

1

Sept. 16th 2015 7:40 am  
Town of Glacier, WA

Shuksan Ridge trail  
investigation

Objective: Hike Shuksan Arm  
to see if geology is interesting  
for possible master's thesis

Conditions: Clear, cool (~40°F)

Mood: Apprehensive

I feel like I'm a bit out  
of practice hiking  
since field camp plus the  
terrain is very rugged.

I Dropoff Point - Lake Ann  
Trail Trailhead  
Parking lot

9:00 am

WGS 84 UTM

10 U 0596392

5411613

▽  
Heading east along trail  
towards Shuksan Arm

9 9:45 am

Base of rocky cliffs

↳ There is a path across  
saddle on west side of first  
hill that continues up middle  
of end of Shuksan Arm

Weather is very slippery

bring poles + use trail if

possible

UTM 10 U 0597099

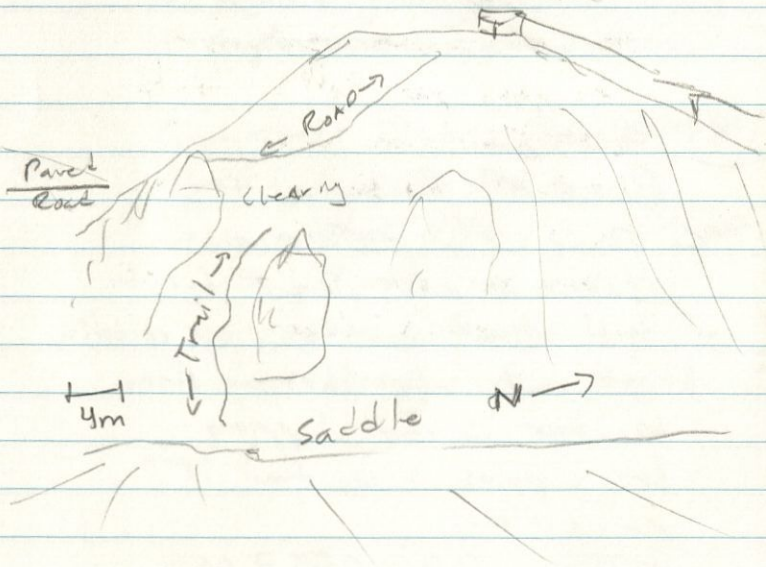
5411466

024 9:55 am Ledge between  
saddle and top of Skutesan Arm

☐ Photo DSC\_737.jpg

Picture looking WNW  
to top of stupa hill showing  
path back

☐ Sketch of route back



9 03 Top of first part of  
ridge

UTM WK 0597 299

5411369

Limestone topped ridge  
dark colored with some clasts  
<1mm - 2mm

☐ Photo DSC\_748.JPG

~~Metasand~~ Meta-sand beds run  
roughly parallel to strike  
of Skutesan Arm  
looking ENE

☐ Photo DSC\_749

Limestone outcrop at 103  
lens-cap for scale

10:30am

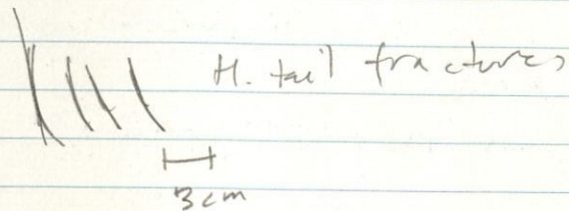
[0] Photos DSC-750.JPG  
DSC-751.JPG

Photos of limestone and sandstone  
layers in gully to east of  
003 (seen in photo 748)

↳ Finny up in sandstone  
from medium to v fine  
Beds are likely altered  
and v. thin (5cm-20cm thick)

? Gully may be a fault (L. Lateral)

Just up ridge about 5m  
there is small L. Lateral fault  
in rock with horse tail fract.



[0] Photo DSC-752.JPG  
fault and fractures

9 04 Top of Shiksan Arm  
UTM 10W 0597564  
5411350

[0] Photos 766 and 767  
Looking North from peat  
to excellent exposure  
light band across rock  
likely dike

9 05 12:18pm  
Limestone/sandstone  
mudstone melange  
UTM 10W 0598425  
5410825

[0] Photos 787-788  
melange with sandstone/limestone  
blocks  
possible shear zone?

