 est 130°

5-22-91

[12,33]

It is overcast this morning and
 we have a heavy ceiling. But, 2:00
 & 3:00 are very clear. They will
 work on the left abutment beginning
 their descent from approx centerline.
 White & Crawford are working at the
 right abutment. Brown is
 near PH 2 and working down channel.

Helicopter is landing down at
 airport. Brown & John will be working
 adjacent to the photo point at 1:00.

7-51-196

Out of the field the point
 on the bank. Brown is working
 between the point and the abutment
 at 140' and west the point.

grained sand particle

D-81-127

~ 210' - 220' down from top

STA #3, 127 : 565' across @ 14° slope

D-81-128

located approximately 30' above

81-127

D-81-129 Many located some material, will work towards the summit to check.
~ 125' down from top.

D-81-130

located ~ 170' down

STA #4 to 130 2° across, 12° up slope

D-81-131 Dike located approximately

located ~ 175' down

D-81-132

Even more and 1/2" from top
with some gravel. High in the
middle of the slope, seems to be
of quantity. 1/2" only lower - 1/2" only 2"

150° 74° NE plane 5' from top
forming a flat, tilted plane

gray to light gray, horizontal
gray. 1" and 2" pieces out to
2" along

- 30' further down

71° 52° SE plane 5' from top
seems to be 2" wide
and is almost clear of
6" spacing

trend of change is 172° here

152° - 165° west plane, 5' from top
and 8" 2" from top
clearly shows and is marked
by bedding plane change

Dear zone viewed from STA #5 trends upslope to the $\frac{1}{2}$ s.l. / river to of the pinnacle. From this angle it appears to be a 167° trend.

5-29-31

[12, 39]

It's a hot clear sunny day.
HOLM, HEINZEN, & I are at DEVL. Chambers
Bjarnes; Jim is climbing down the hill
abatement. 1041- is & Chambers will
visit Blah & the cement by the
beginning today.

PH-1 1715 @ 7 ³²

Top. 1433' @ 2nd

D-81-134

At line of	At line of
They have	They have
1855	1855

5' 10" = 57" 15"

1375' @ 1.14

157

cont. 75' below the crest.

STA # 4 to 123; 570' across @ 644°, 5° down slope
Red road to Waterfall
bec. running hard
- Photos: 5

holocausto	presencia	log
------------	-----------	-----

On 10-1-11	11-11-11
------------	----------

Grouse Hawk - was beginning to
on his descent, must have a nest very
near by. Good thing he has a habit of
Photo: 21-22 of their descent

D-81-135

Open joint. d. 125' 1.4m

340' across @ 356° $\pm$ 13° up of
backcut 177°
1236' @ 90°

D-81-136

1236' @ 90°

J-137



330' across @ $\pm$ 7° up of top

D-81-137

200' down from top, in chert
340' across @ 2° $\pm$ 5° up of top

1236' @ 90° 179°

D-81-138

Characteristics of jointing in
yesterday's fracture but not actual.
Remnant NW trending joint with
subhorizontal set dipping out to the

360' across @ 356°

Photos # 31 & 32

D-81-139

Same jointing was exposed
down other

345 across top of joint
1182' w. joint but not joint
thru set of jointing

D-81-140

Very massive outcrop ~ $\frac{3}{4}$'s the way
down slope. Range ~ 260', range
and has doubly vertical joints??

(~ 12°) @ 24' down slope
✓ 6.5° backslight
1105' @ 1150

Rappelled down to the river where
the block is, Byrne & Jim will
check to determine if there is a chance
that it is a slide block. Appears that
Elev. 1050' 1223

The whole block has slid down the
face. A 8 cc slope is superimposed on
the block due to recent rockfall.
Joint measurement on the block & the
adjacent rock along with the examination
of through going joints will enable us

D-141

- cliff face
89° 51° S1 bedding plane

D-81-142

- back itself
53° 66° SE bedding plane

D-143

Station part way up the face ~ 75'
~ 17° 14° down slope

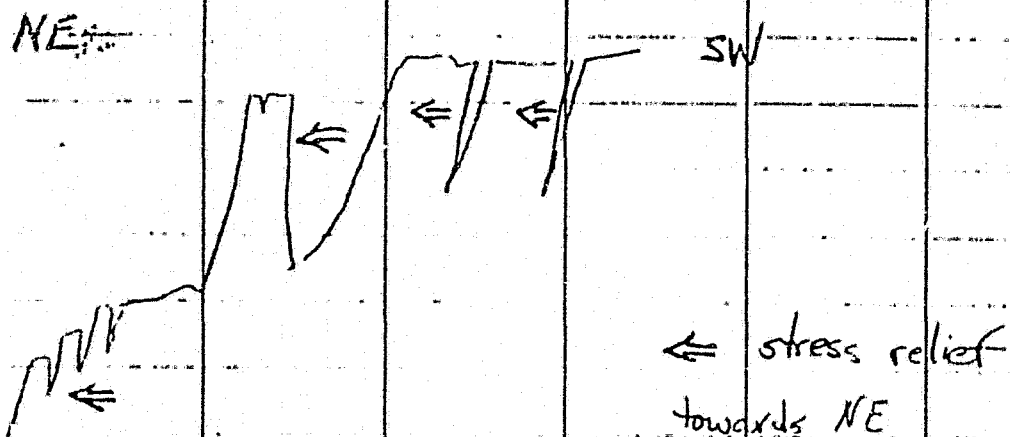
Crest 1578 @ 307
- reached the top

Upon pulling up the caving rope is
getting organized. Will begin short rappels
over the edge, checking for and tracing
the extent of open joints from above.

NOTE: Appears that there is a high
possibility of a large slide block

U-51: 145
 ~ 40' d/s of panel, just over
 the edge ~ 25'; open joint. NW
 trending

TOD: Have a large slide block which
 has slid down the face to river level.
 This block is within 250' of the
 dam c/c, d/s of. One of the large
 open joints near the panel was traced
 over the edge. This joint stays open for
 quite some distance down. Stress
 relief on the left abutment is in
 a northeast; perpendicular to the river.



11 hrs field
 2 hrs office

5-30-81

[12:51]

It's another clear, beautiful sunny
 day. ~ Mrs. MAC has looked real
 good the past two days. HOLM, MEINZIN,
 and I are at Devil Canyon. WHITE &
 CRAWFORD are working at Malheur.

Will have the climbers on the left
 abutment. Had planned for a full length
 rappel but Jim is feeling well. Plan B
 calls for them to do a short rappel
 ~ 400' d/s of centerline at the A-frame

I was at STA #4, couldn't see. On
 moved to clearing

D-81-146

~ 20' boulders in the chute

349° 7°

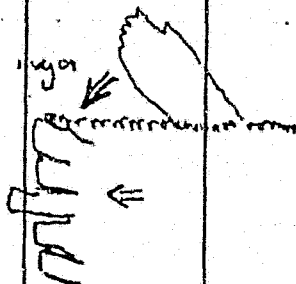
Moved to existing higher d/s of Blt-1
D-81-147

Down in the chute, seeing steep
gully, 1/3 side of rock face is loose
blocks falling over along bedding
plane (?)

NW

SE

Loose
blocks
overhanging
steep relief



View near
top

1/3 side is solid, competent. Pyrite
is 70'-75' down.

> 600' away est. 550'

24/9° 10° down slope

D-81-148

in the chute ~ 90' down
end of traverse.

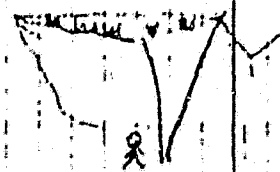
24/9° 10° down slope

Photo; 6, 7, 8, 9

Entered another short descent further
downstream where the overhanging blocks
are. Traverse below DC-17

D-81-149

30-35' below the crest
353° 6° down slope



base of various shaped
blocks

tie in point

40' @ 282°

middle of clearing

to stump in

D-81-150

Continued down slope from above, ~ 75'
down 353° 7° down slope

End this traverse

Move to just ups of the talus slope.
 Short rappel down cliff face

D-81-151 On top of ridge ~ 125' below
 the crest, adjacent to large open pit
 which had a cavity (81-86, 87).
 > 600' away 156° 149°
 1165' @ 12° 6° down slope

D-81-152

On upstream side of separated block
 ~ 100' down from ridge 142° 326°
 13° down slope

~ 50' below the last right
 dike material present.

Trend is curved, depends where measured

D-81-153

Quartz porphyry dike

148° 329°
 4° down slope

D-81-154

344°

3° down slope

D-81-155

On the cliff face near the bottom
 ~ 70' below the top

306°

1° down slope

End traverse, move d/s a approximately
 100' to check a small not well defined
 chute

Photo # 29 205

Start another short traverse, ~ 100' over in
 the d/s direction

81-156

1340' @ 5°

348°

164°

3° up slope

81-157

Mafic dike

152° orientation 72° NE

P

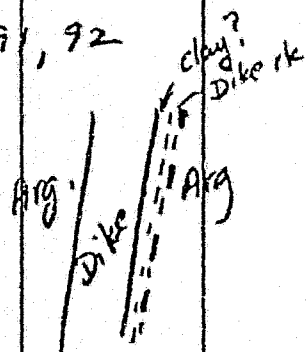
Photo # 30

JA 9, 92 Dike

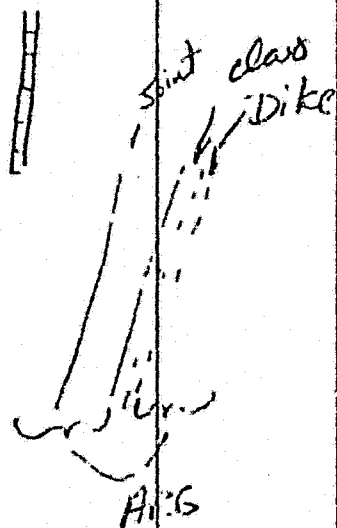
31

STA 157 Dike

81-91, 92



or



End this short traverse.

TOD - Hit a couple of dikes w/s of the
 scree slope, also a shear zone near
 below DC-17. w/s of shear zone, at the
 top, rock is in blocks, incompetent and
 subject to possible rock fall

Hrs.	Field	11.5
	office	1.0

6-1
 5-31-81

It's been raining most of the night
 and continuing right now. Needed an office
 day to plot up everything, will be doing
 that today.

1. Finished putting traverses on (one's
 with control)
- 2.) Sketched in dikes, started putting
 joints & bedding
- 3.) WENT through all samples collected
 and inventoried them
- 4.) HAD Byrne write up rock description
 for DEVIL CANYON, any other thought
 he has for contributing to geology.

12 hrs.

6-1-81
[12:64]

It's cloudy this morning should
break up before long. HOLM, HERNANDEZ,
and myself are at Devil Canyon.
White & Crawford are at Watana

D-81-158

Began the morning by rappelling
down from the panel at c/c on the
left abutment. Adjacent to the
pinnacle, they have found the
mafic dike. Attempting now to
join this segment up with one of
the previous dikes delineated. They
are out of my view, on the SE corner
of the pinnacle ~ 50' away.
Orientation of dike
157° 87° SW ~ 7'

Began descending down into the
shear zone below the panel.

D-81-159

In the chute of probable shear
STA #4 to ; 333° 11° downslope
~ 150' to 165' above the river

D-81-160

Approx 90' above the river in the chute:
STA #4 to ; 338° 17° downslope
JOINTS: backslip 152°
88° 55° SE plane somewhat
aver 8' 2' to 1.5'
165° 86° E ~ 14" ; aver 3"
2' wide highly fractured zone
in the chute
no clay seen

Began ascending the face @ 10²⁰

Photo's 32-36

Stringing of drill rig 1-3

Rem. marker 60A
1417' @ 12⁵⁰

A = 1376' @ 1²⁵

NE corner of building

A-B 100' 22° (25°)
3° down slope

B-C 100' 12° (13°)
1° down slope

B = 1378.5

C = 1365'

C-D 30' @ 253°

Same elevation as C

C = top of mapel for 81-156, 157

D = just below is the maple deler
@ 81-157

B-E 100' 25°
5° down slope

E-F 70' 34° (38°)

F-G 50' 18° down slope
7° (13°)

30° down slope

1339' @ 151°
B = marker 81-154/155

SL-17 to AA

103' 59° (51°)

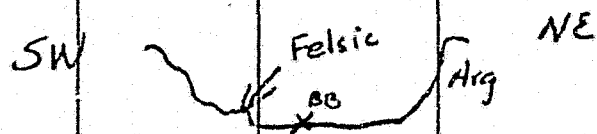
27° down slope

AA = 1273' @ 2²²

AA-BB 97' 344° (34°)

BB = 1260' @ 213

B.B. in trend of saddle
Argillite on NE edge

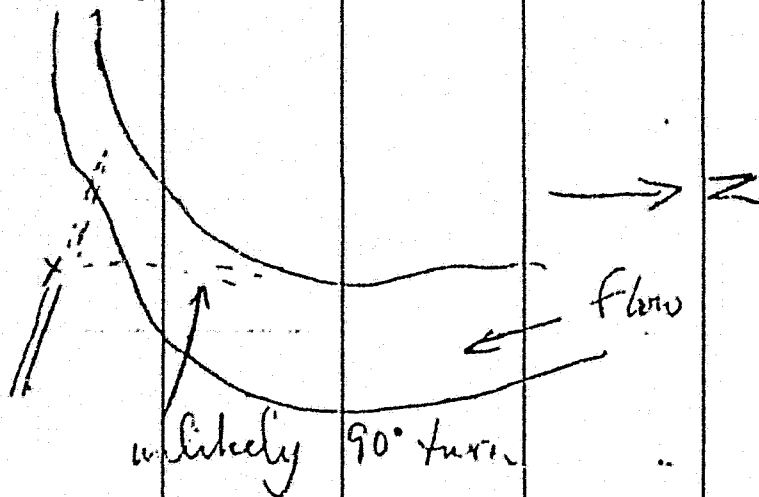


trend is 145°

Felsic material is highly fractured
& incompetent. Highly weathered

Follow the trend $\sim 150'$ more to the
NW to there station

Lies up with chute adjacent to
P.H. 2; but changes orientation
further downslope.
Pinch out



Return to corner of lumberhouse
1412' @ 22°

R & M 60A
1484' @ 25°

Flew around centerline to try to watch
up the dikes

81-91 & 81-157 appear to be two different
dikes

81-158, 81-120, 81-93, & 81-78, all
appear to line up as one dike
in three of the four locations, the
dike is sheared on its W/S boundary.
don't know how the dike at station
ties in on the left abutment

At this moment Brian & Jim are near
the edge on the left abutment at
the W/S side of the talus slope, looking
for and tracing the known dikes below

Two traverses down to find
the mafic dikes

- first one failed
- second one dikes at crest,
flashed. Gave down below
to find the dikes
81-91 to the surface

Found both dikes below approx 25'
apart. Apparent - that STA 91, 92,
dike pinches out ~ 10' from the
surface

X-SECT.

TOD - Got a few dikes to watch up for
some today (ie. opposite sides of the river).
Still haven't determined if 81-79 pinches
out to the south or where it intersects the
left abutment

HRS. 12 (worked 13)

6-1-81
[12, 66]

It's overcast and cool this morning.
HOLM, HEINZEN, and it is at 1200'
Canyon, WHITE and CRAWFORD are at
Wahana

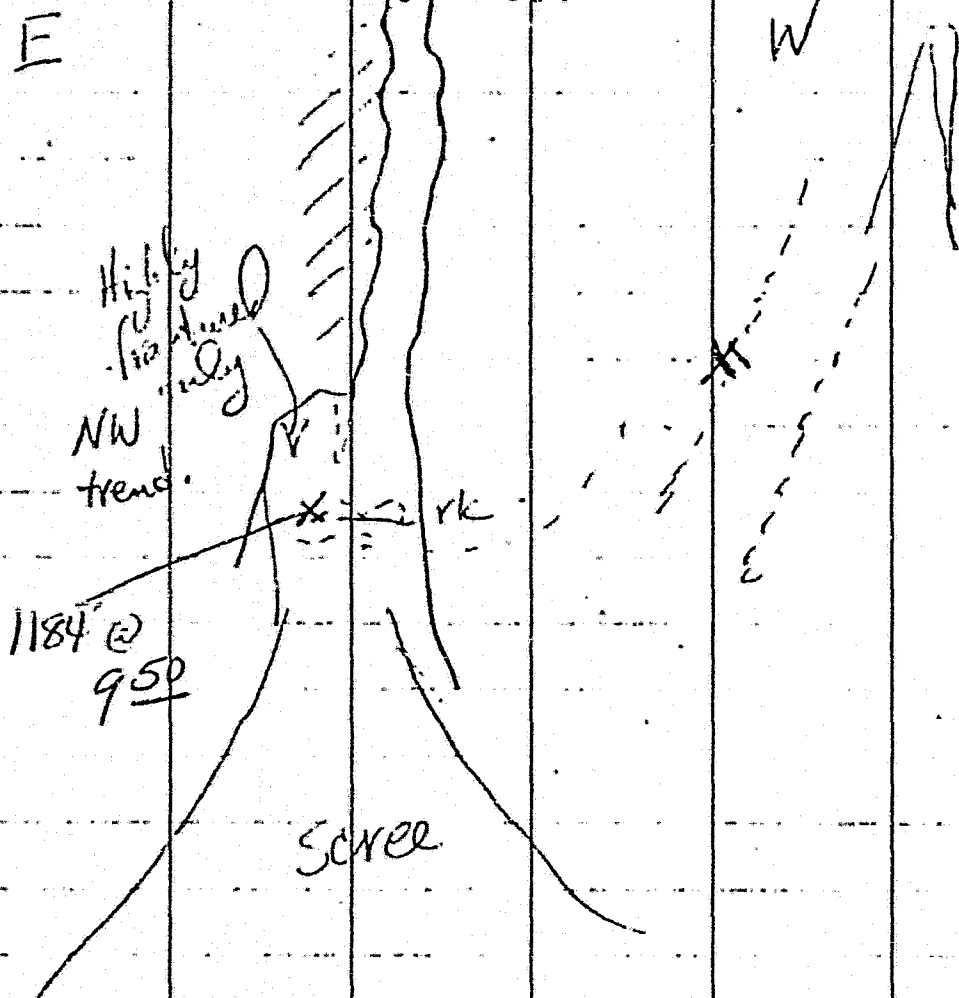
Stopped on right abutment. so
Holm could tie things together.

Moved to left abutment with
work in the cross slope area.

R.M. 60A
1417' @ 8³⁰

Notch at top of water pit;
will go down below here
1371' @ 9⁰⁴
1362' @ 9³⁰

Step above the wire - Cape
~ 175' - 200' down. X - point



D-81-161

Mafic dike exposed ~ 6 feet wide
Weathered to a dull earthy red-brown color
has the characteristic jointing. Rock is
Elev. 1232' @ D-11

Orientation of dikes

357° 76° W

all across the exposure, therefore
It's a medium to dark gray, fine grained
rock. Joint spacing is close. Rock
is hard, slight weathering rim ~ 1/8".
No shearing observed on either boundary.
Not sure where it is on the opposite ridge.
Could be Lyman's Tins station of yesterday.

D-81-162

Mafic dike which we can't get to
continuation of 161, approx trend 0°, west
1294' @ 10°

Top of chute

1391' @ 11° 35'

Dike at top of chute is orient'd
~ 340°

D-81-162

Mafic dikes exposed. Trend
trends to north above section

Orientation 346° cont.

1405' @ 12³²

Joint spacing is close

Waited for a pick-up, so we could go
back to Watana and then start
working at the "Fins". I heard we
were late on Dick's return from TKV

R&M 60A

1417' @ 2³³

D-81-164

Gully near the cliff face,
left abutment, just downstream of
centerline. Bedrock is exposed
in some places on both sides of

ELEV. 1431' @ 2³⁷

the gully. It is between 6' & 8'
feet deep and trends 63° , approx
parallel to bedding?

67° 55° SE

Moved to Watana, Fins:

down dip A W-81-300

W-81-301
about 15" side

W-81-302

D W-81-303

E W-81-304

TED - Working here in the "Fins" no need to use ropes. Didn't see anything in the chute which was ascended today. Assume that a shear probably trends through here, its just covered up with soil.

Went back down notch above the scree slope at Devil Canyon. Traced the dikes in the area.

Things remaining to do at D.C.

- ① spacing & orientation of open joints on the left abutment near the edge.
- ② traverse near 'A' frame, gully & blocks
- ③ river traverse on right abutment 1/2 of C/L
- ④ check where the felsic dikes pinch out opposite the point bar/fan
- ⑤ fly the canyon, sketching in the visible dikes

HRS 12 (13)

6-3-81

[12:82]

It's mostly cloudy this morning, will probably burn off later. HOLM, HEINZEN & I will work in the "Fins" area at Watanabe

PHOTO: MOSAIC of the "Fins"

WATANABE

2260' @ 6:25 @ 53'

W-81-306

At the top of a chute with snow/ice still present. At the beginning of outcrops exposure.

Elev. 2011' @ 7:35

Jointing & fracturing is close to very close. Joints are moderately to highly weathered. Rock is weathering fairly rapidly, iron stained. In the green, medium grained, biotite diorite. Rock is moderate hard to hard, moderately competent.

Joints:

- 315° vert plane, smooth, forms the wide face; 8" to 2.5'
- 59° 82° SE plane to slightly curved smooth; 3" to 1.5'
- some dike material above is approx. parallel to this orientation, 2" and a 1' zone. They don't extend down into the outcrop where I am.
- 245° 25° N plane, smooth through variable orientation, 3" to 2'
- 22° 38° SE plane, smooth to rough
- 27° 30° SE plane smooth 6" to 1.5'

W-81-306 B. Hall's Book #12

W-81-307

Coming down along cliff face. Quartz diorite is a white-gray, medium grained rock. Rock is breaking down along grain boundaries, friable along outcrop face. Highly weathered, soft

Nov. 1970 @ 9³⁰

JOINTS

- 140° 86° NE, rough, curved 2" to 1.5' cliff face. exfoliation along
- 55° vert. rough, discontinuous 6" to 3' over 2', face not

to hard, Discontinuous fine grained dikes intersect, up to 1 1/2" wide. Rock is competent into and away from outcrop face. Outcrop is blocky and on, highly weathered along joints

W-81-308

Shear zone exposed on the cliff face. Range from 4" to a 1'. Several fractures have reformed the shear. Incompetent, little zone. Adjacent rock is the medium grained white gray rock. Exfoliation

Orientation of shear { 81° 45° N 1/2 hrs
61° 35° NW "

ELEV. 1860' @ 10²⁰

~ 20' further down, blocking massive, makes up the ridge to JOINTS:

150° 74° NE, plane smooth
1' to 4' over 3'

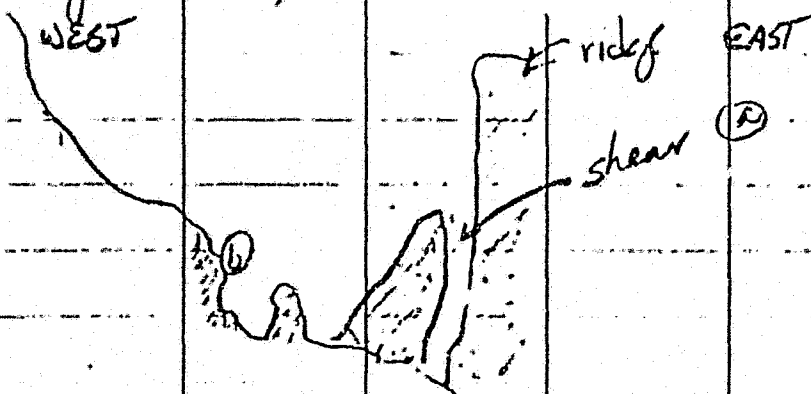
46° 87° SE plane, smooth
2' to 6' over 5'

44° 37° SE plane, smooth
1" to 1.5' over ~ 1'

ous d/s side

W-81-30°

Major shear exposed on u/s side of chute, smaller shears on d/s side



ELEV. 1751' @ 11⁰⁰

② Shear zone adjacent to E comprises the u/s, southwest facing cliff face 154° 80° NE gouge 1' to 2' over shear width 2'

Rock is delaminating along the shear zone, glass, rock breaking down along grain boundaries. friable, hollow sound → exfoliation. Gouge is a white to orange color.

⑥ Shear see B. Holmes notes

⑦ East side gully

Shear: 355°/58°W Sheared 4" wide curved rough / Orange gouge & sandy breccia

Joint I 336°/76° NE Plane & smooth → rough (3'-6' ; AVE. 5')

Joint II 51°/71° NW Plane & smooth spalling?

Joint III 5°/3°W Plane & rough (ave 1')

WATANA

ELEV 2287' @ 12⁵⁰

MOST OF the stations were taken in the chute which coincides with the major drainage from above.

TOD. - Did find some of the shearing exposed higher up in the 'Fins'. Saw diorite and quartz diorite with continuous and discontinuous felsic dikes. The rock is weathered, breaking down along the grain boundaries, & exfoliation. Only where the outcrop face has been exposed for a while is the rock highly weathered on the surface.

Hrs. 12 (13.5)

6-4-81

It is overcast this morning. It rained last night here, but there is a dusting of snow on the Talkeetna Mtns. to the south. It will probably clear off today. Waiting to see what's up today. Thompson, Wolofsky, Singh, & Merritt are coming.

Flew to Devil Canyon, HEINZEN & I. Tried tracing the open joints on the upper surface on the left abutment for tying in and getting their frequency, orientation and spacing. Only the two major ones at the dam c/p show up. Two others found around the edge of the NE-facing cliff terminating at the panel.

RM 60A

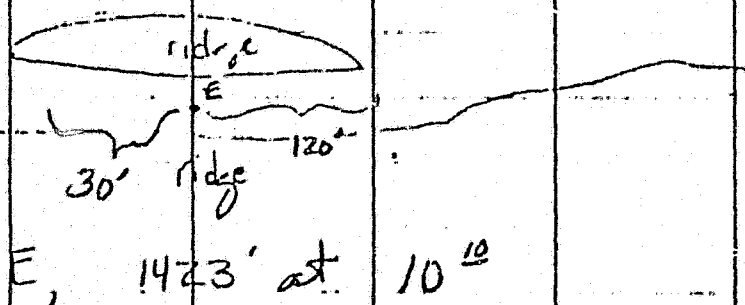
1417' @ 940

62A to panel (A)
 195' 10° (356°)
 A-B 96' 7.0° * 251°
 @ 33' open joint 14° upslope 320°
 @ 48' open joint
 variable direction ~ 325°
 B-C 100' 58° * (238°)
 3.5° upslope
 C-D 100' 255° (255°)
 horizontal
 D-E 100' 259° (259°)
 8° downslope

Plotted 6-18-81

D-81-164 (E) (cont.)

Trend of depression ~ 64°, over
10' depth.



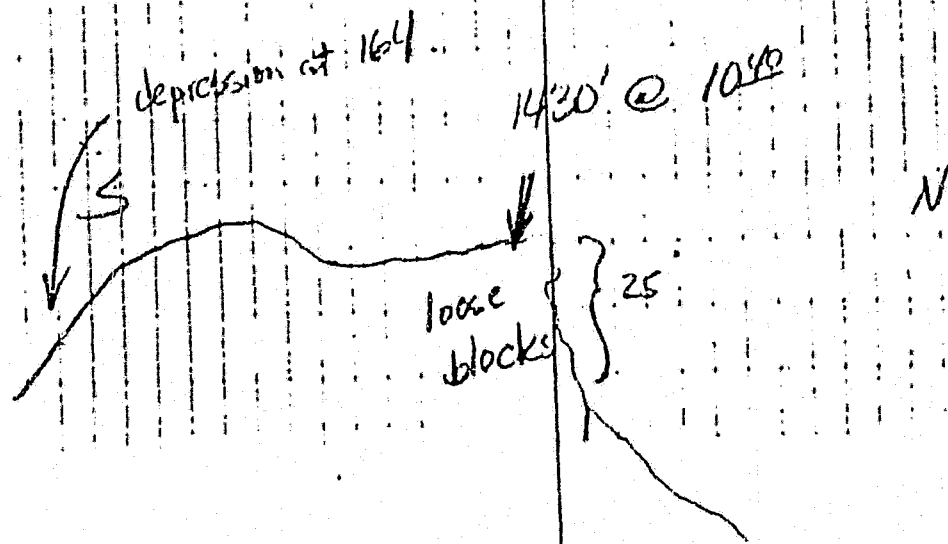
Thinly laminated, dark gray to charcoal
 gray, fine grained, phyllitic argillite
 Some clean sand intercalated with.
 Lots of quartz, shot through the outcrop
 up to 1" wide, conchoidal, following.

Joints

Major { 68° 56° SE bedding plane cleavage
 136° 81° SW plane smooth 1/2" to 3"
 4" to 3.5' one is open to 4"
 Only see { 114° 46° NE irregular rough
 one { 56° 32° NW " "

Some ~ 151° are open

crosscutting the bedding



R & M 60A

1415'

1045'

Open joint @ 33'

can see to 132' from
cliff, still 3" to 4"
opening. Probably extends
further than this, just
no surface expressions.

Open joint at 48° 32' - 331'

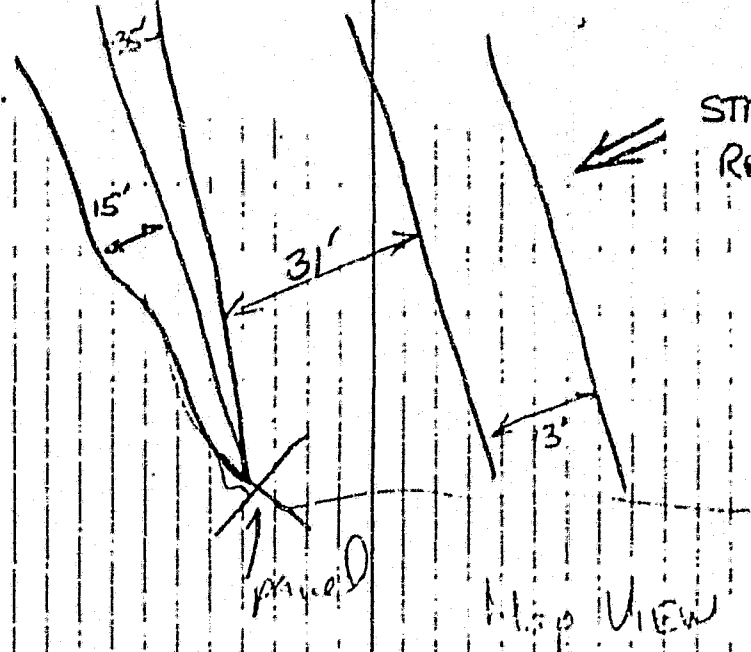
180' has slight surface
expressions. Not as well
defined as the one at 33',

Spacing of 13'

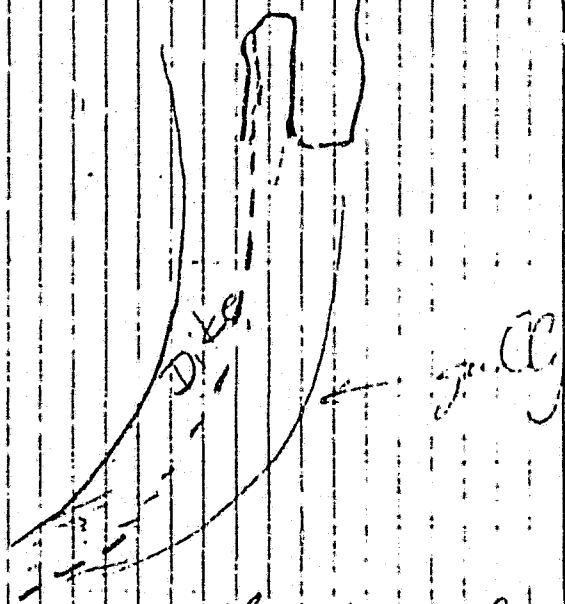
Open joints - 35' spacing

149° (329°) - 240' back
from the panel

145° 155° 180° back
from panel

STRESS
RELIEF

Walked down to D-81-153, looked
at the felsic dike. Exposed in the
upper part of this gully. It isn't exposed



at the base of the gully at river level
(when observed from up above). Appears
that this dike does curve around and

follow the gully, but it appears to have pinched out.

Waited for helo to put us on the north side of the river. Gave up, started back up the slope next to the airstrip. Helo has flown over twice, no results!

D-81-165

Outcrop exposure on one of the benches going upslope. Approximately 10' high and 35' long. Weathered outcrop surface has the thinly laminated appearance. On breaking the rock, the laminae are barely visible in places on fresh surfaces. The rock is the reddish, dark gray fine grained argillite. Some visible quartz stringers, contorted. Hard, fresh, competent. Outcrop jointing is characterized by moderately close spacing.

No real bedding plane cleavage visible here.

Sampled, Flagged

Orientation of laminated bedding
81 62° SE

JOINTS:

80° 80° S irregular, rough
1' to >6'

* 55° 25° NW plane, rough
8" to 2'

ELEV. 1025' @ 31°

D-81-166

In a straight line upslope traverse outcrops which are in steps (steps seem to be along the ~55°, 25° NW set) are massive. Reddish medium to dark gray, fine grained argillite. Weathered surface shows laminated structure.

JOINTS:

Major 318° 83° NE curved, rough
1' to 3'

38° 62° SE plane, rough
1' to 2' at least; outcrop face

1075' @ 33°

Going upslope between these two stations, approx. 70% outcrop exposure.

Helo finally arrived, move to upper pad
4/5 of c/c on the right abutment

BH-1 1414' @ 4⁰⁶

Stump at the old helo pad
1529' @ 4¹⁴

STA 1245' @ 4⁵⁷ ^{flagged}

Just above river level ~ 7'
908' @ 5²³ at the 'X'
- will check feasibility of traverse

904' @ 5⁵³

Can work at least 100' each way,
observe the jointing etc. on the left
abutment. There is a great deal of
loose rocks here. Delineate locations
for potential unstable rock zones.
Begin ascent back-up return here
tomorrow or Monday. Prominent

WATANA 2215' @ 6⁵⁵

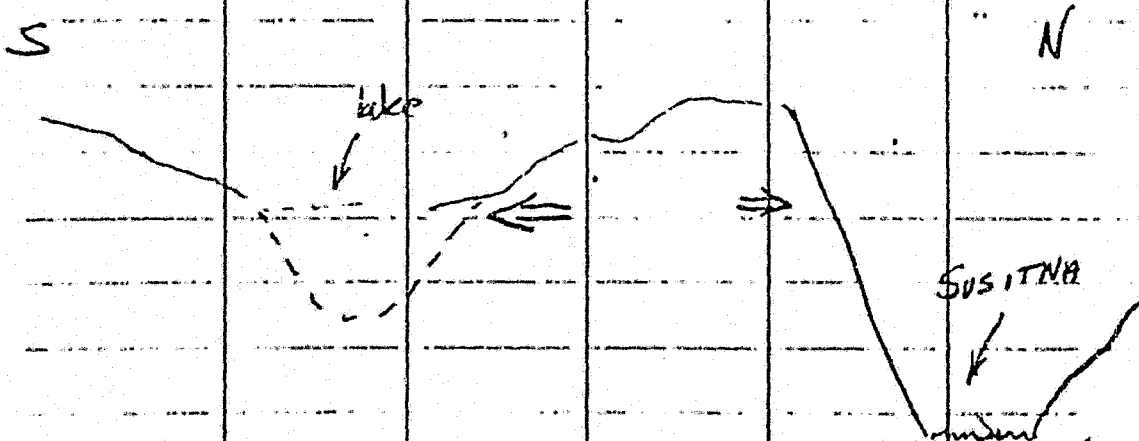
horizontal joint visible on both sides
~ 10'-20' above river level. Some
tightly jointed zones visible, don't
line up though (?).

HRS 12

6-5-81

It's really raining hard this morning. This morning will hold a review at Devil Canyon with Merritt, Wolofsky, Thompson and Swigh.

Late departure due to the weather and we had to wait for the 205. Flew down the Devil Canyon Reservoir. Landed at BH-2; discussed and pointed out the mafic dikes (shears), stress relief features. Stopped at panel on the left abutment, discussed the open joints - stress relief, bedding, loose block area & gully near the 'A' frame



L.W. mentioned that stress relief could have been in both directions (see sketch) as the buried valley is an old stream valley before it hooped over & began cutting in its present position.

A.M. - sketch in all major open joints, very important for visually for engineers.

L.W. - check layouts believe we need to map further to the south

SNT - important to have outcrops on the map.

landed on the air strip.

- suggested that if the hole under the river at BH-5 doesn't disclose any major structural weaknesses and with the dike exposures on the opposite sides of the river appear to line up, why not use the footage at BH-6 elsewhere. Also the river will be going up and down for the next two months, will have to wait on drilling it.

AH & L.W. - suggest putting the footage in the area of the stress relief joints

Flow through the canyon @ ~100' above the river, very slowly and going in both directions

Went to High Lake for a final discussion before departure. Comments are as follows:

- AM
- maps need to be drafted for Oct. meeting, x-sections with each hole showing RQD's, water pressure, etc.
 - data collection and interpretation are not keeping up, need more geotechnical people here (never)
 - all COE cores & last years' cores should be reviewed. RQD's, geology so that they may be used with confidence in design.

Comments on core by L.W.

- whether dikes have welded contact with country rock
- the several types of andesite; are they all andesite (?)
- weathered vs. altered. Mostly see altered rock as not sure that the changes are due to weathering.

- sketches based on the photo mosaics for the report, talk with Keith about doing this.

Flew to TKA and on to ANC.

HRS. 10.0

6-8-81

ARRIVED AT WATHANA @ 200. Will work in today. Wrote up Friday's comments, plotted data, & planned the remaining work at Devil Canyon.

Stopped in the office this morning, also ordered some climbing supplies.

Hrs 9.

6-9-81

Snow on the ground this morning, as the rain changed to snow last night around 9³⁰. It is presently overcast and cool. HEINZEN and I will proceed to Devil Canyon and work on the right abutement. Delayed this morning on account of weather.

Stump at the old helopad on north abutement 1530' @ 9¹⁰

H* Elev. 1225' @ 9²⁷

* see 5-22-81 Book #8, 88

H* - A	90'	192° (190°)
		37° down slope
		(41°)
A - B	42'	181°
		32° down slope
B - C	52'	202°
		50° down slope

C-D	85'	<u>186°</u> (194°) 37° downslope
D-E	100'	178° (188°) 36° downslope (43°)
E-F	100'	~176° (183°) 34° downslope (30°)
F-'X'	56'	~158° (157°) 27° downslope

'X' at river level — tagged (see joint
886' @ 10' ^{on horiz. surface}
[actual is 893']

Will set up a line parallel to the river which will go up and downstream from the 'X'. Outcrop exposure is continuous along river

distance from 'X' to upstream 245'

distance from 'X' to downstream 480'

D-61-167 (225'-245' w/s of 'X')

Thinly bedded, some cross-bedding, 260% very well defined. Intercalated argillite and phyllite. Hard, competent, blocky exposure

One of the subhorizontal joints are open to 2", all others are tight. Numerous scattered quartz stringers some parallel to and (next page →

JOINTS:

✓ 56° 55' SE, bedding plane
clear, plane smooth
aver 3', 3" to 4"

✓ 152° 82° NE, smooth, curved
2' to 3', aver 1.5'. Well defined

64° 12° NW, smooth, plane
aver 1', 4" to 2'
(probably subparallel to the horizon
at that prominent near etc)

@ 225'
approx 3' wide, a closely
jointed zone

→ Closely jointed zone:

1) 166° - 135° 75° NE curved
(160°, 155°) plane, aver 4"

2) 31° 29° NW } plane, smooth
64° 12° NW } subhorizontal
joints within 1' to 3'

mostly
cross cutting the bedding. Closely jointed zone is evident on the left abutment at river level, they appear to line up exactly, orientation 147° . Our base line ends just $4/5$ of the chute with possible shear $81-147, 148$.

Horizontal joints on left abutment are prominent opposite here, horizontal to gently dipping to the southwest. Also the northwest set is prominent.

@ 200' ($1/5$ of 'X')

JOINTS - all major

70° 23° NW plane, smooth
aver 2', 4" to 3'

59° 60° SE plane, smooth to rough, bedding plane

163° 86° NE plane, smooth
aver 2', 6" to 4'

D-81-168' (@ $80-125'$ $1/5$ of the 'X')
lots of loose blocks on the horizontal set, up to $> 10'$ in diameter. Blocks

appear to have become detached/slide along the subhorizontal and the bedding plane cleavage

JOINTS:

$\sqrt{74^\circ}$ 19° S plane, smooth to rippled
2.5 to 5'

Charcoal gray fine grained argillite

@ 65' ($1/5$ of 'X')

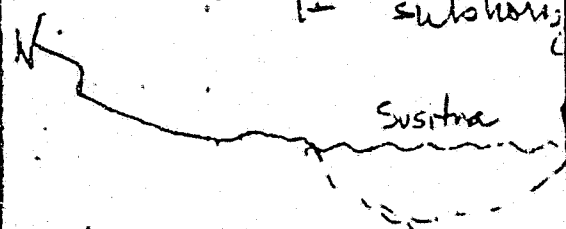
Very close to closely jointed zone

$165^\circ \pm 5^\circ$ smooth curved joints

aver. 3", 1" to 6", Approx 6' wide

- localized fracture zone, spacing 1 to 2' $\rightarrow$ widens out somewhat on left abutment

Open joints seen on left abutment
1- subhorizontal $\approx 100'$ in length
5



3- northwest trending $\approx 6''$ opening
extend minimum of 15' up slope

0' (X') to 120' ; 1/2 of the 'X'
numerous blocks ; slope is
talus now covered by veg.

D-81-169 (480' d/s of 'X')

At the 1/2 end of the bedding plane
slab. Weathered surface of outcrop is
a dark gray & earthy red brown color. Rock
is the slightly reddish, dark gray, fine
grained argillite. Thinly bedded, laminated
intercalated argillite & phyllitic argillite.

JOINTS:

✓ * 71° 65° SE plane, smooth
over 1' est. 1" to 2' ; possible
detached blocks along - 12'
wide

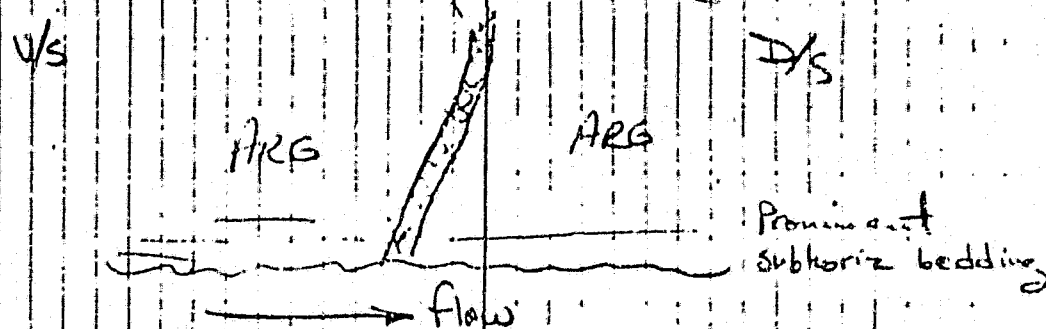
✓ * { 159° 84° SW plane, smooth,
152° 86° SW over ≥ 2'
151° 62° NE, locally tightly
fractured, plane, smooth

✓ * 53° 8° SE irregular, smooth to
rough 1' to 3'

Prominent bedding plane cleavage. Some
quartz stringers. Rock is hard, fresh,

competent, blocky.

@ 495' dike is exposed on left
abutment, river level to ~ 50'
above, max 3' wide. Irregular.
dip & strike. Tightly fractured



D-81-170 (430' d/s of 'X')

Narrow chute, which trends up slope
Main dike exposed in the chute approx
15' above the river estimates 2' wide, but
may be up to 3' wide. Trend with
dike on opposite side is 168°. This is
a dark gray fine grained stannic material
has the characteristic earthy reddish
brown color. Highly fractured
Argillite is exposed on both sides of
the chute, large amount of Fe staining,
on rock - hard, competent. Dike is
(over)

JOINTS:

✓ 165° 78° NE : plane, smooth
 approx contact of the dikes
 68° 55° SE, bedding plane
 cleavage, plane, smooth
 locally = 1", but generally several
 feet
 an incompetent zone. Sampled.

@ 360'-370' local NW trending tightly
 fractured zone through
 going joints are close to moderately
 close: spacing

D-81-171 (4/5 @ 340' from 'X')

Dark gray to charcoal gray, fine
 grained phyllitic argillite

JOINTS

✓ → 169° 81° NE ave 3' plane, smooth
 locally down to 1" fracturing
 Major
 ✓ { 184° 18° W. plane, smooth
 ✓ { 64° 5° NW 1' to 4'

Tightly Fractured Zone ~ 320' (~ 3' wide)

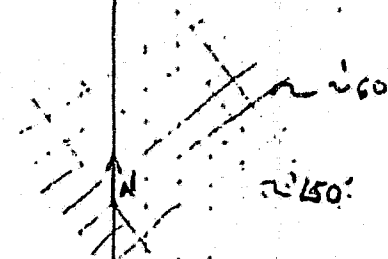
338/83 NE } Plane, Smooth (1"-8" AVE 4")

348/80 "

Trend of notch 20° (Produced by intersection of
 bedding plane & NW joint set?)

49/79 SE Bedding } Curved smooth (1"-2" local, → 6")

52/71 SE "



in the argillite.

@ 200'

massive quartz veins 1" to 1"
 pinch and swell

'X' 872' @ 143

Old hole site
 1494'

254

Started traversing near the mouth of the
canyon on the right abutment between
BH-2 and BH-5A.

BH-2 1251' @ 345
reset 1215'

BH-2 to A 60' 4°
7° up slope

D-81-172 (A)

Outcrop ~ 30' long and 15'
high, domed shape, Dark gray
fine grained, some white, phyllitic
1229' @ 342 base of
outcrop

av. lite. Hard, base is slightly weathered

Joints:

166°	82° NE plane, smooth, 3" to 2'
149°	68° NE. subvertical to 166°
66°	66° SE approx. to bedding plane cleavage; curved smooth to rough 6' to 3'-est. aver. 2'
60°	35° NW plane, rough 6' to 3', aver. 2'; discontinuous
115°	5° N NE plane, irregular, 6" to 3', discontinuous

BH-2 - B

125'

383°

19° up slope

D-81-173

Outcrop of the charcoal gray, fine
fine grained phyllite, 12' to 15'
high, and 35' long, across the slope.

Joints:

82°	15° S, plane, smooth aver. 1.5', 3' to 2'; discontinuous
76°	rest rough, irregular 2' spacing
20°	rest 2" to 1" aver. plane, smooth to rough, discontinuous

Actually off 1/2 on 70' 70+'

A-C

105'

57°

6° down

C-D

100'

16°

22° down

D-E

100'

76°

long

E-F 50' 134° (137°)
13° upslope

D-81-174 (F)

Series of loose blocks on the side of the topographic high. Trend of the gap (open joints ???) between these blocks is 166°. In situ bedrock should be close to the surface. At the d/s edge of this zone, extends 50' upstream.

✓ F-G 75' 167°
21° downslope
at G rock exposed 3' high and 30' across slope
87° 147°

G-H 80' 32° downslope
222° (220°)
horiz

D-81-175 (H)

Outcrop ~ 75' and 6' to 10' high and trends 162°, surveyed to mid-point of upslope/downslope direction

Medium to dark gray, fine grained argillite

JOINTS:

162° vert. plane, smooth

1' to 4' aver. 2'

locally 1" in a 1' zone

cliff face

✓ 125° 56° NE plane, smooth to rough

locally aver. 3", 1" to 2.5'

{ 80° 65° SE open to 1"

plane, irregular, rough

✓ { 70° 63° SE not well devel. 1"

bedding plane cleavage (?)

Elev.

1124' @ 4.58

H-I 100' 135°
25° downslope

I-J 50' 145°
horiz

top of outcrop
107.5' @ 5.07

D-81-176 (J)

Outcrop ~ 75' high, bands approx
along the bedding plane cleavage
approx 8.5' across, Dark gray,
fine grained argillite. Hard, slightly
Elev. same 1049' @ 5°
weathered face, competent.

JOINTS:

66° 67° SE plane, rough
3" to 8" across, 5'

165° 154° 34° NE plane-curved,
smooth to rough
ave. 2'

✓ 75° 21° N plane, smooth
1" to 2' across, 1'

I-K 100' 145°
elev. 1045' @ 5°

K-L 100' 110°
18° down slope

K-K' 35' 110°

D-81-177 (K')

Outcrop ~ 10' high and 50'
long, across slope. Argillite.

JOINTS

165° 15° west to 80° NE 2" to 1"
curved, smooth to rough
40 12° W 6" to 3', irregular
rough
71° 75° SE outcrop face

D-81-178 (L)

Argillite, hard, competent.
Outcrop is stepped, 20' high, greater
than 80' long, along the 169° trend.
Adjacent to BH-5A

✓ 67° 66° SE plane, smooth
bedding plane cleavage, 3"
opening → stress relief
towards river, another
is open 6"

✓ 109° 86° NE large, smooth to rough, cliff face

21° 24° W discontinuous

area 2'

✓ 67° 15° SE irregular, smooth 3+ blocks separating along the bedding plane will come out; fall along this joint set.

Open joint that is 6" wide can be traced for 50' parallel to the river, stress relief towards the river

L - BH-5A 58'

37°

~~19°~~

19° down slope

BH-5A

991' @ 543'

developed

NW

drill site

SE

SUSITNA

Stress relief here is to the southeast. Reviewed core which was at a depth of approx. 240'. Too far like core is too good, lost then with near 150' (45" hole). Did not observe this core higher up as the boxes are ready for shipping.

PLOTTED 6-18-81

TOD - Got a few good stations down on the river d/s of c/c. Subhorizontal joints are so prominent just above river level. Assume that they exist higher up in the canyon walls, just that vegetation covers and weathered rock doesn't allow one to see it. Found more of the dike material which lines up with an irregular trending dike exposure at river level, therefore further evidence against any possible fault in the river channel. Stress relief joints are evident adjacent to BH-5A (d/s side). These may correlate with those (?) observed (?) in the drilling, i.e. dropping of rods.

HRS. 13

6-10-81

It's a beautiful, clear sunny morning.
HEINZEN & I will go to DEVIL CANYON.
I'll work this morning & then fly to
ANC, Jim will canyon.

Recon. of south side of river looking
for scattered outcrops

R&H 60A 1417' @ 740

60A - A	61'	195° 7° downslope
A - B	100'	247° horiz
B - C	100'	232° horiz
C - D	100'	275° (280°) 7° downslope
D - E	100'	215° (224°) 10° downslope
E - F	100'	196° 14° downslope
F - G	100'	156° (159°) 11° downslope

G - H	85'	202° (209°)
H - I	100'	210° (212°) 5° upslope
I - J	100'	202° (205°) 17° upslope
J - K	100'	142° (147°) 10° upslope
K - L	67'	178° (185°) 13° upslope

D-81-179 (L)

Outcrop - 12' high and 35' long.
Reddish, dark gray fine grained argillite.
Elev. 1428' @ 82° base of outcrop
Weathered face has that thinly laminated
appearance. Trend of face 58° 72° NW

84°	50° S	bedding plane
74°	60° SE	cleavage plane
		smooth to rough (AVE 2'±)
322°	45° NE	Plan/south (6-5' AVE N/A)
350°	73° NE	

- Rk is hard slightly weathered competent

L-M

75'

105° (108°)

14° upslope

D-81-180 (M)

Outcrop beginning on cliff again
outcrop which trends 51°. Weathered
appearance has the laminated bedding.
Elev. 1462' @ 84' base of outcrop

Blocky outcrop of argillite.

Outcrop is 60' long and 10' high.