↳ Some chert in area too

\* Lunch Report 12:50pm  
So far have been unable to  
locate ribbon chert outcrop  
plan to go east two miles  
in ridge then head back,  
weather permitting

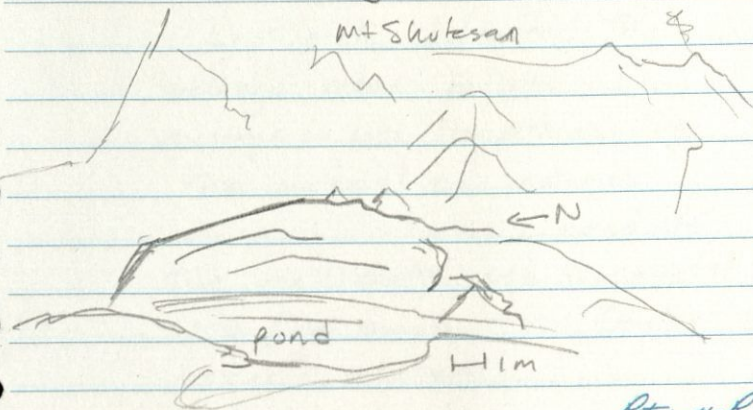
Conditions: Cool, Partly cloudy  
Mood: Relaxed

9 06 End of traverse

UTM 10U 0598864  
5410686

Ended traverse at deformation  
zone just west of Mt. Sholesan  
by small, alpine lake

☐ View looking ESE



≡ Traverse takes about 4.5 hours  
possibly less with less stops  
for photos, maybe 4 hours minimum  
with lunch. Location overall  
features amazing exposures  
and deformation but reaching it  
can be trying.

⚠ Plan to head back along  
traverse, there was one spot near  
lunch to take a GPS, but  
otherwise will try to make  
faster time

✶ 11/27/15 Shoshone, CA  
7:00 AM

⚠ Goal: Today we're going  
to do a preliminary  
investigation of the  
Badwater Turtleback  
in Death Valley. (Collect samples,  
take notes, general sightseeing)

⚠ Conditions: Windy, partly cloudy  
cold (~40°?)  
Probably warming later

≡ Notes: Slept well in small house  
just south of town, Marli  
setup this trip for me  
and Maria.

Last night I learned that  
melange means mixed. So  
melange is more the process than  
the material as melanges  
are large chunks ripped off  
the wall rock and incorporated  
into the main rock (mplonite  
breccia, whatever)

...x From Sho shore head north  
on 127.

↳ To east Resting Springs Range  
rock layers dipping to  
east can be seen in distance

↳ After passing badwater  
turnoff, to North west  
can see Green water Range  
Tertiary volcanics in nature

↳ Further north on west side  
is Eagle mtn., its fairly  
isolated from other ranges  
Resting spring cont. on east

≡ Eagle Mtn.  
Cambrian and Younger  
'Dark stripe'  
Tan sediments at base  
maybe river deposits from  
batolith 80km to north

△ Just past Eagle Mtn.  
to north are Funeral range  
Eastern most peak  
Bat Mtn., debris flow  
between two red peaks looks  
kindalike head

≡ Furnace creek fault runs  
NW-SE along base of funeral  
range, disappears in valley  
to east

...x Take 190 west after DV Junction

△ At narrow point ~10min  
Banded peak to right (North)  
Pyramid peak  
light band at top ordovician  
Banded stuff to NW is Bonanza something  
Fm.

E 9:40 am Base Camp/Parking  
Just a few miles north  
of bad water pool parking lot  
just immediately north of Onkator  
TB striking out to west

400  
007  
UTM 11S 0519 931  
4012691  
WGS 84

→ Planning to Head SE to  
base of TB

\* Lunch Report 12:04

Reached Canyon about an  
hour ago, the gneisses  
and marbles are amazing

Project idea

Compare Gneiss + Marble  
Then  
Characterize marble in  
detail

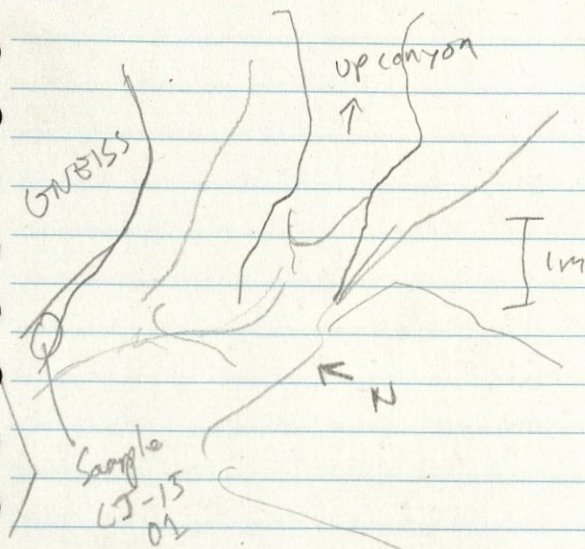
P Lunch Stop  
009 UTM 11S 0521292  
4012530

∠ Gneiss on NE side of  
Canyon

N10W 16SW  
Magnetic Dec. 15°

☒ Sample CJ-15 02  
Gneiss, top oriented  
to N10W 16SW  
(350)

☒ Sketch



△ Sust up canyon ~ 10m  
There are good kineratic  
indicators (s-fabrics)  
visible on South wall

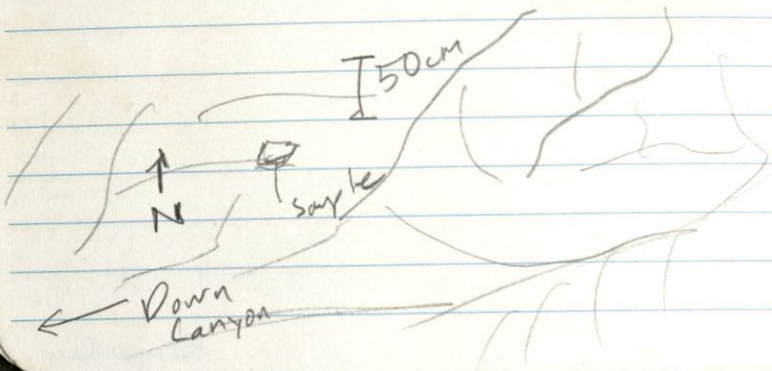
△ Complexity of mylonites  
is much higher near  
greiss

? Are more regular mylonites  
dolomite rich?

X Dolomite? Mylonite  
N9E 20 NW

☐ Dolomite mylonite sample  
CJ-15 02

☐ Sketch of sample location



X Mylonite Melange foliation  
surface  
N60E 28 NW

☐ Photo 1456  
Sample collection location  
for melange

☐ Sample CJ-15 03  
Dolomite clast  
from melange

☐ Sample CJ-15 04  
Zone around pegmatite clast  
in mylonite melange

☐ Sample CJ-15 05  
melange not near  
pegmatite



11/28/15 4pm

☐ Samples CJ-15 06, 07  
collected by Mark Miller

From second canyon

06 Well layered unit

X N30W 27SW

07 Melange

X N35W 35SW

Magdec 12°

From first canyon

08

X Unoriented

\* Mar 21, 2016 6:35 am  
Shoshone, CA

Badwater Turtle Back shear zone  
research trip 1, day 1

Objective: Begin mapping, cross-  
section and photo/sample  
collection mainly in canyon 2  
(southern canyon)

Conditions: Warm, 57°F Clear  
Mood: A little anxious about  
the whole endeavor.

I'm not really sure  
what I'm going to find  
and what story I will  
try to tell. A little  
worried about the heat  
but forecast doesn't look  
too bad.

Equip next notes:  
GPS Garmin etrex 20 UTM UPS  
Unit #2 from WGS 84  
U of O Dept. of Geologic Sciences

*Rite in the Rain.*

I 001 Drop off point 9am

☰ Very windy conditions  
82°F  
Starting from same dropoff  
as previously.

I 001 UTM 11S 0520134  
±3m 4012386

I 002 Start of photo section  
Canyon I 10:07am

I 002 UTM 11S 0521310  
±3m 4012579

I 002 Photos for 30  
meters

Reference point  
Small green bush on dike  
Photos 002 - 280

🔑 Equipment notes:

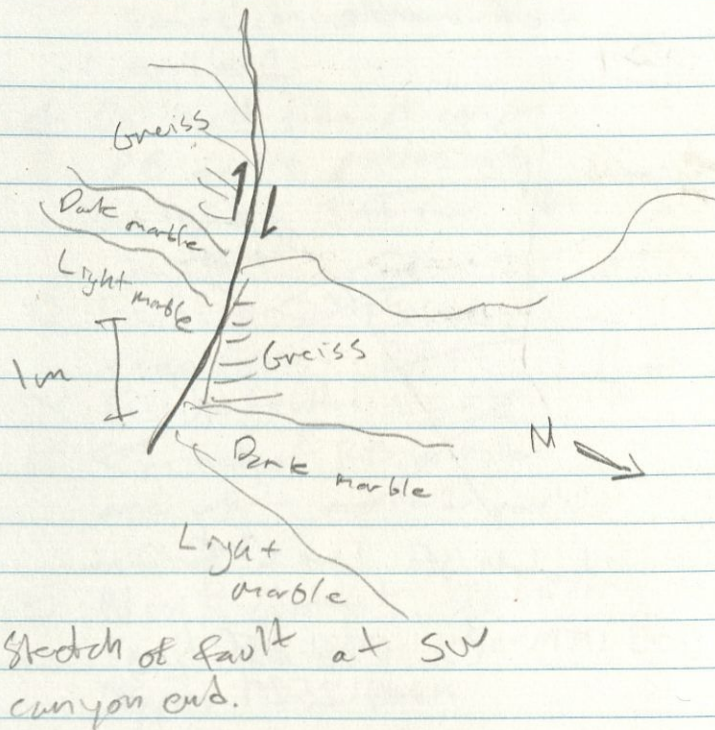
Branton Compass SN: 5073715016

Mag. Dec. 12° E

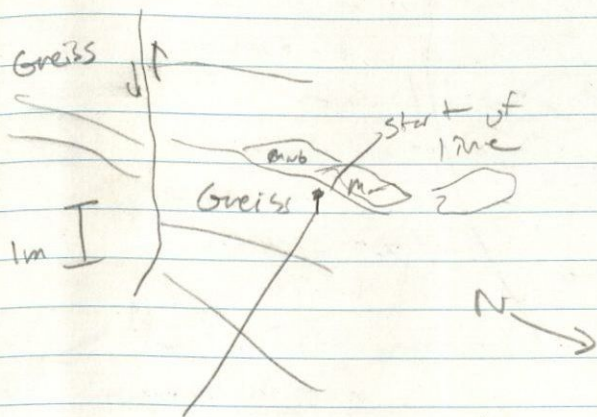
11:10am Starting map of  
canyon shear zone