JOINTS:

Major 165° 80° NE plane, smooth
1" to 1' on fractures, no
through going joints

Major 77° 61° SE bedding plane
cleavage plane, smooth to
rough, 1' to 3"; aver. 2"

74° 52° SE

some open to 2" bedding
overhangs towards lake,
probably undercut

U-M

67'

210° (205°)

18° upslope

N - eastward at 90°

outcrop at 84180 extends for ~170'
off and on again, & 20' in
elevation.

N-D

100'

145°

10° upslope

D-P

100'

172°

horiz.

P-Q

105'

horiz.

185° (190°)

Q-R

100'

188° (189°)

7° upslope

R-S

100'

151° 10° up

S-T

100'

151° 5° up

T-U

130'

142° 5° up

station U - sighting on BH #1 (upper 34) - 185° → O.C.
D 81-181 (U.H) O.C ~ 70' LONG ON 66° TREND 150' off
RK is very hard, competent, lt. gray GRAYWKG. 200' off and on

Prominent bedding cleavage - very planar & continuous

- B.P. cleavage - 72/64 SE Planar smooth Open → 3"
& FORMS DETACHED SLABS → 8' HIGH. (2'-6', AVE 3')

- RK IS SILICIFIED ON BED. FRANK & THROUGHOUT.

- 155°-5° 80-VERT (NE) - smooth curved, sub H,
(2'-2' AVE 6°) continuous.

Hardly fractured Bedding.
CONT ↓

Elev 1405 @ 10:40

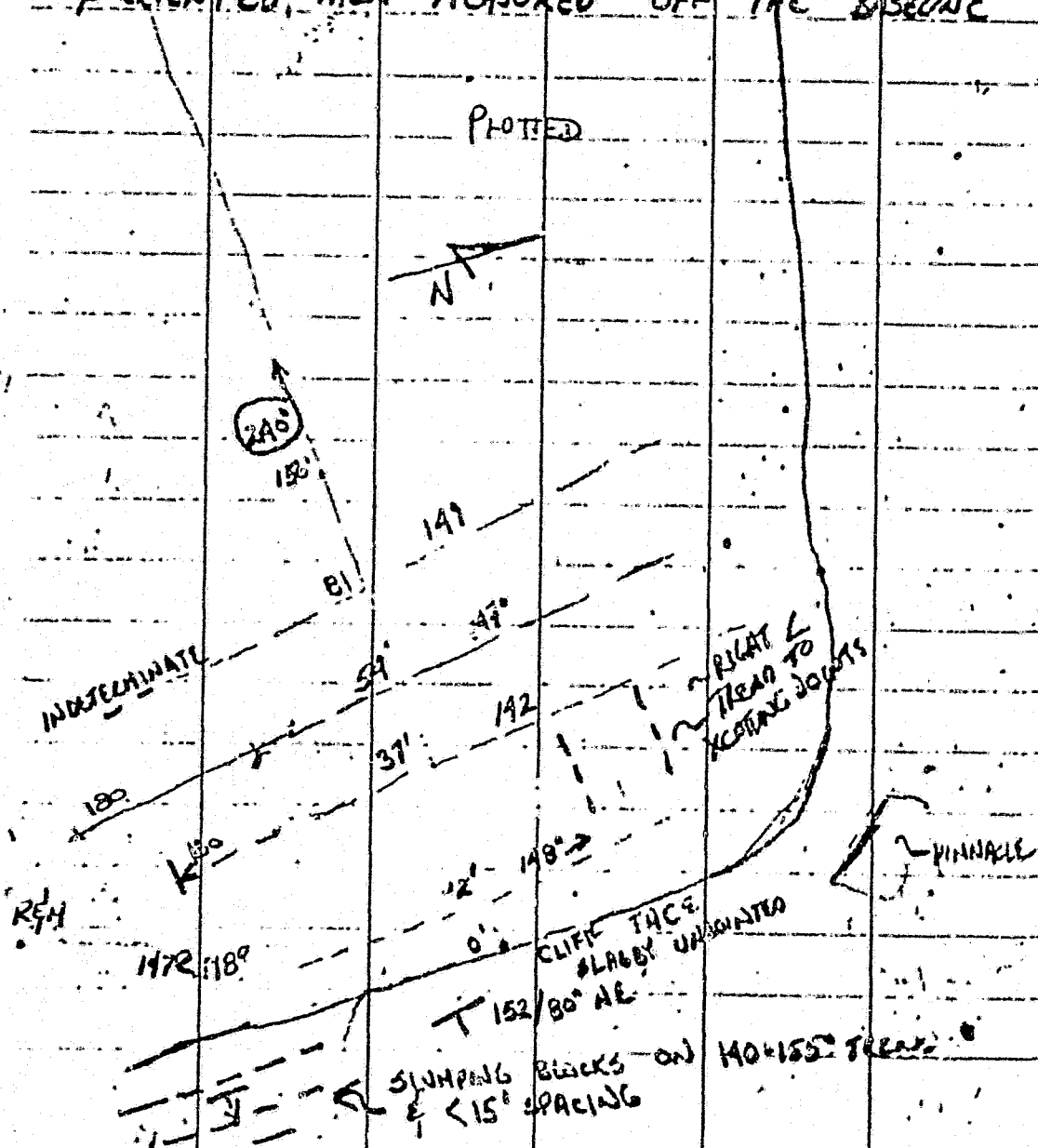
CONT. O.C. IS ~ 20' HIGH - LOCATED ON PHOTO -
IS THIS LABELLED B-14 (K&C)?

PLOTTED 6-12-81

OPEN JOINTING @ E - 1 ATTEMPT TO SET
UP BASELINE & PROMINENT CLIFF FACE

REM SURVEY → START BASELINE 147' @ 18° ^{NO SLOPE}

ALL THE PROMINENT LINEATIONS WERE FLAGGED
& ORIENTED, THEN MEASURED OFF THE BASELINE



NO HELIOS IN AREA @ 9:00. WOULD LIKE
TO RETURN TO WATANA & PLOT TRAVERSES. 5 PM. ^{SUCCESSOR}
Total for 11

6-12-31.

It's mostly sunny and warm.
 J. Heinzen worked on plotting up
 Devil Canyon data. Will proceed
 to Devil Canyon and try to tie
 any scattered outcrops south of the
 lake on the south abutment.

Set altimeter 1605' @ 145
 at 81-181

81-181 = A

A-B	58'		232°
		15° upslope	
B-C	100'	horiz	255° (254°)
C-D	100'		244° (242°)
		3° upslope	
D-E	100'		235° (236°)
		3° upslope	
E-F	55'		215° (219°)
		horiz	

P-81-182 (F)

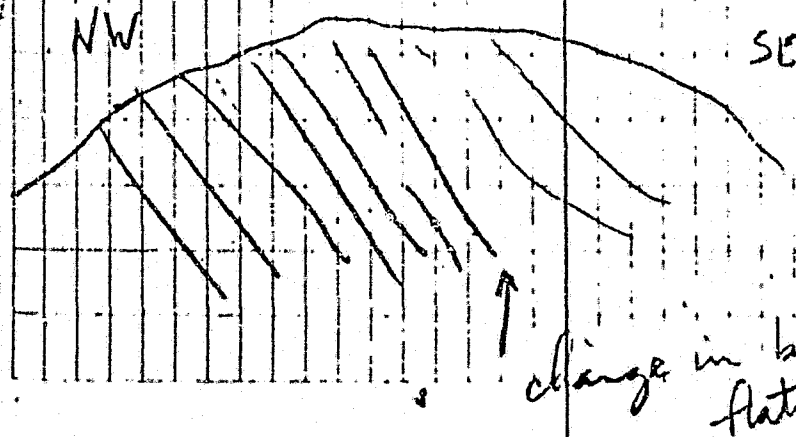
Trench of outcrop is 152'. Surveyed
 to top of the outcrop. Outcrop is 55'
 long and 10' high. Bedding plane
 cleavage is prominent. Dark gray, very fine
 grained phyllitic argillite. Weathering
 on outcrop face is a little deeper. Fine
 weathering along laminated bedding
 surfaces. Moderately competent.

JOINTS:

Major 80° 67° SE bedding plane cleavage
 plane, smooth. 1" to 6" over 4'
 some are open.

165° 82° E cliff face, plane,
 smooth to semi-smooth, est. 6" to 24"

Minor 22° 86° NW plane, smooth
 6" to 3.5'



F-G	100'		222° (224°)
			5° upslope
G-H	100'		179° (181°)
			8° upslope
H-I	100'	long	217° (218°)
I-J	100'	3° d/s	216° (207°)
J-K	100'	4° d/s	245° (247°)
K-L	100'	7° d/s	240° (242°)
L-M	100'		207°
			5° upslope
M-N	100'		210° (211°)
			20° upslope
N-O	100'		204°
			10° upslope
O-P	100'	long	220°
P-Q	100'		241°
			8° downslope
Q-R	100'		258°
			2°
R-S	100'	long	232°
S-T	100'	"	235°
T-U	100'		23°
U-V	200'		227°
V-W	300'		166°
W-X	100'		174°

X-Y	100'		139°
Y-Z	100'		5° upslope
			141°
			3° upslope
Z-AA	100'		122°
			10° upslope
AA-BB	100'		124°
			15° upslope
BB-CC	100'		149°
			5° upslope
CC-DD	100'		172°
			10° upslope
DD-EE	100'		214°
			197°
EE-FF	78'		10° upslope

J-81-82 (FF)

Outcrop is ~ 15' high and 85' long, found on a W-NW slope. trend of the outcrop is ~ 200. Rock is a medium gray fine grained sandy siltite or graywacke. Small sand grains are 1-2 mm and are

Plotted
6-18-81

elongated. Surveyed to NE end of outcrop. Rock is hard, competent.

ELEV. 1834' @ 4°

JOINTS:

Hjm
101° 55°S bedding plane cleavage plane, rough, 2" to 1.5'; ave 1"
168° 71° NE plane, smooth 4" to 1.5', ave 1"
101° vert, quartz filled, irregular occurrence, plane rough
124° 54° NE ~~vertical~~ bedding plane, rough 3" to 2', ave 1.5'

Weather station

ELEV. 1518' @ 4°35'

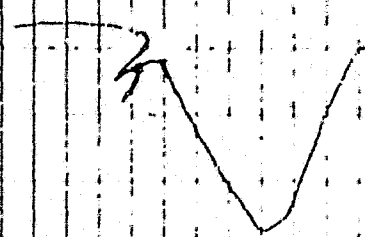
Walked to the drainage visited during the winter program, dyolitic dike, moose remains

D-81-183 (D; 12 80.)

Outcrop is ~ 10' high and 50' long. On the west side of the drainage

trend O.C. 157/10 NE. O.C. IS MASSIVE & COMPETENT. SINGLE JOINT N50/10 NE TREND SEPARATES SINGLE 10'x10'x3' BLOCK. NO BED PLANE VISIBLE ELEV. 1372 @ 4° SOME LAMINATION OF BEDDING ON WEATHERED SURFACE. Reddish dark grey, fine grained ALG/LITE
1° 76/59° SE Bed Plane? cleavage IRREG ROUGH (6"-4", AVE 3")
✓ ~ 6°/16° W ROUGH IRREG CONTINUOUS
✓ * 161/80 NE CURVED ROUGH (AVE 1')

D-81-184 (A)
← Su



Map View

Nearly continuous outcrop exposure from here around to the nose. Massive quartz, vein estimated 6'-7' wide. Some phyllitic schistose fragments within the highly fractured quartz. Not certain of its dimensions and extent
ELEV. 1348 @ 5°20'

away from the outcrop face. Trend of possible veins is 35° 71° SE. irregular sharp contact. Contact metamorphism of argillite/ph. slate to a schistose rock; sampled! Adjacent rock is phyllitic argillite; dark gray, very fine grained foliated rock, sampled.

Notes:

✓ 32° 87° SE curved, irregular, rough, fractures

✓ 51° 66° SE curved - irregular 1° to 6° , over 4° , bedding plane cleavage

Moderately competent to competent rock, hard. Weathered outcrop face exhibits the laminated structure in places.

Plotted 6-13-81

A-B	100'	171° horiz
	ELEV. 1260'	
B-C	100'	159° (339°)
		12° downslope
C-D	100'	132°
		10° upslope

D-E $\sim 300'$ (276°) horiz to spruce tree on ups side of drainage. Return to this location tomorrow and continue working ups.

WATANA 2284' @ 6³⁰

TOD - Picked up the two outcrops observed from the air, south of the river - no other outcrops have been observed from the air. Vegetation is out now but believe, one still wouldn't see any. If out in September when vegetation is out, check this area. Started traverse S/S of ch on the left abutment working back towards 'A' frame, continue tomorrow

HRS. 12

6-13-81

It's a beautiful clear sunny morning Heinzen. I am off to Devil Canyon but first I have to locate the arroyo holes at Borrow H for the luncheon. At Devil Canyon on left abutment, downstream. Continue from yesterday. Clouds on peak of McKinley till 10⁰⁰, great day to reach summit. Photo: 1-3-4
 R.M. 60A 1417' @ 8¹⁰

LEFT ABUTMENT:

Yesterday's 'E' at the end of the day begin with 'A' today

A = large spruce

1408' @ 8²⁰

A back to yesterday's 241'

7° down slope

A-B 55'

256°

B-C

75'

24° (21°)

30° down slope

D-61-150V (C)

Large outcrop 20' (d/s end) to 90' high, approximately $\geq 170'$ long. rock consists of the dark to clear gray, very fine grained phyllitic argillite. Sand, fresh, competent. Some white quartz discontinuous quartz stringers, cross cut bedding. A great deal of small faulting trending NW. Friend's outcrop is 45' EHEV. 1372' @ 9¹⁵ mid pt. elev.

Joints:

✓ 66° 57° SE bedding plane

leaving est. 4'

✓ 83° 58° SE curved, smooth

Major $\rightarrow 147^\circ - 157^\circ$ 85° NE plane, smooth, 1" to 1'

fractures and through going joints

138° 15° NE plane - irregular,

rough

Joint $\rightarrow 141^\circ$ 77° NE plane, smooth

2" to 2' fractures; joints some quartz fillings

Joint $\rightarrow$ 141°
 main joint
 further
 + d/s

- one is open at level but
 top is still 10' below horizon
 highly fractured, joints 8" to 1' wide
 71° 45° SE, within 10' of level but
 16' 15" W plane - irregular, rough
 6" to 6'

60° 53° SE plane, smooth to
 rough bedding plane cleavage
 Bedding plane cleavage is not well
 defined through here.

A-D 115' 241°
 est. 11° downslope

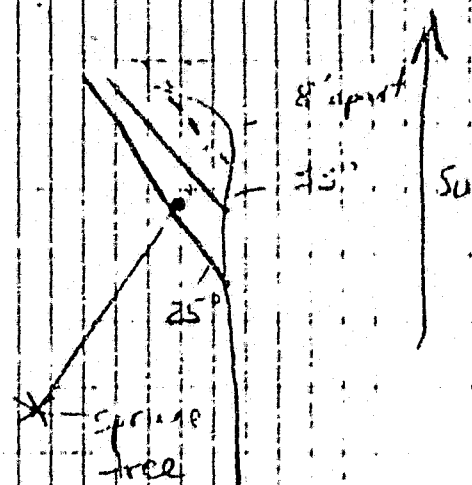
D-81-125 / 53° 71° SE open joints 16"-10"
 wide

- two parallel, 8' apart
- joints approximate the bedding plane cleavage
- minimum distance is 65' before both daylight on outcrop face to the W side
- can't trace down the cliff face.

LEV. 1385' @ 9³⁷

drainage →

Nip
 View



A-E 1417' 100'

9⁴³

237°
 8° upslope

D-81-186 (E)

Bedding plane cleavage produces
 overhanging cliff top

JOINTS

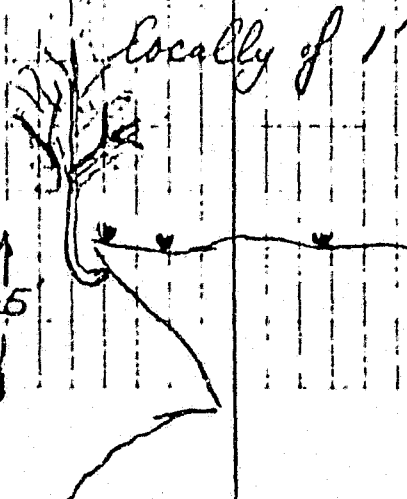
66° 77° SE plane, smooth both
 56° 74° SE 1" to 3", over

locally of 1'

NW

SE

25'



159° 82° NE plane, smooth
2" to 1', aver 4"
13° 17° W 4" - 1' aver. 8"

E-F 100' horiz 268° (266°)
60' from F joint 157°
could be an open joint, don't
think so no surface expression

F-G 100' (255°) 257°
cliffs not overhanging from
bedding plane cleavage

G-H 53' 211°

D-81-187 (H)

Outcrop exposure has been virtually
continuous along the crest. Dark gray
fine grained argillite. Hard, fresh to

ELEV 1448' 102°

slightly weathered, competent. A few
quartz stringers

JOINTS:

Major { 82° 34° S plane, smooth
77° 36°
20° 83° NW.
1" - 1.5', aver. 6"

20° 83° NW plane, smooth
✓ 126° 70° NE plane, smooth
4" to 1.5' aver 8"

Major ✓ 347° 77° SW plane, semi-smooth
1" to 1.5', aver. 1'

H-I 100' horiz 267°

I-J 100' 3° downslope 240°

J-K 50' 11° downslope 221°

D-81-188 (K)

Rock breaks along bedding into slabs.
Jim is over ridge crest on a rope. Slightly

ELEV Top 1425' @ 105°

JOINTS:

76° 64° SE
✓ 66° 64° SE curved, smooth,
bedding plane cleavage 3" to 3'
aver. 2"

✓ 35° 70° SE plane, semi-smooth
2" to 1' aver. 8"

Major 342° 82° SW plane, smooth
1" to 1' aver. 8"

Major 63° 68° plane irregular, smooth
bedding plane

overhanging along bedding. Rock is
the dark gray are illite, slightly
phyllitic. No open joints or mafic dikes
observed. Hard, competent.

This station was flagged previously

K-L 11' 14° upslope 224°

L-M 100' 10° upslope 225° (228°)

Open joint parallel to cliff face

52° ~ vert

and L-M faced traverse

- exposed minimum of 20'; 4"-6" wide
~ 45'-50', @ 280° from M

- other joints here: - from cliff face
130° 64° NE plane, smooth

55° vert

at USBR marker - Walt

D-81-189 (M)

Thinly laminated bedding, clean &
* dark muds, come back for photo, Hard
competent, blocky

✓ 26° vert. bedding

Joint

✓ 204° 70° NE

M-N

100'

horiz

206°

starts between these
- several short linear trends in
this blocky area. Possible
jointed faces, steps in the bedrock.

Also some may be open joints,
difficult to determine w/ remaining turf.
Their trends are 5°, 60°, 320°, 310°.

* major

N-O

100'

horiz

227° (229°)

O-P

125°

5°

downslope (340°)

D-81-190 (P)

Low steeply sloping area, towards the
river, along the crest. This is found

on the portion of the ridge crest that
juts out. Dark gray fine grained
argillite, Hard, slightly weathered, competent.
Outcrop is 15' high, 40' long. Tuff
above where it drops

ELEV. 1475' @ 1235

JOINTS:

Major $\sqrt{45^\circ}$ 67° SE bedding plane
cleavage, curved, semi-smooth
1" to 2'; aver. ext. 6"

Major $\sqrt{312^\circ}$ 75° NE plane, smooth
1" - 4"

Is this a block that's slumping/
rotated?

100' upstream of last station

30° 72° SE

40° 71° SE

313° 75° NE plane, smooth

open joint

3 S° 81° NE open 4" - 5"

- can trace back from
cliff face 40' minimum

O-Q	100'	horiz	283° (277°)
Q-R	100'	horiz	266° (262°)
R-S	100'	"	278° (271°)
S-T	100'	"	285°
T-U	100'	"	273°
U-V	100'	5° clockwise	258° (266°)
V-W	100'		208° (218°)
W-X	100'		251°
X-Y	40'		242°

panel at edge of canyon

Potted 6-13-81

R&M 60A

1485' @ 112

reset 1417 @ 120

START NEW TRAVERSE

D-31-191 (A)

Large outcrop of the reddish medium
gray fine grained argillite. Hard
competent, slightly weathered.

ELEV. 1204 @ 135

Outcrop is ~ 70' long and 15'-20' high. No prominent bedding plane cleavages. Trend of outcrop is 145° .

JOINTS:

Major / 63° 35° NW plane, smooth to rough
4" to 2' area, 1'

Major / 146° 86° NE plane, rough
6" to 2'; area, 1'

secondary / 81° 65° S plane, smooth
2" to 2', area 15' to 2'

Will survey this in to auger hole on air strip

A-B	75'	22° downslope	255° (252°)
B-C	80'	39° "	237° (241°)
C-D	85'	horiz.	226°

(D) 81-165, 81-166 is just above

D-E	100'	22° downslope	226° (221°)
-----	------	----------------------	-----------------------------

E-F	90'	9° up slope	210°
-----	-----	--------------------	-------------

F-G	100'	horiz.	22°
-----	------	--------	------------

G-H	35'	"	246°
-----	-----	---	-------------

H = AH-G1

AH-G1

PLOTTED 6-18-81

1085' @ 2° [actual = 983']

RIGHT ABUTEMENT:

Moved to right abutement will work upstream of BH-SA along the river

BH-SA - B 100' - 20°

Decided to use the foot bridge, estimate the distance upstream and downstream along the river

D-E1-192

Extending from the canyon around under the foot bridge and beyond, outcrop exposure is continuous. Rock is the reddish dark gray, fine grained argillite. Blocky hard, competent. STA is 50'-100' $\frac{4}{5}$ of foot bridge on river. Quartz stringers some contorted which parallel & crosscut bedding. Some layers of more quartzitic material.

JOINTS:

67° 74° SE bedding plane
cleavage; plane, smooth

Major

4" to 2', aver 1'
 { 147° 67° SW plane, smooth
 165° 85° SW ~ 3" to 2'
 139° 76° NE locally aver 6"
 166° vert.

tightly jointed zone seems to
 be subparallel to the river here.

Secondary

{ 112° 55° N plane, smooth
 discontinuous 3" to 1'
 aver 8"
 ↓ 136° 57° NE plane, smooth
 aver 1.5'

Tightly jointed zone, close to veg
 329° vert plane, smooth
 337° vert " "
 closely jointed, trend is ~ 345°
 Ranges from 7' - 10' wide
 Joints are tight

— under foot bridge

Major { 115° 51° NE plane, smooth
 168° vert plane, smooth
 1" to 1.5' aver 1'
 158° 80° NE plane, smooth
 64° 7° SE } prominent irregular
 59° 20° SE }

smooth horiz joint Est. s' d
 A

- A quartz stringer is offset along a tight
 NE (60°) joint offset = 1".
 Sampled

foot bridge to outcrop u/s on river

10° must be off!

D-81-193

Back site to bridge 180° Approx
 300' to 350' from bridge at river level.
 Medium to dark gray, very fine grained to
 fine grained rock. Argillite varies to a
 graywacke? — fine grained sandstone, Blocky
 hard, competent, fresh.
 STA is 260' from foot bridge.

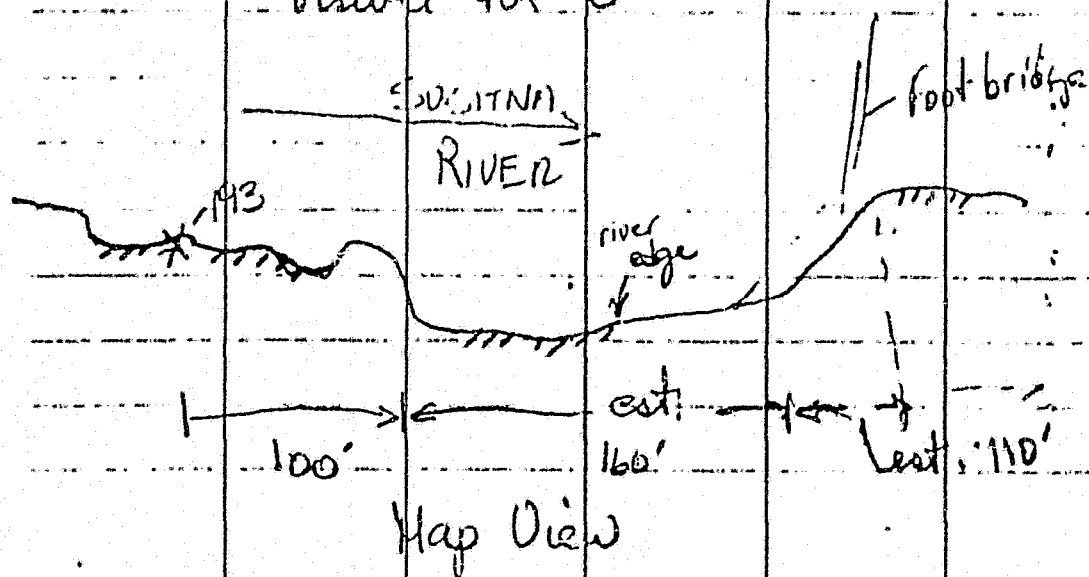
JOINTS:

Major { 162° 74° NE curved smooth
 170° vert 3" to 1.5'
 59° 65° SE aver 6", some part open
 bedding plane

clearance
 58° 72° SE plane, smooth
 6" to several feet
 349° 6° W }
 23° 3° NW } plane, smooth
 308° 16° SW } prominent
 subhorizontal joints

$\approx$ 0-150' rock exposure
 150' - 260' talus rubble bench
 260' - 360' outcrop ($> 360'$)

@ 280'
 Pinched out crushed rock zone:
 up to 6" wide - trends 175°
 visible for 6'



Some graywacke, sandy argillite is
 intercalated with

D-81-194 @ 190' from foot bridge
 Outcrop exposure due to mass wasting.
 Have the medium gray fine grained
 argillite. Rock is hard. Moderately
 to highly jointed outcrop. Fe stained.

JOINTS:
 445° $60'$ up
 69° SE plane, smooth
 $4"$ to $1.5'$ aver $8"$
 147° vert. curved, smooth
 $4"$ to $2'$ aver. $1'$
 38° 85° SE
 159° 25° NE irregular, smooth
 $3"$ to $1.5'$ aver $1'$
 -several joints are open

Found a gray, highly siliceous
 igneous material, dike, which cross
 into thin poor exposure in 60'
 above the river. Sampled. It is
 highly jointed, close to very closely
 jointed. Sharp contact. Possible
 orange brown gouge along the contact

Difficult to ascertain if it is ^{due to} soil processes as clay zone. Dangerous outcrop to get around on. Estimate dike to be 2'-3' wide, curved boundary. Orientation

✓ 325° 62° SW

Appears to arc upslope right in the chute. Dike is generally fine to medium grained (?) with quartz eyes. Felsic (?) Strike ~ 30° d/s along trace

307° 62° SW

Outcrop is approx 190' from the foot bridge upstream

Don't see any exposure of the dike along the river or higher up on the slope when working our way back to BH-5A, may pinch out

Looked at the core at BH-5A; presently down to 545'. Saw a shear zone at ~292' - 298' - characterized by reworked fractures, trace of clay, highly fractured. Only ~5.5' wide horizontally. Hole should end 60' to 70' into the left abutment

Top - Saw a few open joints, overhanging cliff areas due to bedding plane cleavage. No mafic dike was observed in the upper section of the canyon wall at 81-188. Too dangerous to ascend down due to loose blocks. Saw a narrow mafic dike exposed at river level approx beneath this location. A felsic dike was observed upstream of the foot bridge, its narrow and we were unable to trace it back to the dam site. It is feasible that it pinches out. It is of a different composition and width than the one observed just upstream during the winter mapping. A tightly jointed zone subparallel to the river is exposed at river level beneath the foot bridge.

Field Hrs 11.5

Office Hrs 2.0

PLOTTED 6-18-81

6-14-81

It's another clear, beautiful sunny day. HEINZEN & I are working at Watana, on the left abutment in the 'Fingerbuster' area.

PHOTO: 1-4-5

WATANA 2260' @ 7¹⁴

Will ascend up the 'Y' shaped chute.
ELEVATION @ base 1456' @ 7⁰⁰

W-81-65

1560' @ 8⁰²

W-81-310

Ascended up d/s side of 'Y' shaped chute. Continuous outcrop on both sides and in the chute higher up.
Elev. 1645' @ 8⁴⁵

At this location there is a minor split in the white with 4" wide zone of a tan to brown clay gouge. The rock on either side is not highly jointed as in most places. Just a gouge zone along a joint. Orientation 342° 67° E. The rock on both sides is the green-gray, fine to medium grained chlorite. Epidote is chief mafic mineral. Rock is hard to very hard, fresh, competent. Outcrop is characterized by moderate close joint spacing. Outcrop is Fe & CO₃ stained.

JOINTS:

Major { 173° 85° E plane irregular,
179° 75° E semi-smooth, 2" to 3'
aver. 1' to 1.5'

Major { 89° 70° N plane, rough
79° 76° N aver. 2"
78° 68° N 4" to 5" to 10" thick (5'?)

Major { 34° 41° NW plane irregular
rough; aver. 1.5'; 8" to 3"
29° 36° NW

A few discontinuous gray, fine to medium grained highly siliceous aplitic

dike, sampled.
1.5' wide

Dikes are 6" to

136° 54° NE plane, semi-smooth
dike trend. Two that
are parallel 1' to 1.5' wide
Not exposed on opposite face

Ascended up the ups fork of this 'Y'
shaped chute. The going is somewhat
treacherous.

W-81-311

Shear zone exposed at the top of the
chute. Have an orange-tan sandy clay
gouge zone, contains rock fragments. Rock
fragments are deteriorating due to weathering.

ELEV. 1706' @ 10²⁵

Rock outcrops on either side are highly
weathered and fractured, rotten. Gouge
zone is approx. 3' wide and trends
145°. Rock is Fe & Co₂ stained,

appears to be a gray medium grained
highly siliceous rock. This might be
just near the shear - yes; shorter

Clay gouge further down in chute 2.0' wide, nonplasticity
@ 100' @ 110' horiz. still in
DET

Trend of gouge 2.0' NE 145/75 NE

145/87° SW Smaller than w/ deteriorated weathering
but no gouge

{ 2/68°E PLANAR SMOOTH (2'-2', AVE. G') CONTINUOUS
* { 123/15° NE PLANAR SEMI SMOOTH (4'-4.5' FEET, AVE G'
{ 110/76° NE PLANAR ROUGH (6-18', AVE 12")

Shear (lightly fractured) zone discontinuous → 15'

Main gully shear/gouge zone appear curved

W-81-312

Miles elevations from (above) shear notch to
station in narrow steep chute, 80' from 211,
Joints

110/77° NE (3" CLAY GOUGE ZONE, ORANGE TAN COLOR)
(NON PLASTIC)

86/74° N Trend of chute CURVED. GULLY - 4' WIDE
Rt on RIVER SIDE - CLOSELY JOINTED. HARD → ROTTEN
102/87° N Probable small shear. No CLAY - 3' ^{SANDY} BESSON

In ascending up this chute, found
that a shear zone is the cause of this
gully, with several small shears which

crosscut. No andesite found.

River level.

1495' @ 11²².

Tried traversing to other chutes just $\frac{1}{2}$ s but couldn't get there without a goat. Waiting to get dropped up top, then we will proceed to the top of these chutes & work our way down slope.

Deck of helo platform ~ 6' above river.

1540' @ 1³⁷

[actual is 1480']

Go dropped at BH-8 and traversed over to the chute $\frac{1}{2}$ s of the one we did this morning. Jim will rappel down a steep chute paying particular attention for a shear, dike, or andesite. Chute is just below a small mudflow and scar.

ELEV. 1792' @ 2⁵⁵

on the $\frac{1}{2}$ s side of the flow.

ELEV 1818' @ 3¹⁵

W-81-313

Down in chute ~ 35' from the top. A gray-green fine to medium grained diorite is exposed on both sides of the chute. Hard, mostly fresh, competent. Jointing is generally moderately close to wide. Possible gouge zone exposed in the chute. A yellowish-brown to brown mostly sandy zone with rock fragments. Approx 2.5' wide, trends

JOINTS

85° 35°N plane, semi-smooth
1' to 3', aver. 2'

75° 81°NW curved, smooth

somewhere between 169° & 176°. Also joints parallel to clay gouge seams. $\frac{1}{2}$ " & 2" wide, low plasticity. Some of it could be soil development (?)

Couldn't go lower as the chute had too many loose blocks.

Moved to another chute just $\frac{1}{2}$ s of the last. It's the last major chute before the andesite-diorite contact just $\frac{1}{2}$ s. Elev. 1729' @ 4²⁰

W-81-314

Rock exposed down along both sides of the chute. Very little is exposed down in the chute itself. Whitish-green medium-grained dioritic rock. Biotite is the chief mafic mineral. Rock is hard, slightly weathered on outcrop face, competent. Occasional zones along the cliff face moderately to highly weathered. Carbonate staining is common along joints.

JOINTS:

- * 104° 62° ~ curved, smooth.
2" to 1' area. 6"
- * 158° vert. curved, rough,
trend of the gully. 1' to 2.5'
- * 178° 30° W plane, rough.
2" to 2'; area. 1"

Irregular trending zone of diorite which has undergone differential weathering. Looks like a sandy conglomerate but actually the more resistant stabs remain. Sampled

DH-28 2046' @ 530

TIE IN OF ALTIMETER

DH-28 2046' @ 530

[actual is 1971']

Plotted in chutes which were examined today by helicopter.

TOD - No andesite was found in the first gully which we ascended. Did find a prominent gouge zone. Several secondary shears were also observed. Also found a gouge zone in a chute just d/s of the first chute in another. The major shears for the chutes are 325° and ~ 352° respectively.

HRS. 10.5

6-15-81

Mostly cloudy morning, rained some last night. HEINZEN & I will work with Rob Swartz in Borrow 'H'. Get the sites marked and cleared. Later we worked on the left abutement ups of CR, traversing down chutes.

Borrow 'H' - ended up working there all morning. Some of the clearings may be small for both a 205 and an auger rig. Also Dick may want to string a portable landing platform to each site.

DH-ZE (A) 2045' @ 135

A-B	175'	26°	16° downslope
B-C	100'	48°	near horiz.
C-D	100'	49°	"
D-E	100'	33°	"

E-F	100'	34°	terodogged
F	1926'	@ 212	Flagged
	1947'	@ 303	
F-G	40'	362°	13° downslope
G-H	62'	57°	
H-I	54'	15°	12° downslope
I-J	53°	355°	20° downslope
	top of the chute		
	45'	16°	35° downslope

W-81-315

Large outcrop on N side of chute, first exposure. Approx 15' high and 30' across. A green-white, medium grained diorite. Hard, slightly weathered, compact.

ELEV. 1956' @ 323

Chute here is full loose debris, sand to boulder size. Chute meanders down. Probably difficult to observe if a shear is here.

JOINTS:

Major 139° - 84° NE, rounded, rough
4" to 2' over 1.5'

Major 115° 15° S plane, smooth
 4" to 1.5', aver 1'
 42° 75° SE curved, rough
 1' to 3'; aver 2'
 36° 37° SE plane, semi-smooth
 2' where seen.

J-K 65' 353° 35° downslope

N-81-316 (K)

Outcrop exposure with the trend of 135°, vertical. This trend is outcrop face coincides with a 15' wide shear zone with 3" of a yellow-orange to red orange sandy clay zone. On either side is ~ 8" of sandy brecciated rock with maybe a trace of clay.

ELEV. 1817' @ 34°

Outcrop face on d/s side has a highly weathered zone, rind, ~ 3" to 4". Rock is iron stained. Outcrop face has a very distinct jointing pattern. Rock on both sides is the gray-green, medium grained

diabase rich diorite. On the upstream side, the diorite is much coarser grained, sampled. Rock from outcrop face is moderate hard to hard, highly weathered, mostly competent (ie get rid of outside edge).

JOINTS:

Major 66° 26° NW plane, smooth
 4" to 1.5', aver 1'

57° 17° NW
 Major 40° 60° NW curved, smooth
 3" to 2', aver 1'

135° vert plane, semi-smooth

At 30' downslope of this shear there is a possibility of a shear trending 115°

K-L 50

K-L 50 110 38° downslope
 121° vert tightly fractured zone
 with soil filling, 6" wide.
 Don't think it is a shear

no clay gouge & no exposure in the opposite rock face. Fractured zone ~ 3' wide, highly weathered, trace clay due to weathering of diorite.

L-M 40° 33 1/2° 27° down slope

W-81-317 (M)

Several small shear zones in decomposed diorite. Rock is a green-gray medium grained, biotite rich diorite. CI = 20-25%. Generally hard, fresh to slightly weathered, moderately competent to competent. Joints are carbonate stained. Joint spacing ranges from close to moderately close.

Shears

112° vert. up to 6" wide yellow orange to brown sandy gouge. Has a little bit of structure. Could be just the deteriorated

diorite, decomposing but its linear 96° vert. yellow orange sandy gouge. trace of clay 4" wide, vertical structure

Joints
major 25° vert. curved, smooth 3" to 1", aver. 1'

major 126° 20° NE plane, smooth
major 64° 12° SE plane, smooth, 4" to 3", aver. 1.5"
J 114° 86° NE plane, smooth 6" to 2", aver. 1"

- where joint spacing is close, rock is loose

Elev. 1756' @ 450

M-N 50' 36° 44° d/s
est + 755 " overall 55°

W-81-318

- Rappelled down to this station from above, near vertical section of chute 15'-18'. Rock is a gray-green, medium grained biotite rich diorite.

Elev. 1689' @ 515

JOINTS:

63°

28° SE plane, rough
6" to 4', aver. 3'

134°

77° NE; cliff face,
plane, smooth, aver. 2'

39°

vert. plane-curved, smooth
locally down to 2", aver. 8"
up to 1.5'

secondary

138°

47° NE plane, smooth
aver. 1'trend of adjacent gully 5' wide
117° 85° NE - vert.no stepped section to look for a
shear

N-D

75'

351°

30° d/s

W-81-319 (0)

Shear zone, in a steep walled
narrow chute which intersects the
main chute. The width of thechute is 2.5'. Rock fragments
sandy clayey gouge. discontinuous
zones of clay. Yellow orange to brown.
Yellow-orange pockets of clay. Resembles
a soil formation but feel a shear
must go through here

Orientation

130° vert.

Chute is very straight & continuous.
Elev. 1650 @ 545

D-P

100°

322°

36° d/s

P-Q

0-30°

W-81-320 (Q)

Gray-green medium grained, diorite
intruded by a dike. Dike is a white-
gray, medium grained, aplitic dike -
sparsely textured. Matrix ~ 5% and
fine grained. Dike is 1'-2' wide
and highly fractured. Dike rock is hard
but incompetent due to jointing. Lat.
121° 67° NE smooth, curved

stage magma from the same source as the diorite

P-K	130'	316°	14° d/s
R-S	80'	0°	35° d/s

river level

Pad at C/L near DH-21
1470' @ 6°

TOD - A couple of shears were observed today which trend 310° - 315° . Difficult to ascertain whether the rock is sheared or its due to weathering. Sometimes there is a vertical structure, indicating that it is probably a shear. If uncertain we call it a shear.

Hrs. 11

6-16-81

It's a mostly cloudy morning. R. in last night will probably turn off somewhat this morning before we get our afternoon shower. HEINZEN and I are working at Watana on the left continent. J. of C/L. WHITE & CRAWFORD are working at the Knob' area.

DH-25

ELEV. 2045' @ $7^\circ 22'$

Traveled to STA 'F' of yesterday, pg. 109. This will be point 'A' today

A-B	100'	58°	low
B-C	92'	47°	" "
C-D	100'	307°	25° d/s
D-E	45'		35° d/s

W-81-321 (E) see 81-315 same outcrop
 White-green, medium grained biotite
 rich diorite, CI ~ 20%. First outcrop
 exposure in descending down-the chute.
 Outcrop is 10' high and 40' across on
 the $\frac{1}{2}$ s side of the chute. Blocky
 exposure. Joint spacing is close to
 moderate close. Hard fresh,
 competent. Cliff face trend ~ 122°.
 Fe stained in places.

ELEV 1863' @ 8³⁰

JOINTS

122°	84° NE	plane, semi-smooth
6" to 3'	aver 2'	cliff face
26°	85° SE	curved, rough
1' to 3'	aver 2'	
132°	9° SW	plane, smooth
2" to 1'	aver 6"	

D-F 105' use yesterday's

K=F

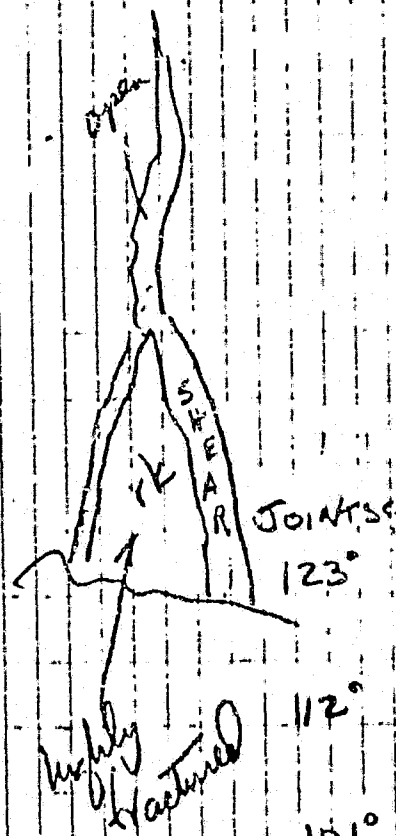
F-G 100' 83° 13° $\frac{1}{2}$ s

W-81-322

Outcrop 20' to 40' high and
 55' across. Rock is the white-green
 medium grained, biotite rich diorite.
 Biotite is finer grained. CI ~ 20%.
 Several shear/gouge zones. All one
 shear zone or several small ones. Two
 shears in the same trend within a 3'
 wide zone. Two shear branches. Joints
 are generally part open ($< \frac{1}{8}$ ")

SHEAR

112° 72° S 3" wide of highly
 weathered rock → granular, sand,
 highly decomposed. Orange to
 light gray. Pockets of light
 gray clayey silt. 1" weathering
 rind, decomposing of diorite
 on either side. Shear branches
 here. Loose blocks



123° 61° S plane, smooth

112° 32° NE plane, semi-smooth
 to rough 1" to 1' over 6"
 101° 76° N plane, rough over 4"
 adjacent to shear

ELEV. 1852' @ 9¹²

Outcrop leads a chute which joins the one we were in yesterday. Incompetent to competent. Very close to close joint spacing
 G to H 30' 74° 55" 0/5

H to I 60' 113° 1/2

I to J 39° 201° 37° 0/5

W-81-323 (J)

Outcrop approx 20' to 30' high and is 70' long trending 305°. Green-gray, medium grained biotite rich diorite. Could be a quartz diorite. Hard, fresh, competent. Very blocky exposure. Joint spacing is close to moderate close. Blocky talus below.

JOINTS:

44° 85° NW plane, smooth
 4" to 2' aver. 1"

[159° 32° NE plane, smooth
 [164° 34° NE 6" to 2.5'
 aver. 8"

99° vert. plane, smooth
 4" to ? aver. 2'
 31° 40° NW plane, smooth
 all 2', spacing uncertain

J to K 90° 91° 8° 0/5

J to J' 30' 91°

small gully, outcrop exposed in, no shearing visible, probably just more closely jointed

K 1902' @ 10° 05'

Near the top of this chute will traverse down and then return to this spot to ascend out of this chute

W-81-324 (K)

Outcrop exposure high on both sides of the chute. Green-gray, medium grained diorite. No shearing exposed here in the chute, soil is too deep. Jointing ranges from close to wide, 10,

staining. Hard, slightly weathered
face, generally competent, remove

JOINTS

86°

57° N plane, smooth

109°

vert. plane, smooth

4" to 4' aver. 3'

forms one of the gully
faces, 1/5 side.

MAJOR

174°

59° W plane, smooth

4" to 3' aver. 1.5'

secondary

191°

vert. curved, semi-smooth

aver. 1', 6" to 2'

"

133°

vert. plane, smooth

aver. 1.5'

loose blocks ~ 10' aver.

K-L

110'

343° 42° d/s

W-81-325 (L)

Green-gray medium grained diorite
Biotite-rich Outcrop is 10' high
and 110' long. Trend of outcrop is

~135°. Mostly a blocky outcrop. Hard,
slightly weathered on face, competent

JOINTS

25°

62° NW plane, smooth

1' to 3', aver. 2'

171°

51° E, plane, semi-smooth

4" to 2' aver. 6"

Major

134°

vert. plane, rough

1" to 2.5', cliff face

89°

25° N curved semi-smooth

to rough, variable trend

6" to several feet

L-M

75'

349°

30° d/s

M-N

100'

352°

42° d/s

N-D

50'

358°

41° d/s

W-81-326

From N to D and 30' further
downslope this outcrop extends, averages
20' in height. Outcrop trends 151°.

and is exposed on the $\frac{1}{2}$ s side of the chute. Rock is the green gray, medium grained, biotite rich diorite. Blocky to massive. Hard, slightly weathered outcrop face, competent. A few 1" felsic dikes can be seen. Light gray-white fine grained rock, sharp contact, welded.

ELEV. 1695' @ 11³⁰

JOINTS:

3²⁰ vert. curved semi-smooth
4" to 2' aver. 1.5'

31° 64° SE plane, smooth
aver. 2'

Major 46° 79° NW plane, smooth
3" to 2' aver. 1'

151° 79° NE plane, rough
outcrop face

Major 52° 24° SE curved, smooth
2" to 3', aver. 2'

Sampled

O-P 75' 339° 32° $\frac{1}{2}$ s

- no more real good exposures
further down.

This chute has been a disappointment so far, we haven't found any shears! Will go back upslope and ascend up a chute which joins this main one from the $\frac{1}{2}$ s side. Too much vegetation & rocks in the slope to see anything.

W-81 + 321

Outcrop extends for 80'-100' and is 10'-15' high. Trends 114°. Greenish gray medium grained diorite

ELEV. 1650' @ 12³⁰

JOINTS

114° 84° N plane, smooth
4" to 5', aver. 2'; cliff face

secondary 172° 54° E plane, smooth
8" to 2'

39° 82° NW slightly curved, smooth
4" to 1.5' aver. 8"

65° 22° NW plane, medium grained
to rough 4" to 1.5' aver. 4-6'

Going upslope from N in the adjoining chute.

N-R 100' 139° 22° u/s

Q-R 35' 169° 42° u/s

Q-S 100' 169° 45° u/s

W-81-328 (R)

Step in the chute where bedrock is exposed. Green-gray, medium grained, biotite rich diorite. CI ~ 25%. Difficult to get joint measurements, no shearing exposed.

W-81-329 (S)

Exposure becomes cliffy from here up especially on the d/s side. Very massive outcrop. Rock is a green-gray, medium grained biotite rich, diorite. Blocky outcrop. Hard, slightly weathered on surface < 1" = fresh, competent.

JOINTS:

134° 80° SW open to 2" plane, smooth 6" to 1.5' aver. 1'

129° 36° NE curved, smooth
4' to 1.5' aver. 1'
166° 29° NE

JOINTS are iron & carbonate stained

ELEV. 1858' @ 133

ELEV. 1898' @ 149 same trend upslope possible 8" to 1" wide where or joint tightly jointed & weathered, accessibility is a problem. Rock seems to be weathering as exfoliation.

Abandoned ascent here, to dangerous, will return to 'A' and start working upstream from there. Couldn't find 'A', also fresh bear signs.

TRAVERSE from W-81-231 to top of traverse we will begin in a chute.

A'-B' 50' 167° 170° 20° u/s

2045' @ 31°

B'-C' just 30' u/slope of 81-231
100' 223° 21/6° horiz

C'+D' 100' 213° 21/6° horiz

D-E 75' 300° 16° d/s
 E 2054' @ 33° - top of a
 traverse } PLTS ROCKY

E-F 65' 29 32° 32° d/s

F - Station W-81-330 Down 30' wide CRTE

Rx EXPOSED IN MASSIVE CLIFFY RIBS ON BOTH SIDES
 CLIFFS ARE BLOCKY → MASSIVE, EXFOLIATION (MOSTLY ON) (EAST CLIFF)

Rk - MED-GRAINED LT GREEN/BLUE DIORITE W/BOTITE

VERY HARD & COMPETENT & white-green

JOINTS

* 141° VERT PLANAR ROUGH (CLIFF FACE) (AVERAGE) (2')

* 48/87° NW PLANAR SEMISMOOTH → ROUGH (6' 3' AVERAGE) (2')

515/8° N PLANAR SEMISMOOTH (2' 6' AVE 3')

516/32/16° NW

PLATED AT
 BACK
 BEARING

F'-G' 75' 216 219° 2. 35° d/s

go 30' across slope to east, same
 cliff as above, 50' wide



Joints on west facing cliff face
 Major 71° 81° N plane irregular
 smooth; 2' to 6' aver. 4'
 one is open to 1/4"

6° 28° E plane, smooth
 1" to 1' aver. 3" as fractures
 not joints, discontinuous

136° vert. plane, semismooth
 discontinuous, aver. 2'

- continuation of joint measurements
 above

G-H' 100' 303 306° 35° d/s

H'-I' 100' 323 326° 35° d/s

- nothing exposed in the cliff
 walls for the past 200'. Very
 massive, joint spacing generally
 moderate close to very wide

I' 1852' @ 420
 40' at 2', intersect cliff!
 face for STA

W-81-331 (I')

Still continuation downslope of this ridge
on west facing cliff face. White-green
medium grained biotite rich diorite.
Rotten on outcrop face in places due
to weathering, exfoliation. Soft to hard,

ELEV. 1845' @ 4²⁰

slight to moderate weathering, competent
with removal of weathered material.
Joints are carbonate stained

JOINTS:

Major { 145° vert. cliff face, plane,
semi-smooth. 6" to 2', aver. 1.5'
53° vert. curved, semi-smooth
6" to 3', aver. 2'
2° 62° E plane, smooth
aver. 1.5'

I' - J'

100'

305°
309°

35° d/s

J' - K'

70'

302°
301°

35° d/s

K' Continuation outcrop exposure ends
here on 1/4 side
ended on 1/4 side ~~also~~ also

K' - L' 75' 305° 25° d/s
100' 301° 35° d/s
1838

Little outcrop until the river, ended
our descent, returned to Watana
Watana 2295' @ 5²⁰

TOD - Traversed down to major chutes
today and some of their tributaries. No major
shears observed. Generally the soil/vegetation
cover was too thick and the slope too gentle
to enable us to observe any shears in
the chutes. Several times we tried to
ascend up some adjoining chutes but the
going was treacherous, abandoned several
attempts. Only one minor shear zone
was observed. Exfoliation exists in places,
necessitating the removal of a thin veneer of rock.
Not a major problem.

HRS: 11.0 FIELD
05 OFFICE

6-17-81

It's a beautiful clear sunny morning.
Will get really hot today. HEINZEN &
I will work a traverse at Watana from
BH-6 d/s past the 'major shear zone'
at approx 1600' elevation. WHITE &
CRAWFORD are going to town.

SURVEYED POSITION @ ~1635'
(ASSUMED ERROR IN TOPO LINES)

BH-6

ELEV. 1605' @ 755

A-B

100'

283
265°

horiz

B-C

100'

298
361°

8° d/s

C-D

70'

348
361°

16° d/s

W-81-332 (D)

Small outcrop ~ 5' high and
30' across, broken-up somewhat.
Green-gray, medium grained, biotite

rich diorite. Rock is close to or at the
surface here and further downslope
CI ~ 25%. Hard, generally fresh,
competent rock. Outcrop is breaking into
blocks.