△ At ~~was~~ south western  
end is a fault, right  
lateral

△ Fault strike' S54W



- ≡ 11:15 am  
 We will be mapping  
 the extent of various  
 layers from SW to NE  
 along canyon bottom exposures.  
 Start of section is 2m to  
 NW of fault where  
 Gneiss contacts lenses  
 of marble.



Sketch of line start

UTM 11S 0521250  
 4012529 ± 3m

- ≡ Gneiss extends for 10ft  
 before contacting red-brown  
 marble.
- × Contact Gneiss - RB marble  
 N48W 37SW
- ◁ Fault disappears into canyon  
 floor at RB marble
- ≡ RB marble extends 4ft  
 before contacting white  
 marble 1.
- ◁ On North side of canyon  
 RB marble pinches out  
 as far as 3ft from  
 line start
- ◁ Fault or crack may  
 reappear at 27ft
- × Possible fault N55E
- ≡ Contact of RB marble  
 and white marble 1 poorly  
 defined
- ≡ Next contact 56ft  
 Small red-gray layer  
 approx 7cm thick  
 pinches out ~2m on each  
 side from canyon center

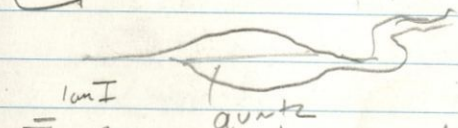
△ White marble 1 continues  
for 1/2 ft until a  
white-brown marble (56.5 ft)

≡ White-brown marble extends  
for 1 ft (57.5 ft).

× Top of white brown marble  
S 66 E 18 NE

△ New layer contact at 57.5 ft  
Gneiss + ~~quartz~~ quartz  
Highly deformed gneiss  
with elongate clasts of  
quartz or possibly pegmatite  
Quartz is in layers  
1 cm - 20 cm thick

≡ Shear sense indicators  
may show dextral sense



≡ Sense indicators unclear in  
some areas, complex motion

△ New layer Gneiss/quartz  
gives way to melange 1, ~~zone~~  
at 83 ft

× Gneiss/quartz - melange 1 contact  
N 5 E 33 NW

△ Melange 1, ~~zone~~  
Primarily light colored  
with thin dark ribbons  
occasionally (1-3 cm thick)  
Large areas of uniform  
marbles with ductile edges  
10-30 cm

Occasional pegmatite or  
quartz clasts 3-10 cm

△ New layer at 92 ft  
Melange 2

△ Highly folded gneisses  
fold amplitude ~ 4 ft  
occasional light colored  
pods/clasts and layers  
of microcrystalline massive  
calcite/marble  
Rare pegmatite/quartz  
clasts ~ 5-10 cm  
Continues to 100 ft

△ Melange 2 gives way to melange 3 after 2 ft

△ Melange 3 consists of Brown marble and light, massive marble veins as well as quartz or pegmatite clasts increasing in size to east.

At the western edge peg/Qtz. are 5-15 cm across after 8 ft boulders are now 30 cm across

△ At 110 ft melange 2 reappears, but peg/Qtz. boulders still present albeit slightly smaller  
Continues to 118 ft

△ At 118 ft melange 3 returns with small peg/Qtz. clasts 0.5 cm - 10 cm distributed evenly in folds of marble. <sup>a light</sup> Elongate clasts are ~~rotated~~ to folds

△ At 120 ft melange 2 returns briefly, with small peg/Qtz. clasts 0.5 cm - 10 cm

△ At 126 ft new layer melange 4 appears primarily light colored layered marble with occasional thin dark colored layers of greiss

Clasts of greiss are also present 3-15 cm as well as clasts of peg/Qtz. 0.5 - 10 cm

△ Moving east the pegmatite clasts increase in size to 25 cm at most until 131 ft

△ New layer at 131 mylonite 1 almost entirely folded marble of light and dark varieties with light in thick layers 2-10 cm and dark in thin layers and veins  $\leq 5$  cm

△ Mylonite 1 continues to 145ft and ends with several boulder sized clasts of pegmatite

30cm - 1m

△ Immediately after a layer of black-gray material approx 2ft across with small peg/tz clasts 1cm - 8cm

Fairly uniform in color and composition, no layers or small folds (layer itself is slightly folded)

△ At 147ft through 162ft slightly layered marble ~~mylonite~~ with highly melange

deformed greiss clasts (boudins) 1cm - 30cm

some large marble clasts also present 5 - 30cm

✓ Mafic dike  
N10W 90

△ At 162ft to 164ft is a mafic dike

It does not appear to be deformed, although it has some ~~big~~ jogs in it but they are continuous

In the canyon middle it does thin slightly, but this may not be deformation.