ELEV. 1651' @ 822 →

JOINTS:

116°

81° N

trend of outcrop, plane

smooth

Major

19°

76° SE

plane, smooth

D-E

100'

269
272°

20° d/s

E-F

76'

87
90°

25° d/s

W-81-333 (F)

Following a continuation of the last
outcrop, group together. Outcrop ~ 12'
high and 36' across, surveyed to
middle of the outcrop. Green gray, medium
grained, biotite rich, diorite. Blocky
outcrop, trend is 359°. Hard, slightly
weathered outcrops face, competent.

JOINTS:

Major 46° 83° SE plane, smooth
1" to 1.5', aver. 8"

Major 114° 71° N, plane, smooth
one is open 6' to 1' - stress
relief here towards river(?)
1" to 1.5', aver. 8"

secondary 140° 14° SW plane, smooth
fractures 1" to 1.5', aver. 1"

" 359° vert. plane, rough
cliff face

Major 2° 50° E plane, semi-smooth
8" to 1.5', aver. 1"

E-G 100' ^{210°} 266° 15° d/s

G-H 100' ^{283°} 291/2° horiz.

H-I 87' ^{23°} 4° 13° v/s

W-81-334 (I)

Outcrop 6'-8' high and 50'
long. White-green, medium grained
ELEV. 1639' @ 90°

rock. It's a diorite or quartz diorite.
Biotite is fine grained, CI = 25%
Sampled. Rock is hard, slightly
weathered, mostly competent. Overall
joint spacing close to moderately close.

Joints

77° 84° S plane, smooth
4" to 8", aver. 6"

355° vert. curved, semi-smooth
4" to 25", aver. 1"

126° 20° NE plane, semi-smooth
1' to 3' aver. 2"

112° 72° N plane, smooth
trend of outcrop

I-J 100' ^{273°} 276° horiz.

J-K 100' ^{245°} 248° 15° d/s

through this stretch is the next
50', have boulder stream,
diam up to 4'

K-L 100' ^{291°} 294° horiz.

L-M 100' ^{288° (291°)} 288° horiz.

N to N	100'	289 $2\frac{1}{2}^{\circ}$	horiz
N to O	100'	289 $2\frac{1}{2}^{\circ}$	horiz
O to P	100'	282 $2\frac{1}{5}^{\circ}$	horiz
P to Q	50'	276 $2\frac{1}{8}^{\circ}$	15° d/s

- boulders on slope over the 50' section

W-31-335 (u)

Outcrop ~10' x 20' high and 50' long.
Generally a blocky outcrop. Green-white
medium grained, possibly a quartz
diorite. Like this last outcrop.
Hard, fresh to slightly weathered, competent.

ELEV. 1615' @ 10²⁰

JOINTS

1585 correct @ 127 ft from

Major { 14° 60° E plane, smooth
4" to 15' over 1'
 24° 21° NW plane, smooth
1' to 3', aver. 2'
 95° vert. plane, smooth to
semi-smooth, outcrop face

Q-R 100' 280
horiz
boulders beginning to outcrop

on the slope from R downstream

R-E	100'	289 $2\frac{1}{2}^{\circ}$	horiz
S-T	80'	287 $2\frac{1}{5}^{\circ}$	10° u/s
T-U	100'	285 $2\frac{1}{5}^{\circ}$	30° d/s

boulders end at S

W-31-336 (u)

Surveyed to top of d/s end of outcrop
Outcrop is 22' high and 75' across.
Rock continues up higher than U, ~50'
with a very thin soil cover. Green-gray
medium grained diorite. Biotite is the
chief mafic mineral. Hard, moderately
weathered.

ELEV. 1538 correct @ 13.7 ft from

top of the weathered material, probably
very much. Outcrop trends across slope
CO₂ staining along joints

JOINTS:

Major { 142° 62° SW curved, smooth
4" to 2', aver. 1'
 187° vert. curved, smooth
1" to 2'

116° 64° N plane, smoothed
 forms part of cliff face
 - all others are irregular

U to V 100' 288° horiz
 continuous outcrop across both
 up slope & down slope ~ 80% of
 area

W-81-337

Large outcrop exposure and a
 continuation of the last one. Rock outcrop
 is moderately to highly weathered. Heavy
 carbonate staining. Variable highly fractured
 zones occur, maybe as a result of the
 adjacent chute on the d/s side ~ 50'
 over. Rock is a green-white medium grained
 diorite

JOINTS

129° 31° NE plane, smooth
 aver. 6"

16° 84° E plane, smooth
 1" to 2" aver. 15"

109° 86° S plane, smooth
 cliff face

175° 22° W curved, semi-

smooth to rough 1/2" to

ELEV. 1605' @ 1143

Chms

V-W 85' 257° 25° d/s

Chute trends 303° - vert. up to
 2.5' wide. Can't see any shearing
 in the chute to much vegetation/soil
 Presume it could be. Found

Found closely jointed and fracture
 zones 20' lower in the chute ~ 2.5'
 wide Jointing is $\leq 1"$ over two 8"
 to 1' wide zones. No gorges seen.

W = 1572' @ 1205

- continuous outcrop to here from
 U, at the base of the outcrop known.

Stopped had lunch on the river
 walked back up to W

W = 1585' @ 130

W-X 70' 261° 10° d/s

X-Y 80' 292° 5° u/s
 first chute begins at 40'
 Y-Z 55' 267° rising

W-81-338 (Z)

Just finished crossing the first chute zone. The rock is massive and fresh here, in between the two chutes. (The one we crossed & the next one. Outcrop exposure extends up slope but not down. Rock is a green gray, medium grained, biotite rich diorite. CI ~ 25%. Outcrop is massive, 50' across. Rock is very hard, fresh, competent. Jointing is random, spacing is close to moderate close over the outcrop.

JOINTS:

1° 74° E curved, smooth
 122° 86° SW plane, smooth
 42° 84° SE plane-curved, smooth
 139° 69° SW plane, semi-smooth
 108° 12° S plane, semi-smooth
 aver. 1.5'

ELEV. 1602' @ 227

Z to A' 75' 290° 5° u/s
 @ 45' another chute ~ 25'
 wide. Continuous rock exposure across

W-81-339 Shear zone 330° 70° NE

tan to yellow orange sandy clay gouge, ~ 6" wide. Jointing on either side is closely spaced. Diorite on either side is hard to very hard, slightly weathered to fresh, competent.

JOINT measurements at A'

71° 59° N plane, smooth, aver. 2'
 136° 71° NE plane, semi-smooth, 3" to 2' aver. ~ 1'
 74° 50° SE plane, irregular, 4" to 2" aver. 1.5'
 19° 64° W plane, semi-smooth, discontinuous, variable

Heavy carbonate staining, some calcite coating

✓ A' to B' 40' 250° rising
 30' 262° "

B' - C' 65' 226° 15° d/s

C' - D' 100' 265° horiz.

D' - E' 100' 351° 35° u/s

Going up u/s edge of chute which has andesite on the d/s edge at river level
W-81-340 (E')

Poor exposure of the green-gray medium grained biotite rich diorite. Outcrop is in blocks. Ten feet high and 15' across.

E' to F' 112' 23° 38° u/s

W-81-341 (F') Tagged

Outcrop on the u/s side of the chute. Outcrop is 15' up and on again upslope for ~ 75'. These two mound outcrops trend upslope. The lower one which we surveyed to is moderately weathered, highly fractured.

Different to get any good joint measurements. Measurements came from the upper more competent and massive outcrop. Rock.

JOINTS:

Joints { 8° 85° W plane, smooth over 3'
91° 79° S " " " " " "
Hjors { 6" to 3' over 2'
60° 60° NW plane, smooth
6" to 4', over 3'

is the green-gray fine to medium grained diorite Sampled
ELEV. 1767' @ 4²²

Will now cross the gently sloping, highly vegetated chute to what should be the andesite on the opposite side.

F' to G' 60' 280° horiz

W-81-342 (G') Tagged

Large outcrop on the d/s side of this wide (~ 60') chute. Outcrop goes upslope to a undetermined (at this time) distance. It goes downslope from here ~ 15' in

downslope and then trends across the slope in a downstream direction.

25' @ front) Outcrop is approx 10'-12' along the slope and forms a pronounced ridge in the d/s direction. Rock is a medium green, mostly aphanitic rock with a few fine grained xtal of biotite plagioclase phenocrysts. Sample. Locally highly fractured. Joints are carbonate stained. Rock is generally hard slightly weathered, moderately competent - due to the fracturing.

JOINTS:

Major { 111° 55° N curved, smooth
1" to 3" locally, aver. 5"
 90° 77° S plane, smooth
2' to 1' aver. 4"

where the fracture zones are these are the dominant trends.

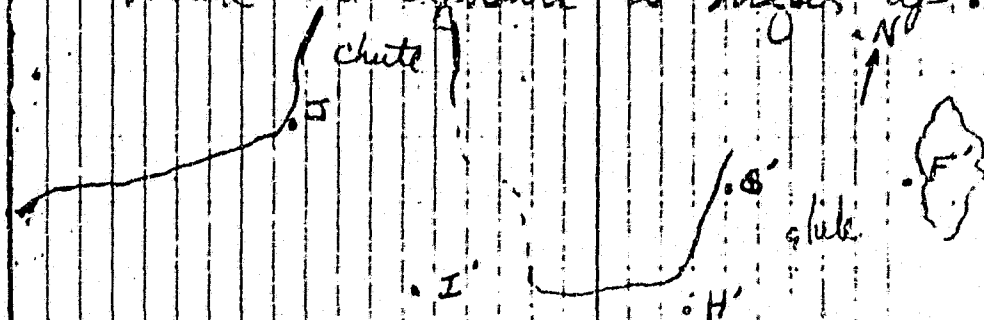
G' to H' $42^{\circ} 30'$ 195° 28° d/s

H' to I' $100'$ 262° horing -

I' to J' $94'$ 290° 16° d/s

W-81-343 (J')

"Crossed a open area in the outcrop where the exposure is higher up."



Map View

Medium green, aphanitic rock - andesite
Hard, slightly weathered on outcrop face,
Moderately competent to competent depending on the fracturing in the outcrop.
Carbonate staining. Outcrop is > 20' high here

ELEV $1805'$ @ 55°

JOINTS:

Major { 101° vert. plane - irregular
rough, cross slope face
 183° 85° W irregular, rough
3" to 2', aver. 1.5"

BH-2 1962' @ 5'43"

1835'

Walked up the chute, which is very wide. Vegetation is thick, slope is so gentle to ascertain if this chute is controlled by shearing.

BH-2 1962' @ 5'43"
actual = 1835'

TOD - Crossed a couple of wide boulder streams, will require removal. Should trace these to their source. Two shear were seen today oriented 303° and 330° . Crossed over into the andesite, no contact was observed as it is covered with vegetation/soil.

HRS. 11

6-18-81

It's a mostly clear, sunny day. HEINZEN and I will have an office day, plotting data for Devil Canyon and Watana.

Walked up the chute, couldn't
observe anything in the chute, not steep
enough, too broad, and

SAMPLES

WATANA:

W-21-310

W-81-314

W-81-316

W-81-326

W-81-334

W-81-341

W-81-342

149
GRANITIC DIKE

DIORITE

DIORITE

DIORITE

FELSIC DIKE & DIORITE

DIORITE OR QTZ DIORITE

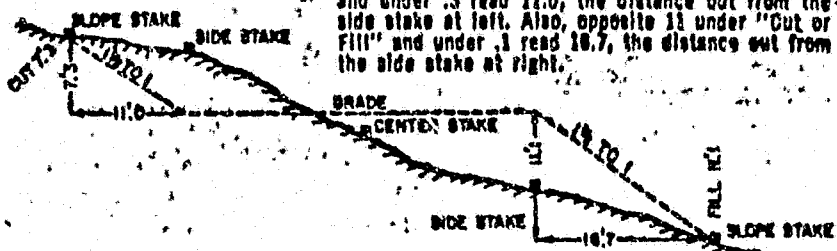
DIORITE

ANDESITE

DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING

Roadway of any Width. Side Slopes 1 1/2 to 1.

In the figure below: opposite 7 under "Cut or Fill" and under .3 read 11.0, the distance out from the side stake at left. Also, opposite 11 under "Cut or Fill" and under .1 read 10.7, the distance out from the side stake at right.



Cut or Fill	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	Cut or Fill
	Distance out from Side or Shoulder Stake										
0	0.0	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	0
1	1.5	1.7	1.8	2.0	2.1	2.3	2.4	2.6	2.7	2.9	1
2	3.0	3.2	3.3	3.5	3.6	3.8	3.9	4.1	4.2	4.4	2
3	4.5	4.7	4.8	5.0	5.1	5.3	5.4	5.6	5.7	5.9	3
4	6.0	6.2	6.3	6.5	6.6	6.8	6.9	7.1	7.2	7.4	4
5	7.5	7.7	7.8	8.0	8.1	8.3	8.4	8.6	8.7	8.9	5
6	9.0	9.2	9.3	9.5	9.6	9.8	9.9	10.1	10.2	10.4	6
7	10.5	10.7	10.8	11.0	11.1	11.3	11.4	11.6	11.7	11.9	7
8	12.0	12.2	12.3	12.5	12.6	12.8	12.9	13.1	13.2	13.4	8
9	13.5	13.7	13.8	14.0	14.1	14.3	14.4	14.6	14.7	14.9	9
10	15.0	15.2	15.3	15.5	15.6	15.8	15.9	16.1	16.2	16.4	10
11	16.5	16.7	16.8	17.0	17.1	17.3	17.4	17.6	17.7	17.9	11
12	18.0	18.2	18.3	18.5	18.6	18.8	18.9	19.1	19.2	19.4	12
13	19.5	19.7	19.8	20.0	20.1	20.3	20.4	20.6	20.7	20.9	13
14	21.0	21.2	21.3	21.5	21.6	21.8	21.9	22.1	22.2	22.4	14
15	22.5	22.7	22.8	23.0	23.1	23.3	23.4	23.6	23.7	23.9	15
16	24.0	24.2	24.3	24.5	24.6	24.8	24.9	25.1	25.2	25.4	16
17	25.5	25.7	25.8	26.0	26.1	26.3	26.4	26.6	26.7	26.9	17
18	27.0	27.2	27.3	27.5	27.6	27.8	27.9	28.1	28.2	28.4	18
19	28.5	28.7	28.8	29.0	29.1	29.3	29.4	29.6	29.7	29.9	19
20	30.0	30.2	30.3	30.5	30.6	30.8	30.9	31.1	31.2	31.4	20
21	31.5	31.7	31.8	32.0	32.1	32.3	32.4	32.6	32.7	32.9	21
22	33.0	33.2	33.3	33.5	33.6	33.8	33.9	34.1	34.2	34.4	22
23	34.5	34.7	34.8	35.0	35.1	35.3	35.4	35.6	35.7	35.9	23
24	36.0	36.2	36.3	36.5	36.6	36.8	36.9	37.1	37.2	37.4	24
25	37.5	37.7	37.8	38.0	38.1	38.3	38.4	38.6	38.7	38.9	25
26	39.0	39.2	39.3	39.5	39.6	39.8	39.9	40.1	40.2	40.4	26
27	40.5	40.7	40.8	41.0	41.1	41.3	41.4	41.6	41.7	41.9	27
28	42.0	42.2	42.3	42.5	42.6	42.8	42.9	43.1	43.2	43.4	28
29	43.5	43.7	43.8	44.0	44.1	44.3	44.4	44.6	44.7	44.9	29
30	45.0	45.2	45.3	45.5	45.6	45.8	45.9	46.1	46.2	46.4	30
31	46.5	46.7	46.8	47.0	47.1	47.3	47.4	47.6	47.7	47.9	31
32	48.0	48.2	48.3	48.5	48.6	48.8	48.9	49.1	49.2	49.4	32
33	49.5	49.7	49.8	50.0	50.1	50.3	50.4	50.6	50.7	50.9	33
34	51.0	51.2	51.3	51.5	51.6	51.8	51.9	52.1	52.2	52.4	34
35	52.5	52.7	52.8	53.0	53.1	53.3	53.4	53.6	53.7	53.9	35
36	54.0	54.2	54.3	54.5	54.6	54.8	54.9	55.1	55.2	55.4	36
37	55.5	55.7	55.8	56.0	56.1	56.3	56.4	56.6	56.7	56.9	37
38	57.0	57.2	57.3	57.5	57.6	57.8	57.9	58.1	58.2	58.4	38
39	58.5	58.7	58.8	59.0	59.1	59.3	59.4	59.6	59.7	59.9	39
40	60.0	60.2	60.3	60.5	60.6	60.8	60.9	61.1	61.2	61.4	40

A&Z Book 11

Watana

North bank

W-81-139 west to 81-150 : 1-40

South bank

SW-1 Ext 41-43

W-81-151 to 81-157 : 45-61

U-81-158 to 81-192A : 66-161

Consultants Meeting : 62-65



The paper in this book is made of 50% high grade rag stock with a WATER RESISTING surface sizing.

KEUFFEL & ESSER CO.

F' to G' 64' 270° 0°
 G' - H' 57' 280° 0°
 H' - I' 63' 270° 0°
 I' - J' 58' 260° 0°
 J' - K' 42' 255° 35° down 34
 K' - L' 27' 285° 0°
 outcrop W-81-139

Continuation of 6/1/81
 traverse d/s along N
 bank at Wotana

W-81-139 west

Diorite, fine grained, light
 grayish green, less
 than 15% mafic (bio.)
 texture noticeably finer
 than at previous outcrop

✓ Fracture zone east end
 N-S/90, 6"

Joints

30°/80° to 90° in
 spacing - zones of 2"
 spacing, generally
 greater than 5 ft

4
360/80 SW pl, rgh
spacing av 6"

150/55 NW irreg, rgh
spacing av 18"

110/20 N irreg, rgh
spacing less than 1 ft

295/85 S faconaher
v rgh, irregular-slow
spacing? 3 ft??

Sample

L'-M' 40' 260° 0° top of steep gully

M'-N' 33' 260° 8°

N'-O' 71' 270° 0°

Station S'-P
series of small east-west trending scullies about 10' wide, which may be the top of slide blocks along E-W joint set and NE trending set (65/55 NW)

Photo ^{K8-18} looking at NE striking joint slumping

Photo ~~K8-18~~ ^{K8-17} "stone wall" pattern of top of slump

Dispute as at 139

difficult to determine what rock is in place

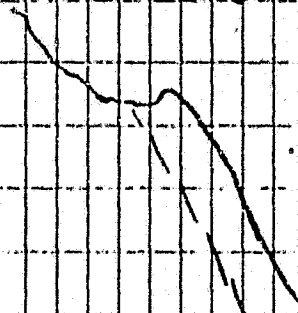
Rock in some places is moderately to severely weathered top of blocks appear as a wall with a 2-3 ft

O'-P'	52'	280° (L10)	0	
P'-Q	66'	250° (L10)	0	
Q'-R'	52'	280° (L10)	0°	
R'-S'	25'	180°	30° down	22
S'-T'	43'	215°	40° down	32
T'-U'	34'	300°	15° down	33
		W-81-140		
U'-V'	74'	285°	0°	edge of gully across from 140 andesite, green small plagioclase

Depression on the
uphill side

N.

S



W-81-140

50' X 30' L

massive, large
blocks

Diorite, green to greenish gray
color is variable in texture
from very fine grained to
medium grained, and
possibly aphanitic in what
appear to be veins of
andesite with pieces of
diorite. surface
is slightly wtd, massive
with few well defined
joints

Joints

25/80W irreg, rgh,
6"-5' av 18", open
to 3 in130/85S face
irreg, rgh, ~ 2 ft
spacing190/405' pl, av,
spacing 2 ft

Sample of finer grained

V-W' 68' 330° 35° up W-81-141

W-81-141

Andesite Porphyry
aphanitic, 30-46%
plag. phenocrysts to
1/4" long, dark green

Sample

Contact is in gully
no exposure, prob
on west side
Joints

35/70S planar, smooth
|| to face
spacing ~6"

30/80E planar to irregular
smooth
spacing 1'-2'

295/80S planar, smooth
spacing ~3'-4'

return to
 V'-X' 18' 225° 25° up 16
 X'-Y' 56' 220° 10° down 55
 Y'-Z' 44' 130° 25° down at " 11
 BH-2
 Z'-A'' 64' 250° 15° up 12
 A''-B'' 92' 230°

transverse plotted

C 6/2

closure adjustment between OC 137 east
 and OC 140 to fit tops

Geology plotted

6/3 C

141 can't

14

minor

NS/40W planar smooth
 spacing 4' to 4'

Sample

June 2, 1981

at Wadene

K White C. Crawford

From Helicopter pad (A) at Bt-2 (

A-B 58' 324° W-81-142

B-C 66' 224° 15° down 64

C-D 72' 225° 30° down east 65
edge of
gully

14

W-81-142

Cinderite porphyry, dark
green, plagioclase crystals
(20-30%), fragments of
argillite and diorite (medium
grained, texture) up to 2"
angular, diorite(?) rounded
to joints

270/60 N pl, fine
grained 6 in

N-S/80E irreg-rgl
Sp 6"-18" av 12

215/20 S irreg, rgl
Sp 6 in and greater

280/65 N pl, rgl,
Sp 6"-12"

D-E	49	220°	10° down	48
		west side of gully		

E-F	24'	155°	25° down	22
		down gully		
		W-81-143		

F-G	24'			
-----	-----	--	--	--

W-81-143A west edge of gully, possible fracture zone
no exposure
Andesite, medium gray,
10-20% plagioclase phenocrysts,
fresh, all with surface

Sample

Joints

50/85 SE sl. curved or rth.
spacing 1" to 12" (ave 6")

325/70E planar, sl. rough
ave 6"

295/vert (?) gully trend
plane to irregular, rough
spacing 6" min

F-G	47'	200°	25° up rock edge	38°
G-H	56'	225°	20° center of gully down	53
H-I	26	230	0	W-81-143 B
				west side of gully

W-81-143B

Andesite, medium gray
 a, basites, 10% mafic
 phenocrysts, 10% plag
 phenocrysts
 outcrop is fractured
 with many open joints

? Gully is probable from zone, 320°

Joints

195/42 E pl, sl, rgh
 sp 4"-10", arc

55/85 SE pl, sl, rgh,
 sp 4"

90/90 sl irreg, sl, rgh
 up an 1 ft fracture zone
 face of outcrop to 6"

200/85 S pl - sl co
 sl rgh
 sp 6"

I-J	28'	205°	45 up	20
J-K	69'	210°	35 down / center	57
K-L	62'	235°	40	47

of deep gully, 40-50 ft wide, 295°
 top of gully
 W-81-144

W-81-144 tagged
 West edge of large gully, NW
 trend probable fracture zone

Andesite, medium greenish gray, aphanitic, 20-30% plagiophenocrysts, 10-20% mafics (Hbl?)

Joints:

285/80 S planar to sl. curved, smooth spacing generally 1' to 2' w/ zones (w/1' wide) w/ spacing 2 to 4"

345/65 E planar to sl. curved sl. rough spacing 11 or ~ 3 to 4'

320/vert curved, sl. rough spacing 1' to 2'

175/20 E planar to sl. curved smooth spacing 11 to 12"

L-44 to M	45'	170°	14° down	44
M-N	39'	185°	30° down	34
N-O	87'	250°	0°	
O-P	172'	275°	10° up	71
P-Q	60'	265°	0°	
Q-R	47'	265°	20° down east side of gully	
R-S	265'	280°	0° middle of gully	

20
~~Rhobar K8-15~~
 looking up river from
 point 50 ft below
 W-81-144

21
~~K8-20~~ same location
 as above
 looking at south
 bank contact between
 diorite (left) and
 andesite (gully).

Point N

andesite with 30-40%
 diorite fragments and some
 to 6"

W-81-145 A

Andesite same as 144
 fresh

Joint

335°/90° pl, tm
 sp. 12"
 some open to 1/2"

S-T 33' 250° 0

T-U 32' 280° 0° W-81-145 B
west side of
gully

230/45 SE irreg
rgh, sp 3', some
open

50/90 co, sl rgh
form face, spacing
~ 18"

✓ Fracture zone 350°
2 ft wide, incl sp str
parallel to trend of
gully

290/90 pl, sl co
tm, sp 6"

W-81-145 B

Andesite or above
but with green "bleb"
similar to that seen near
dio/and contact of FB

Saints

20/90 pl. rlyh
up 6" - 2ft

170/55W pl, sm
up 18"

210/85E pl, below, d. rlyh
up 2ft

285/105 neg, rlyh,
up 3ft

Minor

75/15N neg, rlyh,
up 2ft

70/25N neg rlyh
discont up ?

U-V	47'	340°	40°	up	up 30 gully
V-W	36'	336	42°	up	34
W-X	29'	205	47°	up	20
X-Y	20'	180°	0		out of gully
Y-Z	50'	240°	0		Bird attack
Z-A'	31'	275°	0°		
A'-B'	47'	227°	300	down	40
B'-C'	32'	295°	0°		W-81-46A

W-81-146A
outcrop at edge of
200ft wide gully
east side

Andesite, ^{porphyry} medium greenish
gray, plagioclase phenocryst
same as at 145

Joints

80/455 SI curved to irregular
rough
spacing 6" to 12"

65/85NW-85SE curved, rough
spacing 1' to 3'

300/80SW planar to SI curved
rough
spacing 1' to 2'

"55/75SE" also Fracture -
Shear zone
2' zone U. closely spaced

C'(146) 100'	34'	250°	18° down 32
D'-E'	35'	250°	15° up 33
E'-F'	23'	255°	0
F'-G'	42'	230°	0 west side of W-81-146 B gully
G'-H'	46'	185°	0
	49'	255°	50° up 31 up gully
H'-I'	27'	290°	45 up 19
I'-J'	22'	200°	0
I'-J'	21'	300°	55° up 12
J'-K'	26'	325°	51° up 10
K'-L (147)	55'	355°	48° up 37

W-81-146 B
west side of gully 315
Possible diorite breccia
in andesite(?) groundmass
rock is mod. well
crumbly, soft not fresh
face is 330° at angle to gully
Rock fragments to
6", some angular

W-81-147
west edge of gully
andesite basaltic, med
greenish gray, diaphanous
20-30% plagioclase
rock appears massive
Joints
295/40 N
spacing 2' to 3' smooth

(147)

L'-M'	45.5	355°	35° up	37
M'-N'	66'	257°	35° up	54
N'-O'	19'	045°	35° up	15
O'-P'	49'	330°	35° up	40

Traverse
Plotted
6/2/01
C
topo wall

Geology plotted C 6/3/01

(81-147 cont)

34

50 / 85 SE planar, smooth
spacing 1' to 2'

295 / 80 S irregular, rough
spacing min 5'

270 / 35 S planar to sl. irregular
sl. rough
spacing ~ 4'

~~K 45 - 20 23~~

view from point on
looking upstream

W-81-148 small outcrop
overgrown & weathered

N 45° ^{W/S} from top of island
at volcanic vent

240° ^{W/S} top of island near house

Volcanic, mod. altered,
phyritic, 20-30' plg
1 ph. scoria
orange

W-81-149

Large exposure on
W side near break in
slope above river

Volcanic? same as above

Sample

Joints

35/85° planar, st. rough
spacing 2 to 3'

Small fracture zones
associated

300 / 800 to 1000 Planar, smooth
Spacing ~ 2'

65 / 75 SE / slightly curved, smooth
Spacing 1 to 2'
also helps form fracture zone
with Set ①

(thin) General trend ~ 310 / 25 SW irregular
smooth to rough
spacing 1 to 2'

W 51-150
50' sequence of volcanic (basalt)
sandstone and shale (top
all moderately well
rusty stained)

Bedding (?) 310 / 155 W

Shale very thinly laminated

Samples

K8-²⁴~~23~~ shale - coarse
farther up slope shale is

covered by conglomerate
clasts to $\frac{1}{2}$ in, argillite
and other, thickness not
known

Sample A

shale - B
same material - C
Sample E

Cong

Plotted
Traverse
6/3/61
E Geol
C

6/3/81

KWh. to C Crawford

South bank

Layout SW-1 extension

From SW-1A (PT A)

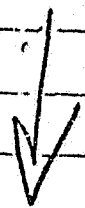
PTA-B 72' 90°

Total

72

B-C 82'

154



C-D 60

214

D-E 100

314

E-F 68

382

F-G 37

419

G-H 55

474

H-I 70

546

I-J 70

616

J-K 63

679

42

Extend SW-1 @ 94° for
1200 feet
from DH 12

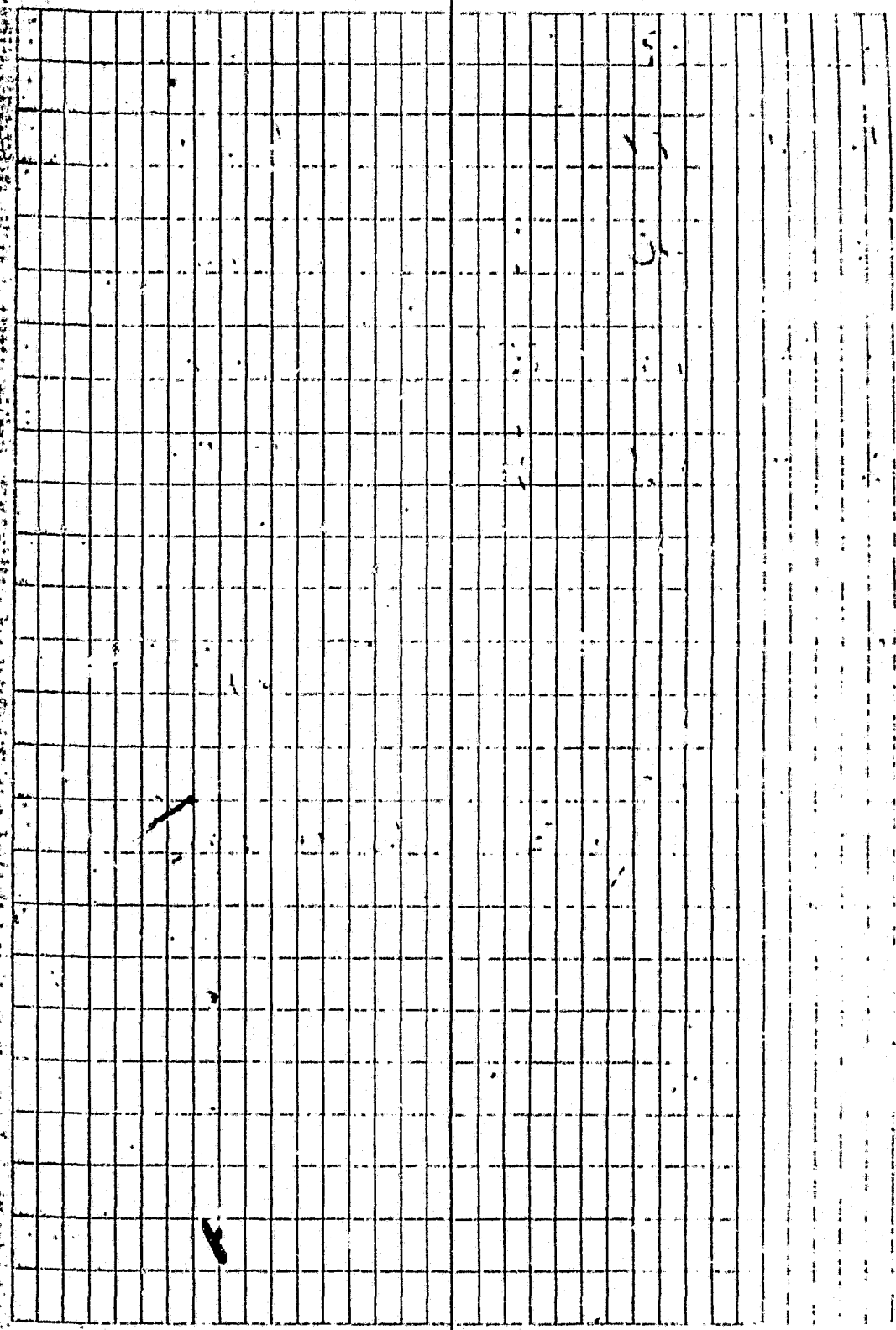
322 5738
744 628

From BH-12 to SW 1A
27' at 110°

K-L	58		679
L-M	42		737
M-N	66	↑	779
N-O	65	90°	845
O-P	53	↓	910
P-Q	73	↓	963
Q-R	63		1036
R-SL3	13		1099
SL-3, hubs 10' down slope			
R-S	65	↑	
S-T	36	90	1164
end of SW-1 EXT.			

322 SB5
745743

Az 178.9



T-U	92'	35°	10° down	91
U-V	100'	48°	15° down	97
V-W	40'	0°	15° down	39
W-X	54'	30°	20° down, west	47
X-Y	53'	0	20° down, edge of gully	down 48 gully
Y-Z	94'	30°	25° down	81
			~ center line of gully	
Z-X	24.5	280°	0 west side of gully	
			X = outcrop W-81-151	

Continue traverse from T&T
W-81-151
Qtz diorite, med. grnd, greenish gray, alt. ~ 10%
20 to 30% mafic (maybe bio. or chloritized Hbl) pink
stn on some feldspar.
Sample

Joints
350/vert sl. curved, rough
spacing ~ 2' open to ~ 2"
trend of gully
230/85E planar smooth
spacing 1 1/2' to 2'
open to ~ 4"
295/60S planar to irregular
rough
spacing 2' to 3'

X(151) to Y. 55' 30° 0 east side

Y-Z 33' 50° 30° up on east wall, 29

returns 2 = outcrop W-81-152

Y-A' 39' 340° 5 down 39

A'-B' 35' 275° 40° down 26

many loose(?) blocks on
slope difficult to determine
if in place.

B'-C' 35' 335° 20° down 33

W-81-153

W-151
cond

48

15/25w paracr, smooth
spacing 1' to 4'

50/65 NW irregular, rough
spacing 18"

W-81-152 east wall of gully
Quartz, Diomite, light
gray to light greenish
gray, gtz varies from
~10-20%, 20-30% mafics

Lenses on all major
nets are open up to
2 ft, blocks have slumped
and rotated, blocks
20 x 20 x 30' in place

W-81-153

Quartz diomite (?) med greenish
gray, 10% gtz (?), 20-30%
mafic (bio and Hbl(?))

Outcrop is generally fractural
whether from slumping or

C(153)-D'	25'	300	20° down	23
D'-E'	57'	215°	0° center of gully center of gully small stream, filled with boulders 1-3 ft, angular	
E'-F'	23'	255°	0° toward west side	
F'-G'	52'	310°	5° down	
G'-H'	37'	315°	25° down	31
H' = W-81-154				

as a result of the gully being
a fracture zone is not
certain
CO₃(?) staining in fractures

Joints

290/80N planar sl. rough
spacing 3' to 2' (ave 18')

15/65E planar to sl. curved
smooth
spacing 1" to 24" (ave 12")

60/65NW planar to sl. curved
smooth
spacing 6" to 12"

W-81-154 west side of gully
assuming outcrop is in place

Diorite / Q Diorite, med grnd
med grayish green, couldn't

H'(154) to I'	24'	10°	25° down	22
I'-J'	37'	34.2°	37° down	30
J'-K'	36'	32.5°	27° down	50
across from end of cliff face on east side of gully				
K'-L'	31'	30.5°	5°	
L'-M'	57'	29°	35° up	40
west side of gully				

no any quantity, 20-30% mafics

Sample Qdw(?) with
new pocket of fine, dk grn dior
outcrop has fractured
appearance

Joints

50/85 NW planar smooth
spacing 4" to 12"
some open to 1"

10/85 E planar smooth
spacing 1" to 12" (some 6")

30S / 30 SW planar smooth
spacing 1" to 6"

M-N' 23' 255' 20' down 21
 Seismic line
 N' = W-81-155

W-81-155
 outcrop at seismic line
 face parallel river
 approx E-W
 150' L x 30' H

Diorite, possibly gtdio,
 med grnd 20-30%
 mafic (bio) same
 as previous, fresh
 hard, several well
 defined + poorly defined
 joint sets,
 Tagged

Joints

280/vert planar to sl. irregular
 sl. rough
 spacing approx 12"

30/85E planar to sl. curved
 smooth
 spacing 1" to 2" (ave 12")

(1554)
cont.

N(155) to O'	40'	235°	0	
O'-P'	23'	335°	35° down	19
P'-Q'	56'	240°	5° down	
Q'-R'	25'	210°	35° down	F. edge of 20' gully
R'-S'	46'	220°	0	center of gully
S = center of W-81-156				

325/415E. irregular, rough
discontinuous
spacing ~ 1'

05/15 W. irregular rough
spacing 1' to 2' (case 2')

W-81-156
center of gully trend 20°

Diorite, medium gray,
med. grnd, fresh
20-30% mafic (biot).

✓ Fracture zone, open
fractures and loose
blocks of cl to cl
spaced fr.

Joints O.C. is mainly base blocks
measurements taken to give
approx trend.

(156 cont)

S'(L153) to T'	48'	005°	25° down u3
T'-U'	30'	023°	20° down to east side
U'-V'	41'	285°/15° down	west side of gully
V'-W'	21'	307°	0
W'-X'	43'	278°	0
X'-Y'	58'	265°	0
Y' = W-81-	157		

Traverse plotted 6/5/01
 Closure - good

315/80 NE planar to sl. curved
 smooth spacing 2" to 6"
 || to trend of gully
 20/85 W planar to sl. irreg
 sl. rough spacing 1" to 3' (ave 6")
 45/15 NW planar smooth
 spacing ave. 1"
 335/20 NE sl. irregular sl. rough
 spacing 1' to 3'

Station at intersection of
 small gully 315° also
 appears to be face zone

W-81-157 at base of
 cliffs

Diorite / qtz diorite, med
 gray, red. gneiss, some
 fine grained and veins(?)
 like of dark green, andesite(?)

Y (157) to 2'	44'	310°	25° down	40
2'-A''	33'	305°	10° down	32
A''-B''	52'	275°	0	
B''-C''	45'	275°	15° down	43
C''-D''	51'	270°	10° up	50
D''-E''	48'	255°	24° up	44
E''-F''	15'	210°	-	
F''-G''	21'	254°	33° up	18
G''-H''	68'	265°	0	
H''-I''	54'	250°	15° up	52
		across gully prob free zone		
I''-J''	24'	300°	-	
J''-K''	36'	265°	-	

fresh, hard, a few
well defined joints

Joints

05/85 E planar smooth
spacing avg 2'

30/70 NE sl. irregular
sl. rough
spacing ~1' parallel face

330/25 NE planar to
sl. curved, sl. rough
spacing 6" to 12"

K'-L''	18'	275°	250'	Joan	16
L''-M''	41'	253°	0		
M''-N''	100'	254°	0		

Geol. plotted
6/5/81 C

June 4

AGENDA

Fins
Fingerbuster
Talkextra Thrust

Tour of Watana dome site
and Reservation

- A. Merrill
- V. Singh
- L. Wolfstey
- S. Thompson
- C. Crawford
- K. White

Flew around site for overall
view. Then stopped across
river from Fins to point out
major shears. Went across
river and hiked up to Fins
saw some of the minor shears
and climbed up above talus slope
noted several N-S shears

Landed at Quamby. A
 consensus that the andesite
 porphyry was a good, usable
 rock.

Flew upstream along Sunset
 (also Watana + Jay Creek) past
 Vee Canyon. Noted potential
 for clumping in the incised
 material (sands, gravels and
 clays) particularly on Watana
 and Jay Creek. These areas
 to be mapped later in summer.

Stopped near location
 of Talcottna Fault. Outcrop
 of metabasalt, brecciated,
 sheared, gouge over ~ 100 ft
 sample of basalt.

Flew over relict stream
 channel.

A. Merritt comments
 - Interpretation of features
 - Profiles across localities
 with all boring info
 including previous
 work.

DC - map
 relict fractures

Schedule of mapping activities

Boring or in for stress
 relief joints

Single Comments

Extend DC mapping to south
 to cover emergency spillway

Wednesday
 Outcrop map

5/5/81

Entourage flew to Devil Canyon
 for summary of mapping activities

5/6/81

66

Thompson + White
above "slide block"
south bank, Watana

From top of gully marked on
air photo:

PT A
shifted to
align with
gully
Bulge of dip porch in Tins
at river level
341° / 18° down
Top of "slide block"
13° / 11° down

A-B 26" 155° O east side of gully

B-C 41" 250° 25° down west side of 37
stream in center gully

C-D 24' 335° 35° down continuous 23
exposure from PT B down,
west side

D = W-81-159
gully is filled with
boulders 6" - 6 ft, or 1 ft

W-81-158 may be float
Quartz diorite? 10% of
dark green to gray,
sl. with, surface is
higher covered and
smooth, difficult to sample
outcrop approx 20 x 5' h!
Location not plotted

W-81-159

Diorite, med grained
sl. with, no qtz
light gray with FeOx stain
20-30% mafics (biot + Hbl)

3 11 160

Joints

300/80 W, irregular,
rough, parallel to
face and gully spacing 1-2 ft
some open 4"

260/10° W, rgh, cld,
spacing uncertain

225/74° S irreg, rgh,
spacing 5 ft

30/65° NW irreg, rgh,
spacing ~ 3 ft

D-E 62' 330 35 down Down 51'

center of
gully

E-F 52' 273' 20° down 49
below bend
EW face in
gully to continuation of
west face

F-G 21' 316° 20° down 20
G = outcrop 160 sample
outcrop continues from pt B

W-81-100

Despite as above may have
some gty, ol with surface,
fresh, hard, some CO₃ (?)
staining,

Joints

275°/82 S co, irreg rough
ap 3-5 ft

190°/8-10° W pl-slow, sm
ap 5 ft

305°/40° E ap 4-5 ft
slow, sm-slow
block failure along this
surface and 330 trend

G-H 31' 152° 30 down across 32' gully

H-I 65' 35° 10° down east 64 side of gully

I = W-81-161 sample outcrop from 30' horiz south of I

330/75° W dip - irreg, on - rgh, spacing 1-3 ft some open to 1 ft along aligned blocks

W-81-161 Diorite, light orange gray, fresh - bluish, gen fine grnd, one med, different from west side in grain size, generally massive with some areas of vcl to cl jts

Joints Major 335°/82° E irreg, co, rgh face - trend of gully 6"-1' and greater?

I-J 50 345° 29° Down 35

outcrop continues from I

J-K 18' 15° 0 18'

K = W-81-161A

outcrop continues

295/22° W sl, some
zone filling, crushed rock
sp. 3" - 1/2 ft
possible slippage along
surface CO₂ coating
photo K 8 - 29.30

90/70° N irreg,
sl open, 3-5 ft

W-81-161A

Dipote as above

✓ Fracture zone 1 ft wide
150/85° W, v. cl. for its open
rock is all mud with
many loose blocks
fracturing on either side of
zone but not intense
probably small frac parallel
to larger frac in gully?

K-L 61 314 40° down 47

L = W-81-162

Can see nearly continuous exposure of outcrop west side; East side also exposed but more vegetation.

Joint near face zone
40/43° S pl, sm,
2"-1ft, open

W-81-162
Diprite or above but
light greenish gray

Joint

115/12 SW
pl, sm, sp 2"-6"

65°/72° S irreg, sligh
sp 1'-3', cl.

160/78 E irreg, rgh,
sp 1-3 ft, with surf
parallel to gully

L-M 43' 4° 20° down 40'
 east side of gully onto
 slope

M-N 56' 65° 6° up 54'
 heading upstream
 across slope
 slope covered with
 boulders up to 3 ft
 and vegetation (thick)

N-O 55' 40° 13° down 54'

O is approx end of
 boulder field
 outcrop starts 55 ft from O

O-P 84' 55° 7° down Sample 83
 P = W81-163 tagged

130° to bottom of talus pile in Fms

123° to "point" S of Fms

W-81-163
 large gully with good
 exposure

Rock is highly variable in
 texture
 much seems to be
 1) diorite / gty diorite with
 veins, pieces (?) of fine
 grained, andesitic looking
 material, green,

2) fine grad, med-dk green,
 diorite(?) almost seems
 andesitic

3) Combination of above

Outcrop is close to contact
 zone with andesite and rock
 may be result of mixing or
 injection of andesite

Outcrops are slumping
along EW trending
joint.
Few if any blocks in
place.

Strike of gully $330^{\circ}/65^{\circ}$
face is K_2O_3 stained

$95^{\circ}/8^{\circ}$ tight fracture
approx 100 ft uphill
from P
2" - 1 ft wide

Several sets of slicks

Major

surface 50/70°S

slicks dip 10°W, grooved
and irregular surface
covering 10's of sq ft of outcrop

inner

surface 105/150°E

slicks dipping 15°N

block may be slumped
side of block is grooved
and polished into
an irregular surface

No gouge or friction appears
across with these
features joint surface
are gone closed to sl open

Photo K8-31

both sets of slicks & slickensided

NE set on right

Photo K8-31 NE set

P-Q	39'	020°	0	39
Q-R	55'	025°	10° down	54
R-S	29'	009°	30° down	25
S-T	80'	055°	0	80

T-U	85'	036°	20°	leading to 80
U-V	62'	049°	007° down	open area in saddle 62
V-W	37'	037°	006° down	37
W-X	71'	050°	005° down	71
X-Y	64'	025°	19° down	64
Y-Z	39'	000°	19° down	39
Z-X	62	040	0	62
X-AA'	53	35°	0	53
in saddle at open area - western end				

at Point T

33 34 35 86
 Photos 1/8 - 32, 33, 34
 looking toward Fin

5/7/81 Secondary
K White, C Crawford south
bank, Watona
to map upstream

Start at DH 21 (A)				
A-B	99'	70°	0	
B-C	83'	75°	0	
C-D	74'	135°	25° up	67'
D-E	67'	95°	20° up	63
E-F	46'	130°	45° up	33
F-G	42'	105°	45° up	30
G-H	48'	100°	30° up	41
H-I	35'	125°	25° up	32
I-J	40'	130° (?)	30° up	35
J-K	15'	105°	0	
K = W-81-164				Sample tagged
base of outcrop				

W-81-164

tagged

88

Quartz diorite, med.
grnd, light gray, ~10%
qtz, 30-40% mafic (bis
and Hbl (?)), fresh, hard
jointing gives outcrop blocky
appearance, many loose blocks
on face, sliding off along 200/85
joint set

Joints

200/85 N planar, sl. rough
|| to O.C. face
spacing ~ 1' and greater

310/85 E planar to sl. curved
smooth
spacing 1' to 4' (ave 2')

350/20 E planar, smooth
spacing 4" to 18" (ave 12")

30/85 NW planar, smooth to
sl. rough
spacing 2" to 3' (ave 12")
some fracturing || to set w/
blocks slumping off o.c.

Point K continued outcrop
begins 40' at bearing 210
from K
vertical exposure ~ 40 ft high

K-4 25' 55° 20° up
Outcrop continues 20' past L
L-M 39' 75° 0
talus slope, moss covered

M-N 23' 78° 0
west edge of small gully

N-O 27' 136° 0 east
side of gully
O = W-81-165
outcrop extends across
gully 20'
O in east end of exposure

W-81-165

Qtz(?) diorite, med greenish
gray, med grnd, Qtz(?)
30-40% mafics, fresh,
larger blocks on either
side of gully, more
slaked jst in 8 ft
wide zone in center

Joints

245/vert planar smooth
face of oc.
spacing ~ 2'

310/75 SW planar to irreg
smooth
spacing 6" to 2' (ave 12")
- generally open up to 1"
in center zone
degree of "fracturing" ? all
appears to follow trend of
gully, up slope indicating
depth into hill > 10'

O(165) to P	21'	30°	0°	
P-Q	54'	70°	0°	
Q-R	49'	90°	0°	west side of gully, landslide
R-S	48'	70°	0	east side of gully, no exposure, angular blocks generally 6" - 1', up to 2 ft
S-T	27'	90(?)	20(?)	24 on now covered talus slope
T-U	39'	50°	10° down	35
U-V	27'	95°	10° up	27
V-W	46'	115	20° up	42
W = W-81-166 face trend 30° and ends 25' 210 from W				

280/20N near to sl. curved
smooth
spacing 3" to 2' (ave 12")

25/85 NW sl. irregular
smooth to rough
spacing ave 12"

Note: Intersection of 25/85 NW
and 310/75 form gully to
"V shape"

W-81-166

Diorite, med grnd, light
gray to light greenish
gray, fresh, hard
conspicuous open joints
on face of outcrop blocks
may have moved, joint
readings are questionable

W 1166 to X 27' 033° 30° down 23
outcrop continues above
talus below

X-Y 47' 112° 20° up 43
X = W-81-167
base of cliffs - 50 ft
high

Joints

check for rotation

55/vert sl curved smooth
spacing are 12'
11 ac face
Joints open to 2"

325/80 NE. Harar, smooth
spacing 1' to 2'

20/20 N. Harar, smooth
spacing 4" to 12"

Minor sets discontinuous

W-81-167

Diorite / Q Diorite, med grnd,
light greenish gray, fresh
hard, minor red staining,
30-40% mafic

Series of slump blocks
sliding along several
joint sets

Y (unit) to Z 39' 150 35° down 32

Z-A' 25' 120° 0 west
 side of very narrow,
 deep gully, trend 320°
 walls dipping 85° NE
 gully filled with clean
 angular, blocks 6 into
 2 ft long; trend along
 major NW joint set
 fracture zone; jointing
 on gully walls, widely
 spaced

Joint

305/85 NE planar to sl. curved
 smooth
 spacing ~ 3'
 - slumping parallel blocks
 (large > 5' wide 20 high)
 pulling away from slope

70/80 NW planar to sl. irreg
 smooth
 spacing 6" to 3' (ave.?)
 - helps form blocks (15x4x20 ft)
 - open to 1' filled with
 rubble (small blocks)

30/05 NW planar to sl. curved
 sl. rough
 spacing 3' to 18'

A'-B'' 49' 150 30° down 42
 east side of gully
 35' from point A''
 B=W 81-168 samples
 outcrop continues above
 us

W-81-168 outcrop blocky
 Quartz diorite, medium
 grained, light gray to light
 greenish gray, 10-20% qtz,
 somewhat larger grain size
 than previous, 20-30%
 mafics (Hbl), compositional
 and textural change from
 previous outcrops,

West side of outcrop -
 mafics are predominantly
 biotite (25%, fine grained)
 and Hbl 5%
 grain size is fine-medium
 appears to grade into
 comp. + text to east side

Joints
 major

40/85 SE planar, smooth to
 sl. rough
 parallels oc. face
 approx spacing 1' to 2'

305/80 SW planar, smooth
 spacing 2' to 3' (ave 12")

near

0/60E planar, smooth
spacing ~ 3' to 4'
discontinuous

290/10 N sl. irregular
sl. rough spacing 4" to 2'
core 6 to 12"

Samples - finer B west
coarser A east

W-81-169

Qtz diorite, light gray,
fine-med grnd,
10% qtz, 20-30% mafic
(Hbl and Biot(?)) gr fresh,
sl. wtd surface
face of cliff appears to
be a series of detached
blocks, parallel to
the 290° joint set

B'-C' 25' 60° 0°
corner of outcrop

C'-D' 23' 145° 50° up 14

D'-E' 30' 130° 40° up 20

along massive face
trending 305°/85 NE
traversing along
base of face, talus
below, face 30-50' high

E'-F' 26' 80° 0°

F'-G' 16' 95° 0°
beneath cliff, talus below

G'-H' 31' 115° 25° up 21

H = W-81-169

H(49) to return to G'

G'-I' 24' 60° 30° down 2'

I'-J' 27' 122° 30° up 23'

J'-K' 32' 93° 0°
 east side of gully
 fogged with yellow
 ribbon

K'-L' 34' 90° 0°

L'-M' 28' 85° 0°
 Outcrop begins 10 ft west M'

M' = W-81-170 Sample
 continues 40' at 125°
 ends at gully

305
 180
 125

290/75 N parallels 2x face
 planar, smooth
 spacing ~ 2' to 3'

70/15 N planar to d. irregular
 sh rough
 spacing 2" to 5" (avg 2')

10/80 W planar to irregular
 discontinuous
 smooth to rough
 spacing 1 1/2' to 3'

W-81-170

Diorite (Qtz Diorite?)
 med. grnd, light gray
 to light greenish gray
 20-30 mafics (biot +
 hbl), all with surface,
 gen fresh, hard

Joints

55/85 NW planar

M'-N' 33' 0/5° 35° down 27
 (70) west edge of narrow
 gully filled with
 angular blocks 3' to
 2 ft long
 east side 20' at 95° from N'

N'-O' 45' 95° 30° up 30
 "beginning of outcrop
 - vegetated below"

O'-P' 27' 70° 30° up 30
 P' = W-81-171
 outcrop
 25' high
 (continued)

(170 cont)

sl. rough
 spacing 1' to 2'
 few open 1/2" to 2"

340/vert planar smooth
 spacing 2' to 3'

175/85N planar smooth
 spacing 2" to 3" (ave 18")

305/80NE face of o.c.
 planar, smooth
 spacing ?