△ 166 - 169ft

Layered marble melange continues

△ 169ft new layer

Mylonitic melange highly deformed light colored marble and yellow-brown marble flow around cracked pegmatite clasts

1cm - 30cm

Light layers form 'shadows' around clasts at points

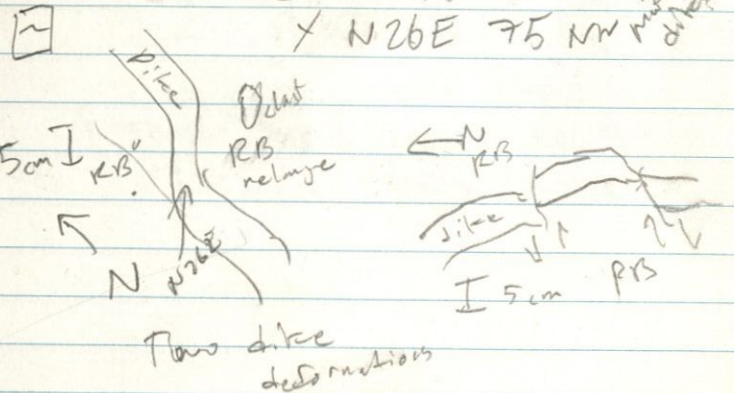
181ft new layer (to 200ft)

△ Red-brown melange  
reddish-brown marble  
with massive pegmatite  
clasts, 1cm - 5m

⊖ Almost looks like the  
edges of the pegmatite  
getting ripped apart

⊖ Layer continues to 247ft  
peg. clast distribution  
fairly random although  
appears to decrease  
structurally up

⊖ New layer Mafic dike 2  
5cm across  
Definitely faulted  
or deformed in areas



△ After dike

RB melange continues to  
261ft

△ New layer

Yellow pink marble

⊖ mylonite

almost entirely marble

some dark layers 1-3cm  
thick, rare

few clasts of peg/qtz  
if any

Continues to end of  
section (300ft)

Photos of various

layers:

282-283 YP marble mylonite

284-286 Mafic dike 2

287-289 RB melange

290-292 Mylonite & Melange

293-295 Mafic dike 1

296-298 Layered marble melange

299-300 Uniform gray-black

301-303 Mylonite 1

304-306 Melange 4

307-309 Melange 3  
310-313 Melange 2  
314 Melange 1  
315-316 Gneiss/peg/ate

≡ Gneiss/peg may be large  
peg boulder surrounded by  
thin layer of gneiss

317-318 white-brown marble

319-320 Red-gray layer

321-323 White marble I

324 RB marble

325-326 Gneiss/fault

□-off Section start  
±5m

3/22/16

☆ Drop off point 8:30am

Conditions: 75°F, Calm + Clear

Objective: Map & Characterize  
Canyon 2 (North)  
And photos

Mood: Reserved

☆ Canyon 2 10:30am

Journey very difficult  
shortest route too dangerous

[Tab] UTM 11S 0521 075  
±3m 4012814

[Tab] 300 meter photos  
363- 560



! Descriptions of shear zone units from west to east.

Observations followed by interpretations.

Distances in ft. (sorry they were out of metric tape measures)

△ Start of section to 11ft

Light colored mix with clasts of light colored material. clasts

5cm - 50cm across.

Layers/flow lines of yellow brown material in between and around clasts

Occasional darker flows appear isolated

? Mylonite marble with pegmatite/Qtz. clasts

Some areas cut by significant veins

0.2cm across primarily N-S oriented

△ 11ft to 12ft

Dark gray mixed layer with small folds throughout

Gradual ~~transition~~ contact with surrounding units.

? Highly deformed gneiss

△ 12ft to 48ft

Appears similar to first unit. Clasts smaller

5-30cm but one

boulder present (~1m)

veins criss-cross rock

filled with dark material

By 33ft no clasts or

flow lines appears

uniform with veins

More brownish color

at this point

? Mylonite marble

same unit as start

△ 48ft to 61ft

Light colored and brown colored material in flow lines, chaotic and folded veins present with some dark material  
occasional clasts are large and undeformed  
30-40cm

? Mylonite marble (cal/dol mix?) and peg/Qtz. clasts

△ At 61ft Thin dike  
~1.5cm across, heavily faulted as it cuts across canyon

✓ Striking N25W ~~78SW~~  
78NE

△ 64ft to 77ft

Light and brown material flowing around clasts of very hard material  
1cm - 70cm  
and some clasts of softer material, light colored and filled with thin, dark veins. ~80cm  
Occasional dark flows highly folded and stretched

? Similar mylonite marble with both peg./Qtz clasts and marble clasts

△ 77 - 78ft

Dike, significantly faulted (3ft offset right lateral)

✓ Fault surface  
~~N25W~~ 42 SE  
N89E

✓ Dike  
N35W 52NE

Δ 78ft to 94ft

Similar light and brown  
flowing material with  
light clasts of hard  
material 1cm - 60cm  
Also clasts of gneiss  
undeformed  
as well as zones of  
highly veined marble  
surrounded by ~~dark~~ brown  
flows

Dark colored flows  
highly deformed and  
folded some times into  
layers

? Marble mylonite with  
peg./qtz., gneiss and  
marble clasts

Δ 94ft to 107ft

Highly layered light  
and brown material  
with light colored clasts  
occasionally present  
15 - 40cm

One large boulder of  
gneiss at 100ft  
1.4m across

? Marble mylonite  
with gneiss + peg./qtz. clasts  
no veins

Δ 107ft to 148ft

Light colored material  
with barely visible layers  
lots of small clasts  
1cm to 10cm and  
occasional large clasts  
of hard material  
20 - 40cm

? Marble mylonite  
with peg./qtz. clasts

△ 148 ft to 168 ft

Similar material but  
Now with some dark  
colored, highly deformed  
material (gneiss)

Large amounts of small  
clasts 1cm - 10cm

Almost no larger sized  
clasts until boulder  
sized (2m+) occasional

? Marble w/lonite with  
lots of pegmatite and  
a little gneiss

△ 168 ft to 194 ft

Pegmatite boulder / outcrop  
undeformed

△ 194 to 196 ft

Very thinly layered  
light brown / yellow  
material, fissile  
but much stronger than  
a typical shale

Almost no clasts  
very uniform, flowing  
around pegmatite  
outcrop

? Marble w/lonite

△ Abrupt transition at 196 ft

to light gray material  
with occasional white  
layers

layers terminate in a conformity  
with w/lonite above

? Gneiss ~~and fact?~~

note, some material  
from gneiss in marble  
but only a little

① 178ft to 290ft

Thinly layered yellow/brown material around boulders of peg and gneiss

Some thin dark layers occasionally, 1-2cm thick all non-clast material flowing and folded

Clasts: Peg: 2cm - 1m

Gneiss: Deformed  
~ 1m

≡ End of Canyon 2

☐ Deta. photos

561 - 563	178ft - 290ft
564 - 565	<del>196</del> 196 Abrupt. trans.
566 - 568	Thin layered
569 - 570	Peg boulder
571 - 573	148 - 168ft
574 - 576	107 - 148ft
577 - 579	94 - 107ft
580 - 582	78 - 94ft
583 - 584	Dike + Fault

585

586 - 587

588 - 590

591 - 592

593 -

64 - 77ft

48 - 64ft

12 - 48ft

Pk. Gray layer

St. to 11ft

\* 9:45 am 3/24/16

Conditions: Clear, 65°F

Prof at 6 location

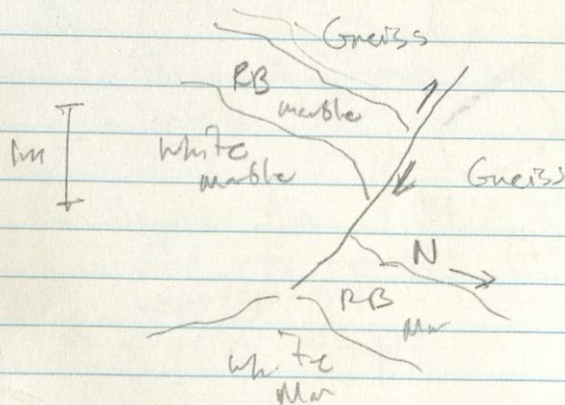
Objective: Collect samples from canyon 1

\* 10:05 am

Canyon 1 reached

△ West end

Mylonitic gneiss bits above  
Red brown marble



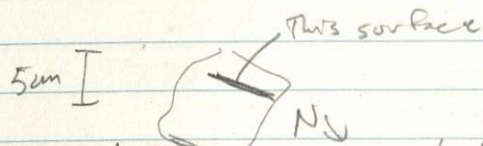
3/24/16

③ Sample 1 CJ-16 C1 01  
Mylonitic greiss at  
west end of canyon 1 along fault

① Photo # 713 10:20am

Photo of Sample in place

✓ S30E 47SW



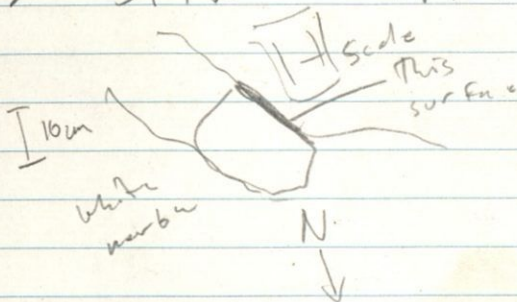
○ A abrupt transition between Greiss + RB <sup>marble</sup>