W-81-171

Describe as at previous
 outcrop light greenish
 gray, med. grained
 mafic, mostly Hbl, fresh
 outcrop broken along
 two prominent joint sets

Joints

50/80NW oc.
 planar smooth

P(171)-Q' 27' 50° 0°
outcrop continues

Q'-R' 48' 70° 0°
end of outcrop above us
approaching gully

R'-S' 41' 35° 25° down 23'

S'-T' 35' 110° 20° down 23'
center line of summit
line

T'-U' 27' 80° 20° down 24'

U'-V' 27' 110° 15° up 20'
in large gully
talus filled & vegetated

V'-W' 31' 75° 10° down 25'
talus blocks 6" - 2ft, gen 1ft

W'-X' 23' 72° 0°
beginnings of outcrop

spacing 2'-3' (?)

② 295/75 N planar smooth
spacing 1' to 2'

50/15 NW irregular rough
discontinuous
spacing 2' to 3' (see 1-2)

✓ Fracture zone at o.c. base
along 50/15 NW joint - 12"
wid - looks slumped.
N.C. joints

Point R' 05
Photo K9 - X
looking w/s at
"slide block"
Quarry L

W. 50/15

X'-Y' 17' 100° 25° up B

Y'-Z' 41' 125° 35° up 34
Z = outcrop W-81-172

Z'-A' 73' 35° 40° down anisogully
talus continuous exposure
above dip 56

A''-B'' 41' 82° 5° down
outcrop

B''-C'' 38' 80° 20° up 35
C'' = W-81-173 sample

W-81-172

Diorite, medium grained
light greenish gray
as at previous outcrop

Joints

25/80 SE sl. curved
sl. rough spacing 6" to 3'
(ave 1' to 2')
some are open 3' to 4"

290/85 N parallel to sl. irregular
sl. rough
parallel to D.C.
spacing 4" to 4" (ave ?)

NS/10 E sl. curved sl. rough
spacing 1' to 2'

~~C11/41721~~ to

U-81-173

Diorite (Qtz dio), med grnd,
light gray, qtz⁺?, fresh,
hard, no fls, 20-30%
mostly bio.

base of large exposure
~ 100 ft high, a few
widely spaced joint sets

Joints

290/85N planar to sl. curved

sl. rough

spacing > 3' parallel
o.c.

some open to 2"

possibly slumped

305/65N planar to sl. curved

smooth

spacing 2' to 3'

some slumping noted

40/85SE to 85NW

C" (L73) to D" 53' 105° 25° up 53
along base of cliff
widely spaced jts

D" - E" 36' 90° 0°
E-W-81-174

(L73 cont)

sl. curved smooth
spacing 4" to 2 1/2' (ave 1 to 2')

300/40 S sl. irregular
sl. rough
spacing 1' to 2'

Photo K9-6
Outcrop

W-81-174

Diorite (Qtz Dior) as
at previous outcrop
smooth massive faces

Joints

35/85 W sl. irregular
sl. rough
forms one face of o.c.
spacing 6" to 3' (ave 1 1/2 to 2')

①

300/85 N planar smooth
spacing 1' to 5' (ave
forms other face
often joints to 8" of large
blocks

E"-L174) to F"	14'	70°	0°
F"-G"	32'	95°	0°
west side of gully at 23'			
G"-H"	27'	110°	20° up
in gully talus filled base, outcrop above trend parallel NW pt set			
H"-I"	20'	90°	0°
east side			
I"-J"	16'	68°	0°
base of cliff			
J"-K"	32'	98°	0°
K" = W-81-175' sample			

174 con'd

55/10 SE Sl. irregular
sl. rough
ave spacing 3'

Point G

✓ 8 ft wide zone where
NE trending set pts are
v. closely spaced (less than
2") no topo expression

K-81-175

Q to Pointe, light gray
med. grnd, ~100% of
20-38% mafic (biot
and Hbl), fresh,
outcrop is blocky
along major joint sets

Joints

35/85 W Honor to sl. irreg.
sl. rough
spacing 6" to 1'

K' (175) 26 6' 45' 150° 300° down 39

4"-M" 44' 350° 35° down 36,
west side of gully, trend 155°
east side 18' from M"

M"-N" 33' 85° 0°
gully filled with
angular blocks
6"-3', or 1 ft

N"-O" 40' 65° 0°
outcrop above
~ 20 long ft

O"-P" 31° 90° 0°

P"-Q" 17° 125° 0°
base of outcrop
W-81-176

(175 con't)

330/85 NE planar, smooth
spacing 6" to 12"

Minor

310/55 SW planar sl. rough
discontinuous
spacing $\geq 1'$

270/30 N sl. irregular sl. rough
spacing 2" to 10" (ave 12")
discontinuous

W-81-176

Diorite, fine-med grained,
light greenish gray,
sl. wtd surface, gl. fresh,
20-30% mafics (mostly
biotite)

Joints

35/20 NW planar to sl. irreg
smooth to rough
spacing 6" to 12"

Q(17b) to R" 32' 92° 15' up 30

R"-S" 68' 65° 0°
outcrop above
gully 30' from S"

S"-T" 45' 75° 0°
east side of gully
gully filled with
angular blocks
as 1 ft
no outcrop

T"-U" 41' 180° 30° up 35

U"-V" 61' 70° 0°

V"-W" 62' 55° 0°

W"-X" 100' 50° 10° down 99

X"-Y" 34' 70° 0°

305/75 NE planar, sl. rough
spacing 1' to 2'

275/50S irregular, sl. rough
spacing 4" to 2" (ave 12")
white. CaCO₃ (?) coating

Y-Z 39' 750 - 100 down³³

2" W-81-1717

20x10' to wall exposure in gully.
running water

W-81-1717

Diorite, dark greenish
gray, medium fine grained
20 to 30% mafics (hcs
and hbl)

light yellow, fine grained
felsic dikes, from
1" to ~ 6" no
discernible trends

Joints

35/80 W planar, smooth
spacing 8" to 12"

315/80 NE planar, smooth
spacing 6" to 12"
open to 1/2"

These two form gully
trend NS



Minor

10/40 E slightly irregular
smooth discontinuous
spacing 2" to 12"

2" (177)	to A	22'	35°	0	18
A ³ - B ³		45'	75°	25° up	42
				across gully to ridge	
B ³ - C ³		40'	80°	0	
				across gully trend 330°	
C ³ - D ³		31'	25°	15° up	30
D ³ - E ³		18'	75°	25° up	17
E ³ - F ³		18'	70°	0°	
F ³ - G ³		31'	120°	0	
				outcrop from F ³ - G ³	
				G ³ = W-81-178	
				15-20' high	

(177 cont)

minor subhorizontal sets w/ varied orientations

Point D³
boulders / outcrop
Diorite and felsic dike material

W-81-178

Diorite, med gray, med grained, mottled
FeOx and CO₂ (?) stain
outcrop overall has a fractured appearance, though it is still hard and resistant

Outcrop on edge of gully

Joints

300/75 NE face of oc
planar, smooth to sl. rough
spacing ~ 1' to 2'

(178 cont)

G³(178) to H³ 55' 70' 10° down 52'
 in broad, wide gully

H³ - I³ 45' 35' 0

I³ - J³ 31' 0° 25° down 29'

J³ - K³ 25' 340° 25° down 24'

East edge of gully
 rock wall 20' high
 extends up slope
 at least 200'

K³ = W-81-179

355 / 20 W irregular, rough
 discontinuous
 spacing 2" to 3"

minor 20 / 85 E irregular, rough
 discontinuous
 spacing 2" to 3"

W-81-179
 same as 178

Joint 315 / 85 SW planar to sl. curved
 smooth
 spacing 2" to 18" (ave 6")
 Parallel band of gully

55 / 85 SE - 85 NW planar
 sl. rough discontinuous
 spacing 3" to 18" (

minor 340 / 30 SW irregular
 sl. rough spacing 2" to 3" (ave 2")

(177-15)

L³(179) → L³ 42' 355° 20° down to corner of outcrop

L³-M³ 28' 40° 0° end of outcrop

M³-N³ 26' 50° 35° up 21

N³-O³ 21' 70° 25° up 19

O³-P³ 25' 15° 0

P³-Q³ 30' 70° 7° up 32

Q³-R³ 53' 12° 15° down 51

at tree above
winter mapping outcrop 80-75

edge of gully
filled with angular
blocks 2'-1 ft
outcrop d/s from river
joint pattern

Traverse C Plotted
6/2/81

5/8/81

K White + C. Crawford
South bank at Watanan
S/S DH28

From DH 28. Point A

A-B 76' 40° 10° down 75
Andesite boulders

B-C 96' 40° - 15° down 43

C-D 82' 50° 18° down 81

D-E 41' 270° 0

E-F 19' 270° 0
outcrop begins below us; cliff face 20-30'

F-G 28' 230° 30° up 24

G-H 34' 264° 0

H-I 30 90° 10° down 24

outcrop top of small gully

I = W-81-180

outcrop extends below
traverse, back to ~ pt E.

Sample
tagged

total

SW-B ~ 7 ft part of
DH-28

Point C

Andesite boulder field

W-81-180

Blocky outcrop, trend 65°
Andesite porphyry, med.
greenish gray, aphanitic
groundmass, 20-30%
white plagioclase phenocrysts
to 1/4 inch, ~ 10 to 20%
mafic (can't tell if bio or hbl),
inclusions of melanite(?) or
metased(?) to 1/2 inch, green,
aphanitic to fine grained.

Check color with diorite

Joints

345/40 E planar to sl. curved

I-Lies to J	36'	315°	0	
J-K	44'	345°	0	
K-L	31'	0°	25° down	20
			outcrop continues, andesite	
L-M	39'	270°	0°	
M-N	37'	305°	0°	
N-O	32'	10°	20° down	
			outcrop continues below	
			10-20' high	
O-P	27'	10°	35° down	18
P-Q	35'	135°	0	
			W-81-181	
			No outcrop between Q+R	
Q-R	31'	145°	10° up	81
			R = W-81-182	
			tagged sample	

sl. rough
spacing 6" to 2' (ave 18")

340/85 E curved, smooth
spacing 1' to 4' (ave 2')
crabbling are fracture
zones up to 1' wide

70/85 NW face of o.c.
planar to irregular, smooth
spacing > 6"

W-81-181

Quartz, Diomite / Diomite,
fine med grnd, light gray
to light greenish gray,
sl. with to fresh,

felsic dikes, light yellow,
1/4 to 6 in wide
6" trends 30°/85° NW
outcrop is with, can't tell
orientation of others

W-81-187

Andersite/Diorite Breccia

Andersite to diorite groundmass
aphanitic to fine grained,
≤ 10% qtz in groundmass,
very thin qtz veins to 1/8 in
inclusions of: angillite,
dark gray, tabular, to 1 in;
andesite porphyry, green, aphanitic,
plagiophenocrysts to 1.5 in; green
"aphanitic to fine grained fragments
of andersite (?)

Fragments make up
35 to 50% of rock

Janes

315 / 85 NE planar to sl. irreg
smooth

spacing 6" to 3' (ave 1')

mostly all open 1/4" to 6"

70 / 05 S irregular rough
spacing 18" to 3' (ave

R-S 25' 62° 0

S-T 45' 135° 15° down 43
W-81-183

T-U 31' 75° 35° down 25

U-V 49° 100° 0°
across small stream

(102 East)

Minor

00/85 W to ESE planar to irreg,
smooth to rough, discontinuous,
spacing 6" to 2'

50/50 NW irregular, rough,
spacing 2" to 3' (are 2 to 3')

W-81-183

Andesite breccia,
andesitic groundmass.
(apparently) green, fresh to
sl. oxid., FeOx stain on
some jts.
30-40% rock fragments
same as at 182

possible slumping along
NW trending jts

str.

65°/90° face
pl, sm - rgh,
spacing ~ 1-2 ft

V-W	38	75°	15°	down	37
W-X	43	98°	0	Continue beneath outcrop	
X-Y	46	110	20		43
Y-Z	26	100	24		24
Z-A'	49	100	-	East side of gully	
				A' = W-81-184	
A'-B'	22	135°	25°	up gully in frac zone	20
				Continued as W-81-184.	
				Samples tagged	

W-81-184

Andesite porphyry
aphanitic, greenish gray (?),
plug phenocrysts, fresh to
all well

breccia
Andesite grades ~ eastward
into andesite porphyry
with a few clasts

Fracture zone
vel to ch str FeOx sta
crosses major gully (trending 5°)
305/90
appears about 30 ft wide
at edge of major gully
but seems to narrow
+ form small gully
10-15 ft wide up slope

at Point B
rock in center of gully
approx 5-6 ft wide of

B-C 51 135 45° up 36
 up face zone
 gully 10-15 ft wide

C-D 38 110 (60) 19
 turn back to step

Plotted 6/11/81
 closure seems off
 check against total
 K.E.J. do today
 corrected 6/20/81
 K.S.W.

rock has sheared and
 granular appearance, somewhat
 schistose in places;
 rock is soft to hard, appears
 to be a healed shear zone
 andent path on either
 side
 also a gouge zone 11"
 wide parallel to bend

Samples
 gouge
 "schistose" rock
 "massive" rock

Point C
 rock on both sides
 of gully is andent path
 south side massive
 and
 north side is highly
 fractured, CO₂ outcrop

A²-B²

working toward DH 28

A = W-81-185

sample
log

W-81-185 40 x 20' h

Granodiorite (?) 20-30% qtz
fine grain, light orange
gray, 10-20% mafics,
(possible K feldspar, pink
may be due to weathering)

talus pile in front of
outcrop consists of
small irregular fragments,
Fe-Ox str, mod wldd

outcrop is CO₂ str, generally
fresh

✓ Probable fracture
zone, subparallel
to previous outcrop's
Shear is 305°

Joints

305/vert face of o.c.
Damage to sl. irregular
spacing > 1'

185	to C ²	49	06°	44°	35
	D ²	40	84	0	
	F ²	46	25	10	45
	F ²	74	45	20	70
	G ²	26	60	0	
	H ² DH=21	56	62	18	53

125 cont

142

75/25 NW planar, smooth to
slightly rough,
spacing 8" to 2' (ave 18")

05/70 E. planar smooth
spacing are 1' to 2'

315/60S planar, rough
spacing 6" to 2'

6/10/81

KW White + C. Crawford - Watona

return to point H on
yesterday's traverse

working 2/s

H-I' 21' 305° ☉

outcrop from Point I', 8' high

I'-J' 27' 295° 20° down 25

~~25~~ J'-W-81-186 3

J'-K' 34' 285° 0°

outcrop continues

sample

144

W-81-186

Diorite/andesite gradation
green, fine-medium grained,
dioritic composition seems
to be a gradation from the
andesite (east) to the diorite west,
fresh, hard

Note: outcrop appears massive
so order of joints in
decreasing confidence

Joints

285/70 N planar to sl.
curved, smooth
face of o.c.

325/vert planar, smooth
spacing > 1'

Point K'

gradation completed to diorite
medium grained, greenish gray

K'-L' 27' 325° 0°

L'-M' 22' 245° 20°
along base of outcrops

M'-N' 28' 270° 0°
end of outcrop, small
gully

N'-O' 42' 260° 0°
outcrop
O' = W-81-187

Point M'
Disconite

W-81-187

Disconite, light orangeish
gray, fresh-splinted,
well ground, outcrop
CO₂ (?) stained and
broken along several
distinct joints.

Joints

90/55N planar to sl. irregular
rough
spacing 18" to 3'

0/vert irregular, rough
spacing 2" to 3'

85/40S planar, smooth
spacing 1/2" to 2" in
fracture blocks generally
however 2' to 3'

O'-L187 to P'	37'	285°	07° up	37
P'-Q'	40'	290°	10° up	39
Q'-R'	55'	312°	0°	
R'-S'	64'	0°	25° down	60
S'-T'	61'	300°	15° down	59
T'-U'	28'	25°	15° down	21
U'-V'	18'	310°	0°	
V'-W	35'	275°	0°	
W'-X	52'	25°	20° down	49
in center of gully				
X'-Y'	107'	308°	0°	
W-81 - 188				
Y'-Z	46'	305°	0°	

W-8-188 in large gully

Diabase, med grnd, fine gr,
fresh, sh with surface,
outcrop has fractured
appearance

Joints

345/80SW parallel to sl.
curved, sl. smooth
spacing 6" to 2' (base 1' to 2')

Approx. trend of gully
270/20N

Z-A	44'	265°	0°	
A-B	43'	280°	0°	
B-C	33'	325°	0°	
C-D	62'	26°	20° down	71
D-E	49'	79°	16° up	47
E-F	75'	325°	20° down	71
F-G	39'	235°	10° down	37
gully, trend 353° 15-20' feet wide				
G-H	27'	255°	20° up	27
W-81-187 H = base of solifluction flow				

Photo K7-10

Fingerbutter from
Point H

W-81-189

solifluction flow
extends 40 ft upslope
25 ft wide
sandy gravel
boulders to 1 ft
generally cobbles
to 2 in, appears to
be fairly recent,
lack of erosion on
surface

rock fragments subangular
to subrounded
30-40% sand

Photo 189-11
flow

H-I	80'	295°	10° down	79°
I-J	100'	30°	10° down	91
			no outcrop	
J-K	51'	300°	10° down	50
K-L	41'	303°	5° down	41
L-M	91'	30°	20° down	85
			Top of large NW blocky fully	
M-N	44'	60°	10° down	43
			small outcrop 10' x 5' loose blocky	
			W-81-190	
N-O	47'	200°	15° up	45
O-P	41'	220°	0°	
P-Q	25'	220°	0°	

Bent L

K 9-12 + 13

Fingert

W-81-190

Diabase med grnd,
greenish gray, fresh to
slightly altered,

Q-R 23' 310° 30° down S
W-81-190A

R-S 23' 225 0° down up

S-T 46' 220 15° down 45
in small gully toward 300°
outcrop continues from S
W-81-90B

W-81-190A

Andesite, med gray,
aphanitic, plag phenocrysts
approx 20-30%, fresh,
hard

Joints

330/85 NE planar to curved
smooth
spacing ave 1' to 1 1/2'

65/80 NW planar to sl. curved
sl. rough
spacing avar 1'

270/70 S planar, smooth
spacing 1' to 2'

Sample

T-U	20'	90°	14°	up	19
U-V	48'	340°	36°	up	40
V-W	34'	185°	25°	up	31
W-X	58'	150°	20°	up	55x
X-Y	56'	195°	15°	up	54
Y-Z	60'	220°	0°		
Z-A'	48'	210°	15°	up	46
A'-B'	49'	230°	0°		
B'-C'	41'	240°	0°		
C'-D'	55'	240°	0°		
D'-E'	43'	230°	0°		
E-F	241'	230°	0°		
edge of gully, lineament					

W-81-120B

Ascent as at previous,
outcrop

trend of gully is
parallel to line
mapped yesterday

no exposure in this
gully, rock on either
side is massive
west side is a wall
approx 60' long and
36-40 ft high

F-G 61' 300° 20° Down 57

G-H 41' 10° 20° Down 39

east side of
gully, outcrop starts

H-I 40' 345° 15° Down 38

outcrop continues, 20' high

I = W-81-191

return to

~~F-G~~

W-81-191

east side of gully
andesite, greenish gray,
aphanitic, 20-30%
plagioclase, phenocrysts,
indistinct fresh band
outcrop generally
massive

Joints

300/70 NE Sl. curved
Sl. rough
spacing 6" to 75' (ave 2' to 3')

25/65 SE planar smooth
discontinuous
spacing 2" to 5' (ave 3' to 5')

F-J 29' 180° 0°
W-81-192 5' high

J-K 44' 160° 35° up
outcrop end 36

K-L 27' 135° 35° up 22

L-M 18' 60° 30° up 16

M-N 44' 145° 20° up 41

N-O 83' 115° 15° up 80

O-P 55' 170° 20° up 52

P-Q 56' 125° 15° up 54

Q-R 30' 135° 15° up 29

R-S 29' 195° 0.3° up 27

S-T 56' 130° 20° up 55

W-81-192 A

Andenite as at
previous outcrop
(191)

Joints

Major

315/70 E to vert. planar, smooth,
spacing 2" to 3' Can 18" to 24"

50/60 NW planar, smooth,
spacing due 1' to 2'

Minor

05/45 E planar to sl. curved
smooth, discontinuous
spacing 2" to 18"

T-U 54' 165° 15° up 49

U-V 73' 145° 20° up
seismic line

V-W 100' 90° 0

W-X 84' 90° 0
shot hole
andesite fragments
sample
N-81-192

X-Y 178' 90 0

Y-Z 92 80 0
solifluction flow, 20' wide
50' ft above, 80' ft below

Z-A' 87' 90° 0

A'-B' 160' 90 0

B'-C' 160' 90 0

C'-D' 98' 90° 0

D-E 102' 90 0

82' from D shot hole
andesite

DH-28

84' 8
52

CURVE TABLES

HOW TO USE CURVE TABLES

Table I. contains Tangents and External to a 1° curve. Tan. and Ext. to any other radius may be found nearly enough, by dividing the Tan. or Ext. opposite the given Central Angle by the given degree of curve.

To find Deg. of Curve, having the Central Angle and Tangent: Divide Tan. opposite the given Central Angle by the given Tangent.

To find Deg. of Curve, having the Central Angle and External: Divide Ext. opposite the given Central Angle by the given External.

To find Nat. Tan. and Nat. Ex. Sec. for any angle by Table I.: Tan. or Ext. of twice the given angle divided by the radius of a 1° curve will be the Nat. Tan. or Nat. Ex. Sec.

EXAMPLE

Wanted a Curve with an Ext. of about 12 ft. Angle of Intersection or I. P. = 23° 20' to the R. at Station 542+72.

Ext. in Tab. I opposite 23° 20' = 120.87
120.87 ÷ 12 = 10.07. Say a 10° Curve.

Tan. in Tab. I opp. 23° 20' = 1183.1
1183.1 ÷ 10 = 118.31.

Correction for A. 23° 20' for a 10° Cur. = 0.16
118.31 + 0.16 = 118.47 = corrected Tangent.

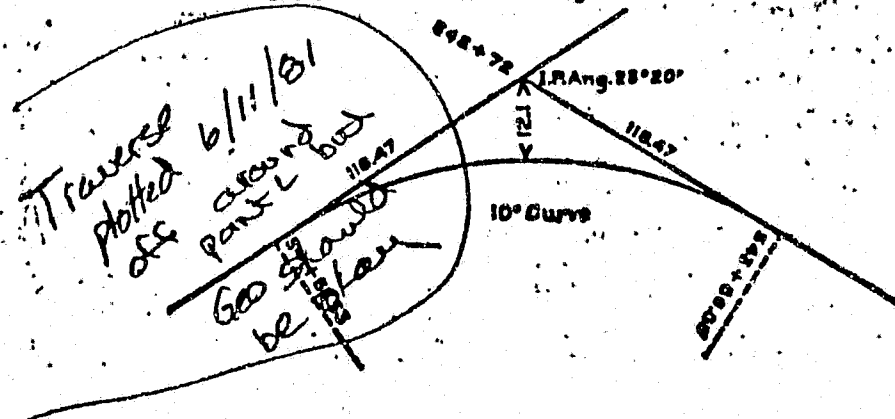
(If corrected Ext. is required find in same way)
Ang. 23° 20' = 23.33° + 10 = 2.3333 = L. C.

2° 19½' = def. for sta.	542	I. P. = sta.	542+72
4° 49½' = " " "	+50	Tan. =	1 18.47
7° 19½' = " " "	543	B. C. = sta.	541+53.53
9° 49½' = " " "	+50	L. C. =	2 33.33
11° 40' = " " "	543+	E. C. = Sta.	543+86.86
	86.86		

100 - 53.53 = 46.47 × 3' (def. for 1 ft. of 10° Cur.) = 139.41' =
2° 19½' = def. for sta. 542.

Def. for 50 ft. = 2° 20' for a 10° Curve.

Def. for 36.86 ft. = 1° 50½' for a 10° Curve.



STATION NOTES DEWMS
CANYON & WATANA

COMPILED BY

BARBARA HOLM
DUN KERNZON
MAY & JUNE 1981

AAI Book 12

5-25-81 (4)

2-83

Joint II $152^{\circ}/87^{\circ}$ smooth/planar/
clean, continuous, g/c face here,
est are spacing 1 ft.

STATION 4 ~~(STATION 4)~~

Joint I $156^{\circ}/79^{\circ}$ E: g/c face
Spacing observed 10". Smooth to
rough, slightly curved, continuous.
Slight parting on joint surface
(slight grainy movement).

Joint II $140^{\circ}/12^{\circ}$ SW planar,
smooth, discontinuous (8 ft)
5 ft spacing (2-6' range) are.

Joint III $170^{\circ}/66^{\circ}$ E variation
of Joint I, spacing 6", slightly
curved.

Bedding $54^{\circ}/69^{\circ}$ SE weathered
rough 6"-2' are 1 ft obser-
ved. Discontinuous, clean
Dark gray argillite & quartzose
argillite.

Monday MAY 25 1981

5-25-81 (1)

AM flew to Watana camp AM.
Conf w/ Jim Heinzen & Mike Bruin.
Lunch. Then brief chopper recon
of canyon. Jim & I rappelled down
gulley S side of canyon.

Waterline Station 1 ~~(STATION 1)~~

1) Argillite 60%

2) Argillaceous

Sandstone bordering
on Argillaceous qtz
40%

E W

Station 2

Station 3

Texture: swirly

Texture are, or probably from
swamping of sediment along
inclined slope. Quartz rich
segregations 0.5-5.0% of rock
Also 0.5-2.0 ft wide light
green band hydrothermally
altered w/ minor sulfides (no
structural weakening).

Joint I $134^{\circ}/3^{\circ}$ NE minor
develop 3 to 8 ft (are 5' +) smooth
w/ 1 mm quartz coating, planar,
continuous over 40' o/c.

S-25-81 (2)
not continuous (width 15 ft)
Joint I 2°/70° W, ave 1 ft (4" to 2 ft range, planar, semi-smooth, clean (2nd in development)
Joint II 320° (40°)/34° E, smooth, major joint set here, 1" - 4 ft (ave 1 ft). 15' max width
Joint III 50°/84° NW; semi-smooth to rough, ave 2 ft spacing range, 1-5 ft spacing, discontinuous - max 15 ft
Note - no distinct bedding.

Station 2 (S-25-81) 60 ft above waterline. Purpleish gray argillaceous sandstone / qtz + sandstone. Also dark gray to black argillite. No calc? because taken over.

Note: for Station 1. Some of the quartzite is primary with some distortion from slumping. However, its real ore is all quartz. No carbonate. Not some quartz underlain. Need to see more exposure to understand fully.

S-25-81 (3)
Joint I 31°/36° SE rough, curved 3 surfaces @ 3"-2' spacing continuous over 4 ft of 10 ft g/c. Ave spacing 10 ft.
Joint II 50°/82° E, smooth, planar - 3 @ 2.5" spacing, continuous over 3 ft length of 5' dimension in that direction of g/c. Semi-smooth no stain/fill. 1 other surface @ 1 ft spacing. Ave spacing 6", but localized.

STATION 3 (S-25-81)

Gray quartzite w/ feldspar porphyroblasts (comp. 81, 82). 0-3% pyrrhotite & up to 1/2% chalcopyrite. The rock must have been altered by some form of heat &/or pressure, poss w/ solutions. Also quartz porphyroblasts.

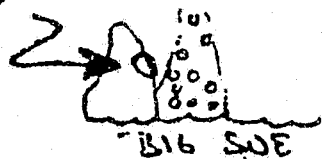
Joint I 120°/12° SW, planar, smooth, 6 joints over 10 ft, 6" - 4' apart. Ave spacing 1.5 ft, clean continuous.

go back to page 1

5-26-1981 ①

Station 5 & 6 Same gully as yesterday w/ Mike & Jim all rappelling down. Plan to leapfrog stations. These stations (D81-86 & D81-87) 80 ft above (approx) river, S bank E side gully.

looks like large block ~ 140 ft tall which has separated from main wall. Approx 5 ft separation. Were the dam placed up against this block water would likely wash out debris now lodged in separation.



Station 5 from detached (3) block
* Joint I $78^{\circ}/78^{\circ}$ NW, planar, smooth, very continuous. From this vantage point appears to be main separation/parting plane of block detachment. NOT parallel with joint surfaces (any) on main wall. Dips $\sim 50^{\circ}$ counterclockwise rotation. First 5' adjacent to (open 1" in places).

5-26-81 ②

separation spacing $\frac{1}{2}$ " - 1 ft, ave 4". Then becomes discontinuous w/ $\sim 3'$ spacing northward through block.

* Joint II $152^{\circ}/68^{\circ}$ W Smooth, slightly wavy, clean, continuous, ave 1 ft spacing.

Joint III approximately horizontal rough, irregular $1\frac{1}{2}$ to 5 ft spacing - ave 2.5 ft. clean, appears continuous.

Joint IV $172^{\circ}/81^{\circ}$ W, smooth, discontinuous, planar. One zone 1.5' wide 20 joints, ave 1" wide, clean. Rock massive argillite, no distinct bedding.

Station 6 (~~21-27~~) 6 ft away across soil fill - main cliff wall (solid). Same argillaceous material here w/ micaceous sheen.

Bedding: $170^{\circ}/80^{\circ}$ W (?)

$170-78 = 92^{\circ}$ & w/ main joint part on block. This surface main parting

5-26-81 (3)

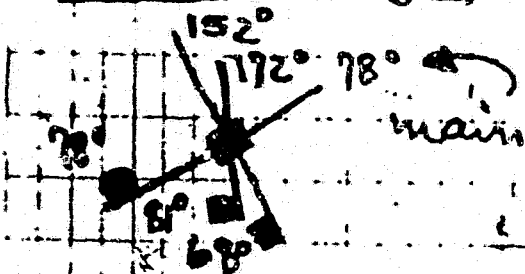
1070 ft @ 9:38 AM (Mike's altitude)

JOINT I - $30^{\circ}/15^{\circ}$ SE. ROCK CURVED. SPACING
AVE 1', 6"-1.5'

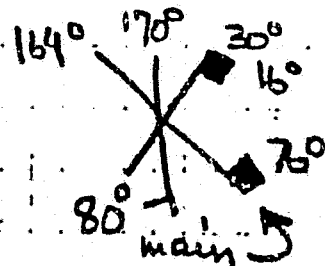
JOINT 2 - $164^{\circ}/76^{\circ}$ E SEMI-SMOOTH PLANAR CONTINUOUS
4"-18" AVE 6" IMM. QZ. JEWEL (main)

- TREND FOR PARSING 309° -

Station 5 (86)



Station 6 (87)



only 1 set really comparable
(170 & 172, 80 & 84)

STATION ? (~~88-90~~)

Bedding (?) $65^{\circ}/25^{\circ}$ SE, 4"-8"

spacing, 6" ave, curved,

semi-smooth, clean, w/

light/dark colored laminations

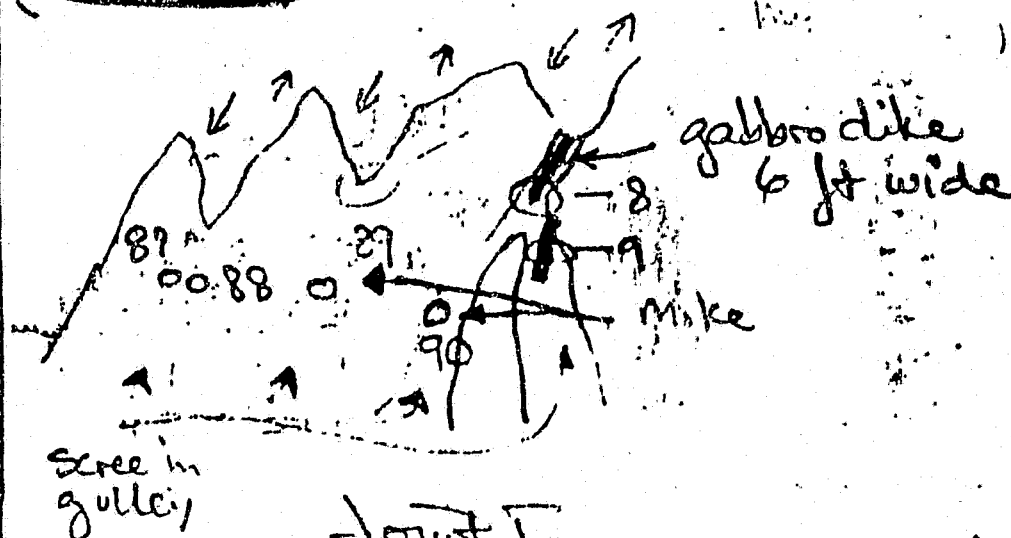
JOINT I $40^{\circ}/43^{\circ}$ SE - ave 6"

spacing, planar, semi-smooth, clean

5-26-81 (4)

This location 50 ft uphill
& to W of last 2 stations
Agillite

STATION 8 up 4th gully - 3 & 4th
gully merge at this station
(Mike's last station was
90 ft below in 3rd gully
(~~88-90~~))



JOINT I

$154^{\circ}/66^{\circ}$ E-SE, planar, smooth
2"-12" ave 6", clean, discontinuous.

JOINT II $60^{\circ}/80^{\circ}$ NW semi-smooth, planar 4"-12" ave 6", continuous through dike

DIKE ORIENT. $172^{\circ}/85^{\circ}$ E N7' wide
Thor

5-26-81 (5)

$\frac{1}{2}$ " - 3" Ave 2" joint surfaces
parallel to dike in argillite
planar, smooth, continuous
all w/in 3.5 ft zone on N
side of dike.

Dike - distinct rounded/
etched weathering pattern.
w/in dike this joint set is
8" spaced, continuous.

162/82° E same as last one (dike)
~~later~~ measurement than
first dike orientation measurement

Dike sample - pyroxene bearing
fine grained gabbro (large sample)

Samples - 3 small - from near
contact w/ argillite (not
numbered)

Sample A (+6") from contact
spheroidal texture - hornfels?

Sample B (+9") same

Sample C (+12") argillite
not much altered in
appearance

5-26-81 (6)

Sample D (3 ft) away from
contact very hard tough
argillite w/ pyroxene
blobs 3% from dike or
native - segregated out through
help of heat (from dike?).

Sample E (+5 ft) same

Sample F (+7 ft) same

Sample G (+10 ft) same

Joint III 10°/80° W open 4"
wide planar, curved, semi-
smooth, 5 ft spacing

Joint IV 155°/81° E-NE ave (1"-
2") - 8" planar, smooth
forms N edge of gully

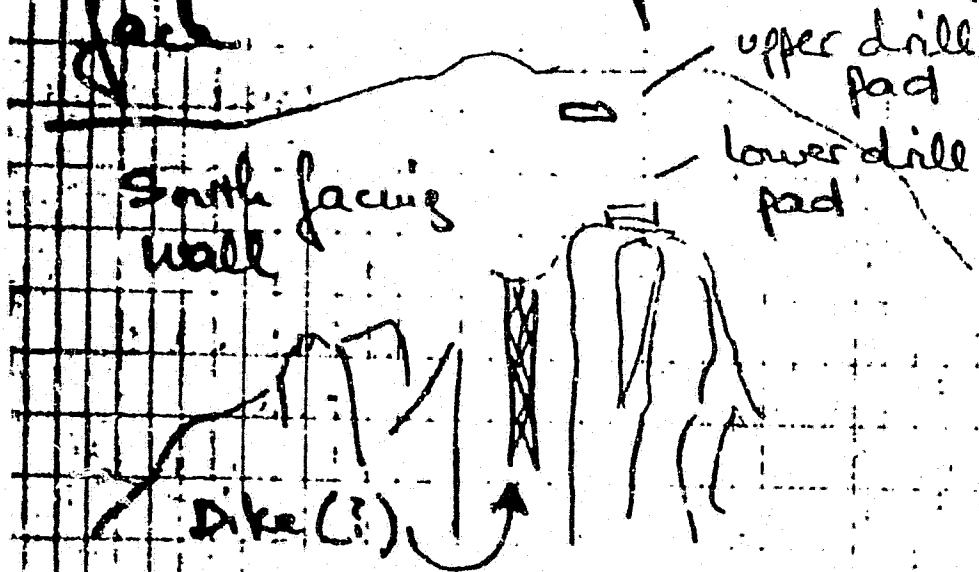
Joint V 120°/18° SW - 6" ave
spacing (2" - 2 1/2 ft range)
discontinuity (max 6 ft) planar
smooth, clean

Joint VI 10°/60° W ave 1.5 ft
semi-continuous, planar,
smooth, clean

5-26-81 (7)

Station 9 (~~Station 9~~)

Connection - dike veers off into
gully - not Mike's (3rd)
gully - looks like dead
dike for match up w/ what
appears to be a dike just
W of lower drill pad on N
face



This evidence suggests no
displacement has occurred
underneath Susitna River.
Station here 40-50 ft below
Station 8.

Dike 165°/80°E

Could not determine for sure
but it appears upper dike
pinches off & starts up again

5-26-81 (8)

slightly ~ 25 ft E to the north
at Station 9 (pitch? - no
evidence of fault displacement
but that also possible).
Steep terrain - could take
several more hours to deter-
mine exact relationship of
Station 8 & 9 dikes.
- Went back up - verdict:
pitch-out -

Station 10 (~~Station 10~~) ^(overlapping)

Jim & I (B. Jane) rappelled &
pendulumed down to gully by
water line to inspect what
appeared to be a dike.
Dike a biotite, plagioclase,
pyroxine gabbro - no free
quartz appears present, could
therefore contain olivine.

Quartz becoming milky quartz w/
epidote (see Sample #)

GAB
DIKES

5-26-81 (9)

↑ North

Station 11 (dike)

← SW
Station 10

(D81-78)

Station 12

In the lacustrine rock
* Joint I. $115^\circ/10^\circ$ Nrt, 2" $\rightarrow$ 12", ave
6", smooth, planar, clean
* Joint II. $104^\circ/72^\circ$ SW, very
pronounced curvature
planar, semi-smooth, cont.
* Joint III. $15^\circ/28^\circ$ E
planar, irregular
semi rough, continuous
in some, 2" - 4", Ave 1 ft.

Station 11 gabbro dike (sample
B) (D81-78)

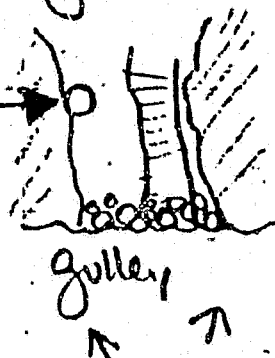
Joint I. $133^\circ/16^\circ$ NE, rough,
irregular, 6", clean,
continuous over the 6 ft
of dike width.

5-26-1981 (10)

Joint II. $100^\circ/79^\circ$ S, irreg, some-
what curved, ave 6" cont-
over width of dike (3" - 12"
range) clean.

Station 12 (D81-81)

5 ft up from river E edge
of gabbro dike + 10 ft



looking south

(D81-81)
directly above
this station

(1.5 ft)

Fault gouge zone; 1.5' wide shear;
 $\frac{1}{4}$ " of that is light gray - whitish
gray clay; $1\frac{1}{2}$ " very shattered,
much silt sized material
bleached greenish white. Shear
open 4" $\rightarrow$ 10" or above.

Shear: $13^\circ/85^\circ$ W - does not
appear to line up with shear
zone at side of dike; difficult

5-26-1981 (11)

to tell - structures could curve slightly or be fault effect

Joint I $84^{\circ}/78^{\circ}\text{S}$ $1'' \rightarrow 2''$ ave
1.5 ft, planar, semi-rough
continuous, clean

Some quartz veins $2''$ wide
to the

Joint II $132^{\circ}/45^{\circ}\text{NE}$ planar,
clean, smooth, $1'' - 1\frac{1}{2}''$ ave
 $8'$, most continuous.

Station 13 (~~88-13~~) - w/mike

Joint I $322^{\circ}/66^{\circ}\text{NE}$

Joint II $32^{\circ}/72^{\circ}\text{SE}$

(1) plain, smooth, continuous
Fe stainer $\frac{1}{8}'' \rightarrow 6''$ ave.
 $2''$, zone ~ 6 ft wide

(2) rough, poorly developed

Bedding plane: $48^{\circ}/51^{\circ}\text{SE}$

smooth to rough, Fe stain
 $5'' - 12''$, ave $10''$, continuous

Agillite - E.C. #115: 1394
at 5:08 PM

5-26-1981 (12)

Joint III $310^{\circ}/72^{\circ}\text{SW}$, curved,
rough - one of 3 open to $1\frac{1}{2}''$
minor Fe staining.

Substation (35 ft higher than ~~581-13~~)

* Joint I $322^{\circ}/78^{\circ}\text{NE}$ plain, smooth,
ave $1\frac{1}{2}''$, continuous w/
Fe stain

* Bedding $287^{\circ}/17^{\circ}\text{S}$ well developed
fissility ($287^{\circ}/20^{\circ}\text{S}$ another
measurement), plain
smooth, continuous, $3''$
ave -

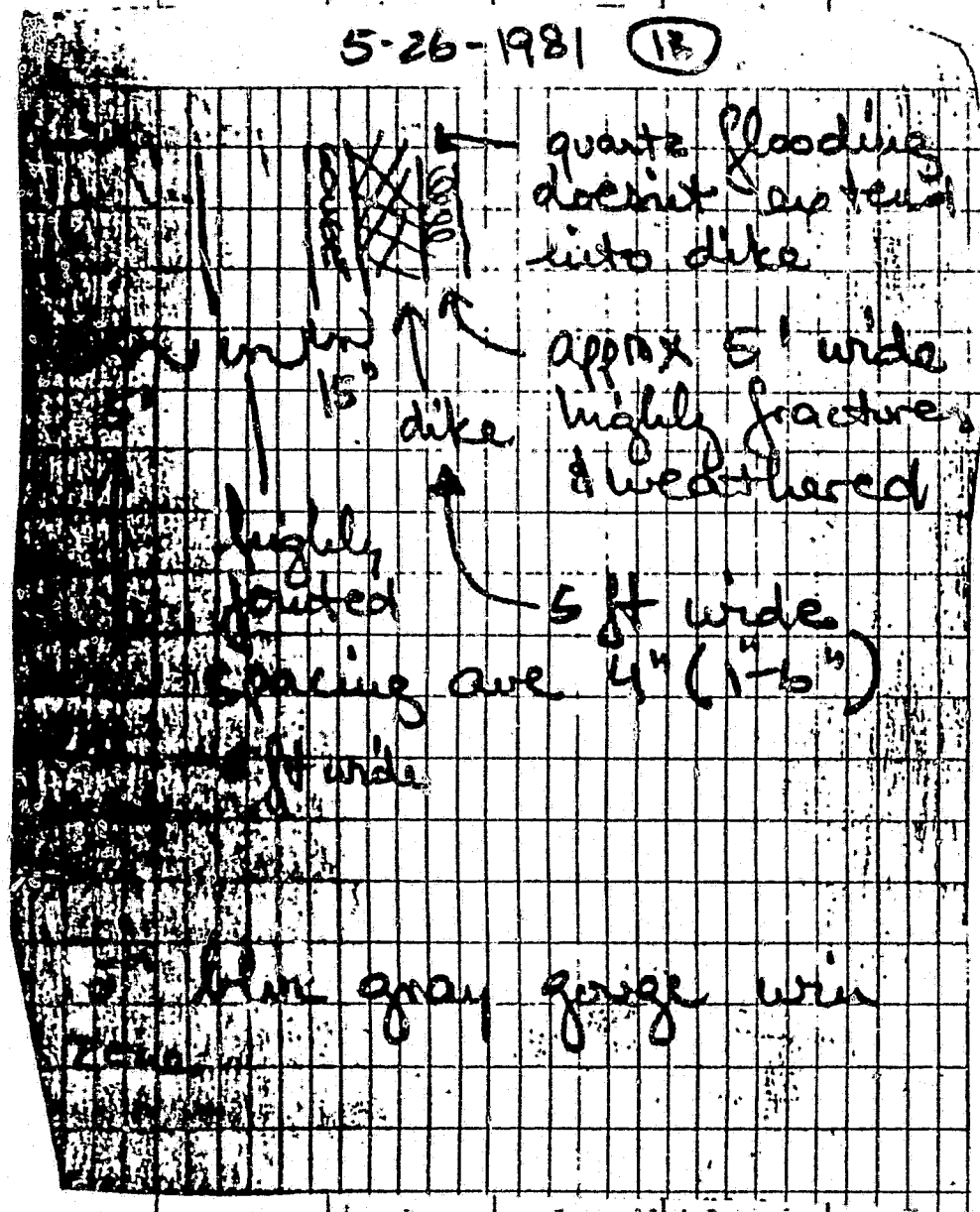
Station (~~88-13~~) 14

Dike - gabbro -

Joint I $350^{\circ}/86^{\circ}\text{W}$ semi smooth,
ave $6''$ - range $4'' - 16''$,
continuous and probably
dike orientation

Joint II $470^{\circ}/17^{\circ}\text{NW}$ plain to
slightly curved, smooth
Joint III $490^{\circ}/51^{\circ}\text{S}$ curved, rough
 $3'' - 7''$, ave $5''$

5-26-1981 (18)



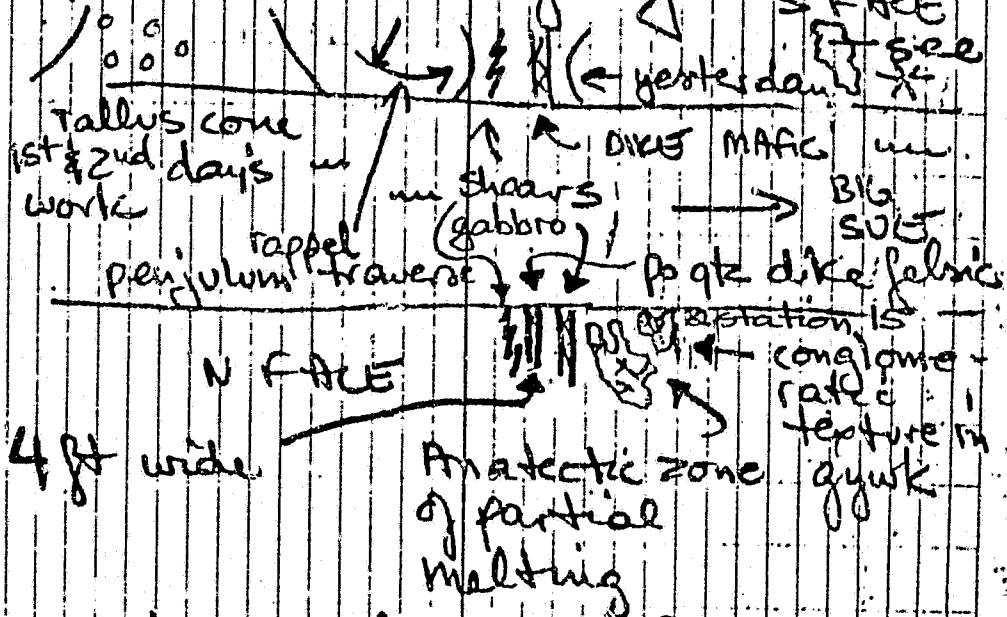
Notch at top of
Talus gully

5-27-1981 (1)

N side canyon - checked rhyolite
quartz porphyry (porphyritic quartz
rhyolite. Other o/c's w/ stopping
and comp porphyritic quartz felsite
(or andesite)

((Station 15 ~~001-100~~ - next))

Currently at ~~001-100~~ - from station
Rappelled down N gully



dike on this side re-planned
All evidence points to shearing
after dike injection
(A) Possible, likely shearing
prior to injection providing

● - 27-1981 (2)

passageway - then cooling & joint formation (shrinkage cooling) that automatically renewed the structural weakness to where this zone continued to be a major structural weakness.

The shears appear to form pathways both for gabbro & perphyritic (P) quartz (qt) felsic dikes.

As fresh as mafic dikes appear I would suspect them to be youngest.

Where does hydrothermal alteration fit in - perhaps related to anatectic phase of partial melting.

See Mike's & Jim's notes on same station.

The two shear zones appear to match up, but certainly not dikes. Could that mean that

● 5-27-1981 (3)

Station 15 ~~XXXXXX~~

Expelled down to water level (3rd step - Mike not along). Now ~ 90 ft W of last station.

(several smaller open joints also 6" → 24" wide ↓)
Open joint 133°/Vertical ~ 2 to 4 feet wide here. Partially melted & characterized by erosion almost exclusively along well developed joint surfaces. Filled with clear qtz also also some iron; limonite common. Random fracturing very uncommon.

Joint I 158°/Vert 1/4" → 4", ave 1.5" planar, irregular, smooth, discontinuous, slightly convergent. Restricted to w/in 15 foot wide zone w/ open joint included.

Joint II 137°/16° SW; 1" - 8" ave 6", planar, smooth, continuous w/in 15 ft wide zone.

5-27-1981 (4)

Joint III 159°/5° ENE, planar smooth, ave 8".

Joints now from E side of (along) gully, where it was partially.

Joint I 179°/78° W super slick smooth (polished) very slightly curved 1" - 12" ave 6" discontinuous.

Joint II 170°/85° E - probably same as Joint I.

Joint III 404°/82° N, rough, discontinuous 1" - 5", ave 3" spacing.

Joint IV 47°/12° SE, smooth planar parallel to

Typical also of this anatectic rock partly melted argillite fragments w/ diffuse boundaries. Pyrochroite common 1/2 - 3%. Open zone above us, ave 3" discontinuous.

5-27-1981 (5)

Note (*) on diagram - our position + 80 ft west projecting to other side of canyon there is a limestone stained zone. This may be similar felsic partial melt material - not distinctive from this vantage point.



looking up this gully
gully 15 ft wide

** from very close by 5-20 ft. irregular fracturing predominant here

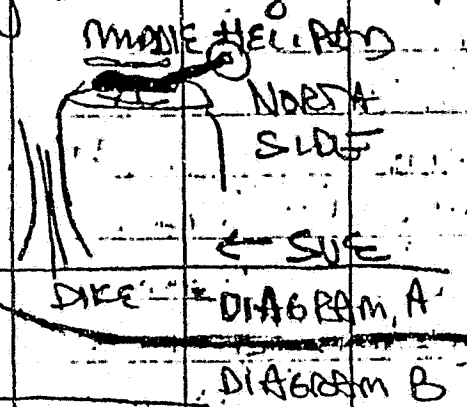
Joint V 55°/15° NW semi-rough 2" - 2' spacing ave 1 ft. Open 1/8" - 1".

5-27-1981 (6)

Joint IV 140°/36E
 belongs w/ joints on page ④
 are b's spacing (3"-18"),
 planar, smooth, discontin-
 uous (typ 4 ft wide)

Station 16 [redacted] Repelled
 400 ft down steep gully to
 where a probable dike had
 been "poked" yesterday

not found here but
 should be present
 as o/c
 (not
 looked
 for,
 not
 sus-
 pected
 when u.c
 were
 there)



SUE ~ NORTH

Gabbro Dike
 match up

8 ft { Same mafic
 10"-12" wide } dikes, a
 pair

5-27-1981 (7)

JOINTS - #1
 B.PUNE CLEARANCE 65/57 SE ROUGH PLANK 1"-2"
 AVERAGE 6" INO CONTINGS VERY CONTINUOUS

JOINT #2 135/28 NE PLANAR SMOOTH 4"-6"
 JOINT #3 EXTENSIVE THROUGH O.C.
 JOINT #3 145/VERT SPACE 6" ave, range
 4"-12", smooth, discontinuous
 planar

Joints I-IV W side of Gabbro
 dike. Within this argilla-
 ceous quartzite leached
 sulfides (1-2% prob pyrrhotite)
 Quartz veins - milky - random
 1% of rock.

Gabbro dike - suspected mineralogy:
 few white phenocrysts (feldspa -
 thoid?) probably olivine, pyroxene
 and biotite & amphiboles. Rock
 has typical dark brown
 weathering pattern typical of
 olivine bearing rocks on
 Seward Peninsula (ref. Don
 Orbeck USGS, Anch.) Dike
 here 8 ft wide, bounded

527-81 (10)

distance between dike pair at this station 9 ft.

Joint V 55°/70° E, smooth curved 1" to several feet, ave 3". Clean

Joint VI 61° vert 3"-6" ave 4", smooth, continuous, extensively developed, clean

Station 17 (redacted)

80 ft above river in same strc.

A) Dike / host rock contact 153°/77° W

B) Contact quartzitic argillite rock

Joint I 348°/vert (next page)

(note: gouge (?) - clay in last station does not necessarily mean movement)
Rock highly fractured w/in 5-10 ft either side dike ave spacing 1"-4", could

527-1981 (W)

be zone readily accessible by chemical weathering agents rather than mechanical grinding.

Joint I (continued) smooth, planar, clean, ave 4" spacing, estm 3' E of dike

Joint II horizontal rough, non continuous, ave 18" spacing.

Station 18 (redacted)

200 ft ~ above river, 1/2 way up to start of rapids.

* Joint I 82°/70° S 1/2" - 6", ave 4" - estm bedding plane cleavage rather than joint planar, semi-smooth, clean.

* Joint II 159°/84° W smooth, clean, continuous 6"-4" ave 3 ft parallel to dike on our W side.

* Joint III 110°/4° N very well developed, ave 1/2 2 ft spa-

5-27-1981 (12)

Aug - All w/in trough
at 1140.

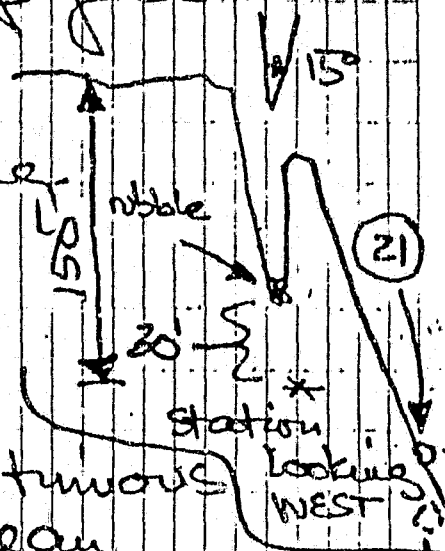
Station 11 (~~1140~~)
I 64/85° with planar clean
cont. ... - 5" R. 1/2"
II 65/81° SE Rough bedding plane
continuous planar clean (2'-2' ave 8")
III 82/12° N Rough discontinuous, planar clean
spacing ... 1-5"
IV ... planar discontinuous
clean (ave 3/8"; R. 1/4-2") very localized.

THRS FOR DAY 14.5 BA

5-28-1981 (1)

Thursday - left by 205 to S side.
Popped to base of large pinnacle.
Station 20 (~~1140~~)

* Joint I main cliff face
143/85° NE, very
extensive, clean
smooth, spacing
6"-3ft, ave 1ft.
Pinnacle rotated
outward 15°



* Joint II 92°/83° S, continuous
smooth, curved, clean
spacing 2"-3ft, ave 1.5ft
Joint III 176°/67° E, smooth,
curved, spacing 6"-3' ave 1ft
not a well developed set,
discontinuous

Joint IV 180°/51° (same as
III)

Rk dark gray argillaceous
rock - fine pebbly clasts.

5-28-1981 (2)

Station 21 (redacted)

Argillite - dark purplish gray
Bedding plane $48^\circ/50SE$, slightly
irregular, "corrugated w/ $1/16"$ amp;
Fe & Mn stain. Some openings
to two inches - prob an
adjustment to pinnacle
rotation.

Joint I: 161° vert, planar
somewhat discontinuous, clean
spacing $2" - 3"$, ave $12"$
 225 ft vert down (station)

Station 22 (redacted)

* Bedding $44^\circ/56SE$ open to
 1 ft max. Slab 3 ft between
open joints.

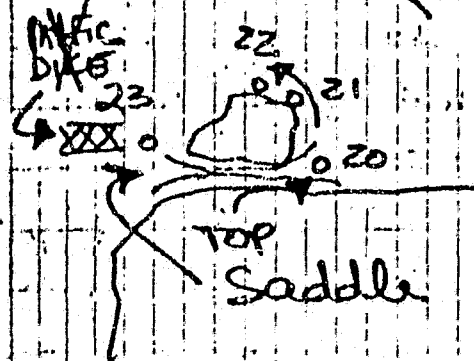
* Joint II: one ft. opening
 131° vert, planar smooth
extensive clean, $1'-5'$,
ave 4 ft.

Purple argillite

Here at end of 300 ft rope
 250 ft vert down (station)

5-28-1981 (3)

looked for fluid joint - none
well developed.



birds eye view

No sign of
mafic dike

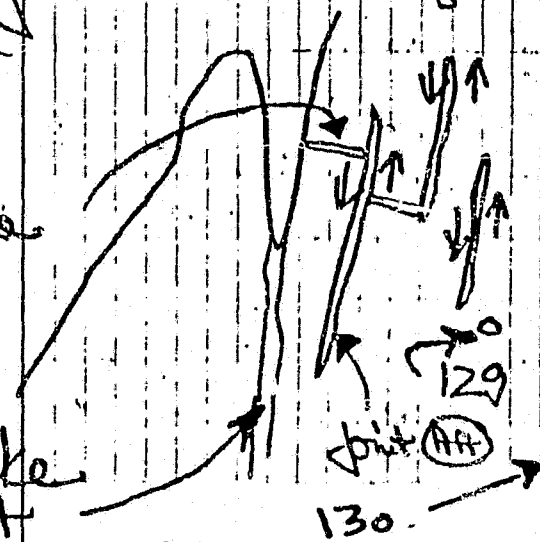
Half way between Stations 20 &
21 massive quartz encountered
 5 ft wide, 1 ft thick.

Station 23 (redacted)

Moved back up saddle between
pinnacle and buttress. Now
 150 ft down from starting
plateau. Then
free climbed

Bedding Plane

NO
gully/dike
contact



5-28-1981 (1) (?)

Bedding Plane 142°/42° SW bedding
plane, corrugated effect
w/ apices plunging down dip
6" major to 1/16" wavelength.
Often open separations.
2' - 4 or 5' ave. 2 ft
spacing, continuous

Joint AA 158° smooth
planar dip 65° E, planar
smooth spacing ave.
(1 ft - 4 ft) 2 ft.

Fe staining throughout
o/c

Typically Joint AA has
openings 2" - 12" with
probably down studding or
slumping to the East just
as possible, very continuous

Joint II 158/44 W, smooth,
curved 3 ft ave spacing
continuous

5-28-1981 (5)

Station 24 (~~24-100~~)

Free climb over to gully
which appears to be the
extension of the gully we
made our previous rappel
to. No sign of dike in
areas we were able to
reach. It appears to have
pinched out (or cut off, but
no evidence of that). Steel
cable draped down gully.

Joint E 154/Vertical SMOOTH PLANAR
CONTINUOUS (3' - 4' AVE 3') (OPEN 1" - 1')

Joint II - BEDDING 102/24 S IRREG PLANAR
ROUGH - PARTING SPACING AVE 5'

I remember steel cable under
day "130" gully few 100 ft
downstream from dike, so
there should have been no
dike to find.

5-28-1981 (6)

Station 25 (~~134~~)

Back to dike below saddle
Joint I 129°/53° E, planar
smooth, continuous, clean
3" - 2 ft, ave 8", clean

(These orientations may
have rotated somewhat
relative to pinnacle-only
prominent joint).

This area could have a
major structural shear
allowing slump, but could
also be nature of cliff
face orientation relative
to developed joints, forming
large slab or wedge
failures. Suspect shear
fault because of major
dike association, but no
evidence seen yet.

Change: Rock is NOT DIKE -
but fine crystalline, cold
quartz rich argillaceous rock.

5-28-1981 (7)

TIME FOR DAY 7-2 PM
8:00 - 9:00 ~~2:45~~

FRIDAY 5-29-1981 (1)

Station 26 (~~134~~)

8:16 AM

Start rappel along / near
large cable 1433 ft top of
plateau. Station elevation 7375' 8:35 AM
- argillite w/ Qtz. veins Dk Purplish-Gray

* Joint I - 35°/7 SE Rough continuous planar (clean)
(1'-5', AVE 2')

* Joint II 129°/80° NE CLEAN PLANAR SMOOTH
(1'-12', AVE 4') DIS CONTINUOUS

* Bedding 58°/50° SE

Gorham's spinning angry eyes
ascend the rock.
transcend the mine.

Station ~~135~~ (D81 & 27)

137°/80° NNE Rough planar, very
continuous, clean, spacing

5-29-81 (2)

3"-4" ft - open to 1 inch in places, ave. 6" spacing.

Bedding $36^{\circ}/47^{\circ}SE$ rough, none of the bedding planes are really well developed in this region of the canyon.

Dark purple / quartz segregations / argillite. One mass of quartzose material 6" x 3'.

9:05 1336 ft - / 177° bearing to Mike across river, Station 28 (~~28-29~~).

$36^{\circ}/41^{\circ}E$ Bedding on block, the block may have moved slightly, 3 ft. ave spacing, continuous ($1\frac{1}{2}$ - 4 ft).

Joint I 165 vert open joint, continuous planar rough in places.

29-1981 (3)

Joint II $75^{\circ}/42^{\circ}NW$, planar, semi smooth, continuous, 12" ave (6° - 18° range) forms "small facets" in the big picture.

Station 29 (~~28-29~~) ~ 30 feet below 1336. Many large blocks which have moved downslope slightly, forming open joints, typically 2" to 6".

Joint I $56^{\circ}/56^{\circ}NW$ rough, slightly curved, forms major face here - many small step-like faces on o/c formed in conjunction with the next 2 joint sets, 4" - 6" opening along this joint.

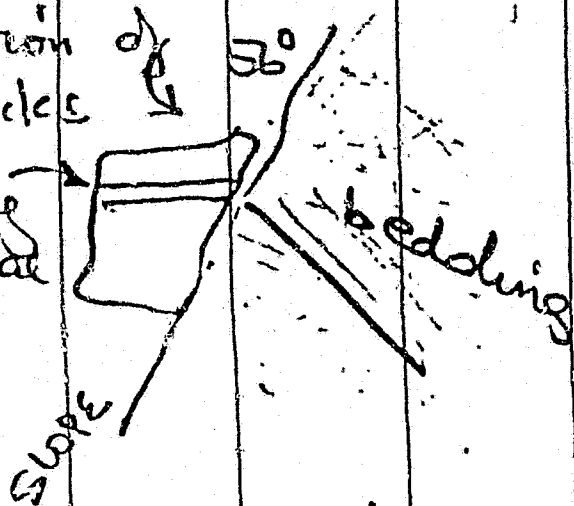
Joint II $73^{\circ}/56^{\circ}$ (bedding) planar semi-rough continuous & discontinuous partings $\frac{1}{2}$ " - 4" spacings ave 8" clean.

5-29-1981 (H)

Joint III 156°/76° smooth
clean, planar, discontinuous
ave 3" range 1"-6"

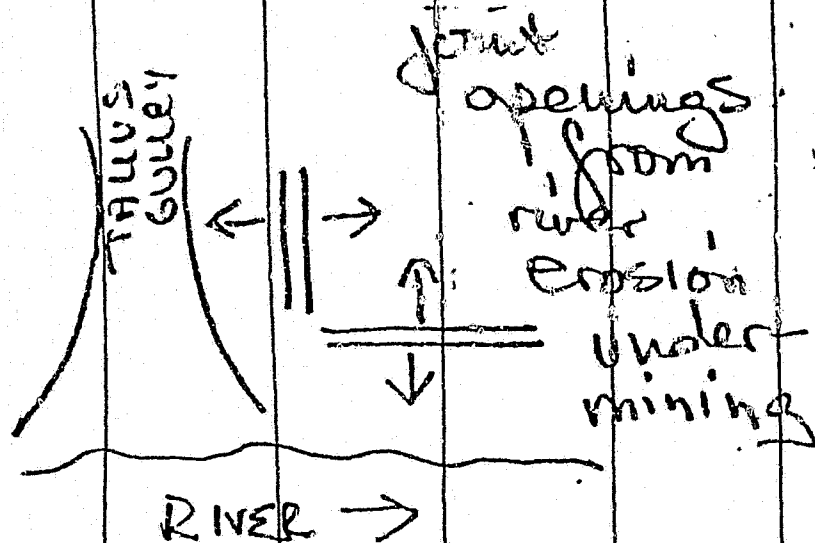
rotation of
loose blocks

bedding
horizontal



elevation (9:45 AM) 1265 ft
bearing to Mike 179°

Station 30 (~~081-158~~)



5-31 (S)

-GRAFFITI IS THE FORCE THAT KEEPS
US STUCK TO THE EARTH - I. NEWTON

Rocks appear very unstable
here

* Joint I - 160°/160° Planar smooth & curved
rough. Open 1/8" - 3" in O.C. (1"-2" AVE 5")

* Bedding - 66°/25° SE (1"-3" AVE 3")

* Joint II - 63°/88° NW Rough clean curved
(6"-14" AVE 18")

Dr. grey argillite - 2% random Qtz. veins

STATION 31 (~~081-151~~)

Joint I 145°/82° NE, planar
smooth, very continuous
thru o/c 3" & 12" ave 6"
very well developed through-
out o/c. Open max 3"

Joint II 61°/60° 3-12" ave 6"
planar, semi smooth

Bedding: 61°/35° SE
quartz veins along (or beds)

5-29-81 (6)

bedding partings, irregular,
1/2" - 18" ave 12"
open 20% of partings 1/8" to
4"
Elev 1192 @ 10:35
o/c stacked, blocks un-
stable.

Station 32 (~~1191~~)

Along massive o/c approx.
150 ft above River. ledge
adjacent to 15 ft overhang

Face - smooth, not
necessarily related to any

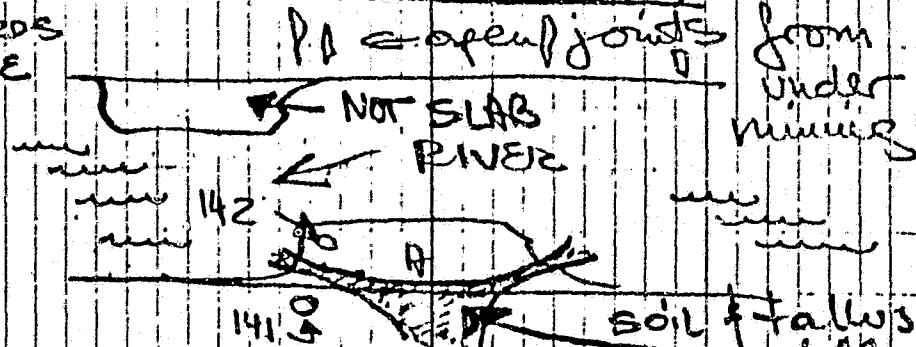
* Joint I, 100°/80° ± 10° curvature
smooth, slabs @
1-14 ft thickness are 2 ft
* Joint II, 10°/vert, smooth
18" - 120", ave. 4 ft
clean, purple massive
red argillite.

5-29-1981 (7)

* Joint III 73°/26° NW, irregular
rough to beryll. smooth, con-
tinuous - other surfaces w/in
200'
Altimeter 1105 (11:45 AM)
bearing to Mike

Station 33 (~~1191~~) 20 ft above
water

BLED
EYE



large (A) block which fall
appears to have slid into
river bed. River 15' below
vegetation line / polished
rocks below.

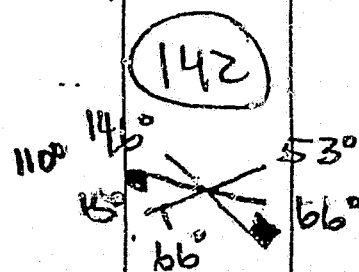
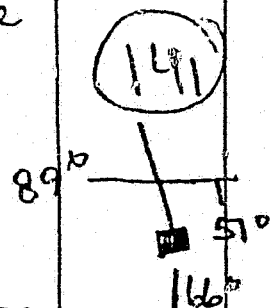
Joint I 166°/vert, smooth,
planar, 1/2" to several feet,
ave 3 ft, massive rock black
phyllite, good sheer (phyllitic
argillite).

5-29-1981 (8)

Bedding 89°/51° SE. (must be bedding, Jim can hear snoring)
ave 1 ft spacing (8"-24")
planar, semi smooth
Joint III 110°/15° S extensive (*)
Station 34 (~~141~~) on block

146/bb NE 1"-8", ave 3"
predominant joint develop-
ment on block, quartz
coexisting, smooth, planar
continuous

Bedding: 53°/66° Southeast
etched characteristic in
block. Same lith as wall
face



(*) ave spacing 6 ft
planar smooth, forms
overhanging cliffs

5-29-1981 (9)

Main criterion for detached
slump block - visual

Elev at 141 & 142 (20 ft above)
river 1050. Total descent
on rappel 383 ft. 120 PM

Station ~~141~~ (142) - 35

Joint I 165°/vert 4"-24" ave 12"
very continuous, smooth planar

Station here 80 ft above river,
Joint II 95°/61° S, continuous
semi smooth face ~ ave 3
ft spacing (1-4")

Station ~~141~~ (142) - 36

15 ft below start of descent
Joint I 75°/26° SE bedding
3"-3", ave 8" planar
rough surface. very
extensive forms over-
hang

5-29-1981 (10)

Joint I 120°/76° NE
smooth, curved, ave 4"
2" - 12"

Rock argillaceous qtz
to quartzitic argillite w/
qtz veins 1 1/2% some
massive aggregations
10" x 4" x 10"

Joint II 59° bedding/61°
SE open joints to 6"

Joint III 26°/Vert, smooth
planar - but single surface

Joint IV 144°/74° West SW
rough curved 7/2" - 1"
opening 1'-3' range,
ave 2 ft.

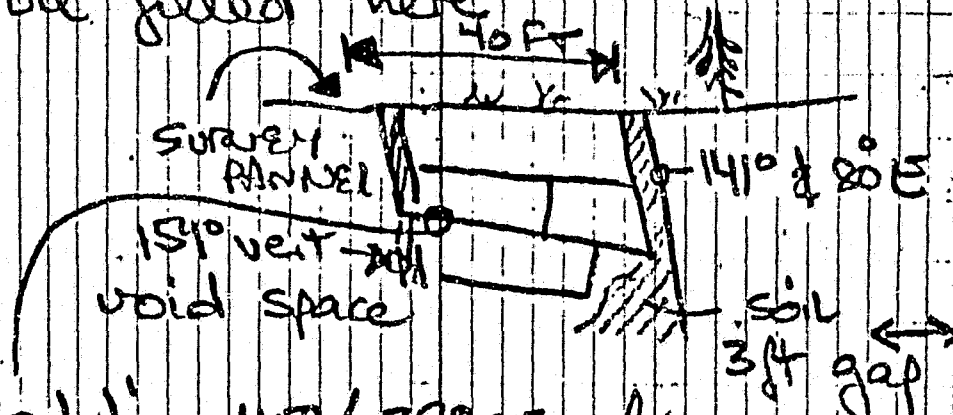
R&M Survey Monument 1578
ft near Survey Monument

5-29-1981 (11)

STATION ~~45-381~~ - (37)

136°/vert open joint
center of survey monument +
(7.5 x 5) 37.5 ft west
birds eye view
NORTH
37.5 ft
37.
opening

Same station but over the
rim 20 feet down. The joint
soil filled here



Bedline 45°/39° SE planar
smooth 1" - 12" ave 8"
3/4" - 1" qtz veins along
some bedding surfaces.
Joint V (open 18") 141°/80° E
planar - acini smooth
continuous, clear. Ave

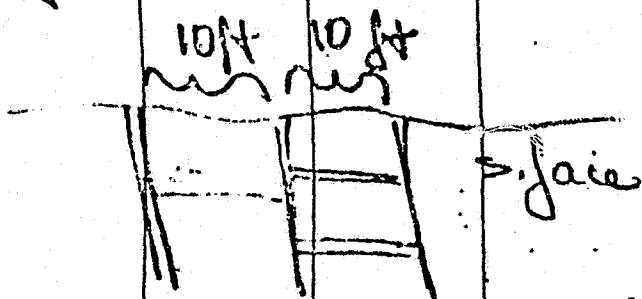
5-29-1981

(12)

spacing 2 ft (2" - 3")

RAPPED ANOTHER 35' → LEDGE (SAME STATION)
 Joint face - 31°/66° SE, OPEN 1"-3" (AVE 5")
 I 149°/73° NE (OPEN 6"-18" ON 10' SPACING)

Joint IV 151°/vert - open
 one foot



Joint IV 151°/80° E - other
 side of opening by joint

Joint II 30°/77° E, curved
 rough, continuous, Fe stain
 open 2" spacing here
 ave 3 ft

Joint III 80°/80° S, rough
 planar, 1'-5' spacing
 continuous

5-29-1981

(13)

5-30-1981 (1)

Elevation S side canyon P.M.
 Survey monument 1417 ft. ± 75
 Calibrated to that elevation.

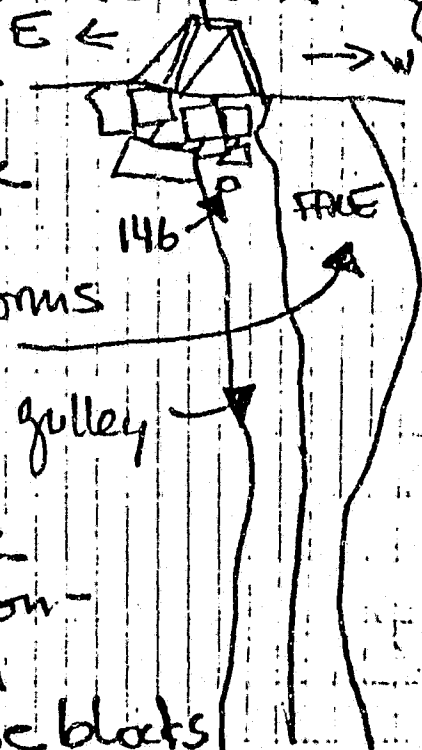
Station ~~1417 ft. ± 75~~

Started down gully from
 large "A" frame. Station
 here 20 ft. south side

Bedding 58°/53° SE well
 defused ave 8" to partings
 E ← → W

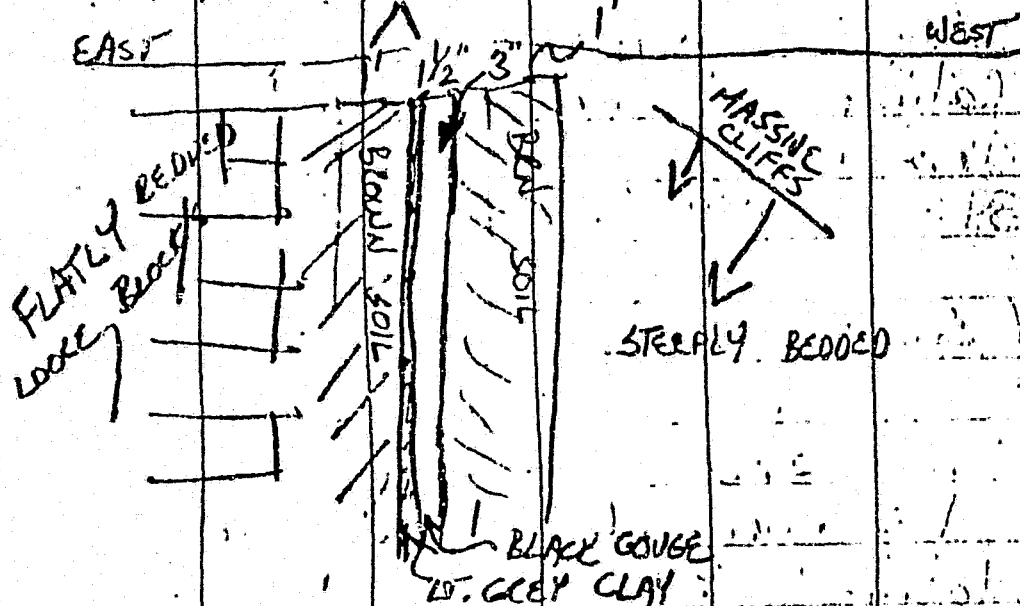
* Joint I 153°/82° E
 ave 4" range
 12"-2" rough
 continuous, forms
 large face

* Joint II 61°/13° NW
 ave 6" range
 1"-18" discontin-
 uous, rough
 - large loose blocks
 to air east



5-30-1981 (2)

Station ~~1387 R~~ 1387 R 845 AM
 Rapped → 7/20' BELOW A-FRAME, PROMINENT
 SHEAR ZONE CENTER OF GULLY



Joint I 139/72 E SMOOTH CONTINUOUS CLEAN
 (2'-10", AVE 4") must be shear zone

Joint II 179/76 W (1/2'-6") DISCONT. ROUGH, CLEAN

Bedding 64/75 SE (2'-18") ROUGH CLEAN PLANAR
 DISCONTINUOUS

BEDDING EAST OF SHEAR ~120°W/IRREG STRIKE
 - PURPLE ARGILLACEOUS QTZITE & PHYLLITE ARG.
 WEST - PHYLLITE ARGILLITE

5-30-1981 (2)

Station ~~1387 R~~ 1387 R
 BLANK RAPED ~50' FURTHER DOWN GULLY
 Joint I 170/74 E (1'-3' AVE 6") SMOOTH
 VERY CONTINUOUS PLANAR (LGE FACES)
 Bedding (WEST SIDE GULLY) 35°/74 SE
 (1/8'-4' AVE 1')

EAST SIDE OF SHEAR ZONE
 Joint I 91/81 N SMOOTH PLANAR CONTINUOUS
 CLEAN (1'-4' AVE 4") WELL DEVELOPED
 Bedding 21/35° E SMOOTH CONTINUOUS
 Purplish Phyllitic argillite
 Joint II 81/42° W SMOOTH CONTINUOUS
 PLANAR (1'-2' AVE 3")

- all rocks east side are loose blocks
 - Shear Zone 3' wide w/ 1/2" tan clay zone

STATION ~~1387 R~~ (personal #46)

Bedding 36°/60° SE range 3'-12'
 well defined on 8" spacing,
 At times smooth curved,
 in other places curved,
 irregular, rough - open
 up to 4".

5-30-1981 (4)

* Joint E 148°/47° SW
Curved, smooth, very
extensive - opening 0" - 3"
4" - 3' spacing, and 18".
(US Bureau of Reclamation
Survey monument at start
of rappel).

Rock type phyllite w/ well
developed crenulations
& shot through w/ quartz
veins locally (50 sq.
feet of $\frac{1}{2}$ c) 12% of
rock. Most highly
regionally metamorphosed
fate I have seen so
far (1 week).

Station ~~1000~~ Personal #41)
Bedding 66° - 60° semi-smooth
irregular surface defined
well on 8" spacing.
locally 15% w/ pyrrhotite,
chalcopyrite & what
appears to be sphalerite
(could probably mine this stuff)

5-30-1981 (5)

* Face (Joint E) 140°/60° NE
extensive slab - open joint
along this surface to ~
6 inches.
Host rock phyllite.

General notes on traverse
we rappelled 150 ft. joints
at top 2" - 6" generally
tagged out as one
might expect.

joints here at top by
Survey Monument "DC 17"
B.M. Bureau of Reclama-
tion

Joint E 139°/vert - 4"
wide to 6" wide - spa-
cing between openings 4 1/2
ft.

* Joint E 58°/56° SE
(bedding) - 6" open
only one seen.

151 5/30/81 (6)

Station ~~151~~ 42) ELEV 1165' (200M)

Reached in rhyolite foot descent → bottom

Black massive argillite w/ spotted texture
w/ non-reflective blue; average 1mm

Joint I 144°/84° SW OPEN 6" Planar
rough (ave 3', 2"-5') Detached 15' block

Joint II 14°/64° NW Rough planar continuous
(3"-2' AVE 1')

Joint III 90°/0° S Semi-smooth, slight curved
(4"-18", AVE 6")

- Rock is lichenous. There is deeply incised
on either side of the bottom

152

10ft Below last measurements
joints less weathered

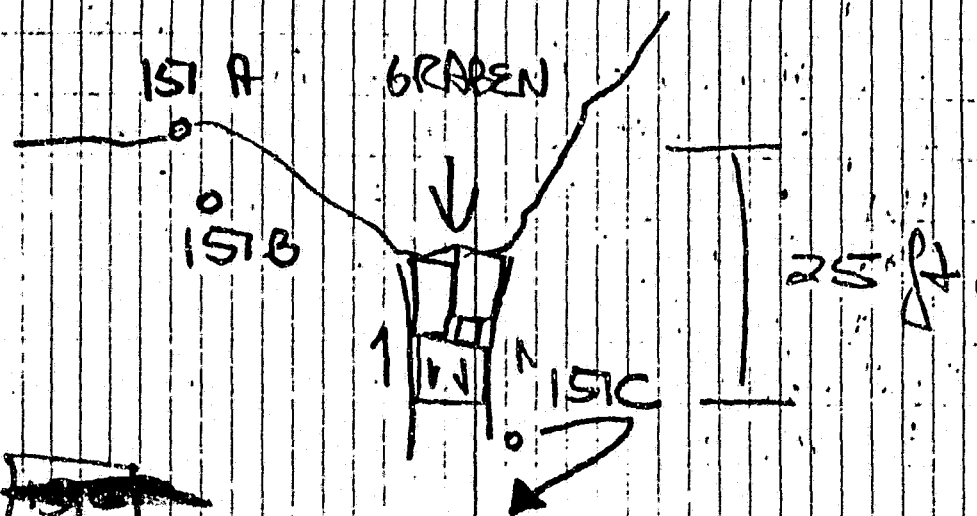
Joint I 61°/43° SE irreg
semi-smooth, range 1ft -
4ft; ave 3ft, clean

Joint II 155°/vert, semi-
smooth, 4" - 2' ave - 1ft
continuous forms much of
face (~ 1 to river).

Joint III 130°/vert curved
rough 1/2" - 8" clean, discon-
tinuous

5-30-1981 (7)

Some of the open over to 18"



Joint 162°/vert - face along
which bottom is falling

Joint IV horizontal 3 ft
spacing planar smooth,
continuous (90°/40° S)

Joint V 49°/79° NW - a
slim block detaching along
this joint - over 6 ft range
opens from 2" (bottom) to
12" at top).

Station ~~152~~ 43) NOTED

Joint I 164°/84° W 2" - 18"
6" ave, planar smooth
continuous.

5-30-1981 (8)

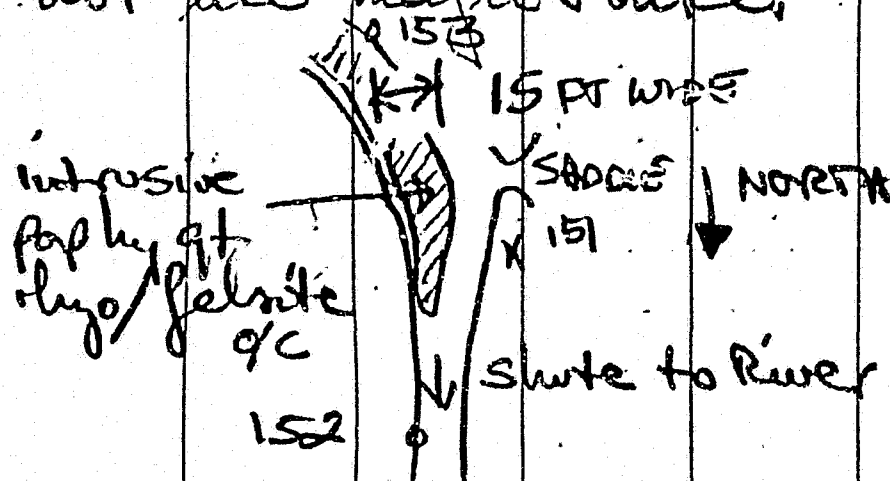
✓ Joint Σ 58°/74° NW, are 2 ft spacing, clean

In this gully - soil filled porphyritic quartz diorite dike float, voids after soil filled. (below)

✓ Joint Σ 65°/40 SE, smooth planar, continuous, are spacing 6" range 1" - 12", clean.

Rx type: dark gray spotted argillite.

* in area checked all float igneous float, but not yet seen in o/c (likely to have irregular shape), not like mafic dikes.



5-30-1981 (9)

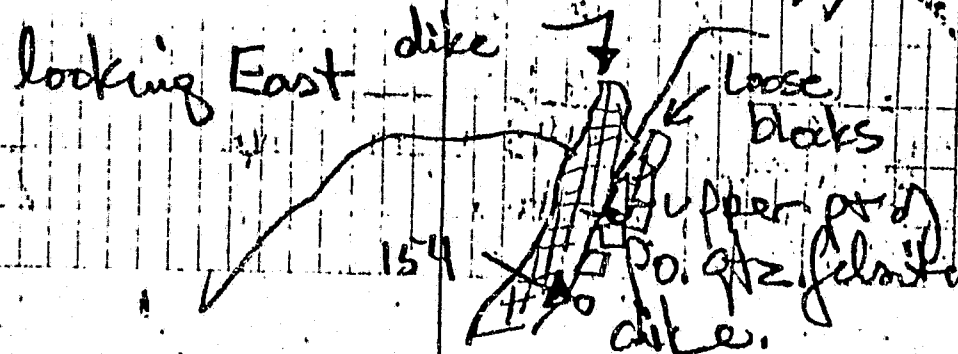
We found the dike in o/c as shown, relative to stations 151 & 2.

Station ~~153~~ 154

dark gray argillite spotted (diff in airt, light reflected) ~ 1mm diam spots
Joint Σ 165°/vert spacing (smooth planar) 2" - 3 ft are 1 ft continuous clean open to 2" in places
Elev here 11950

Bedding 86°/49° SE (ZZZ)
Joint Σ 52°/59° NW planar, but are spacing 1 ft very continuous, semi smooth

(Bedding - planar semi-smooth 1/4" are (4" - 24"))



5-30-1981 (10)

Station ~~101-102~~
Dark gray fine grained
argillite

Bedding 54°/64° planar
rough surface (to semi-
smooth, very extensive/con-
tinuous, tends to form
overhanging cliff faces
1" - 24" ave. 6". Clean
cleavage best defined
at margin of cliff face.
Open joint 15°/76° ENE
very extensive 2" - 18" ave
12" semi smooth. One
open 2".

Joint II 76°/22° N rough
discontinuous 3" - 18" ave
8", discontinuous, irreg-
lar curved.

Station ~~101-103~~

Joint I 113° vert planar,
smooth, continuous 5" - 3"
1 ft ave

5-30-1981 (11)

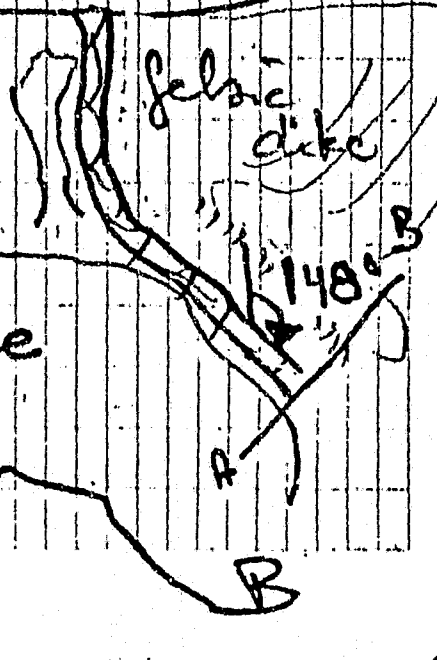
Joint II 52°/62° smooth,
curved, 2 ft ave, continuous
clean

Bedding 58°/48° semi-smooth
2 ft ave parting, range 6" -
3 ft, mostly continuous
this station & while rappelling
back (1/2 way) up the face.

(up & over rim, & tuck down
to top of felsic dike

↑ NORTH

Valley - Joint
148°/vert
A - Section



5-10-1981

(12)

~~6-1-1981~~
R_x are granulated phyllite.

* Joint I 140/80° NE smooth planar
continuous (1"-3", 2" AVE)

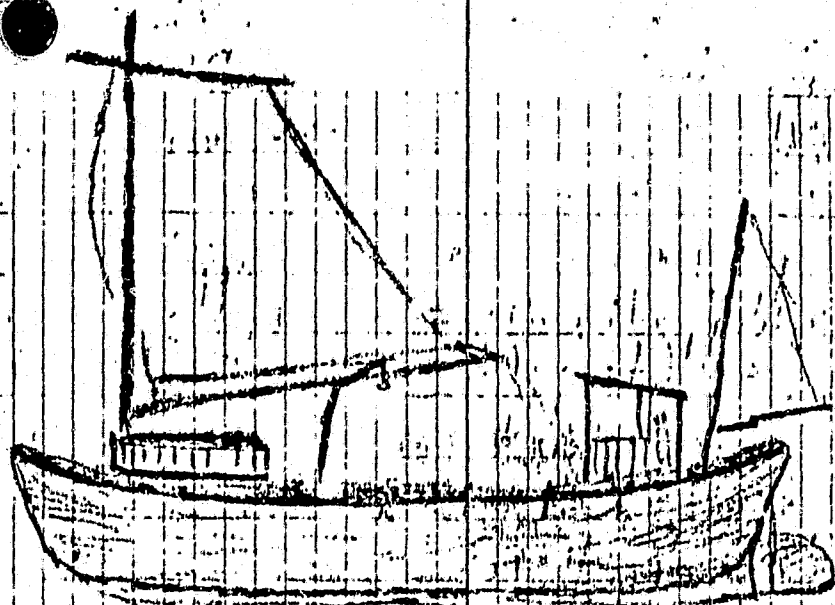
* Joint II 48/68° NW (6"-18", 12 AVE) planar
continuous, rough
Bedding/Foliation 52°/31° SE (1/2"-12" AVE 3")

(Mafic Black Dike, highly irregular
in center of gull)
Joint I 157/70° NE (2-4" AVE 3")

uncreased
Joint II 57/80° SE smooth continuous
(12" AVE
102/13° S (3-5" AVE 4")

1480 P.M. survey monument
at 6:10 PM

Dike orientation 157/70° E



Further Confession - I.A. SEQUEL
as well as that. I'm not even Danish. Not
even G.I. Not even Byrne.

78.5 HRS

12, 12, 14 1/2, 8, 12, 12, 8

6-1-1981 (1)

Dropped off by 205 at Survey
 Panel South side, Rappelled
 E of pinnacle searching for
 U.M. dike. Found
 ~ 225 ft; ~ 50 ft E of
 rappel start point
 Station ~~_____~~

Dike 7 ft wide

Joint I 55°/5' SW (Dike orientation)
 (2"-12" AVE 12") Semi-smooth slightly
 curved, continuous

Joint II 50°/4' NE Continuum semi-smooth
 curved (2"-8" AVE 5")

Joint III 155°/5' W curved, continuous
 (2"-18" AVE 6") Semi-smooth

No shearing here observed.

Station ~~_____~~

Joint I 10°/86° E (shear orientation)

(See next page)

Bedding 88°/38° SE Smooth Bedrock (2"-3" AVE 1")
 continuous clear

Joint II 66°/64° NW

(See next page)

6-1-1981 (2)

Swelled argillite / graywacke mix - almost
 a sandstone

- Interspersed argillite & "stone" & field-
 path material

- Deformation may have taken place
 in sedimentation &/or metamorphism

Joint I (cont.) Surface planar,
 smooth, continuous, spacing
 2"-3" ave 12" - This appears
 to be an open joint here.

Gully filled w/ soil &
 loose rock. No gouge/clay
 to be found after dragging
 around here. Estimate
 open 6"

Joint II (cont.) irreg. curved,
 semi-smooth ave spacing
 18" range 6"-24" least
 developed of all.

(Start H.S. 5-30-81 - 3 days ago)

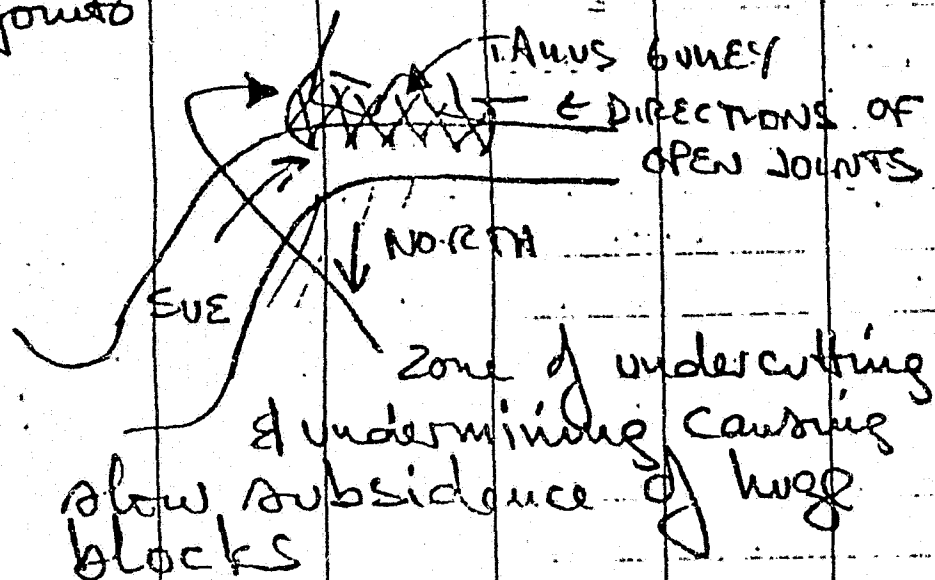
Had lunch - Mike (had spotted
 from other side of canyon) came
 over for lunch.

6-1-1981 (3)
I field checked map of area
I started yesterday.

Spent rest of day tracking down
dikes. Hrs for day 13

6-2-1981 TUESDAY (1)

Notes on Shearing / Faulting / Open
joints

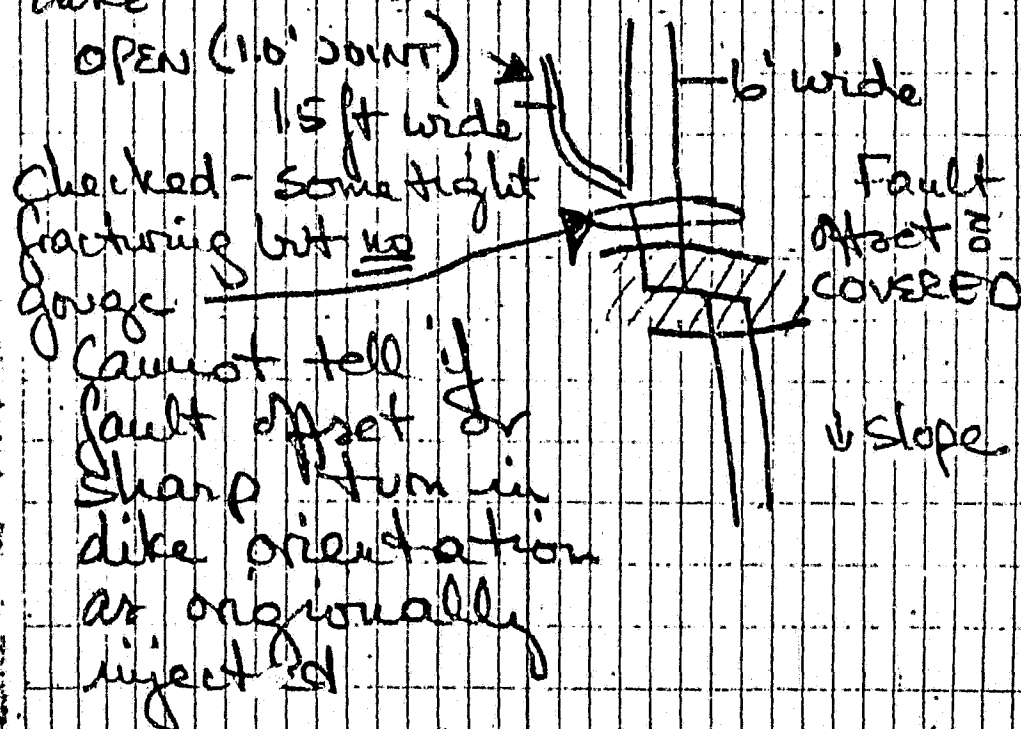


A study should be
completed addressing
development of open
joints - how wide &
how far away from
the plateau these open
joints extend. That

6-2-1981 (2)

would allow engineers to
estimate how much ma-
terial should be excavated
vs. zones which could be
grouted. Should be done
on a tape & bruckton grid.

Revisit to station 849 (91892-
D81) Found another span of
dike



OPEN JOINT illustrated north
side of dike ~ 115 / 75° W

6-2-1981 (3)

One of highly fractured material is associated with the dike, but no clay could in large part be due to weathering. Our purpose today is to try to find shear zones w/d on the Government map.

On the other side of the valley we find shear zones, but none obvious on south side in fallus gully. Open joints are characteristic. Perhaps much gorge material has been washed away by rainwater as joints near the gorges opened up. My opinion - not sure if any movement going on along these NNW trends (any more). I'd feel much better w/a fill dam rather than an arch dam here. Besides - convenient since much loose rock must

6-2-1981 (4)

be removed from this south side. I don't know much about dam construction methods.

STRUCTURE - DEVINS

Compiled 6-3-1981

SUSITNA FAULT - I understand

that a large fault has been mapped down the center of Devils Canyon. If such a fault existed one would expect parallel faulting to be expressed within the valley walls, although on a smaller scale. Jim Heinzen & I scanned extensive a/c of o/c while rappelling down the cliffs in an area defined by the map which has also been submitted. No such complications or structures could be found. Nor would I expect the canyon to be so narrow if it contained a major structural weakness. I feel with 90% certainty that such a major fault does not exist. Drilling will tell.

CANYON

SHEARING NNW

Four zones of shearing have been identified within the past few weeks along the north side of the canyon, and two shear zones along the south canyon walls. All of the zones have NNW trend. The shear zones characteristically contain a light gray to tan colored clay zone $1/2$ to $1 1/2$ " wide. On either side a black highly sheared zone approximately 3" to 12" is common. Tightly jointed, weathered rocks form the outer margins. The shear zones have been found spanning 1.5 to 3.0 feet in width. (SUSITNA Fault thought continued). A major shear zone has been found to cross the Susitna River with no apparent offset (by the "A")

frame). Two mafic (or ultra-mafic) dikes also line up very closely on either side of the river. Such alignments of near vertical structures suggests that no lateral displacement has taken place.

OPEN JOINTS

Open joints have developed in the canyon walls at Devil's Canyon. Large blocks of bedrock are failing along joint surfaces and sliding or slumping in the direction of the river. The area of most active river erosion is along the south canyon wall in the area of the "Tallus Gully". The abrupt right angled turn the river is forced to take concentrates the river's erosive force

Compiled 6-3-1981

at that area. A large 20 foot zone of open joints have been identified on the map I have submitted. Smaller similar zones are located along the rim of the southern bank of the Canyon. Several shear zones which were mapped by Kachadoorian, 1974, many of them probably mapped from airphotos, are in fact open joints. The only movement along these joints, for which there is evidence, is a gravity slumping resulting from erosion / undermining by the Susitna River.

6-2-1981

L. 1.1.1. DAM SITE "FINGERS SHEAR ZONE"

30° 30'

30° 30'

Station A 2' DOWNSLOPE IN GULLY
WEST - MED. GRN. BIOTITE / HORNBLAND DIORITE w/ INCLUSIONS (XENOLITHS) OF DIKE-LIKE MATERIAL
(OR GREEN COLORED). MAFICS PARTIALLY WEATHERED.

Counting I (CLIFF FACE / SHEAR) 135/76° NE / PLANAR / CONTINUOUS / V. ROUGH / AVE 6" 5' 2" - 4")

I 50° / NEFT (6" - 4" AVE 1") PLANAR / SEMI-SMOOTH / VERY CONTINUOUS

II HORIZONTAL / PLANAR SEMI-SMOOTH (6" - 6' 2" AVE) " "

EAST - GRAY FELSITE w/ FELDSPAR, HORNBLAND & BIOTITE - AEGEOLITE 2.5 mm IN AMPHIBOLITE GROUND-MASS

Counting I 140°/63° NE PLANAR ROUGH (14" AVE 2') OVERHANGING CLIFF FACE, MASS

II 29°/61° NW PLANAR SEMI-SMOOTH (12" AVE 1") V. CONTINUOUS

III 98°/45° SW ROUGH SLIGHTLY CURVED CONTINUOUS (16" AVE 2')

Rock lightly jointed due to fine grained nature vs the diorite (much less jointed)
Gully 20' wide, shear zone covered in talus. Average gully slope 44°. Diorite ribs 15' over gully

6-2-1981

STATION B

Tan to light yellow brown to bright orange clay fault gouge
18" wide. Decomposed gussy material near diorite, more permeable,
less clay than near felsite. Felsite w/ flow texture as if we are at
contact (cooling) i.e. felsite younger (see sample)

Shear orientation: $132^{\circ}/8^{\circ}$ NE in felsite - stained surface w/in
3" of shear (Fe ox) are spacing 2 ft planar smooth, continuous
Joint II felsite: $49^{\circ}/55^{\circ}$ NW Ave 8" (1"-12") spacing, rough, cont,
planar, Fe stained near shear.

Joint III felsite: $102^{\circ}/4^{\circ}$ SW - smooth, planar, discontinuous, spacing
ave 4" - all joints very well developed in felsite.
Diorite Joint I $48^{\circ}/37^{\circ}$ NW Ave 8" range 4" - 24", planar, rough
discontinuous

Joint II as above shear.

Diorite has chunks of felsite w/in it. Diorite appear younger
what we termed chill zone in felsite must be prior to
diorite feature.

~~STATION 202~~

BETWEEN E&C WE FOUND FINE/GENEAL W FELSITE ROUGHLY GRANULITE TEXTURE.
STATION C BELOW OVERHANGING NARROW FELSITE CLIFFS GULLY 25' WIDE
DIOXITE (WEST) HAFICS CHOCOTTE/ALTERED. HORNBLENDE → 80% WEATHERING EXFOLIATION PREVALENT
WELL-DEVELOPED LOCAL JOINTING. GULLY 10' DEEP

For. I - 42/72 NW Planes rough/discontinuous (1'-30' AVE 75')

II 130/70° NE Shear Zone Orientation

III 120°/20° NE (4'-20' AVE 6')

FELSITE (EAST) 40% OF CLIFF-FACE FORMED. ALONG FRACTURES (vs Joints) TIGHT Joints/fractures
overhanging gully

Joint I 130/VERT (2'-4' AVE 1') Smooth continuous planes

II 45/58 NW Smooth cont. planes (3'-4' AVE 2')

III 58/36 SE DISCONTINUOUS CURVED SMOOTH (AVE 3' - R 1'-5')

Station D - NO CHANGE. R.K. - PROMINENT SHEAR CROSSES GULLY

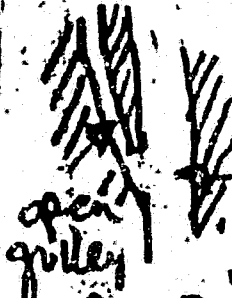
DIOXITE - SHEAR 2'-6" WIDE W/TAN → ORANGE GOUGE - NO A.R. ACROSS SHEAR
ORIENTATION - 175°/58° W

UP A/BENCH IN FELSITE & RIGGE MINNACLE

~~STATION 203~~

00 01 201

STATION E 20 ft high detached boulders. Approx parallel to shear zone gully.