③ Sample 2 CJ-16 C1 02  
Red Brown marble at west end  
fault 10:25am

① Photo # 714

Photo of sample in place  
looking south

✓ S14W 49NW



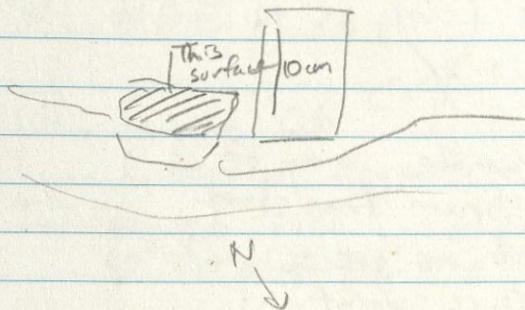
③ Sample 3 CJ-16 C1 03

~~the~~ white, veiny marble  
about 20ft east of  
previous sample 10:35am

① Photo # 715

Photo of sample in place  
looking SE

✓ N55W 16NE



③ Sample 4 CJ-16 C1 04

Red-gray material 10:50am

① Photo # 716

Photo of sample in place  
looking NE

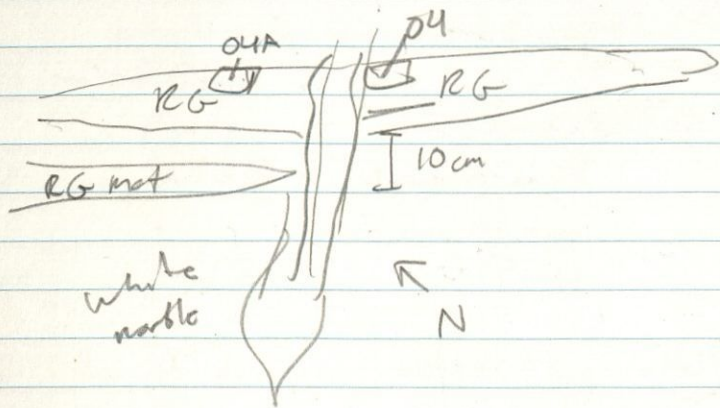
✓ S69E 54NE

③ Sample 4a CJ-16 C1 04a

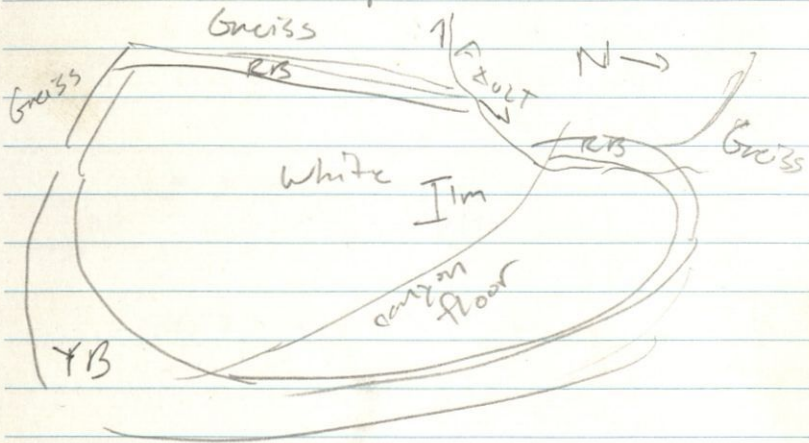
Red gray material 1ft to  
west of 04

✓ S75E 39NE

☐ Sample 04 location



△ YB marble may be  
Red-brown from start  
folded as greiss returns  
at this point



11:30 am

☐ Sample 05 CJ-16 CI 05

Highly deformed gneiss  
and clast

In middle of canyon, very smooth  
area begins

☐ Photo 717

Photo of Sample in place  
looking ESE

✓ N11E 26 NW

☐ Sample 06 CJ-16 CI 06  
11:40 am

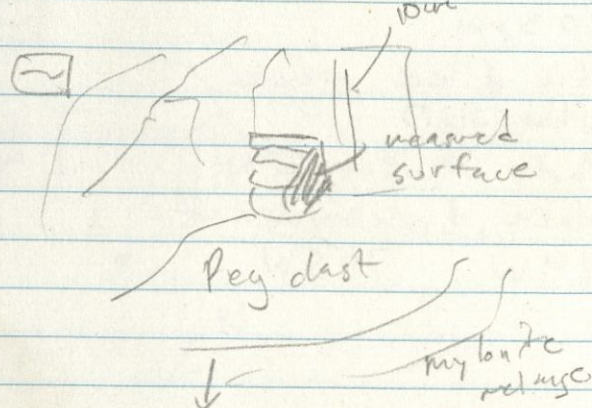
Piece of pegmatite clast?