 Joints - open $130^{\circ}/75^{\circ}$ NE - 1 ft open - 4 ft spacing between 2 such joints. Looks like two planar detached slivers have shifted slightly downward w/in diorite. main gully - evidence of local shearing

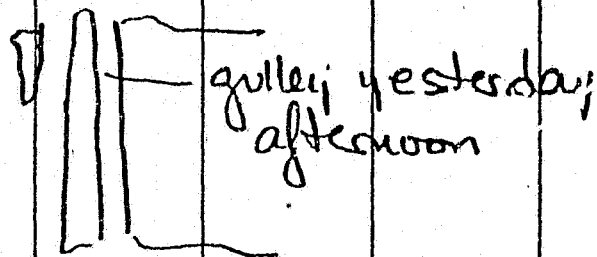
Joint II $10^{\circ}/80^{\circ}$ SE rough, curved, discontinuous. 1-6 are 2' thick
Joint III Horizontal rough, curved, discontinuous - 1-10 are 2' thick

TL for DAY 13 HRS

6-3-1981 Wednesday ①

Originally planned to fly out today, but AM fixed wing already booked up.
Flew to Fours

gullies
current location



~~Station 208~~ elev 1900 ft. 8:35 AM

Small shear zone in diorite
30 ft below surface in gully -
148°/72° tan to orange
gouge ~2" wide
Joint II 336°/78° SW
plain, smooth to rough, 1'-2.5'
ave continuous Fe ox
Joint III 300°/36° NE
plain to curved, semi-smooth
6"-18", ave 1 ft. Fe ox
Joint IV 44°/79° NW smooth
planar 1'-1.5' ave 3", cont.

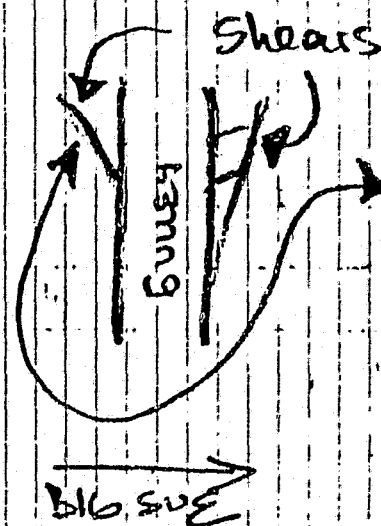
6-3-1981 ②

Fe ox

~~Station 208~~ (See also Mike's 208)

61°/35° rough orientation of
dike in diorite. All dikes
seen discontinuous - dikes have
been sheared pulled apart
but the rock has been re-
healed. I don't think the
dikes are related to the
porphyritic andesite or
upstream side of gully we
went down yesterday.

~~Station 209~~ - (see also Mike's 209)



78°/86° S - width
3'-6" very
colorfully zoned
orange, tan, dark
brown & olive green

Soil surrounding shear gassy
& orange brown.

6-5-1981 (3)

joints 11 to shear $1\frac{1}{4}$ " - 2" apart.
planar semi-smooth to
rough. continuous - are joint
6". planar

Joint I: 170/18 W; 2" - 2 ft
ave 5", rough, planar
continuous, light brown
weathering stain all over
from weathering of mafic is.

Joint II: 145/60° E curved
rough, 6" - 24", ave 12",
discontinuous, poorly
developed.

these joints are from west
side of gully.

~~Station 210~~ w/ Mike

2.5 weathered / bxd gorge
zone. Total zone 5.0 ft
includes highly fractured
rock. Parallel to gully
~ 167° vert

Shear
F gully

6-3-81 (4)

aphitic looking dike material
green - gray m-g diorite

Joint I 57°/88 SE - this
is also orientation of dike
Also 2" quartz vein.
Dike 2" wide w/ diorite
chunks w/in. Sharp
contact, highly fractu-
red diorite adj. to one
side of dike

Joint III 316/88 NE° 1/2" - 5"
(same as Joint I?)
depth of weathering 0" - 8"
[plain semi-smooth
2" - 12" ave 4"]

Elevation here @ 11:35 AM

1868 ft.

this is back up into upper
gully (stream ice).

AAE Contents

Book 13

Watawa

South bank

W-81-200 to 81-208 : 1-28

Seismic line for BH-12 : 36-38 ..

W-81-209 to 81-229 : 39-84

W-81-230 to 81-250 : 99-140

North bank

Quarry B seismic line 130-33

Borrow Areas 86, 98

Devil Canyon

North bank

DH-5 : 3

5/10/81 continued from
Book 11

Fingerbuster site - cont to
South bank

- series of approx EW
trending ridges on
both banks
paralleling trend
of river. River prob.
thickness controlled
by shearing.

- Shearing trends in
center line of dam

- check borings
for angle beds,
across river
any shearing?

5/11/81

K. White & J. Herndon
 South Bank Watana
 at DH-21, working
 d/s
 altimeter set at 1500'

A = DH-21

A-B 51' 342' 75° down 46'

B-C 500' 200' 0°
 line adjusted
 to fit topo
 base of now filled gully,
 measured along edge
 of water

C-D 100' 187° 30° up 01'
 up gully

D-E 100' 185° 30° up 1'

E-F 100' 175° 30° up
 beginning of doubt
 outcrop on both
 sides of gully

F-G 180 196° 30° up 87
gully filled with
angular blocks up
to 5' but generally
1-2 ft

G-H 50 196° 30° up
EL 1753'
W-81-200

H-I 50' 115° 20° up 11'
west side of gully
east side of gully
W-81-201

I-J 35' 106° 40° up 21'
W-81-202
up gully at
contact

W-81-200
RK - DIORITE + MED. GRNEO. GREENISH-GRAY, 20-30% MAFIC
(BIOTITE & HORNBLAND?) FRESH, HARD. Q.C IS
BLOCKY → SLIGHTLY FRACTURED. ONE WELL-
DEFINED JOINT SETS, SEVERAL IRREGULARS

JOINTS -
★ 305/85° NE E SW PLANE SMOOTH (AVE 3')
- FORMS 10 SMOOTH CLIFF FACE - U. CONTINUOUS
- OPEN TO 1/2" → 1" (BLOCK DETACHED)
40°/70 SE ROUGH PLANE → IRREG. DISCONTINUOUS
(AVE 18", 3"-3') SOME OPEN → 1" (POSSIBLE SWAMP)
65°/40° NW PLANE → SLIGHT CURVE ROUGH DISCONTINUOUS
(→ 5' AVE.)

W-81-201
See 202 { Andrite porphyry, at fracture, & &
contact between andrite/diorite
exposed 15' at 60° from 201
diorite overlain by andrite
approx trend 90/465
contact is wavy and at this location
slightly offset 1/2" breccia, & itly
could be related to the
major shear running through
here

Photo
K 9-21-71

Contact seems to run
along "step" on slope
traced along strike
approx 50'

then

Contact may be parallel
to joint set

* $32/12^{\circ}\text{SE}$ pl-ing, rough
up $\frac{1}{2}$ "-2ft, or 1ft
quite pronounced and
continuous
this rd not seen
below in diorite

W-81-20-2

up fracture zone
gully

Shear zone $125^{\circ}/90$

breccia, silt and
clay gouge 3" wide
rock on south is
fractured (spacing to
 $\frac{1}{4}$ " in in shear)

rock on north side is
massive

* this does not make
contact: rock
on either side is
andesite porphyry
with clasts of diorite
and diorite (?) approx
10%

diorite lies below

fracture zone from
here to major shear
mapped on 5/9/81
narrows down to 15'

Joints north side

Major

190/68 E rgh, irreg,
vol. sp. 1/2 to 6' or 3 in.
detached blocks

Minor

47/82° NW pl, w,
1 in - 6 in or 4 in
sm - sligh
CO₂ coating
⊥ to shear

Major

125/90 sl irreg, rgh,
sp. 4 in to 3' or 1-2'

subhorizontal fiss
6 in sp, rgh, irreg

Up major gully
mapped on 5/9/81

to highest point reached
on 5/9 call Pt A

A-B 50' 113° 41° up 38
top of gully, clear

return to bottom
to flagged marker
from 5/9

up major gully to
base of cliffs
W-81-203

bearing to DH 6+7
1980'

to BH-2-315°
E1 1880'

Samples

Don't
plot
light
location
approximate
KJW

Pt A

Cross gully,
1/2 breccia zone

146/76 NE
parallel to prominent
joint set from here
to top of gully

Point B - top of gully
and with outcrop
of gully. Contour
appears to continue
along shallow
depression, trend
of 305

W81-203 ELEV 1880', 88 (LOWER BH → 203: 197')

@ INTERSECTION OF CLIFF FACES (WATERFALL)

- PROMINENT RECENT SLIDE WEST SIDE GULLY @ 40'

CONTRIBUTES TO UNSTABLE RUBBLE IN GULLY

TWO TYPES OF ANDESITE: DIFFERENTIATED

- * I. DARK GREENISH HOMOGENEOUS ANDESITE. APHANITIC TEXTURE. PHENOCRYSTS 30-40% INDISTINCT PREDOMINANT
- II. LT GREY AND PORPHYRY W/ 10-20% PLAG PHENOCRYSTS DISTINCT. TABULAR INCLUSIONS (BLEBS) OF ANDESITE? 'BLEBS' ARE SWIRLED W/ DIRECTION 95/205 ~ FLOW?

Return down gully
to outcrop 81-200
point H, traverse d/s

H-K 100' 331 5° down 100
vegetated - talus slope

K-L 90' 277 10° down 89
to center of next gully
d/s
rubble filled
angular blocks to 5 ft
no outcrop

L-M 50' 313° 5° down 50
W-81-204
West edge of gully
Large outcrop trending 0°
Sample

Rock fragments in upper
gully are angular and
generally less than 6"
Very approximate guess of
depth to bedrock is 10-
20 ft throughout gully

W-81-204
massive outcrop
Diorite, greenish to reddish gray,
med grnd, fresh,
hard, 10-20% mafic
(abundant Hbl? and biotite)

Joints

29/80 E and West, pred E
pl - cnd, sm
CO₂ coating, up 2"-3 ft, av 1 ft
detached block along this
out 30' high, 10 ft wide,
jt open up to 1 ft

269?
M-N 75° 169° 30° up 65
continuous outcrop of
Diorite 10-15' high

N-O 90° 228° 42° up 67
Diorite
N-O outcrop
discontinuous; diorite

O-P 70° 45° up 47
to outcrop 81-182
return to point O

O-Q cross to next gully d/s
to steep and overgrown
to map
will begin to over
lower down and tie
in to DH-21
Q = W-81-205 sample
outcrop across gully
from DH-6 218°
EI 1650'

17
204 contd
165/42 SW
sp 1'-4', av 2 ft

Point O
Diorite

W-81-205

Diorite, medium grained
grayish green, 30-50 mph
(bio and Rbl?)

outcrop is locally
fractured but generally
massive

felsic dike, 8 in wide
20°/75°
sample of dike diorite

Q-R 100' 317° 3° low 100
across base of cliff
narrow diorite that
some areas of
loose blocks, 2-3 ft
long, along joint.
all as at 205

R = W-81-206
tagged

W-81-205 cont. very continuous - slugs & blocks.
* 120°/10°NE Plane Smooth - semi Rough (18"-10' AVE 2')
MINOR { 80°/55°NW Plane Smooth (3'-6') continuous
40°/25°SW Slightly curved smooth discontinuous
(8"-10' AVE 3')
* 0°/VERT Planar - 10' Rough (2"-5' AVE 3')
CLOSE SPACING IN GULLY CENTER - ZONE 2

W-81-206

B.B. (LOWER B.H. → 206) 223°

Containing RK. Fine-grained Green/gray Diorite Weathers
similar on surface → andesite. 30-40% mafics
(Biotite & Amphibole?)

Dike? Folioe. Lt. yellow. Fine-grained. Trend is
indeterminate - may be differentiation of diorite.

~ WIDTH 4'

- O.C. has 'fractured' appearance. Close joint spacing.
20°/VERT Plane Smooth (AVE 1', (3' zone V, close → 2'))
310°/75°NE Plane → 1' REED Semi Smooth. Forms O.C.
(AVE 7-6")

60°/55°NW Slightly irregular → planar (2"-6" zone 10' wide)

R-S 70' 329° 40° down 54

continuous outcrop,
on small ridge

J-T 80' 287° 25° down 73
across cliff face

T is at winter mapping
outcrop 81-67

top of gully with two
felsic dikes.

small gully on west side
of outcrop.

rocky across top of gully

216/86 N. mag. cr., var

1/2 in - 6 in or 4 in

parallel to trend of gully

may not be continuous, frac zone

111/26 N pl, var

sp. 6 - 18 in or 12 in

124/595 pl, var

face across top of gully

sp?

Point T

Felsic dike on west side

is approx 4-8 ft wide

trending ~ 340°/90

along cliff face

contact is irregular and

curved

dike is fractured along

numerous joints

surrounding diorite is
generally massive

around
335°

however there are open
joints NW trending ^{100°} between
here and last outcrop,
open to 2 ft

Joints in diorite

40°/90

pl, sm, 2-6 in. sp

330/85 SW

pl, sm, 2"-1 ft av.
6 in

80/30 N

pl, sm, 2-6 in

Photo

K 9 - 29

alike

T-U 145' 140° 39° down 113
down gully to river edge
bearing 268° back
to the morning
starting point B 1/2

U-V 100' 292° 0° 110
going 2/S
W-81-2017

J-11

25
Point V
Fracture zone (3)
on slope
330° 1/2 sp. ft.
FeO x 100
compare with winter
map

W-81-2017

Diorite, med. and, gray
qtz diorite / granodiorite
dike, 6 in wide
dike is light gray, med
crnd, quartzitic, 20-30"
mass

Sample of contact
between dike and host
rock

dike is not fractured
68°/52° SE

Photo K9-30 dike

Diorite is red stained

V-W	25'	297°	00	25
W-X	27'	192°	25 ap	21
	to COE Survey point			

assume outcrop at pt Z 6/12/81 KJW

27

W-81-208

outcrop at river
level

Qtz diorite/diorite,
light gray, med grnd,
intruded by and with
porphyry, dark green,

diorite has been
brecciated and
healed, fragments
generally 3-4 inches

no trend apparent

at top of outcrop
fracture zone

305°/90

V cl. for fractures,
tight, FeOx str

X-Y 97' ¹⁹⁷
~~117~~ 0

X-Z 74 ¹⁹⁷
~~117~~ 0
return to Parent W

97

74

~~Plot~~
6/22/81
KJW

6/12/81

K White, C Crawford
North bank, Watana
Leaving out seismic
line thru Quarry B

Starting from end of
SL 6 extension

SL 6 appear to have
been extended along
the original trend of
6A $\times 75^\circ$ see map

to Quarry B bearing 70°
1400' to start of seismic
line QB-SL

A	West end of SL 6			
A-B	100	70	0	100
B-C	72		0	172
C-D	30		25° up	200
D-E	100		0	300
E-F	100		15° up 9m	397
F-G	56		0	453
G-H	100		0	553

H-I	100	0	653
I-J	100		753
J-K	100	0	853
K-L	100		953
L-M	75	0	1028
M-N	100		1128
N-O	100	0	1228
	100	0	1328
	72		1400

Start of Seismic Line

A-B	100	70	10° down	98
	100		0	198
	100			298
	100		5	397
	100		0	497
	100		0	597
	100		0	697
	100		0	797
	75		0	872

exposure of boulders
15 x 10 surface, to 2' dia

58	0	930
76		1008
54		1062

Sand flow & running water

Thickly
vegetated
+
Swamp

End Swamp

100	0	1062
82	0	1162
		124 4
		swamp, running water
		+ scattered boulders
		+ cobbles
100	0	1344
26		1370
36		1408
71		1479
48		1527
70		1590
47		1637
62		1699
56		1747
46		1795
32		1827
53		1880
67		1947
91		2038
100		2138
65		2203
100		2303
44		2343
50		2393

300 up 40'

34
57
52
67
73
82
100
65
71
cross SL 8
100
100
100
100
100
100
100
100

poorer by test pit?
end of line

2393
2427
2484
2536
2603
2676
2758
2800
2865
2936
3036
3136
3236
3336
3436
3536
3636
3736

return to camp

2 PM Leave for Devil Canyon
Follow over borrow
area H, some slumping
along north side
check for samples

BH 5 at 450 ft

Water at 48'

Frac zone

288-298'

take on joints

no porge or clay

some which

Recon good

6/13/81

K White C. Crawford
South Bank
Co. out BH 12
Sec 12 line

RA 200ft rail of DH 12 on SW ext

A-B	60'	35°	0	60
B-C	100	35°	0	160
C-D	95	35°	0	255
D-E	45	35°	0	300

return to A

A-F	84	215°	0	384
F-G	100		0	484
G-H	98			582
H-I	98			680
I-J	60			747
J-K	55			805
K-L	68			873
L-M	70			940
M-N	38			978
N-O	42			1020
O-P	57			1077
P-Q	91			1168

BH-12 location line
at 35° ^{100ft rail along SW-1 ext}
from DH 12 extend as
far as possible NE
then to SW for total
length of 1200ft

plotted 200' east on SW-1
6/13/81 C

Q-R 55

1223

End of S. Line

Top

Point E is a cliff line low
30 ft wide at top
mostly angular
cobble and boulders
up to 3 ft, but generally
less than 6 in

Begin Mapping traverse
P.A. = DH-12

A-B 82' 350° 10° down 81

B-C 50' 265° 0

C-D 35' 330° 25° down 32

D-E 38' 007° 30° down 34

top of solidification flow

E-F 46 245° 0°
acc + slope d/s, no outcrop

F-G 28' 240° 0°
small outcrop 30' x 8' high
W-81-209
vegetated slope below

W-81-209

Andesite porphyry, aphanitic,
green, 2.5-3.5% plagioclase
phenocrysts to 1/8 in, less
than 10% inclusions of
arsenite? or volcanic? (green to
dark gray, trace sulphide)

Joints

275/80N curved, sl. rough
face & s.c.
spacing 6" to 12"

NS
0/45E planar, smooth
spacing 2" to 3' (ave 1' to 2')

350/85E to 85W irregular, rough
discontinuous
spacing 6' to 3'

G-H 41' 270° 0°

H-I 35' 250° 0°

east edge of small
gully, running water

I-J 32' 215° 0°

W-81-210

W-81-210 Andesite

Fracture zone
rock is foliated and
broken along
many closely spaced joints,
trend is ~ 350°

Joints

320/vert Irreg, rough

spacing < 6"

one zone 1" to 2" wide of
completely weathered

to yellow-orange

silty sand -

appearance of shear

but not continuous

55/70 NW curved to irreg

spacing < 6"

J-K 23' 275° 0'
west side of gully 13' d. 275

K-L 18' 300° 0

L-M 26 260° 0
outcrop
W-81-211

W-81-211 40' x 20' high
evidently porphyry,
same as previous
but color is dark gray
with orange FeOx stain
on phenocrysts,
all with

Joints

340/80 NE planar to sl. curved
smooth
spacing 1' to 3'
open (1) to 3" → black
(20' x 20' h x 8' w.) sparsely
along this

265/75.5 planar to irreg
smooth to rough
spacing 6" to 3' (ave 2')

25/55 SE planar to sl.
curved, smooth
spacing 1' to 2'
discontinuous

M-N 29' 333° 100° down 28

N-O 23' 294° 0

O-P 40' 280° 0

very small scattered rocks
appear to be boulders

P-Q 38' 200° 25° 27

east side of outcrop
W-81-212

sample
outcrop continues
westward

W-81-212 10' high

Andersite as at 210
fresh, hard

Joints

68/88 NW planar to sl. irreg
sl. rough
spacing 6" to ave 5"
some open to 8"

325/80 SW planar, smooth
spacing 1' to 2'

350/60 SW planar, smooth
spacing ave 2'

Q-R 48' 325° 15° down 4

R-S 28' 300° 0

S-T 50' 270° 10° down 50

29' end of outcrop
small gully

T-U 30' 280° 0

outcrop begins at T
CW-81-214

~~Point S~~ W-81-213

Andesite continues
as before, one
gty phenocryst seen in a
sample

Joints

330/85 NE planar, smooth
spacing 4" to 3' (and 2' to 3')

65/vert irreg rough
spacing 3' numerous open up to 3"

55/65 NW irreg, rough
spacing 2' to 3'

W-81-214

Andesite continues
sl withal, plaz FeOx stain

Joints

305/80 NE planar smooth

U-V 15' 335° 0

V-W 38' 315° 12° down 31

check → at U-81-134
Number

W-X 30' 60° 30° down 40
down NE trending gully
outcrop continues
from above on
east side, no outcrop
on west side

face of o.c.
approx spacing 1'

60/80 NW planar, smooth to
sl. rough
spacing 1' to 3'

25/35 SE planar, smooth to
sl. rough, discontinuous
spacing 2" to 3' (ave 1' to 2')

minor

subhorizontal sets - irregular
orientations, rough, irregular
spacing 18" to 3'

Point X
outcrop has fractured
appearance

X-Y 341 030° 35° down 28
W-81-215

W-81-215

Andesite porphyry, med
gray, aphyritic, 25-35%
plag. phenocrysts to 1/8 in.,
and ~~phy~~ phenocryst? or
inclusion(?), approx
10% inclusions of
argillite(?) and/or volcanic
to 2 in, gen. less than
1 in.
fresh and hard, but
outcrop within 5 ft
of gully is fractured
along close spaced jts.
(≤ 1 ft)

Joints

305/75 SW planar, smooth
spacing 2" to 3' (ave 1' to 2')

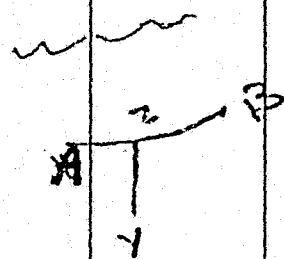
345/80E to 80W planar, smooth
spacing 18" to 3'

270/35 N sl. curved smooth
spacing 4" to 5' (ave 2')

Y-Z 44' 48" 35° down 34
down gully

Z-A 36 335° 0
on west side
outcrop continues
westward to gully but
to steep to traverse
W-81-216

24



Return to Z

W-81-216

Andesite porphyry
at 215

Joints

320/75 NE Planar, sl. rough
one of o.c. faces
spacing 2' to 3'

265/70 S planar, smooth to
sl. rough
spacing 2" to 5" (ave 1 to 2')

0/40 E planar, smooth
spacing 4" to 2' (ave 12" to 18")

355/vert planar to sl.
curved, smooth
other face of o.c.
spacing 2" to 4' (ave 2' to 3')

Z to B 26' 95° 0°
 east side of gully
 W-81-217
 outcrop continues from
 east side of gully
 gully ends at Z.

B-C 25' 100° 0°

C-D 41' 120° 0°
 across gully
 continuous exposure
 on cliff above
 W-81-218

W-81-217 40' x 30' h

Andesite porphyry as
 at 216 face of outcrop
 is CO₃(?) stained, white

Joints

335/35 NE planar to sl. irreg, smooth
 spacing 1" to 3" (ave 6" to 12")

70/75 SE planar to sl. curved
 smooth
 face of o.c.
 spacing 1" to 12"

W-81-218

Andesite as at 217
 but al. with phenocrysts
 FeO, also some
 FeOx. in areas of red jts

Joints

70/vert planar smooth
 face of o.c.

D-E 44 80° 0°
 across small gully
 outcrop end at D/
 east side of gully
 W-81-219

E-F 42 75° 0°
 on north of ridge

spacing 1' to 3'

320/70 SW planar, smooth
 spacing 2" to 18" (ave 6")

0/80 E planar to sl. irreg
 sl. rough
 spacing 1" to 18" (ave 6")

Note: blocks of o.c. appear loose
 ∴ joint measurements may be
 suspect.

W-81-219

many loose angular
 and white cobbles, FeOx
 etc, gen. less than 6 in
 possibly fracture zone,
 cannot tell.

trend of gully 330°

F-G 39' 130° 0°
 outcrop from 29'
 W-81/- 220

G-H 48' 100° 0°
 went sided gully
 mapped as fracture
 zone today
 lower section

W-81-220
 Gndrite as before
 but pl to mod
 with FeOx str
 V cl to cl ap. fractures

Outcrop fractured with
 loose blocks, joint
 orientations uncertain

Joints - questionable

50/85NW planar to sl, irreg, rough
 spacing 6" to 12"

345/70SW irregular, rough
 spacing 1' to 2'

I-I 13 110° 0°
outcrop in gully
W-81-221

I-J 32 70° 20° up 30
22' to east side of gully

J-K 27' 170° 40° up 21

K-L 20° 195° 0
W-81-221 continued
Sample

W-81-221

Diorite, red ground, light
gray with some feldspar
fract to sl with 30-40%
mafic (hio and hbl*),
less than 10% qtz, massive

Jaws

275/40N planar, smooth
spacing 12" to 18"

325/70SW planar, smooth,
spacing 1' to 2'

55/85NW planar to sl, irreg,
smooth to sl. rough,
spacing 6" to 2' (air 1')

Contact with Andesite
Porphyry 15ft above 221

Photo K10-1
Andesite immediately above
contact

return to J

J-M 33° 068° 0

M-N 50 75° 0

west side of solifluction
flow crossed
earlier today
approx length 500ft
downslope

N-O 44' 115° 30° up

W-81-222

outcrop on east
side of flow

3B

Andesite porphyry breccia
aphanitic groundmass with
numerous phenocrysts and
inclusions of argillite
andesite above contact
is highly fractured (< 2 in sp.)
along numerous random
joints, all with, FeOx
etc

W Solifluction flow
mostly boulders angular,
to 5 ft, gen less than 2
also filled with sand
and soil

W-81-222

Debate as at 221
fresh hand

Joints

350/65E

spacing

planar,

smooth

(ave 1-2)

6" to 4'

OP 50 0/0 25° down 45
cont. side of
gully

RQ 49' 95° 0°

Q-R 49 100° 20° up 46
small outcrop
10 x 8' high
continue as ridge
above here
W-81-223

(222 cont.)

230/55 S planar sl. rough
spacing 1' to 3'

50/55 NW curved, sl. rough
face of o.c.
spacing 6" to 12"

Photo K10-2-3
looking S/S from
Point # at approx
center line and
midway down slope

W-81-223

Deserts, light greenish
gray, fine to medium
grained, 30-40% mafic,
fresh to sl. altered, no
glz, mafic - blackish

Jards

55/85 NW face of o.c.
planar, smooth

R-S 57' 65° 0
across
vegetated talus
slope

S-T 54' 75° 0
slope or above

T-U 26' 70° 0

U-V 74' 25° 10° down 73

U-W 30' 70° 0
top + west edge of small
slide of solifluction flow
angular boulders to
3 ft most less than
1 ft

W-X 30' 68° 0°
east side of slide
slide, extends
horizontally about
50 ft toward river

(223 cont)

spacing 1' to 2'

290/50S planar, smooth
spacing 2' to 3'

345/80E planar, smooth
spacing 6" to 2'

minor 55/20NW sl. irregular, smooth
spacing 8" to 2' (ave 12")
discontinuous

X-Y 49' 20° 25° down
 W-81-224
 (outcrop begins at 39')
 Sample
 15' high

W-81-224

Qtz. Diomite, light gray,
 medium grained, 5-15%
 mafic (tbl and lvs?)
 10-15% f₁, fresh,
 hard, outcrop is
 massive

Joints

340/80 E planar, smooth,
 spacing 6" to 4' (ave 2' to 3')

330/60 NE planar, smooth,
 spacing 2' to 3'

65/80 NW face of o.c.
 planar to sl. irregular, rough
 spacing > 3'

290/80 S planar smooth
 spacing 4" to 6' (ave 3' to 4')

Y-Z 31' 450° 0°

Z-A 27' 50° 0°

A'-B' 29' 78° 0°

west side of gully
boulder/outcrop?
Q.D.

B'-C' 41' 60° 0°

30' to east side of
gully
W-81-1225

outcrop extends up gully
~ 50 ft

C'-D 22' 60° 0°

outcrop continues 25' high

D'-E' 31' 90° 25° up

outcrop cont,
gradual, 10 ft
high

outcrops
224 & 228
adjusted for
top of vertical

W-81-225

Qty Discrete as at 224,

Joints

285/50 S planar to sl. irreg,
rough,
spacing 1' to 3'

335/65 E planar smooth
spacing 1' to 2'

45/75 NW face of o.c.,
planar to irregular, rough,
spacing > 1

Point D' 10 ft zone
outcrop & fractured
along cl or joint
top at intersection of
NW + NE sets

ELF 24 38° 0°

P.G 23' 125° 0°

outcrop cont
outcrop cont
W-81-226

W-81-226

Q. Devote as previous
blocky to massive

Joints

355 to 15 / 85E to 85N planar to
sl. irregular, sl. rough,
spacing 1' to 2'

280 / 85N planar to curved,
smooth to rough
spacing 6" to 3' face of o.c.
some open to 8" → possible
slump block (20h x 6d x ?l)

280 / 155 planar, smooth,
spacing 6" to 18"
discontinuous

G^L-H^I 22 85° 0°
 west side of gully, 350' trend
 yellow flagging

H^I-I^I 17 85° 0°
 W-81-22.7
 center of gully
 outcrop continues
 up gully

I^I-J^I 31' 0 15° down. 30'

J^I-K^I 25' 52' 0
 west edge of slide
 angular blocks to
 2 ft
 outcrop above

K^I-L^I 28' 80° 0
 west side of slide
 cont 100 ft down slope

W-81-22.7
 top of gully 50' horizontal
 and 50' vertical
 10 ft wide zone of
 cl up ft along 350' trend

N-D 36 350 300 down

cont exposure
down center of
gully
some areas of
V cl sp etc but
they are tight
rock is fairly
hard.

(228 cont)

minor

300/50SW planar, smooth,
spacing ~4' to 5'
discontinuous

Photo K10-4
outcrop

Point D felsic dike 6 in wide
20°/60W low far?
apparent offset along
subhorizontal joint
(question as to whether
upper block is in
place) rock is fine
parallel to shear(?) joint
in zone from 1/4" to
2 in wide, tight
tight dike no fractures

Photo K10-5

two additional dikes
1 in wide 305°/65°SW

O-P 60 335° 30° down 52
end of outcrop
below

P-Q 66' 15° 35° down 54

Q-R 69' 330° 25° down 62

R-S 70 350 25° down 63
outcrop on east side
W-81-229
10' east of point S.

Point O-P
zone of very clsp
subhorizontal joints

W-81-229

Qtz diorite, light gray,
fine to med grnd, 30-40%
mafics (bix + Hbl)
10-15% qtz, fresh,
hard

Joints

- 330/80E planar to sl.
curved, sl. rough

ave spacing 1' to 2'
zone II of close spaced fracturing along
the 3 sets, discontinuous le exp = 5'

- 45/80NW sl. curved,
smooth to sl. rough,
face of o.c.
spacing 1" to 2' (ave 1' to 2')

- 285/40N irregular to planar,
slightly rough
spacing 6" to 12"

S-T	59	20°	25° down	53
T-U	86	20°	30° down	74
U-V	96	285° to river	20° down	90
V-W	100	255°	0	
W-X	100	255°	0	
X-Y	100	260°	0	
Y-Z	100	255°	0	
Z-A	100	253°	0	
A-B	100	255°	0	
B-C	72	210°	15° up	70
C=DH-2	1			

plotted
6/11/01
✓

6/14/81

KWite & Crawford
Borrow Areas - Watana Site

Borrow Area H

at location shown on
Topo map, slump area, N
Trench, through glacial
material

50° slope, facing West

corrected
Distance

0-5 0-8' Covered

TILL

5-11 8-17 sandy silt, non-plastic

- coarse to fine (* Fine)

sand : 20-30%

- 10-20% Gravel up to 4"
diameter (* < 1")

subrounded

- gray with minor streaks of rusty
orange

4/21/81
sample @ 21-27

17-27 gravelly silt low

plasticity

- 20-35% gravel up to 4"
diameter (* < 1")

sub rounded to subangular

- 10-20% sand, coarse to fine
(* Fine)

- overall color gray with
rusty orange streaks.

sample @ 27-32

- 28 clayey silt, low

plasticity

- medium gray color

28-32

sandy silt, non plastic

18-21

- 35-45% fine sand

- less than 10% gravel
up to 6" diameter

generally < 1/2"

- med. gray color

- 3 layers of silty sand

< 6" wide each from 30-31 1/2'

→

gradational contact (31-33')

32-36 1/2'

silty gravel, poorly graded

21-23

gravel to 3" (* < 1")

- 10-20% fine sand

- 20-30% non plastic silt

- color is yellow gray to red gray

26 1/2 - 42 silty sand, poorly graded
 23 - 27 coarse to fine (* fine)
 - 15-25% gravel
 up to 4" diameter (* 1"-2")
 - 20-30% non plastic silt
 - color overall rusty gray
 to med gray

42 Bottom of trench

K10-6 Photo of trench

Borrow Area F - Filter
 Photo 4-10-710
 Stream Gravel & Sand
 West side

pit at base of steep slope
 see

Pit 1 Gravelly sand, poorly
 graded coarse to fine,
 mostly med - fine
 25-35% cobbles to 5 in
 most less than 2 in
 yellow brown, may be slope wash

Pit 2 Sand, med-coarse,
 some cobbles

Pit 3

Sandy gravel, subrounded
 gravel to 2 in,
 coarse to fine sand, mostly
 med to fine, 10-20%
 non plastic silt, yellow
 brown
 Sample

Pit 4 Sand med-coarse
 grading to fine gravel

Pit 5 Gravelly sand,
well graded, coarse to
medium 15-25%
subrounded gravel to
10 in, mostly less than
3 in light yellowish brown

Small lake, appears
permanent, may indicate
impermeable stratum.

Pit 6 - above river on lowest
terrace, north side
south west bank.
Sandy Gravel, well
graded, subrounded
gravel to 3 ft
generally less than
6 in, coarse to med
sand less than 5%
fines, light yellow brown

Barrow Area F

appears to be predominantly sand with numerous cobbles, volume is limited by small area, extent needs to be mapped to west, eastern limit marked by bedrock outcrop. Small lake approx 100 ft above river may indicate impervious layer.

93
Unnamed Barrow Area Photo 7-10-9

N bank Clark Creek

Stream Gravel

- at position
- sandy gravel, well graded
 - boulders to 6' (ave 4" to 1')
 - 20-30% sand, coarse to fine (coarse to med. with <5% fines)
 - cobbles and boulders = sub rounded, predominantly granodiorite, gneiss, volcanics

Photo K 10-14

exposed, cobbles & boulders are 1-2 ft

K 10-15

bedrock knobs
exposures of bedrock
along creek
less volume of sediments

ungraded

100 yds. downstream
top of slope

- gravelly sand, well graded
- cobbles and boulders up to 2' (ave. < 4") subrounded
- coarse to fine sand * med fine
- < 10% fines

Borrow Area C
test pit on east bank

Sand, well graded,
coarse to medium, 20-30%
gravel to 1 ft but generally
less than 1 inch, subrounded

crossbedded dipping
downstream

pit down slope

Sand well graded, approx.
10-20% gravel, med. fine
some sandy silt layers
to 4 in

Appears to be excellent material
but distance to site may be
a problem, less working
and sorting than area F
and unnamed

5/15/81

K White, C Crawford
South Bank Watana
at major gully/lineament
d/s of Nolt

Taping at approx break in
slope, top has been
flagged previously (orange)

A-B 27' 60° 25° down
center of gully
boulder field 6'-2ft

B-C 12' 325° 0°
outcrop, westside
W-81-230

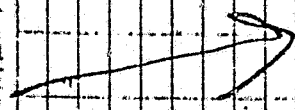
C-D 43' 345° 30° 31

Turn back
top of gully mapped with
S. Thompson

W-81-230

Qtz Diorite light gray,
medium gray, all with
FeOx stain 20-30% mafic
(bio + hbl?), massive

Joints hard to distinguish



Going 2/5 ~ 200 ft
 should be major
 gully this time!
 trend is 300°

A Outcrop at top = W-81-231
 Flagged / Tagged

W-81-231

Qtz diorite, fine to medium
 grained, light gray,
 ~ 10% Qtz 20-30%
 mafics (Bt and Hbl?)
 fresh

Joints

325/85 E to 85 W planar to sl.
 curved, sl. rough
 spacing 1' to 2' (ave 2' to 3')
 loose blocks of material along - 1' to 1 1/2'
 280/vert planar smooth
 spacing 1" to 2'

65/8 NW planar smooth
 spacing 2' to 3'

55/25 NW irreg rough
 discontinuous
 spacing ave 2'

A-B 4/8-300 25° down 43

B-C 24 24/5 300 down
down valley section

34 280 15° low

280
N

W-8/-232

some at 231

245/vert planar smooth to
sl. rough face of a c
spacing 1'

30/85 SE planar to sl. curved
sl. rough spacing 2' to 3'

245/30 S sl. curved rough
spacing 6" to 4' (ave 2' to 3')

350/60 E sl. rough, rough
spacing ave 2'

C-P 56 335° 35° down
 quite open, cont.
 ribs
 W-81-233

W-81-233
 QD same as previous

Tanks

320/80 NE face of o.c.
 planar to sl. irregular, rough
 spacing ~ 2'

340/40 SW planar to sl. irregular
 smooth
 spacing 8" to 3' (ave 15")
 most fine open to 1/2"
 appears to be some
 sliding

60/85 NW planar, sl. irregular
 spacing 6" to 4' (ave 2')

Minor

70/50 SE sl. irreg sl. rough
 discontinuous
 spacing ave 3'

D-E 34 205° 0
 West side of gully
 W-81-231

W-81-234

QD same as above

Lower 6-7' of oc is slightly fractured to massive.

Above this level along joint plane 65/30 S rx is highly fractured

Joints

25/85 W planar, smooth
 are spacing 2 to 3' on lower o.c.
 2" to 6" in front of face

67/30 S only upper o.c.
 planar, sl. rough
 spacing 2" to 4"

300/vert face of o.c.
 planar, smooth to sl. rough
 spacing are 1' to 2'

30/45 E sl. curved smooth
 spacing 2" to 2' (ave 6" 1 1/2")

E-F 50' 335° 300 down 43
East side of gully

F-G 21' 325° 0

G-H 48' 35° 25° down 43
Intersection with upstream
gully
at center
outcrop continues above

H-I 38 0° 25° down 33
East side of gully
W-81-235

Plotting from
first backwards
up to 235
6/16/81 C

PT H ice in center of gully
Possible fracture zone,
talus is small cobbles
softer than in the
at 310°

W-81-235

Diorite, green, fine
to medium grained, 10-20%
inclusions (biotite) fresh
hard, no quartz

Joints

270/20S sl. curved, smooth
to sl. rough
are spacing 1' to 2'
- zone 6" to 12" wide of
highly fract, med. to sap. 0.1
weathered, numerous CaCO_3
veins $\rightarrow$ shearing (?) or
slumping

45/30 NW planar to sl. curved

I-J 38' 290 25° down
west side of gully

J-K 39' 353° 35° down

K-L 26' 350° 35° down

L-M 38 55 0
east side of gully
1'-81-236

sl. rough
spacing 4' to 2' (ave 6" to 12")

315 / vert face of o.c.
planar, smooth
spacing ave 1'

280 / vert sl. curved, sl. rough
spacing ave 1' to 2'

Photo K10-5
shear (?)

Point K

this portion of gully
is north trending
and may align with
N-S shear in Figure
no evidence of shearing

W-81-236

Diorite, greenish gray,
med grnd, 30-40% mafics
(biotite) fresh, hard,
magt

FeO₂ staining on gts.

Joints

320/85 NE

sl. rough

spacing

planar, smooth to
face of o.c.

6" to 3' (ave 1' to 2')

25/55 SE

sl. rough

spacing

planar to sl. irreg

2" to 4' (ave 2' to 3')

20/65 SE

sl. irreg

sl. rough

discontinuous

spacing 2" to 5' (ave 3' to 4')

M-~~N~~^M 56' 160 35 up
W-81-237

W-81-237 top of gully
fracture zone
trend 315°
NW joint open 1 ft filled
with rubble and
sand very partial
cannot determine if
from slope wash or shear
zone
rock on west is
highly fractured
large block on east
has slumped

Joints
315/90 face, pl, sm
up less than 6 in
85/45° pl sm
up 1 in to 3 in

N₀" N₁"

M
N₁-O 50 325° 30° down
gully filled with
angular blocks
less than 1 ft

O-P 57' 312° 30° down

P-Q 74' 0° 35° down
end of outcrop on
east side, west side
continues for ~100 ft
horizontal

Q-R 37' 325° 35° down
outcrop at
intersection of
two gullies 290°
W-81-238

10/30 west
slab on
up at 4-6 in

25/85 NW
pl on, discon
up 6"-1 ft

W-81-238

Qtz diorite, fine med
grnd, light gray feld
stn, fresh, 10-20%
biotite

* Shear zone
310°/90, 4 in wide,
silty sand gouge,
yellow orange
trend is up gully

Dents

315/80 NE Planar, smooth,
spacing 4" to 18" (ave 12")

R-S 45' 330° 25° down
east side of gully

41

S-T 117' 15° 0°
out of gully

T-U 21' 350° 0°

U-V 37' 320° 0°

V-W 45' 50° 0°

W-X 40' 120° 35° up
small outcrop
20 x 10 ft.
W-81-240

33

55/vert regular, rough
spacing 2'

70/40S sl. curved, smooth
spacing 6" to 1'

335/30SW planar, smooth,
spacing axes 1'

W-81-240

Qtz diorite, light gray,
fine to med grnd, 20-30%
matrix, mostly biotite, some
Hbl?, fresh, hard, approx
10% gl.

Joints

330/85NE to 85SW curved, smooth
spacing axes 18" to 2'

270/25S sl. curved smooth
ave spacing 2'

X-Y 35' 350° 15° down

W-Z 49' 310° 40° down
 edge of sol. fluctuation
 flow in gully
 flows may be the
 start of gullying
 extends ~ 70' back
 up slope

Z-A' 17' 530° 0°
 outcrop east side
 of gully (slide area)
 W-81-241

(240 con 4)

50/80 NW Face of o.c.
 Irregular, rough,
 spacing > 1'

W-81-241

Qtz diorite, light to
 med gray, med grnd,
 30-40% mafics (bio + Hbl)
 approx 10% qtz

Joints

300/80 SW planar, sl. rough
 spacing 18" to 2'

50/75 SE planar, smooth,
 spacing ave 18"

0/40 W planar, smooth,
 (exposed for 15' along slope)
 spacing 1' to 2'
 sliding seems to occur along.

A'-B'	23'	0°	0°	outcrop continues
B'-C'	35'	323°	0°	
C'-D'	35'	65°	0°	
D'-E'	31'	53°	0°	
E'-F'	36'	005°	35° down	edge of outcrop
F'-G'	33'	53°	0°	end of outcrop.

W 81-242

29

Bent B'
possible frac. zone
loose blocks, i.e.
jointing may be
slumping along
O/40a joint

W 81-242

Qtz diorite, light gray,
red gnd, 20-30%
mafics (bzo and Hbl?),
approx 10% plg may be
lss, fresh, hard

outcrop has fractured
appearance along vertical
and subhorizontal jts.

Joints

330/85 NE planar to st. curved
smooth
spacing 1' to 2'

(242 cont)

305/20 SW planar to sl. irreg
sl. rough
spacing 4" to 6"
(more common on west side)

55/70 SE irregular, rough
face of o.c.
spacing 6" to 12"

Minion

270/25 S sl. curved, smooth,
discont
spacing 1" to 4' (ave 2')

Subhorizontal - variation $< 10^\circ$
sl. curved, smooth
discontinuous
spacing 1" to 4' (ave 1')

✓ G'-H' 36' 65° 0°
 H'-I' 45' 045° 0°
 edge of outcrop W-81-243
 end of outcrop

I'-J' 40' 60° 0°
 J'-K' 38' 50° 0°
 K'-L' 23' 100° 0°
 L'-M' 23' 63° 0°

small outcrop (extends out slope)
 5' x 20' x 10 ft
 W-81-244

west side of gully
 exposure at least 100 ft
 horizontal into slope

W-81-243
 same as 242

Sinks

325/85 NW planar, smooth
 spacing 1' to 3' (ave 2')

40/80 NW planar to sl. irreg,
 smooth, face of o.c.
 spacing 4" to 12"
 slumping occurs along.
 some open to 6".

305/20 N sl. curved to planar,
 smooth, discontinuous
 spacing 1" to 2' (ave 12")

W-81-244
 same as 242

Sinks

325/85 NE planar, smooth to
 sl. rough
 spacing 1' to 3' (ave 1')

M'-N'	30'	85°	25°	21
N'-O'	83'	30°	0°	
O'-P'	44'	95°	0°	
P'-Q'	63'	65°	0°	
Q'-R'	65'	45°	0°	
R'-S'	60'	340°	25° down	54
S'-T'	61'	340°	25° down	55
T'-U'	48'	340°	0	
U'-V'	43'	320°	0	
V'-W'	100	325°	10° down	98
W'-X'	82	325°	0	
to point 2/s. of line 280°				100
to rd/dio contact in fin 327°				111
to top of knob 55°				135

(294 cont)

55/85 SE curved, sl. rough,
spacing 8" to 3' (ave 2')
some open to 3"

minor

315/55NE planar to irregular,
sl. rough,
spacing 2" to 2'

25/100W planar, smooth
ave spacing 12"

Photo K10-6
Water sample
Sydney River, south
bank, opposite fin

plotted
6/22/81
KJW

6/16/81

K. White, C. Crawford
 South bank, Watona
 uphill of the Nob

A - Flagged mark

A-B 100 120 0

B-C 100 05° 0°

C-D 100 355° 120° down 98

D-E 64 288° 0

small outcrop, possible boulder

W-81-245

smooth & rounded

8' L x 5' H

E-F 100 18° 10° down 99

F-G 100 0° 0°

G-H 100 0° 22° down 93

H-I 77 350 10° down 70

W-81-245

Diorite, med grnd, light
 gray
 rounded surface
 cannot get a fresh
 sample

no joints

I-J	100'	250°	0°
J-K	100'	265°	0°
K-L	100'	265°	0°
L-M	100'	250°	0°
M-N	75'	250	0°
N-O	100'	300°	20° down
O-P	94'	320°	20° down
P-Q	100'	330°	20° down
Q-R	100'	320°	20° down
R-S	68'	330	20° down
S-T	40'	290°	20° down
T-U	33'	300	15° down
U-V	16'	232°	0°

94

87

94

94

63

30

30

V-W	72'	315°	20° down	67
W-X	32'	300°	18° down	32
X-Y	45'	330°	0	
Y-Z	29'	300°	0	
Z-A'	78'	317°	0	
A'-B'	100'	345°	20° down	24
B'-C'	100	324	0	
C'-D'	100	004°	0	
D'-C'	19'	335°	20	

at cliff above river or
w/o side of Nab

W-81-246
tagged + flagged

Sample

W-81-246 Flagged

Diomite Porph / and Porph,
aphanitic to fine grained,
light green 30-40%
plag. phenocrysts to
1/4 inch fresh

this rock "melts" into
a very fine grained diomite
with 30-50% hornblende,
white, fresh, seems to
be variation in original
melt

Sample of diomite

Sants

45/56 SE ^{Perth} planar to sl. irreg,
sl. rough
spacing 2' to 3'
(approx. measurements)

345/vert to 80E planar to curved
smooth to sl. rough

C'-D'	47'	276'	0°	
D'-E'	40'	325°	0°	
E'-F'	52'	235°	35° up	42
F'-G'	46'	260	30° up	40
G'-H'	38'	225°	20° up	36
W-81-2417				
small outcrop				
5' h x 20' l				

face of oc.
spacing > 1'

W-81-2417

and porph / bio porph,
light grayish green, fairly
hard, 30-40% plag
phenocrysts to 1/4 inch,

Joints

300/855 sl. curved, sl. rough
spacing 6" to 75'

335/40 NE planar to sl. curved
smooth
spacing 6" to 12"

345/46 W planar, smooth
spacing 6" to 2'
exposed as face on cliff

70/855 sl. irreg. rough
spacing ~ 6'

H'-I' 20' 340° 0

I'-J' 32' 295° 35° up 26

J'-K' 70' 235° 0

K'-L' 69' 270° 0

L'-M' 30' 225° 0° loose outcrop of sand pough

M'-N' 50' 235° 0° outcrop below

outcrop below
across top of gully
trend 330°

N'-O' 71' 235° 0°

O-P 40' 200° 20° down 38

P-Q 32' 155° 15° down 32

W-81-246

W-81-248

same as 247

Joints

290/50 N

spacing

planar, smooth

1" to 2" (ave 6")

280/75 S

smooth

planar to sl. curved

spacing

6" to 3' (ave 12")

15/70 E

spacing

planar

smooth

ave

6"

Q-R 31' 76° 0
 R-S 37' 215' 20° down, 25
 S-T 26' 280 0
 T-U 57' 305° 0°
 U-V 10 300 0
 outerop
 W-81-248 A

Point T Andesite

W-81-248 A

Andesite / Dio Porph
 fine-lapointe, green,
 10-20% plagioclase,
 plagioclase and Hbl

Jfs.

280/30S irregular sl. rough
 spacing 6" to 2'

300/40 NE planar, smooth,
 spacing 1' to 3'

315/85 SW planar, smooth,
 spacing 6" to 1'

70/vertical planar to sl.
 irreg sl. rough
 spacing 3'

V-W 43' 220° 20° down 41
 W-81-249
 8' wide x 10' h

W-X 49' 250° 20° down 40

X-Y 52' 260° 20° down 49

Y-Z 56 030° 0
 Outcrop
 W-81-250

W-81-249
 as at 248

Joints

35/30 SE planar smooth
 spacing 6" to 3'

65/70 SE planar smooth
 spacing 1' to 2'

290/55 S sl. irreg sl. rough
 ave spacing 1'

W-81-250
 same as 249

Joints

355/80 W sl. irreg to planar
 sl. rough
 spacing ave 2'

15/75 E planar sl. rough
 spacing 72'

65/40 SE planar smooth
 ave spacing 6" to 1'

Return to Y

Y-A 97' 290° 10° 96

A-B 55' 225° 7° down 55

B-C 59' 300 7° down 59

C-D 41' 220° 0°

D-E 100 220° 0°

E-F 95 200 0

F-G 21 130 0

to Control point
Railroad yesterday

Line adjusted to pt. 81-246

6/22/91

K.W.

END OF
BOOK

AAI BOOK 14

2171

DH-24
2061

DH-28 1971

6-19-81

It's a clear, sunny day. It's going to be another scorcher today. HEINZEN & I will look for my hammer. Then proceed to the chute with the andesite/diorite contact. Most of the day will be spent in QUARRY 'A'. WHITE is returning from ANC today. Can see Big Mac today!

Found my hammer!

DH-24 = A

ELEV. 2061' @ 955

A-B	100'	²¹⁵ 180	15° v/s
B-C	100'	¹⁸⁰ 183°	17° v/s
C-D	100'	¹⁸⁰ 192°	8° v/s
D-E	100'	¹⁵⁰ 152°	3° v/s

E - F	100'	156 159°	5° 1/2 S
F - G	100'	158 161°	5° 1/2 S
G - H	100'	165 168°	8° 1/2 S
H - I	100'	166 169°	9° 1/2 S
I - J	100'	152 155°	10° 1/2 S
J - K	100'	135 138°	10° 1/2 S
K - L	100'	168 166°	10° 1/2 S
L - L'	20'	"	"

W-31 - 344 (L')

Outcrop ~ 20' long and 3' high, trends across slope. Outcrop is moderately weathered, heavy Fe & CO₃ staining. Rock is a light to medium gray-green, aphanitic. ELEV. 2316' (2). 10° 1/2

andesite. Andesite resembles that which was seen near BH-2 on 6-17-81. Hard, moderately competent.

JOINTS:

Major	121°	rest	plane, smooth
"	43°	8.7° NW	curved, smooth
"	77°	22° S	open to 1"
			aver. 1", 2" to 1.5"
- to highly fractured here for Quarry			
Rock. Rock is mostly hard but			
there are a great deal of small			
fractures which the rock will break			
along i.e. 2" to 4"			
"	160°	29° NE	plane, smooth
L-M	100'	117 126°	5° 1/2 S
M-N	60'	178 181°	20° 1/2 S
- boulders 2'-3' in diameter cover			
slope between L' - N, these			
interior are covered by moss.			

W-81-345 (N)

Outcrop is ~ 8' high and ~ 30' across. Rock is a gray-green porphyritic andesite. Has a gray-green groundmass with white feldspar, 1-2 mm in diameter. Blocky outcrop, not as highly weathered as the previous outcrop. Rock is hard, fresh to slightly weathered competent.

JOINTS:

Major { 116° 25° NE plane, smooth
6" to 3' aver. 2'
165° 85° E curved, semi-smooth
open to 1"; 3" to 2', aver. 8"
74° 74° N cliff face, curved
smooth.

N towards M 50'

M' = →

M' to O

100'

102

70° 50'

horiz.

O to P

100'

115

118°

50°

1/5

P to Q

100'

124

127°

70° 1/5

Q to R

66'

188

191°

28° 1/5

W-81-346

Outcrop ~ 10' high and 60' across slope. Rock is a light gray-green porphyritic rhyodacite(?). The groundmass is a light green groundmass which contains numerous phenocrysts of feldspar, and mafic mineral(s) - possibly hornblende. Rock displays some lineation of the phenocrysts = flow features. Outcrop is moderately to highly fractured. Need to determine how far back the weathering fracturing extends from the frontal cliff slopes. Sampled.

ELEV. 2413' @ 11 28

JOINTS:

secondary 144° 36° NE plane, smooth
3" to 1' aver. 4"

Major

156°

80°

NE

curved, rough

3" to 2'

aver.

Major

87°

vert.

curved, irregular, semi-smooth

3" to 1'

aver. 6"

140°

vert.

overall jointing is closely spaced.
- orientation of outcrop face - 110°

Q-S

85'

33°

36°

hanging

2405'

E

120'

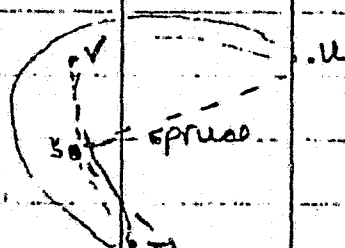
- tagged tree

5' up

W-81-347 (S)

Tagged and flagged this lovely
spruce tree. SW side of outcrop.

Sec 81-348



S-T

35'

111°

S-U

75'

335°

S-V

60'

348°

315°

W-81-348 (V)

Outcrop extends along the slope
10' high from T to V and from
V to U. Station visited last year, 10/9/71.
Outcrop is generally closely jointed.
Key outcrop - hope it isn't fractured
like this with very much depth. Rock
is a light green ~~granite~~ porphyritic
rhyolite (?) or andesite. Sampled.
Rock is hard, competent, but the
columnar-looking jointing may be
a problem because of the spacing.
Sampled. Jointing is a problem here.

JOINTS:

Major { 109° vert curved, plane
3' to 8", aver. 6"
70° 85° E plane, semi-smooth
3' to 1" (aver. 4")
91° 21° S plane, smooth to
rough 6" to 1.5', aver. 1"
+ flow structure subparallel
opposite face → 34° 86° NW curved, semi-smooth
4" to 6"
S-W 100° 104° hanging

outcrop is broken if slope
one includes 20' of slope
vegetation frontal slope

W-81-349 (W)

Outcrop is ~ 10' high and 100' long. Surveyed to the center of the outcrop. Is a large massive slab outcrop. Rock is a ^{light} green-gray porphyritic rhyodacite (?). Contains phenocrysts of white ^{or andesite} plagioclase and ^{or andesite} vesicles. Mostly sharp ^{or andesite} surfaces. 1/4" in diameter. Possible small grains of quartz. Outcrop is slightly weathered on face, hard, competent. Outcrop trends 154°. From through going joints, mostly fracture faces.

JOINTS:

154° 53° SW slightly curved
semi-smooth

124° 80° SW plane, rough

Major 189° vert.] plane, smooth
195° 69° E]

114° 71° NE plane, smooth

discontinuous

Mostly massive, spacing is generally moderately close to wide

S to X

100'

88°

horiz

X to Y

100'

89°

5° 1/2

Y to Z

70'

34 1/2°

25° 1/2

Z to A'

70°

20 1/2°

30° 1/2

W-81-350 (A')

Outcrop ~ 25' high and 60' long. On the frontal face of the Quarry site again. Rock is a light green-gray porphyritic rock, a rhyodacite or andesite. Rock is hard, slightly weathered, moderately competent to competent, as the overall joint spacing is wider than 81-348. Generally averages 8" to 1' overall. Same rock as in the last few stations.

ELEV. 2343' @ 225°

JOINTS:

115° 48° SW plane, semi-smooth
3" to 2' over 1.5'

48° 86° NW plane, rough
3" to 1' over 6"

181° vert. curved, semi-smooth to rough.
2" to 15'; aver. 8"

75° 83° N-NW plane, smooth

trend of outcrop

Flow structure is apparent

111° 33° SW see one above

Is this station 80-107?

A' to B' 50° 3° 30° d/s

B' to C' 100' 103° 3° u/s

C' to D' 100' 109° ~ horiz

D' to E' 67° 132° 20° u/s

W-81-351 (E')

Outcrop ~ 8' high and 40' across. Outcrop is moderately to highly weathered and fractured. Rock is soft to moderate hard, incompetent - rotten.

Rock is a light green-gray porphyritic

ELEV. 2370' @ 252

rhodocite / andesite, where fresh which is rare. On a weathered surface the groundmass is a green and the plagioclase phenocrysts are weathered to a flesh-pink color, can't see imprints were weathered.

JOINTS:

49° 87° NW plane, rough
aver. 1'

164° 76° NE curved, semi-smooth
variable spacing

129° 40° NE plane, semi-smooth
to rough
aver. 2'

E' to F' 110° 120° ~ horiz

- another outcrop like the one at F' is halfway in between.

- slope is a mostly vegetated scree slope

W-81-352 (F')

Outcrop is 10' high and 30' across. Overall joint spacing is close. Moderately to highly weathered. Same rock as at previous station. Rock is soft to moderate hard. Same as previous outcrop except

it has more pronounced jointing

JOINTS:

* Major	34°	44° SE plane smooth to semi-smooth, 1" to 8", aver. 6"
"	146°	75° SW plane, smooth: one is open 1". 3" to 1'
"	13°	82° SE plane, smooth 6" to 1' aver. 8"

F' to G' 100' 125' 10° u/s

G' to H' 100' 168° 5° u/s

~ here groundmass changed to dark gray
H' to I' 100' 95° 10° d/s

I' to J' 125' 87° heavy

- from E' to J' slope consists mainly of small rock exposures and scree covered ~90% by thin veneers of vegetation. Outcrops were generally 1' to 2' high & less than 6' in width.

W-81-353 (J')

Outcrop is up to 10' high and 40' across. Rock is moderately to highly weathered over ~30% of the outcrop face. Rock ranges from soft to hard, incompetent. Rock is mostly

is similar to previous STA's except that the groundmass is more mafic as the rock has a dark gray aphanitic groundmass. It is porphyritic and the plagioclase phenocrysts are weathering to a flesh/pink color. Joints are Fe stained

ELEV. 2410' @ 403

JOINTS:

119°	76° NE plane, semi-smooth to rough	aver. 2'
165°	75° NE plane semi-smooth to rough, 1" to 1.5', aver. 1"	one open 2"

- seems that freeze-thaw has played the major role in the break down of this rock

J' to K' 55' 117' 20° 4/5

W-81-354.

Small outcrop, kela arrived is

notes taken. Return here.

ELEV. 2240' @ 4²⁵

TAD - QUARRY 'A' is a topographic high and therefore it may be somewhat more resistant than the adjacent rock.

In places, the andesite is highly jointed with joint spacings $\leq 6"$, and moderately to highly weathered. The weathering probably doesn't extend to any great depth whereas the close jointing may extend throughout the are. Still need to determine if the quarry will be entirely in the andesite.

HRS. 12

6-22-81

ARRIVED at Watanai, air is cloudy and smoky. Smoke from the forest fires has been bad since Saturday. K. White and I discussed what remains to be completed this summer.

6-22-81

It's a busy, sunny day. It will be warm today. I stopped at the drilling at Devil Canyon to review core in BH-5B. Will stake a line of pits south of the Devil Canyon in the hopes of finding an impervious material. Later in the day HEINER I will work at WATANA.

Plan of CORE BH-5B:

- is being drilled into the at 270° , 45° angle. - thought this was to be drilled between 5" and 250'?

- has been a breakdown in keeping the geology consistent between the day & night geologists

- @ 14.4' - 49.3' the core is layered as a meta-siltstone. It is a dark gray - charcoal gray, very fine

met foliation trends? ... flakes. 17

quinned rock. Has the appearance of incipient mica flakes - this gives a $\sim 40^\circ$ foliation - check with geologists. Would classify the rock as a phyllic argillite (slightly phyllic argillite) but it could be logged as just an argillite

- geologist need to communicate more to keep consistency.

- several zones of hairline fractures ~ 1 mm wide, some filled with quartz, others are not.

- presently at 84.9', rig is down.

RQD's

< 65%

0.0 - 21.5'

34.0' - 39.3'

49.3' - 59.4'

83.0' - 84.8'

- don't all go to ascertain if the hairline fracture zones reduce RQD significantly - is rock is brittle

- weakly developed foliation from a structural point of view

[illegible]

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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A

in each part, and the
- growth of the new 6' - "

STAFF: B is worth it just
worth it. I am in it. On
the other hand, the people
are not all in it. In a
couple of places. This is
a very important
- important nature of the root
two are in it. Up to point
in more. Fall. Then - all

250' Run. (E-W)

ESTAKE 'C'
West of the large lake fine
grained sand with exposed
surface where there is running
water.

Most of these three were very
to 4 good sites. Organics & peat are
at the surface, position is

WHITMAN 2260' @ 1²⁵

W-21-347

- at spruce tree, tagged
2285' @ 1³⁶

runway down to DH 24

A-B	65'	45° (12°)
B-C	105'	12° (15°) d/s
C-D	100'	13° (15°)
D-E	100'	12° d/s
E-F	100'	93° 75°
F-G	100'	100° (105°)
G-H	100'	167°
H-I	100'	15° d/s
I-J	100'	11° (15°)
J-K	100'	100°
K-L	100'	12°

H-I	100'	154° (150°)
I-J	100'	15° d/s
J-K	100'	105° (101°)
K-L	100'	10° d/s
L-M	100'	100°
M-N	100'	11° d/s
N-O	100'	190° (189°)
O-P	100'	10° d/s
P-Q	100'	197° (174°)
Q-RH-24	82'	7° d/s
RH-24	134°	tie in on spruce tree
M-N	100'	170° (166°)
N-O	100'	11° d/s
O-P	100'	168° (163°)
P-Q	100'	11° d/s
Q-RH-24	82'	179° (175°)
RH-24	100'	15° d/s
RH-24	100'	212°
RH-24	100'	16° d/s
RH-24	100'	208° (206°)
RH-24	100'	17° d/s

NOTING NOTE 2060' @ 2³⁸
POINT WAS PLOTTED 35' @ 332° FROM POINT A
TO ADJUST TO PROMINENT TOPOGRAPHY & ELEVATION

TOD - drilling EH-51 at the same
 azimuth. Geology in area are not being
 consistent; are not matching the ends of
 new core, i.e. brown, therefore the
 depth recordings, and RRD is may be of
 reliability, and not all drilling logs were
 read. Therefore RRD may be wrong
 RRD needs to spot check the logs
 to see if everything is going correctly.
 Flange of three possible test pits
 at D.C. The one that probably has
 a promise is 'C'. We could
 not get the quantity needed for only
 one that would be in the
 landscape.

6-24-81

It's a partly cloudy day. RRD
 called BURRO, discussed changes in
 borehole at DEER CANYON. FLY to
 DEER CANYON.

EH-3

① ~125'

② ~72°

closer to river

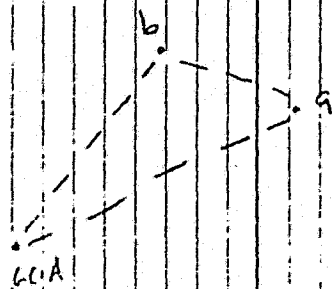
③ ~132'

④ ~51°-52°

closer to pond

⑤ 48'

155°



- Surveying

- G Smith cleared both of these sites, still not sure which one will be drilled.
- flew over the three sites which were staked yesterday. all were cleared.
- flagged another one, west of 'C' called it 'D'
- it was also cleared.

Approved for clearance for all.

Reduction of data at Witana.
- plot traverses

9-4-81

Arrived with Ron Mees, WCC, to do a magnetometer survey at Devil Canyon. Determine its effectiveness as a tool in tracing out the dikes. Will work on south abutment, near C and near the major gully.

Near bunkhouse, N & NW of

Line M-1 0+00 to 2+40

traverse 55'

0+00 to 7 NE cliff

dike 1+0

Line M-2 0+00 to 2+00

traverse near bunkhouse

oriented 50°

dike 1+40

M-1 parallel to M-2

" " " "

Line M-3 0+00 to 4+00

SL 15', 1980

- flag + new dike location

& metal working west @ 205°
270°

2:15 AM. ... the lake
... ..

Don't see very much in these lakes
could be interpreted as its graphy, or being
etc. Called SWT
... more days. No
... ..

More on Saturday.
... more on Saturday

M-3
South side of lake 200'
- 10' change, may be due
to trash

... .. could be explained in
other ways, e.g.,
topography, whereas or fracture zones in
... ..

9-8-81

It's a mostly sunny day. Heisinger
I arrived at Watauga. Will proceed to
Derek Canyon, where we will work on the
north abutment d/s of ch. Rhyolitic
dike.

D-81-195 Top of dike, nearly opposite the
small drainage on the north abutment. It hits
... .. with - Rhyolite on
below dike, sample
on the side of dike,
It is in the physical ridge. High Clite
is at
Estimated width is 20' maybe as much
as 25'.

... .. joint up facing

340° 9° NE
60° 11° SE

... .. is exposed
60° 11° SE

H&G

1

2

ARG

17

contact

25'

30'

jointing sinuous along down slope
 at present the dikes are in situ
 and rotten, soft to moderate hard,
 highly fractured < 1' diam, generally
 sandy & friable in places
 Trend of dikes here is N 35° E
 or contact line
 1/2' wide

354° - 0°

410'

li

T

dike

exp. to

units

E

340°

74°

SW

- orientation

of joint in Dike on W side

346°

71°

SW

B

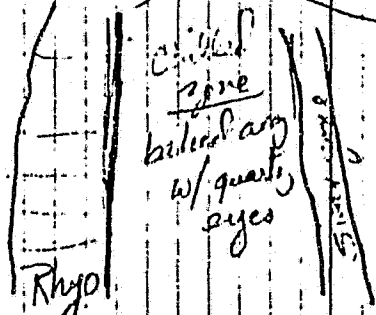
→

~ 50' downslope of 81-195

Contact exposure on W side of cb. to
 as well as a bedding plane shear

contact 7' west

Dike breccia



White felsic/rhyolitic dike is exposed on
 cliffs above brown to brownish
 color of the bedding in contact with
 a bedding plane shear which is about
 6" wide with 3-4" of clay zone
 53° 66° SE

1" wide blue gray clay zone
 with thin plate of crushed argillite

D-81-197 (12)

approx. 30' above contact of the
 sandstone is exposed on the surface of
 the dike. Not exposed in the chutes further
 down as more dense sandstone.

Contact between bedded zone & argillite
 with bedding plane cleavage
 $52^{\circ} - 60^{\circ}$ SE

Bedded zone is a medium, thin bedded
 sandstone of red brown color. A medium
 fine grained sandstone. Flashed.

Maximum width of white to white gray line
 along dike with quartz veins is 15'
 at this point

This point approximately corresponds to

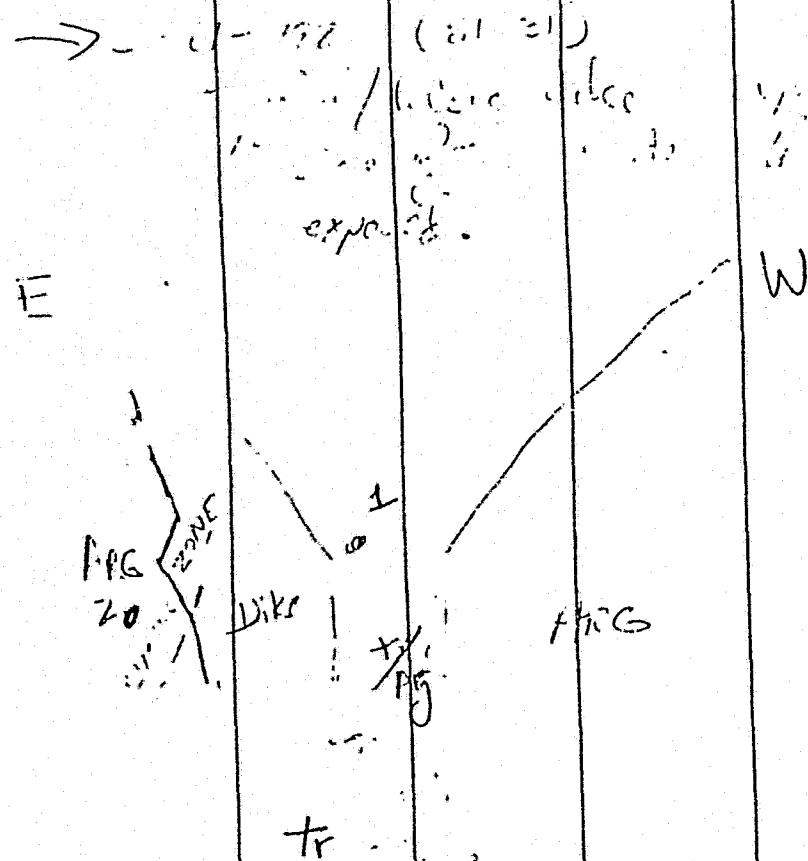
→ STA 1-2 on the river (Box #6).

First exposure of the dike in the chute
 is 5' above the river. Thinned five
 points outlining the dike on this side.

On the south abutment, dike is
 E. just above river level on the
 N. side of the small drainage. Don't
 go to it very wide on the south
 side unless this is a splash of the main
 feature which is covered up by sand.

TOD: Ready to survey in this dike d/s of
 c/c. Will tie in the dike on the south
 side tomorrow. Dike ranges from
 15' - 40' wide. It's strike in two
 places coincides with the bedding
 plane but this is misleading as
 the overall trace doesn't follow this
 direction.

Hrs. 11



Orientation of argillite face adjacent to the
 133° 67° NE
 chill zone 2' to 3' wide. No chill
 zone on argillite face on d/s side of
 this small drawing. Dike is a white-
 gray fine grained rock with quartz veins
 highly fractured, incompetent. Near the
 argillite contact, the ground mass of the
 dike is a medium gray color. Chill zone
 rock has an earthy appearance medium gray
 fine grained rock with phenocrysts $\frac{1}{8}$ "

Orientation of argillite

67° 52° SE

Width of dike (including the chill zone)
 is 30'-35', can get a maximum but
 difficult to estimate exact width.

Flagged two points

1, 2

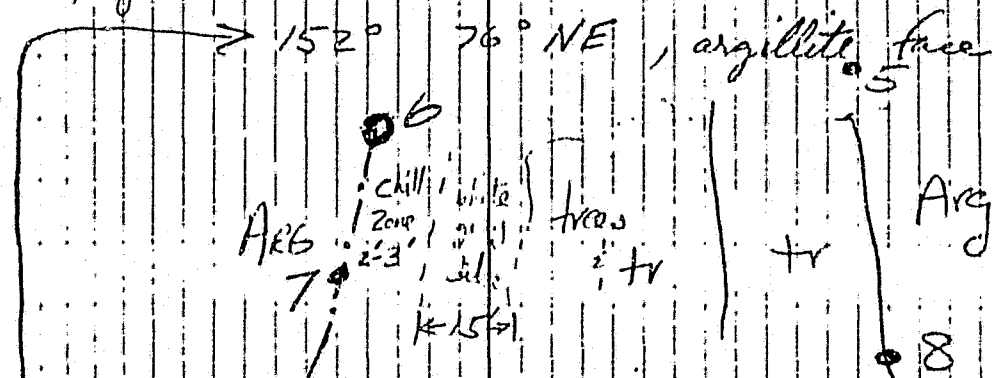
30' down in elevation appears
 that the contact which is exposed on the
 side may be a fault. The fault is highly
 fractured, small pieces of argillite can
 be seen. May be due to soil erosion.
 Argillite / chill zone contact. Flagged 3

Maximum width is 20' at base of
argillite and core on N/S side where
probably coincides with the
strike & dip

146° 76° NE

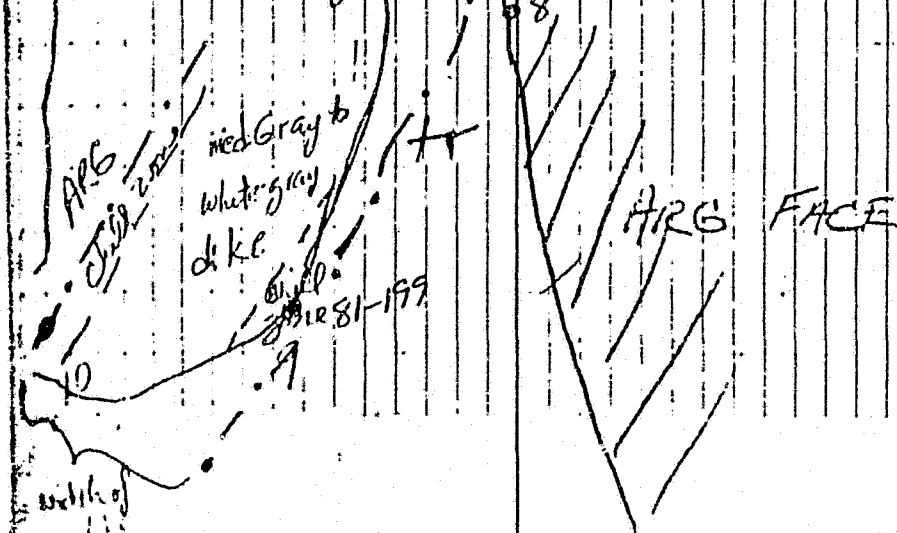
Control exposed again at
second slide area on N/S side of
small drainage. Flagged Max
width 20'-25' across. 20' gray
matrix of dike, fill core, argillite
covered area is up 3' of actual
contact. White gray portion of dike
at confluence of slide - but
75' down slope to our next
Flagged location on N/S side. Argillite
appears to be shattered adjacent to bank &
into 1"-2" pieces. Contact between
dike & argillite is covered
by small debris. It looks
like may coincide with second
see next page

11' dike 20' down in elevation
Flagged the contact which is exposed
on N/S side. Will try to climb around
& get an orientation.



GOOD CONFIDENCE IN ORIENTATION
OF DIKE. Dike has max. width of
30'-35'

D-81-199 ~ 75' above the river on the
N/S side of the drainage



Exposure of dike as in a. p. 1. a. m.
 direction at this lower end of the
 drainage and it appears that the dike
 will line up with the north side. Contact
 width to be in the range of 30 to
 40 ft. in some places. It is
 all chert zone as well as some
 other dike exposures in the area. It is
 certainly not a very good one. It is
 certainly not a very good one. It is
 certainly not a very good one. It is

Direction of strike (?)

164° 71° NE

Can - to trend on to

at 15' above the river level
 the dike is exposed here and continues by
 stream. The dike which is not exposed
 here should be adjacent to this point
 covered up by the river. The dike is
 in the place of a dike
 53° 50° SE

In the south
 side of the river

40' Any dike is exposed at river level
 12' Blinded. In between these two points, the
 dike must pass through. The approximate
 trend from this point to 81-199 is 196°

JOINTS (in K₂)

54° 59° SE bedding plane

2" to 2'

Major # 161° west 1' to 1'
 over 8"

Numbered the blighted locations on the
 way back up. Climbed upstream & downstream
 along the river as far as we could go & didn't
 pick up the dike.

Electronic Distance
 Meter

EDM

Holm & John Kerr, surveyor
 arrived at 140. Held a brief discussion
 then Holm & HEINER began looking for
 the furthest d/s dike on the south side
 across from the control point. A very
 subtle topographic expression exists which may be the location
 of the dike.

gray quartzitic material, apparent
 width 25' small rubble exposure
 1.5m. and 1.5m. Medium gray fine grained rock
 with some quartz, eyes and biotite

81-202

Picked up the dikes again a little further down slope. Found on d/s side this dike has a very subtle topographic expression, unlike the north side. Same as 81-201

81-203

Good exposure of the dike. First hit is on u/s, second on d/s side
↑ 203'

Then HENZEN climbed back up and didn't see any other exposure of the dike. They traversed across slope and didn't pick it up any place else.

100 - First dike of the day, looks in an optimum direction at river level and appears to line up with the dike of yesterday. We have 12 points to survey in on the south side and 5 points on the north side.

Tried matching up the dike at 81-10 to the south side. South side has a heavy vegetation cover. But looked in a subtle depression which trends

down slope. Found it exposed in a couple of places over a change of 91' in elevation. Lost in the lower section of the slope due to cover, believe it or not though.

If the exposure on the south side is sufficient for the second dike, then we know where all the dikes are and we just have to survey them in.

HRS 12.5

Reviewed section of core in BH-5A FROM 292.1' - 297.6' highly broken, polished surfaces, faint shales throughout. Talcy feeling surfaces, carbonate present many small healed fractures where core has broken along. Core loss 0.5'. Would call this more of a shear zone than the sill zone encountered at ~251.8' - 252.1'. Actually from 288.3' - 297.6' core deteriorates numerous healed fractures where the core has broken along, core loss 1.3'.

7-13-61

... in the morning, it
... right. ... to ...
... with a ...
... the plan. ...

... at approx 9:30 ...
... for the moment. ...
... in the ...
... at this radio ...
... to camp ...

... a ... on the
... abutment, 32-33 ... where
51-2 ... in the ...
→ ... of 51-2, 195, & 196. ...
... rain today.
... is approx 220' - 230' ...
... ..

... numbers with ...
51-1952, etc

- 75 81-1951 highest point 1/2 mile
of dikes. Flagged location
- 76 81-1952 highest point 1/2 mile
of dikes. ... 81-195, flagged
- 77 81-1953 1/2 mile of dikes, point
6 - 2' off through ... of
brush obscuring the point
flagged. STA B
- 78 81-1954 1/2 mile of dikes adjacent
to 1953; on contact; ...
- 79 81-1955 1/2 mile of dikes, flagged
location 81-196
- 710 81-1956 1/2 mile of dikes exposure
flagged location, 30' above
the river
- 711 81-1957 1/2 mile of dikes across
from 81-1956, approximately
where the contact might be.

Ernie agrees with my interpretation from the south side yesterday, that the dike is not matches up. Ernie will take a picture from the south side looking back to the changed locations on the south side. Picture is from the e.s. c. of the dike on the south side.

716 81-1958 dike exposed in the scree just above the water edge. d/s side of the dike 1/2 contact is not exposed.

717 81-1959 dike exposed in the scree just above the water edge. d/s side of the dike 1/2 contact is not exposed.

STA 22-232

81-1960 with 2nd number 81-1961 to the river and 81-1962 from the river to the

715 81-1981,2 river level, dike is exposed to the d/s side of this point. The dike passes through here between survey stations 81-1981,2 & 81-1981,1 (81-200)

716 81-1981,1 (81-200) Point is 12' d/s of argillite exposure.

717 81-19810 u/s end of contact

718 81-1984 (81-199) d/s side of contact

719 81-1988 d/s side of chute argillite exposed to d/s side presumably face is close to the contact - couldn't see stations 1987 & 1986

720 81-1985 d/s side of chute argillite exposed

721 81-1984 u/s side of chute, adjacent to slide area, approx contact

81-1982 -

 - couldn't see 81-1982

In the vicinity ~ 12' d/s
 of the d/s contact of the dila, some
 estimated to
 be ~ 10' across (all)

32 - As we walked earlier it appears
 there is a definite match up
 2200'
 of the dam c/c. Will
 pick up characterization of the dam with
 on Friday and begin working around
 c/c

HOURS 12

Eric CHATTEAISON

9-11-81

It's mostly cloudy this morning, probably
 will clear up some later in the day. Off
 to Devil Canyon will survey in the
 prominent dila ~ 4500' d/s of c/c, the
 north side segment. Later we will
 move to c/c and begin surveying in
 those dila.

Phones are not working this morning
 again!! Needed to call Alysha Air,
 BUF & ANC office. Send message with
 today's flight out.

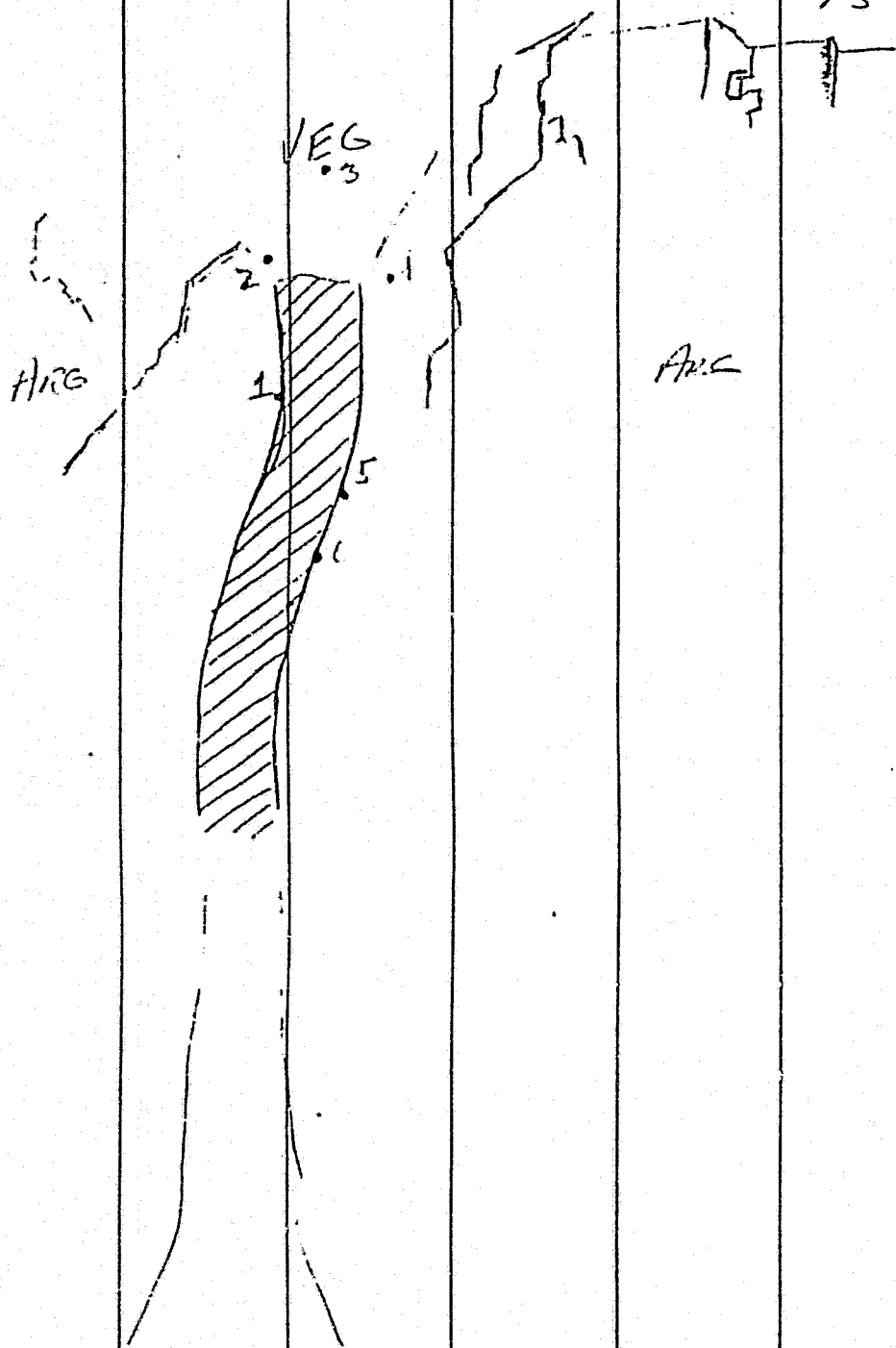
Set up of soil station on the south
 abutment opposite control number 32-331.
 This station is 32-331B. Will use
 geology station number 81-10 surveying
 in from east of canyon to river.
 Ascending down, numerous loose
 rocks, slow going.



L.H.C.

H.C.

1/2



81-10₁ d/s side of dike exposure.
Climbers will take some measurements
at this point.

81-10₂ d/s side of dike exposure
2'-3' wide zone of mafic dike on
d/s side, sampled

81-10₃ u/s side of dike, point is within
 $\pm 2'$ of actual contact which isn't
exposed here

81-10₄ approx. $12' \pm 3'$ from u/s side
of the dike. Point is east of the
dike, tjarna dropped his notebook
pages all over the cliff face!!

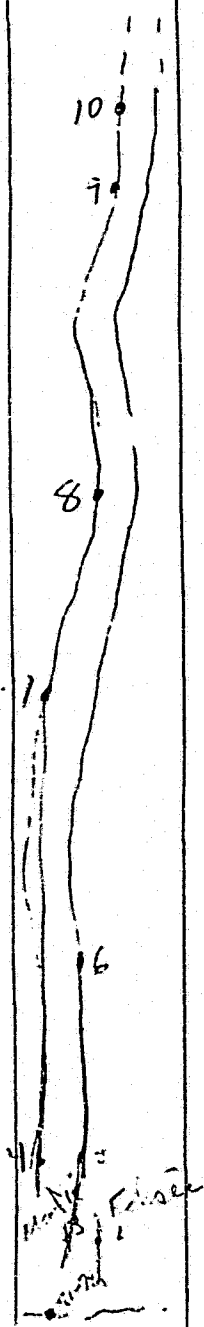
81-10₅ on u/s side contact of the dike

81-10₆ on u/s side of contact, dike
stands out contact varies as
much as 30° in azimuth on contact
surface

To dangerous on the u/s side to
ascend any further down, too many loose rocks

Flowed in ... on south
 - out ... station
 12-352D ... ascending down
 ... Geology station
 81-78, ... river ... working
 ← BH-1

W



81-78, river level

81-78₂ up side of false river, clay
 gauge exposed.

81-78₃ up side of mafic dike

Kag | Mafic | Kag | false
 ← 6' → 11' → 4' → 18₂
 REM Notebook

81-78₄ d/s side of the mafic dike
 dike is 6' wide

81-78₅ up side of dike

81-78₆ up side of dike

81-78₇ d/s side of dike

81-78₈ d/s side of dike

81-78₉ d/s side of dike

81-78₁₀ up side of dike

minerals moved to surface
which is the fault stream on the
north abutment will not go in

7/10 81-79

81-79, dike exposure is 10'
wide just above river level

7/11 81-79, dike exposure

7/10 81-79, dike is not exposed
but believe it would fall
the 1/2 edge of the dike

7/13 81-79, dike is not exposed
but believe it would fall
close to this point

7/14 81-79, dike is not exposed
but believe it would fall
close to this point

7/15 81-79

9-12-81

It's a nice, mostly sunny day. Will
try and finish up today, have an early start.

Diagrams were dropped on the north abutment
will record down from BH-2.

Diagrams are sitting up at 32-3320
on the south abutment. Will station number
for this mafic dike will be 81-122.

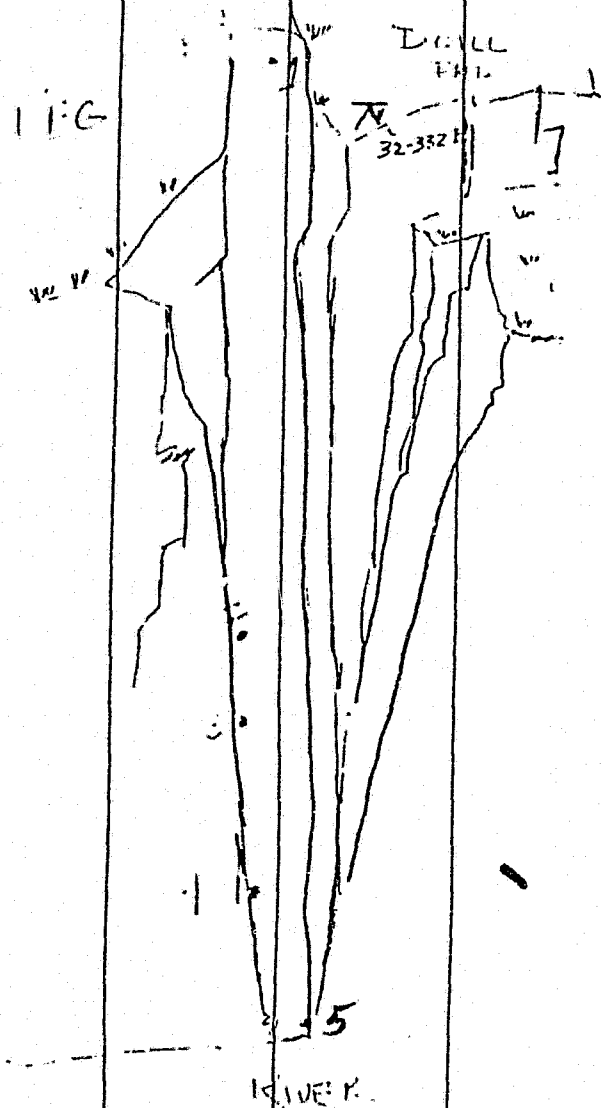
7/11 81-122, center of dike where dike
passes through, adjacent to BH-2

7/15 81-122, 2 1/2 edge of dike

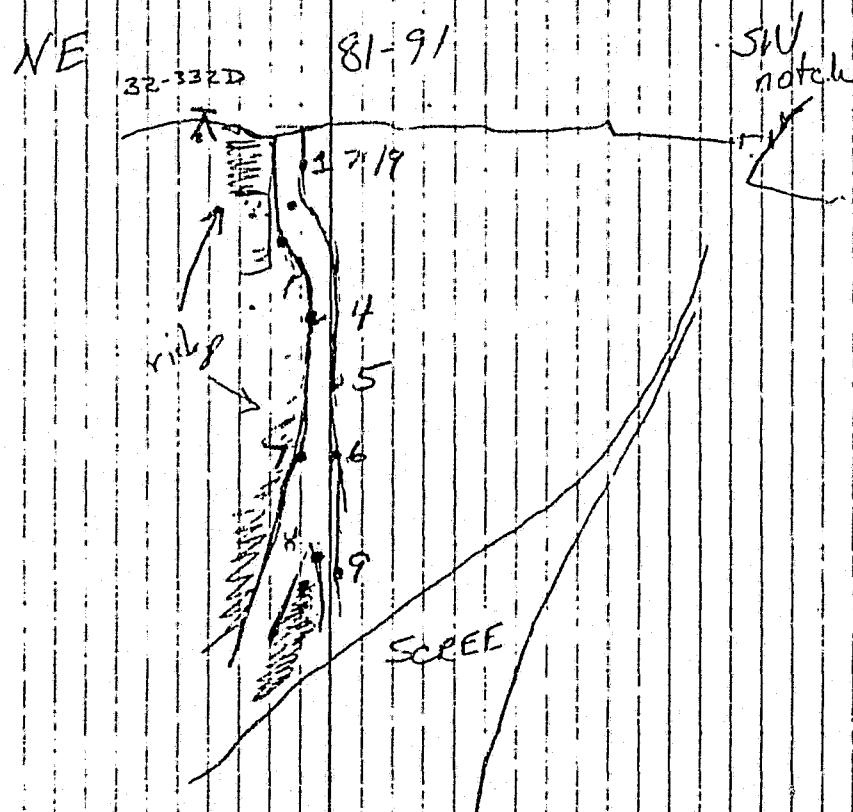
7/16 81-122, 3 1/2 edge of dike

7/17 81-122, 4 1/2 edge of dike

81-122, 5 1/2 edge of contact/dike
couldn't get to the edge, point
is 2' above the river



Survey & Mapping Crew switched side of the canyon. Setup of station at 332E on the edge of drill pad BH-2, ~ 35' down slope. Timbers will start down slope 81-91, w/s side of the same slope.



81-91₁ 1/2 edge of 1st dike
at $\approx 4'$ wide

81-91₂ approx center of the dike

81-91₃ 1/2 edge of "2nd gully" dike.
appears that we do have two dikes,
here which may join but there is
degree of uncertainty due to vegetation
disturbance

81-91₄ 1/2 edge of dike

81-91₅ 1/2 edge of dike. Dike is 8'
wide here.

81-91₆ 1/2 edge of dike

81-91₇ 1/2 edge of dike

81-91₈ 1/2 edge of dike

81-91₉ 1/2 edge of dike

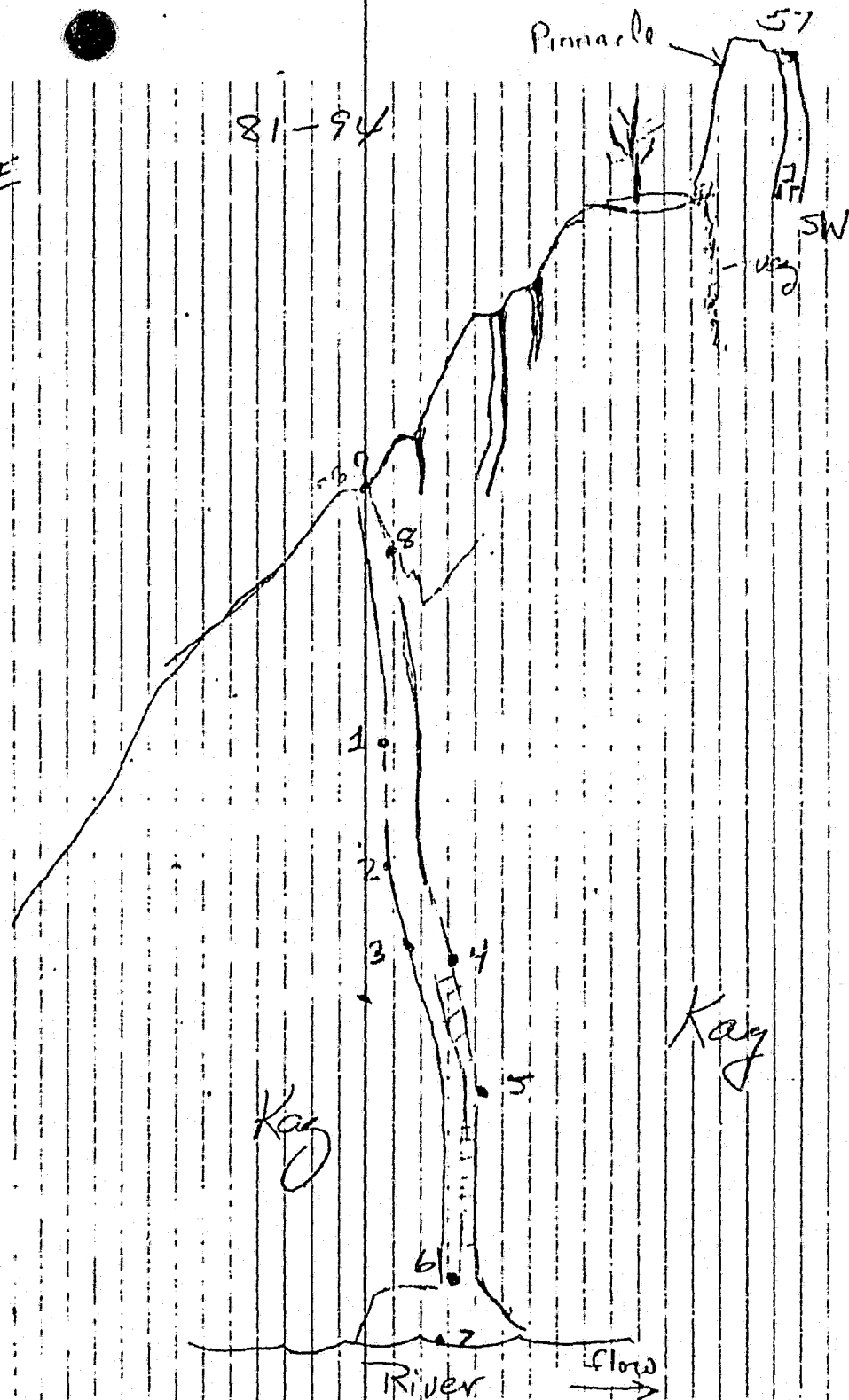
NE

81-94

Pinnacle

57

SW



- 763 2-94, v/s edge of ditch
- 81-94₂ v/s edge of ditch, 6' wide
- 1-94₃ v/s edge of ditch, 6' wide
- 1-94₄ v/s edge of ditch
- 764 81-94₅ v/s edge of ditch
- 1-94₆ v/s edge of ditch
- 81-94₇ river level
- 1-94₈ v/s edge of ditch
- 81-94₉ v/s edge of ditch
- 81-94₁₀ v/s edge of ditch
- 81-94₁₁ v/s edge of ditch
- 81-94₁₂ v/s edge of ditch
- 81-94₁₃ v/s edge of ditch
- 81-94₁₄ v/s edge of ditch
- 81-94₁₅ v/s edge of ditch
- 81-94₁₆ v/s edge of ditch
- 81-94₁₇ v/s edge of ditch
- 81-94₁₈ v/s edge of ditch
- 81-94₁₉ v/s edge of ditch
- 81-94₂₀ v/s edge of ditch
- 81-94₂₁ v/s edge of ditch
- 81-94₂₂ v/s edge of ditch
- 81-94₂₃ v/s edge of ditch
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- 81-94₂₉ v/s edge of ditch
- 81-94₃₀ v/s edge of ditch
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- 81-94₉₄ v/s edge of ditch
- 81-94₉₅ v/s edge of ditch
- 81-94₉₆ v/s edge of ditch
- 81-94₉₇ v/s edge of ditch
- 81-94₉₈ v/s edge of ditch
- 81-94₉₉ v/s edge of ditch
- 81-94₁₀₀ v/s edge of ditch

after they have been plotted. That finishes the surveying in of the ditch. Tomorrow the surveyors will tie in the subsections.

Feel that 81-94 & 81-121 are probably the same ditch, see how they seat up. There is no outcrop in between these points where the ditch is exposed but the streamers in it find it.

Ditch 81-93 may be in fact two ditches and not one with an offset from one chute to another. Problem is that it isn't exposed in the top in one & in the bottom of the other (chute). May be a function of being covered by vegetation & rubble.

Hour: - 12

9-23-81

Arrived on site with Merritt, Thompson, & White. It's cloudy and flurries are falling. Could not come snow tonight. Snow work completed in Butte. Went to the site/diagram contact on the south aditment just below the break in slope in a chute S of the fault to the north side of the river to BH-2. Observed where zones of slump blocks. Pictures of snowfall

Hours 9

9-24-81

Snowed all night, ended up with ~ 16" on the ground. Retrieved core in warehouse during the day. Couldn't travel any place as it snowed till mid-day and everything was covered.

Hours - 10

9-25-81

Merritt, Thompson, & Henschel left Watana. Ken White & I began logging the geology in the remaining core. Completed BH-3, 5B at Devil Canyon. Pictures of Watana Camp, sunset. Snowshoe for exercise in the evening.

Hours - 11

9-26-81

It's a clear, beautiful day.
Overnight low was ~ 50°F. Ken and I started logging BH-4 @ Watana.
671' core on BH-4. Northern
lights were out last night. Don't think it
is above freezing today
Hours 11

9-27-81

It's a clear, sunny day. Overnight
low was 3°F. Ken and I will finish
BH-4 and then start BH-3. Ended
217' on BH-103.
Hours 11

9-28-81

It's partly cloudy, looks wintery.
Overnight low was between 11° & 12°, with
a slight north wind all night. It's beginning
to gust this morning. Start BH-103 @
317'. Got a slight dusting last night.
Finished BH-103. Was windy all day.
Hours 11.5

9-29-81

It's mostly cloudy this morning, the
wind is still out of the north. Overnight
low was 10°, snow hasn't started melting
at all. Will finish off BH-12 @ Watana.
Start @ 497.0'. Finished BH-12.
Ken & I went snowshoeing to Tsusena
Creek ~ 3 miles. Wind still today.
Hours 10

Samples for Lab Testing
(Based on memo from R. Gorny)

Vatana

Boring	Sample No	Depth	Remarks
12	W-12-650.9	650.9-651.7	sl. altered Q. Dio
12	W-12-647.3	647.3-648.1	sl. alt. Q. Dio
12	W-12-456.9	456.9-457.6	Dio. w. ill. v. cl tight joints
12	W-12-465.4	465.4-466.4	Dio., Fresh
12	W-12-423.1	423.1-423.8	Dio., Fresh
12	W-12-328.8	328.8-329.5	Dio., Fresh
12	W-12-272.4	272.4-273.3	Dio., Fresh Fine-mal' grad
12	W-12-270.2	270.2-270.8	Dio., Fresh
12	W-12-227.9	227.9-228.9	Dio., Fresh
12	W-12-229.8	229.8-230.0	Dio., Fresh
12	W-12-94.0	94.0-95.1	Lithic And., Fresh to sl. with d. v. cl + tight frac.

Boring	Sample No	Depth	Remarks
12	W-12-96.8	96.8-97.5	Lithic And., Fresh, not frac. better of samples
12	W-12-41.1	41.1-41.7	Lithic And., Fresh
12	W-12-38.0	38.0-38.8	Lithic And., Fresh
Boring 12 Sample corral, p 69			
4	W-4-896.6	896.6-897.7	Dio, Fresh
4	W-4-888.1	888.1-888.8	Dio, Fresh
4	W-4-822.7	822.7-823.6	Dio, v. tight frac
4	W-4-809.3	809.3-810.2	as above
* 4	W-4-837.7	837.7-838.3	Dio Chlorite on joint surface
4	W-4-680.0	680.0-680.8	Dio, ch. frac, tight
4	W-4-690.8	690.8-691.9	as above
4	W-4-533.4	533.4-534.2	Dio, Fresh
4	W-4-535.8	535.8-536.7	

* Sample for Direct shear test

<u>Core</u>	<u>Sample No</u>	<u>Depth</u>	<u>Remarks</u>
* 4	W-4-436.4	436.7-437.2	Dio, fresh
	Slacks on chlorite on joint		
4	W-4-285.8	285.8-286.7	Dio, fresh
4	W-4-284.1	284.1-285.0	as above
* 4	W-4-181.4	181.4-181.9	Dio.
	Rough, plane to irregular, FeOx.		
4	W-4-70.7	70.7-71.5	Andesite, fresh
	W-4-70.4	70.4-71.3	as above
4	W-4-146.2	146.2-146.7	Dio; fresh,
	W-4-147.5	147.5-148.5	as above
4	W-4-14.2	14.2-15.1	Fresh Andesite
	W-4-17.8	17.8-18.7	as above
4	Direct Shear Test		

Wena Lab Samples (contd)			67
Boring	Sample No.	Depth.	Remarks
3	W-3-54.8	54.8-55.8	Healed Dio.
3	W-3-54.8	57.4-58.2	Breccia as above
3	W-3-199.6	199.6-200.7	Dio, fresh
3	W-3-193.4	193.4-194.2	as above
3	W-3-320.7	320.7-321.6	Dio, fresh
3	W-3-317.95	317.95-318.9	as above
3	W-3-480.0	480.0-480.8	Dio, mod. alt
3	W-3-462.8	462.8-463.5	Dio, fresh
3	W-3-528.9	528.9-529.7	Dio, sl-mod altered
* 3	W-3-610.8	610.8-611.1	Carbonate healed joint
3	W-3-600.2	600.2-603.2	Dio, sl. alt.
* 3	W-3-757.9	757.9-758.4	Dio. Chlorite on joint
* Direct Shear Test			

Boring	Sample No	Depth	Remarks
3	W-3-762.6	762.6-765.2	Dio Fresh vel H, tight as above
3	W-3-767.3	767.3-768.0	
*3	W-3-945.8	945.8-946.2	D:O
	Shear		
3	W-3-954.8	954.8-955.7	Healed Dio Breccia
		955.7-956.3	D:O, vel its, tight
1	W-1-137.0	137.0-137.8	Q. Dio Fresh
1	W-1-134.9	134.9-135.7	as above
1	W-1-221.0	221.0-221.8	Q. Dio Fresh
1	W-1-230.3	230.3-231.0	as above
1	W-1-273.6	273.6-274.4	Q. Dio Fresh
1	W-1-267.5	267.5-268.3	+ healed frac Q. Dio
1	W-1-80.4	80.4-81.1	Q. Dio Fresh
1	W-1-81.7	81.7-82.4	+ healed frac Q. Dio Fresh
1	W-1-44.2	44.2-45.1	Q. Dio Fresh
1	W-1-41.6	41.6-42.4	as above
Direct Shear Test			Sample

Boring	Sample No	Depth	Remarks
12	W-12-657.6	657.6-658.5	Grano Dio Fresh-s. alt.
12	W-12-637.3	637.3-640.7	Q. Dio, shall

Volcano Core Samples (Continued) 69

In the afternoon, to white and
picked up little samples from
Quarry E, till sources

STOP #1 BERNARD H

W-80-256, Two large bags

STOP #2 DEEDMAN CREEK

W-80-282, Two large bags

STOP #3 QUARRY A

W-80-303 2 Bags, simplified 6 loose rocks

STOP #4 QUARRY A

just over cliff edge of W-80-304?
loose rock. 2 bag samples + 3 loose.

STOP #5 DEVIL CANYON Proposed

QUARRY SITE

W-80-82

3 loose rocks, 2 Bags

J. Gill called @ 6⁰⁰ asked me
to fly tomorrow with Larry. I
can't make it
HOURS 15

Lab Samples, contd Devil Canyon

Boring	Sample No	Depth	Remarks
5B	D-5B-149.9	149.9-150.8	Arg, fresh
5B	D-5B-155.2	155.2-156.1	as above + healed joint
5B	D-5B-183.5	183.4-184.5	Arg, phyllite grade
5B	D-5B-170.8	170.8-171.5	Arg, highly folded
5A	D-5A-221.5	221.5-222.5	Fresh Arg, fol 10°
5A	D-5A-231.3	231.3-232.3	as above
*5A	D-5A-229.2	229.2-229.8	as above chlorite on plane, smooth joint
5A	D-5A-269.1	269.1-269.8	Arg, fol 10°
		271.1-272.0	as above
7	D-7-174.6	174.6-175.4	Arg, fol 90°
7	D-7-178.1	178.1-179.0	as above

Sample for Direct Shear test

Boring	Sample No	Depth	Remarks	Boring	Sample No	Depth	Remarks
1	D-7-182	181.0-181.7	Arg, Fol 90°	3	D-3-83.9	83.9-84.7	Arg, Fol 60°
1	D-7-185.1	185.1-185.9	Arg	3	D-3-89.6	89.6-90.6	Arg above
	D-7-202.1	202.4-202.1	Arg				well secondary Fol. at 10°
			Int. with clay etc	3	D-3-124.0	124.0-124.9	Arg + Gwcke
1	D-7-210.7	210.1-211.1	Arg	3	D-3-127.3	127.3-128.1	well tight fine + sandy layers
			For polished rock; rock; fol.				Arg
1	D-7-252.4	252.4-252.8	Arg	3	D-3-212.8	112.8-113.7	Sandy Arg
			Irreg, fol. joint	3	D-3-276.0	276.0-276.8	Gwcke
1	D-7-317.5	317.5-320.3	Arg	3	D-3-350.4	350.4-351.2	Matrix Dike
			well fine gr. Fol 90°				
1	D-7-325.7	325.7-326.6	Arg				
			Fol 90°				
1	D-7-327.3	327.3-327.6	Arg				
			Shear at 20' structure				

Sample for Direct shear test

335 / 85W to Vertical
Spacing 1' to > 10'

Minor
40 / Vertical

81-1001

Ridge ~ 100ft long x 20' high
trending about 290°

Ardite Porphyry, medium
~~gray~~ green, 20'-30% feldspar
phenocrysts, apophytic
groundmass, fresh below
a weathering rind ~ 1 inch
appear same as ardite
porphyry on south side
of river.

Contact with Diomite at
W-81-1000 not exposed
gully ~ 200ft wide between
outcrops

It's a warm sunny morning. The
night air was 18°. M. Brown will
fly the reservoir with L.A. of
L. K. White will map the outcrops
adjacent to COE trailer & slide blocks
opposite to BH-2. Need to bag & number
all rock samples.

K. White

Approx 300 yds east of COE
trailer on ridge of outcrops
see airphoto Note diatom
cold, compass needle is not swinging freely

W-81-1000 trend of face 290° E 2325

Diomite, med grnd, grayish
green
Mostly snow covered

Joints

Major

290 / 55 S forecreek

Joints

Major

315/80 N

pl, sm, spacing 2" to
3 ft or 1-2 ft

40/70 SE

pl, sm sp 6"-1 ft

290/80 S

pl, sm, sp 1-2 ft

~~10~~ 10/15 E

pl, sm, sp 3-5 ft

top of outcrop has been
glacially polished and
marked, possible
striations trending 20°-100°

W-81-1002

Dioite boulders

W-81-1003 ridge 300' south of COE trailer
Dioite med grained
greenish gray

Outcrop is highly fractured with
~~very~~ very close spaced, tight
joints of generally
random orientation, ~~locally~~
generally has appearance of tight breccia
trend of face 280/
exposed in 300' x 20' high
to 40'

East ~~West~~ end of outcrop
has an irregular shaped
felsic dike, light gray,
aphanitic, 1 ft wide,
v.l fractures
trend is 70/70 NW

Strongest fracture trends
appear to be

330/70 E

0/70-80 E

W-81-1004 see map photo
large outcrop on west side
of broad gully
~~150~~ 150' x 20-30' high
trend of face ~~80°~~ 50°

Outcrop is a mixture of
diomite, diomite breccia
and agglomerate(?)

East end is diomite
fine to medium grained
light gray to med. green
from moving from east to west
the diomite becomes
mixed with diomite breccia
(fragments of diomite in dark
green "green" matrix)
Rock has a massive appearance
overall

agglomerate →

West end appears to
be zone (?) of diomite and
other lithic fragments in
a finer grained matrix
very visible best on

77
weathered surfaces
Rock fragments are 60-70%
of rock and range from
0.5 in to 6 in, av 2-3 in,
subrounded to
subangular

Joints

330/70 W
sp 10-15 ft

50°/85 NW-85 SE
face maker
sp > 4 ft

W-81-1005 200' x 20-30' high
Agglomerate
as at 81-1004
massive
trend of face 295/80 S

~~W-1006~~
W-51-1006

Small outcrop 40' x 3-4'
trend 3/01

Diorite(?) fine grained,
dark green
local white
in places

Joints

40/80 SE

sp. 1-2 ft

320/80 NE

face maker

5/90

spacing 2-3'

Outcrop on N-S
seismic line

~~large~~

previously mapped
in summer

W-81-111

Flies the mountains with R.H. forest.
Bry. rock samples.

Contents
AAI Book 15

Watana

North bank:

W-81-400 to 81-404: 1-16

South bank

Quarry A

W-81-405 to 81-410: 17-23

6/20/81, Saturday

K. White and

J. Heinzen at north
bank Watana
tracing Fingerbush and
"E-W" shear

A = base of major fingerbush
gully

Photo K11-28

shear trending

300° ~~also~~ on west side of
N.S. gully wall
main Fingerbush shear

A-B 1° - 105° 37° up 80
 up gully,
 gully generally vegetated
 but numerous angular
 cobbles (approx 2 in) 50
 B-B 246° 48' 0° west side, and to pool
 B-C 344° - 80° 46° up 56

WB1-400(8) @ SMALL O.C. IN MID-GULLY -
 HIGHLY FRACTURED, FLAGGY → LGE. ANGULAR BRECCIA
 RK IS ON A/D CONTACT IN ZONE OF MIXING/BRECC-
 CIATION. INCLUSION OF DIORITE (BRECCIATION?) IN
 MOSTLY ANDESITE - 'DIORITE BRECCIA'. O.C. IS
 INCOMPETENT & MODERATE → SEVERE WEATHERING.
 JOINTS MOSTLY IRREGULAR

ROUGHLY -
 { N-S / VERT IRREG. ROUGH SPACING AVE ~ 2'
 * { 580° / VERT PLANE → CURVED ROUGH (1'-1' AVE) 26°
 { 350° / 80° SW IRREG - ROUGH (6"-1')
 MINOR 130° / ZONE PLANAR SLIGHT CURVE, SEMI SMOOTH
 (1'-2', AVE 1.5')
 85° / 50° S IRREG. ROUGH. DISCONTINUOUS (6"-1')

Going up gully rocks
 continue to be highly fractured
 along the major joints
 the "300°" trend is pronounced

Rock is as described above
 but also is mixed with some
 diorite that has been
 injected by andesite. probably
 same material as above but

C-D 76' 337° 40° up 58
above split in gully
vegetated

D to W-81-342
50' 66° 0 50
30' 356° 40° up

D-E 80 313 34° up 66
base of cliff
below BH-2

E-F 70 248° 0° 70
base of cliff

F-G 40' 252° 0° 40
G = W-81-401

no brecciation and mixing
Pt. B' west side of gully
Andesite Porphyry, med
gray, aphanitic groundmass,
20-30% eq. phenocrysts to 1/8"
approx 40% mafic (bbl + brot).
rel. intact

W-81-401

Andesite Porphyry, aphanitic,
light to med gray-green, fresh,
generally massive, with
several well defined joints,
10ft ^{at thick} zone at base of outcrop
where blocks are slumping

Joints

302/85° SE

semi smooth, curved, opens to
1 inch in places, up to 3ft
or 2ft

G-4

60 240° 0°

60

below cliff face
edge of gully trending
approx 290°

W-81-402

+ 15' 240 0

15

to shore

~~W-81-402~~

401. contd

281/7° S pl, semi sm,
sp 6 in to 2 ft, or 18 in5°/90° pl fine, semi sm
sp 3 in to 3 ft or 1 ft

Minor

330°/90°

weakly expressed

outcrop is east side
of spire seen from
355° shore on south
bank

W-81-402

Andesite porph as before
but slightly to mod with
iron cl to cl sp ft, highly
fractured

Shale zone

1 ft wide, 290/90°
4 in zone of yellow to tan

702 contd

Silty sand with trace of clay
8 in with colored zone of
sandy breccia with
rock fragments to 4 in

This shear is subparallel
to the shear on south
bank

Major joint

$40^{\circ}/90^{\circ}$, cr, semi sm
sp 4" to 1 ft. av 6 in

$290^{\circ}/90^{\circ}$ pl, sm
right shear { sp 1/4 in to 3 in
av 2 in
av 8 in away from
shear

Minor

$330^{\circ}/70^{\circ}$ NE
pl, smooth
discontinuous

H-I 90' 306° 44° up 65
up gully

I-J 64' 306° 38° up 50
up gully

Pt I

Jointing is cl to v cl
at sides of gully, farther
away on cliff face
rock is massive.
Gully is at least a
fracture zone, most
probably a shear zone

lower

294/90, or more
up 2 in, 2 in shear
with this set, breccia
Gully is vegetated

Between I & J

235 & 250 / 90
open jts, fractured,
sp 1 inch

J-K 74' 292° 44° up 32
W-81-403

Station W81-402A (J)

RK in ANDESITE PORPHYRY AS PREVIOUS.
MODERATE WEATHERING. HIGHLY FRACTURED / SHEARED
Shear Zone SW SIDE OF GULLY
6" WIDE TEND 290/VECT. BRECCIA/GOUGE
SILTY SAND TRACE CLAY. ANGULAR FRAGS → 2"
LIGHT YELLOW → YELLOW ORANGE.

Point
290/VECT CURVED, SLIGHT ROUGH (1"-2") MANY OPEN
SUB ⊕ DIAS < 5° PLANAR → CURVED, SMOOTH
(1"-6", AVE 3")
90°/14-5° CURVED SEMI SMOOTH (AVE 6")

W-81-403

Andesite Porph as previous
Shear zone 10ft SE of
pt K, not accessible no
data is questionable

300°/90°, approx 1ft
wide, sandy breccia
yellow orange

K-L	100'	309	34° up	83
			top of gully	
L-M	35'	235°	0°	35
M-N	65'	230°	15° down	64
			across major gully to SW of previous gully	
			W-81-404 Sample	
N-O	100'	338°	25° up	91
O-P	100'	338°	15° up	97
P-Q	100'	323°	22° up	93
Q-R	70'	51°	14° up	68
R-S				
S-T	100'	67°	0°	100
T-U	80'	92	11° down	77

W-81-404

appears to be a hydrothermally altered andesite (typical andesite porphyry away from gully) white to light gray, silty to mud with

no exposure in gully but some fracturing on walls, CO₂ coating: probably fracture zone at best

Point to a diorite boulder

U-V	100	106°	16° down	96
V-W	100	82°	5° down	70
		diabase and andesite boulder		
W-X	100'	146°	38°	79
	at 50' andesite outcrops			
X-Y	90'	129°	33° down	75
	andesite outcrops			
Y-Z	100'	150°	38° down	79
Z-A'	98'	58°	12° up	96
A'-B'	75'	73°	12° down	73
	B' = BH = 2			
	end of traverse			

Over to south bank
at Quarry A
starting at W-81-347
(flagged tree) heading
southwest across strike
of gullies

→ plotted
07/13/21

A = W-81-347

A-B 100 215 0° 100
216

across major gully
trend 295

no exposure in center, swampy
some water

B-C 100 227 330 up 84
231

C-D 75' 186 150 up 72
181

D-E 100 243 0 100
246

E-F 100 247 0 100
249

F-G 100 240 0 100
244

G-H 100 155 0 100
157

corrected
slope

100

84

72

100

100

100

100

↑

H-I 60' 155 0' 60' 157

outcrop W-81-405
small exposure 40 ft long x
6 ft high
Sample
marked with flagging

~~155~~

W-81-405

Andesite Porphyry, dark gray,
aphanitic, 15-25% plag
phenocrysts to 1/8 inch, fresh,
hard, ^{minor} inclusions of
green, very fine grained aphanitic
material to 1/8 inch

less phenocrysts and darker
than on Northside

Joints

Major

114/90° pl, am,
sp av greater than 2 ft

7/77° E facemaker
pl, am, sp 2 in to 3 ft
av 2 ft

Minor

91/44.5 cr, am
sp 8 in to 2 ft, av 1 ft

F-J	100'	201 201	0	100
		outcrop begins, extends 30' south along same ridge as 483		
J-K	100'	249° 251	0°	100
		Swamp begins at K		
K-L	100	232 232	0	100
		end of swamp at 85'		
L-M	100'	291° 293°	0°	100
		outcrop begins below us at 40 ft		
M-N	85'	315° 318	18° down	81-
		along cliff		
N-O	50'	270 271	0	50.
		along cliff.		

405' contd

74/24 N line rough
sp on 1 ft

O-P 65' 287 20° down 61
291

along cliff base
W-81-406

W-81-406 cliff approx 30' high
Andesite porphyry as
previous, overall
outcrop has massive appearance
ANDESITE IS LIGHTER - MEDIUM GREY
could be low

Joints

- * 260°/VERT +/- 5° CURVED SMOOTH - ROUGH
(O.C. FACE) (G'-1', AVE 8') SOME OPEN - 1"
SOME FAILURE ALONG PLANE
- * 0°/VERT PLANE - CURVED SLIGHTLY ROUGH
(G'-3', AVE 1.5')
- * 60°/VERT +/- 20° CURVED SMOOTH - SEMI SMOOTH
(AVE 8") MINOR JOINT - LOCAL
~ THAT'S IT! ~
- * 132°/07° NE PLANE SMOOTH CONTINUOUS
(G'-4', AVE 2')

Inclusions include argillite
and green fine grained or aphanitic
rocks both are seen as
tabular and subrounded
Andesite is generally lighter in
color where inclusions are
present also with inclusion rock

P-Q 79' 285° 0' 79
284°

Q-R 75' 250° 0° 75
258

end of continuous outcrop

R-S 100' 263 5° down 100
262

W-81-407

S-T 50' 254 0 50
254

W-81-408

is very similar to andesite
porphyry on south bank near
the ice filled gully (305 shear)

W-81-407

Andesite porphyry as previous
outcrop is featured more
than previous.

Fracturing along

173/72 E

col, semi sm, up 2 to 8 in.

as 3 in

open to 1/4 inch

76/90 pl, sm, face
up 1 ft and greater

W-81-408

Andesite porphyry, med gray,
aphanitic, 20-35% plagioclase
to 1/4 inch, less than 10% mafic
inclusion as at previous

T U SW O

outcrops, generally fresh but
 surface is all weathered, feldspar orange
 joints

Major 60/86 NW, cnd semi cnd
 spacing 3 in to 12 in, av
 1 ft

104/90
 sp 1/2 in to 12 in, av 4 in

175/84 E
 cnd, sm, sp 6 in to 18 in
 av 12 in

Minor
 164/12° E, pl sm, sp
 3 in to greater than 3 ft
 discontinuous
 av approx 18 in

U-81
T-U 100' 242° 0° 100
242°

across gully trending
3/10°
outcrop and soft
from T

U-81-409
10' x 4' high

U-V 64' 306° 0° 64
W-81-410
tagged, flagged
sampled

W-81-409

Andesite porphyry, dark
gray, 30-40% plagioclase
to 1/4 inch,

too small for jets

W-81-410

Same lithology as 409

169/42 NE pl, sm
up 1.5 to 5 ft, av 2 ft

64/90° cod, semi sm
up 3 in to 18 in av 8 in
very continuous

167/80° NE cod, semi sm
up 3 in to 12 in, av 8 in

410 contd

161/DINE pl, min am to
 am, up 4 in to 2 ft, or
 1 ft.

Traverse (no direction shown)
 Geology
 O.C.
 plotted 6/13/81
 C

6/21/81

35

AM - Office Work KIW

PM - Went to Devil Canyon
to lay out location of
borehole (BH-6?) on
top of south bank

Location is 200ft
@ 215° from survey
point 303

6/22/81

Office work

Finish Traverses

8PM volleyball

High Lake vs. Watana

Watana 3 games

H.L.

0

6/23/81 Office work

8/8/81

Duncan, Henschel + White

Above Bonob BH-2

150' horiz distance, at 0°

west edge of gully at and/or distant

COE 5' wide shear zone (FB)

Andesite / Andesite Porphyry,
dark gray, non to
porphyritic

Joints

d/s of shear

N 56° W 76° SW

N 77° E 60° S

Shear / Fracture zone

very closely spaced joints

305 / 90° to 85° S

10-350° / 80° W

Surfaces coated with carbonate
locally

P1

12 25 41
Photo K 100 - ~~24~~

Zones of leached breccia
no gouge, within more
massive rock

to outcrop 81-107
slide along 290° set

W-81-500

approx 10-15' wide
Shear / Fracture zone
shearing along 300° trend
vcl frac along 270° trend
breccias govt to a
irregular to thick
granular

to be Q dis with
or breccia veins

06
Photo K-100 - ~~25~~

BH-2

220/66°

PM

Went to showed dike(?)
in snow filled gully
Explained alignment of this feature
with d/s cliff face and
to gully d/s of BH-2 in
Fingerville

Duncan + Herschel agreed,
but felt the feature was
not a major problem for
decision

Looked at andesite/diabase
contact. Rocks typ. agree
with COE interpretation

Went to COE pl. 404

where breccia dike mapped
could not find dike,
breccia approx 1/2 in on
~240 t. d. tight / loaded
looked more like weathering
to me but COE microscope
examination showed

melting and recrystallization

DEVILS CANYON 9-9-1981

Flew in from Dutch Noon

D81-201 Felsic Dike - first field station. Found felsic dike material, 20-25 ft wide; max - only rubble - no ok. See sample D81-201. Some clear "phenocrysts" have cleavage, don't fizz w/HCl. Possibly qtz? Met saw one qtz pyramid (cubical) but lost it. Typical weathering pattern of dike. Reflector placed roughly in center of dike.

D81-202 Two samples @ DIKE, RK

O.C. - (2nd) ~~DIKE~~ NEAR EDGE

Structure

1 1/2' Hgt. CONTINUOUS PLANE CLEAN SMOOTH (1/2-3') AVE 1'

DIKE SMOOTH CLEAN (1'-2' AVE 6")

3' Hgt. (O.C. FACE NO SAMPLE)

RK EFFECT HARD & TOUGH

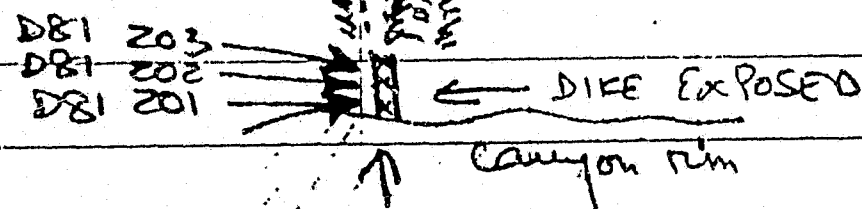
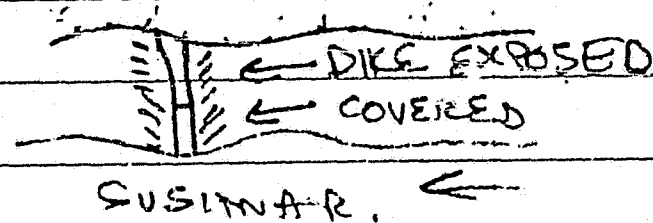
- COULDN'T DETERMINE UPSTREAM CONTACT

D81-203 along eastern margin of dike - 1st reflector pickup. 3rd sample from last station horizontal probably.

Lost the dike at the same approx elev it gets covered up on the other side of the canyon. Country rock. The rock softer to the hammer than the dike.

9-8-81 (3)
No constraints to west the ridge

No Evidence of dike on lower slopes of canyon



dike only Exposed in upper canyon walls - deep gully below most certain a topographic expression of where it is (but covered)

Gully upstream definitely not an alignment in continuance of dike.

Exact alignment of two dikes. Usually apparent while working

9-9-81 (4)
Mag work prob ineffective on this dike such as this since dike (as apparent from other field relationships ~~seen~~ last time climbing in canyon) originated from the westing of country rock nearby (below or some lateral distance). If anything it should be last magnetic. Only one mafic mineral seen (biotite).

In place could an attitude of the dike contact be determined. Even if it could it probably varies $\pm 20^\circ$. It'll be surprised if surveying shows anything useful alignment & topo maps don't show (would have to be worked out)

Cedar ~\$22-42/each
need protected environment

9-10-1981 (2)

D&I - 195, approx ± 1 ft of
contact in rubble. Picture
from here on E side looking
south to flagged dike, looks
exactly as memory,

081-1958; 10ft above water level o/c of dike. looks like flag; marking bottom of dike on opp side river off ~ 1-3ft; but that's w/in (well w/in) accuracy this type of work is able to produce!

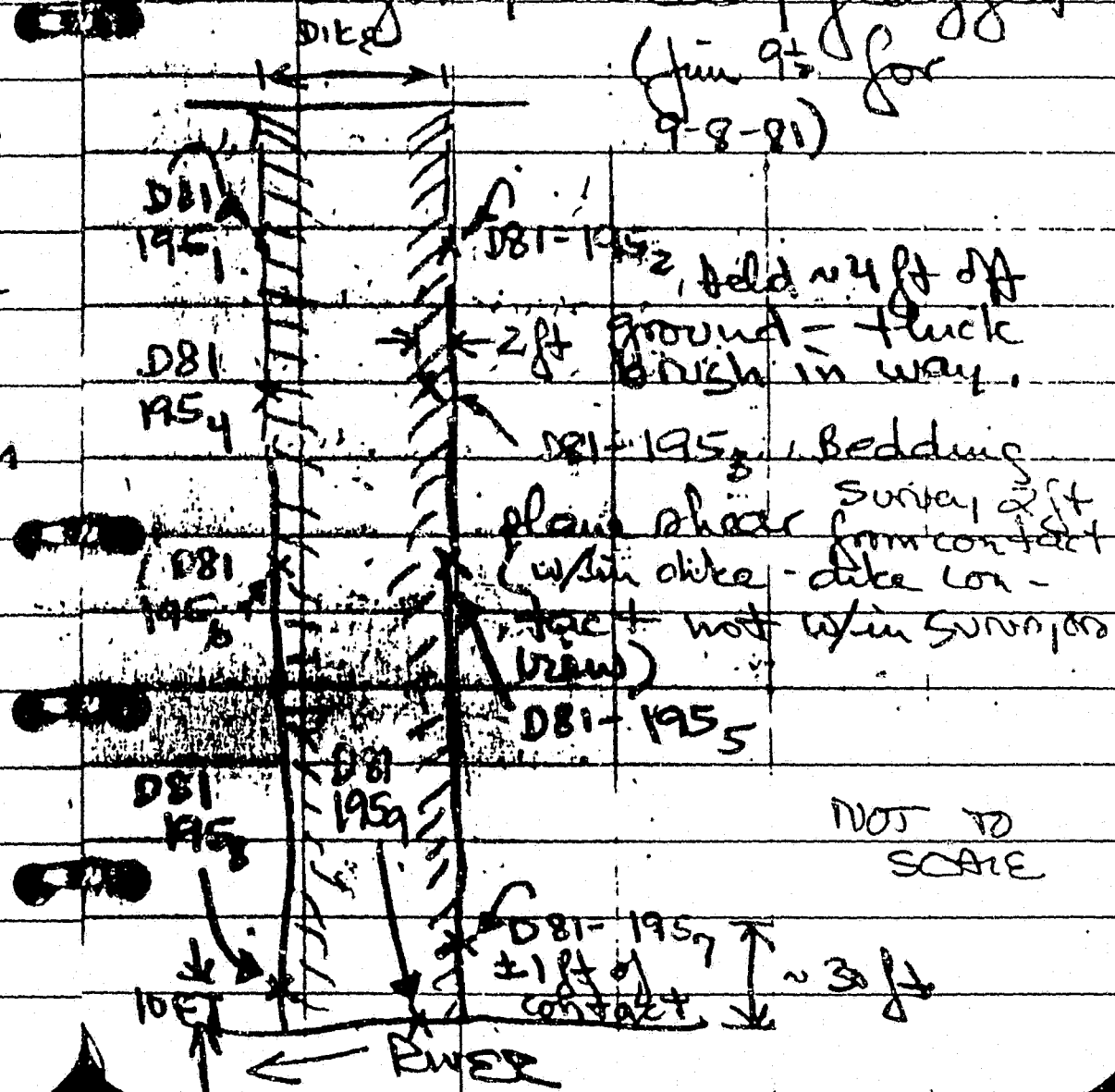
USBR maps which show better canyon topography) written in Chopper.

44 11

PH 8

9-10-1981 (1)

Auto gully already flagged
 (Jun 9th for
 9-8-81)



7-10-81 (2)

~~XXXXXXXXXX~~ 9-10-81 (9)

192₁₂ bottom of gully by argillite
boulders - large o/c or boulder

CP1-138, (Jag DEL-200 * N)

Was 2 ft upstream from
pavement. This upstream
side of dike.

DE 1-198-10

D81 - 1987 - Mike says near cliff zone downstream side (# to near cliff zone upstream side).

D81-1288 - other side of gutter
~ 22 ft from dike o/c mass.

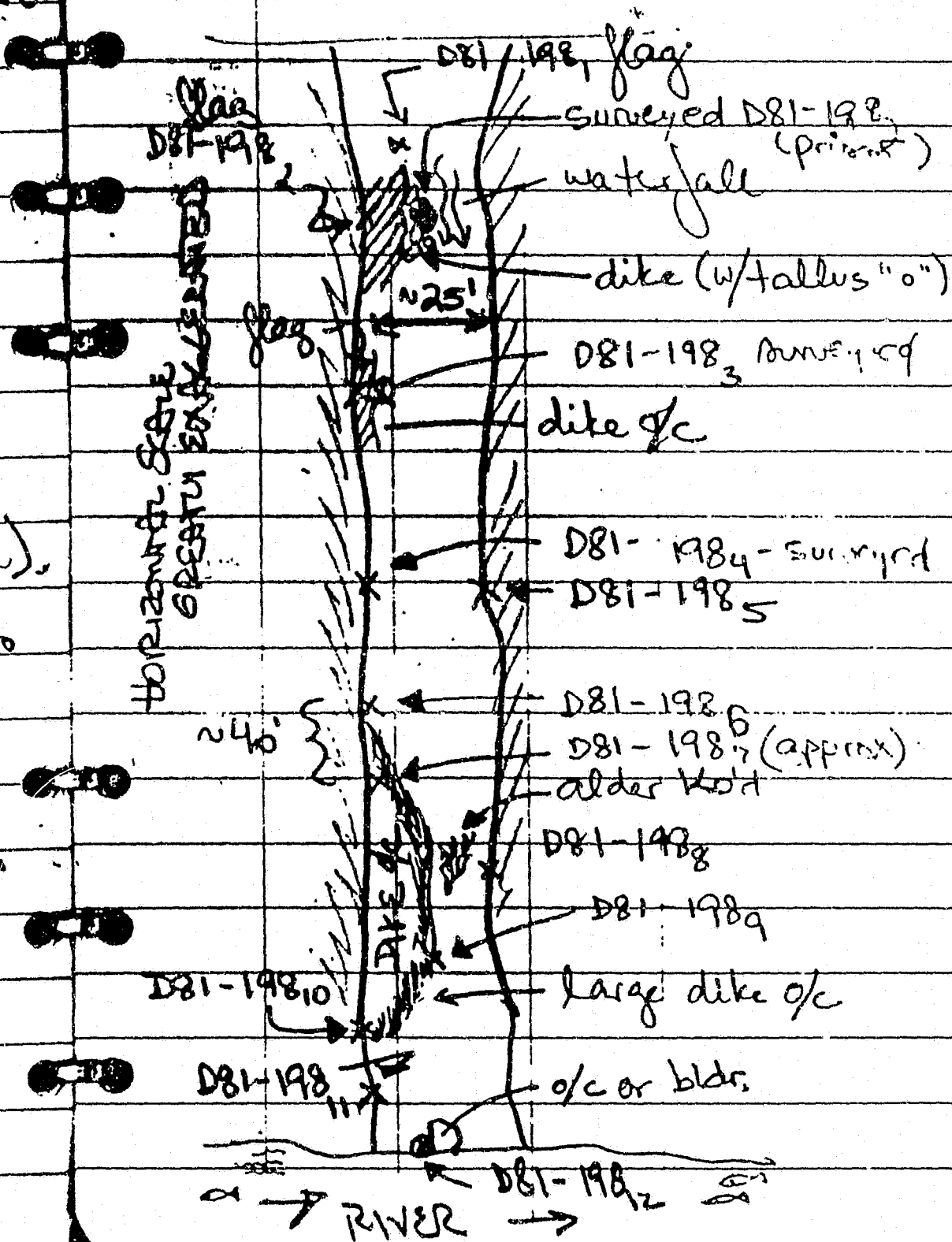
121-172746 not visible from
any point.

D81-198534 removed

5-downstream; 4-upstream.

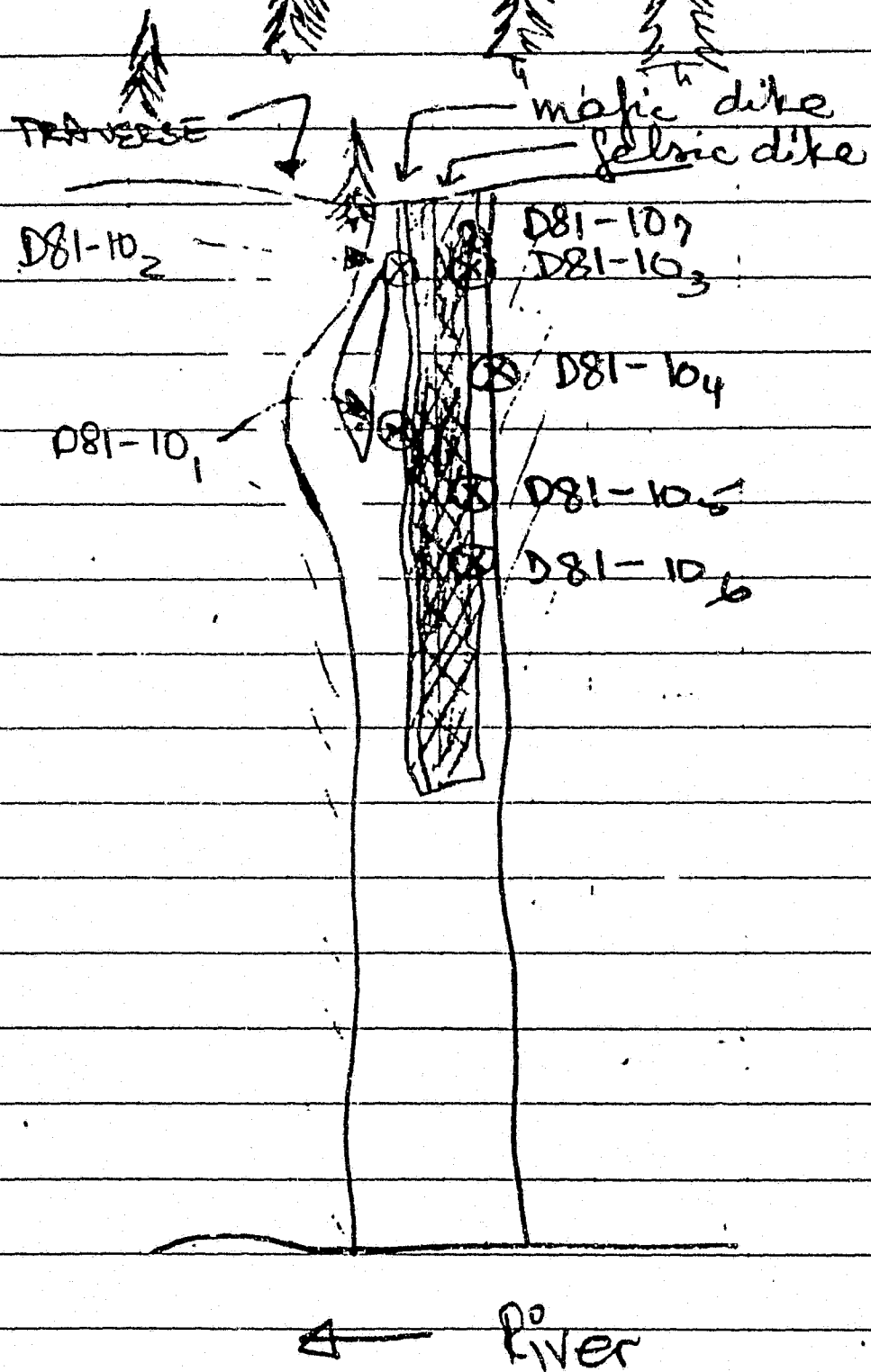
D81-1983 - buoyed - prism
held 5 ft downstream
from contact of flag,

DEI- 1982 - dike ~ 18 ft wide
prim shot ~ 12 ft from
dike - above stream
(west)



9-11-81

(2)



9-11-1981 (1)

Station D81-10₁ w/ $\pm 8^\circ$ declinat
Strike 174° / Dip 86° E joint set
which appears to parallel dike
contact. Can be expected
to vary locally $\pm 20^\circ$. Smoo
Station D81-10₂ margin of
mafic dike - see suppl -
adjacent to mafic dike is
felsic dike.

Station D81-10₃ Grass Area
ft wide. Feel accuracy of
proin shot ± 2 ft (max ± 3.5 ft). Argillite upstream
and medium gray dike
rock - see sample (near
margin obtained).

D81-10₄ 12 ft E of dike ± 3 ft

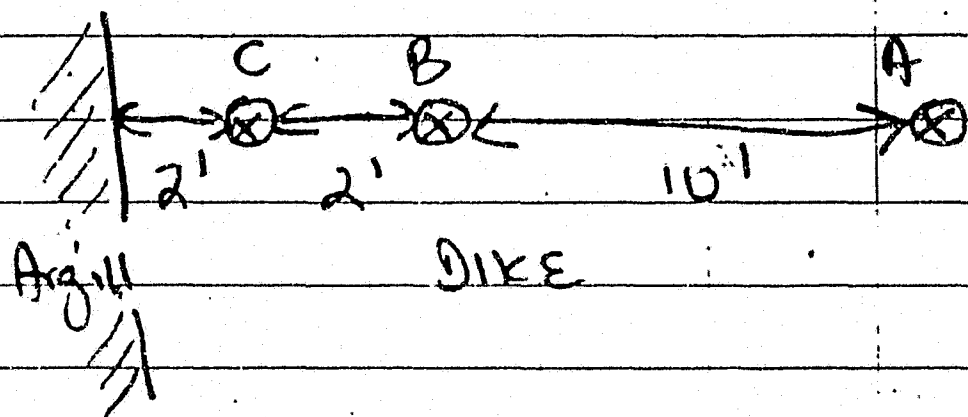
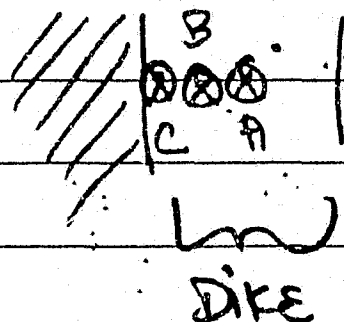
10₅

10₆ large curving face
dike outcrop (over)

9-11-1981 (4)

Correction

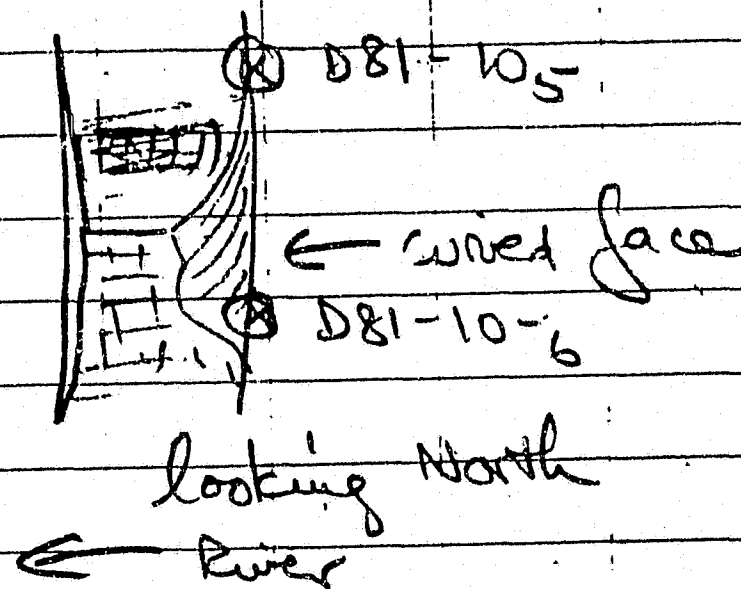
D81-10₇



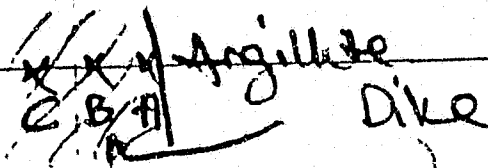
New traverse - mafic dike by dam site D81-78, at water level

9-11-81 (3)

D81-10₆ - could be exposure of dike contact surface indicating $\pm 30^\circ$ curvature at any location due to irregularity of injection plane. Overall dike is remarkably straight



D81-10₇ - 3 samples - not sampled - zonation



9-11-81 (54)

739 D81-78 9 or 10
738 D81-78 8 or 9

D81-78 737 ← 6 ft wide

D81-78 736 ← D81-78 5

784 mafic dike 735 Felsic Dike
D81-78 2
D81-78 3

RIVER ← D81-78 4

D81-78, water level

D81-78₂ upstream felsic dike

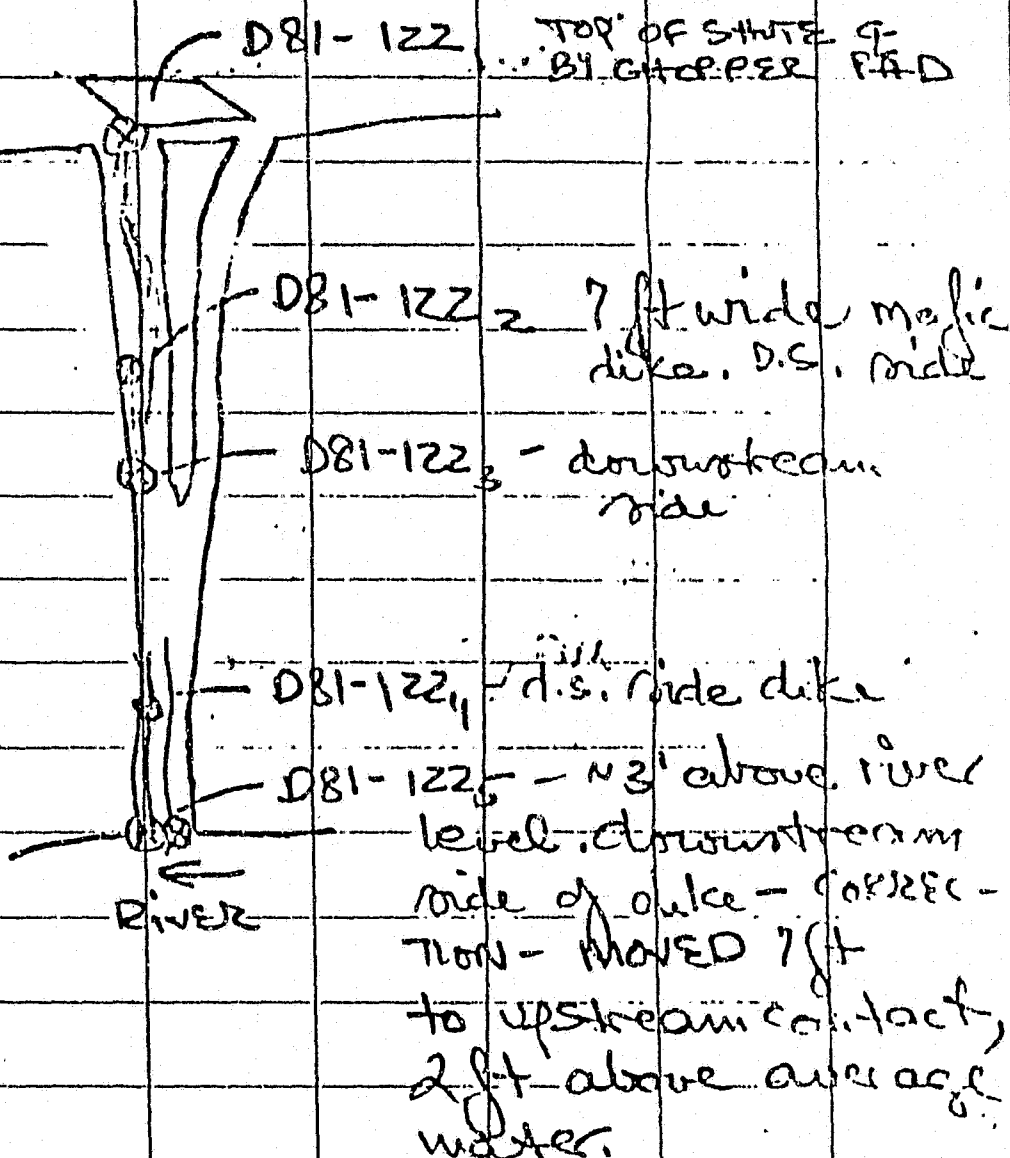
D81-78₃ upstream mafic dike

4 ft felsic dike & 4 ft
country rock

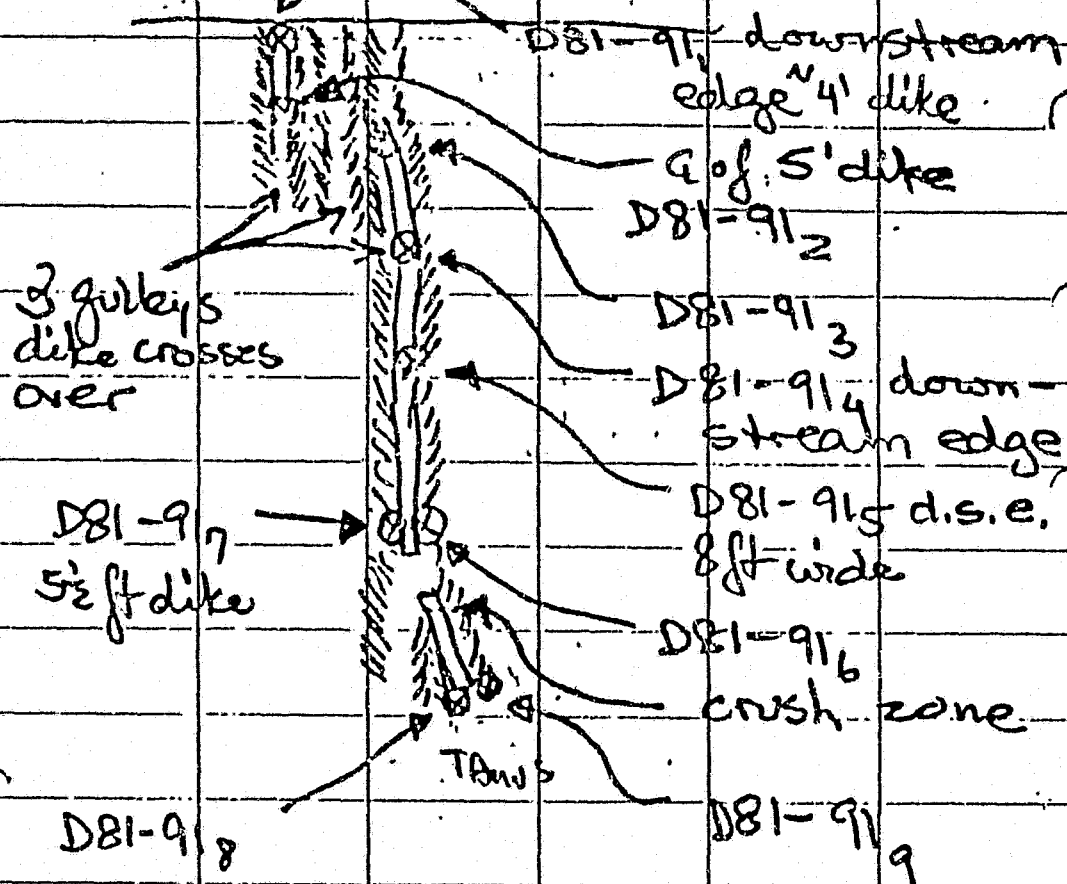
D81-78₄ downstream edge mafic
dike

D81-78₅ - 9 ft wide

9-12-1981 ①

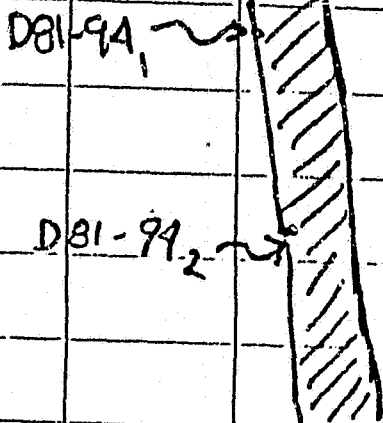


9-12-1981 (2)



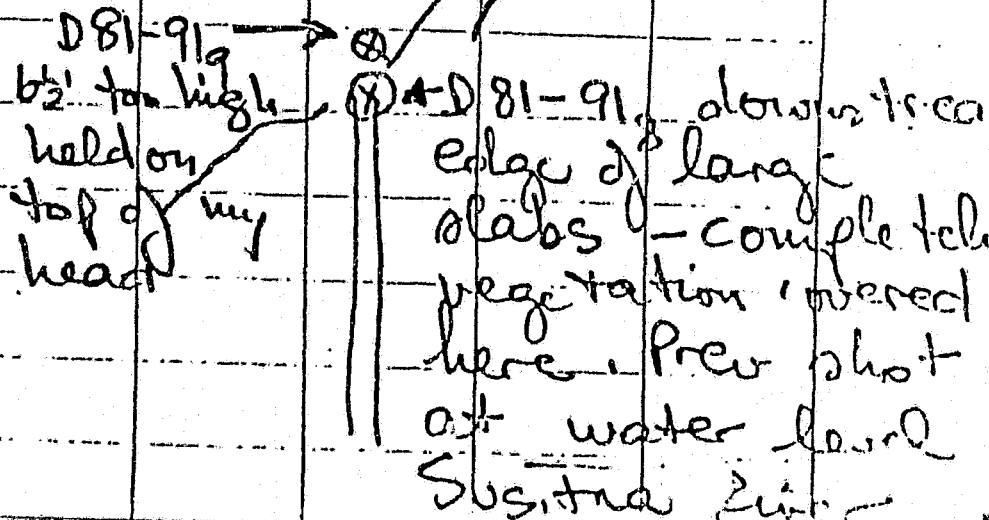
9/12/81 (#3)

DOWNSTREAM



no water taken rest of traverse (rappe)

Dike exposed ~6' above river - below covered by rubble. Last shot ~2 ft above the level.



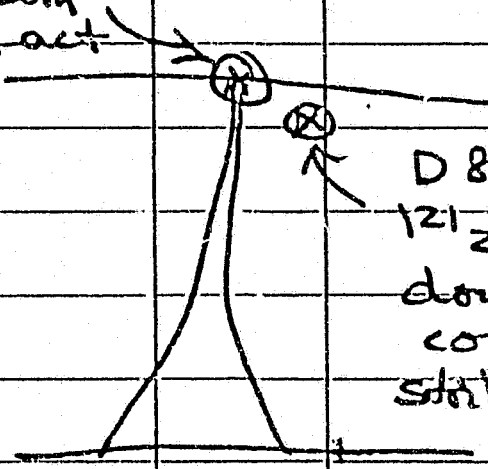
9-12-81 (4)

D81

121 (1)

upstream
contact

at top notch



D81
121 2

downstream
contact

strike 162 / Vert

apparent
contact

RIVER →

B. H. 4
FIELD NOTES

9/8 - 9/12/81

DEVIL CANYON

[14; 34-59]