☐ Photo 718 (near center  
in place)

Photo of sample in place

looking S

✓ S13E 82 SW



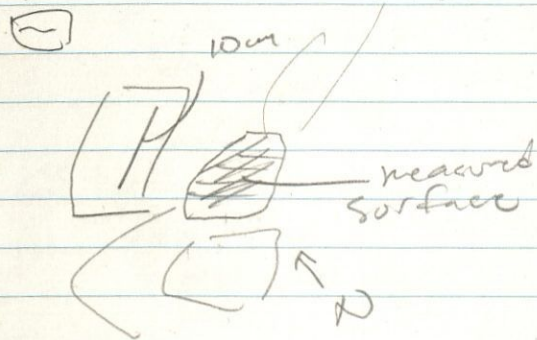
☐ Sample 07 CS-16 CI 07  
11:55 am

Layered mylonite marble  
near greiss layers

☐ Photo 719

Photo of sample in place  
looking east

✓ N5W 29SW



☐ Sample 08 CS-16a CI 08  
12:03 pm

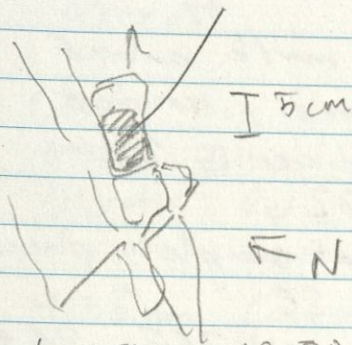
Mafic dike piece

☐ Photo 720

Photo of sample in  
place, looking east

✓ N24W 76SW

☐ Measured Surface

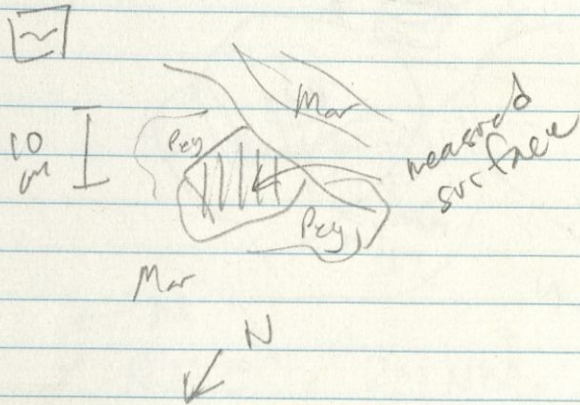


☐ Sample 09 12:30 pm CS-16 CI  
Pegmatite chert on 09  
mylonite marble

☐ Photo 721

Looking South at sample  
in place

✗ N19W 16SW





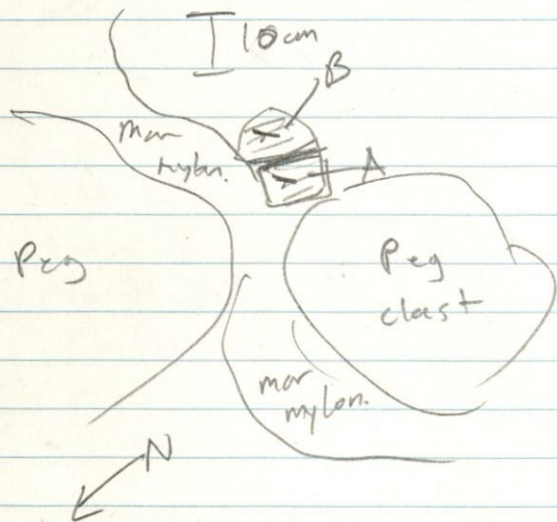
☐ Sample 10 CJ-16 C110 A+B  
12:40pm

Mylonite matrix around  
peg. clast, just west  
of last ditch by 20ft

📷 Photo 722

Picture of sample in place  
looking SE

✓ C110A N 25E 26NW  
✓ C110B N 35E 34NW



☀ 8:50am 3/25/16  
Drop off

Conditions: Clear, warm ~70°

Mood: Tired

Objective: Retrieve samples  
from canyon 2

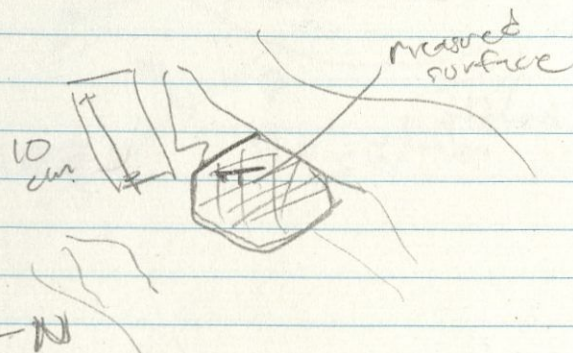
☀ 9:55am Canyon 2  
Starting collection of  
samples

☐ Sample 11 10am

CJ-16 C2 01 Call/Pol marble  
with veins

📷 Photo 754

Picture of sample in place  
looking East



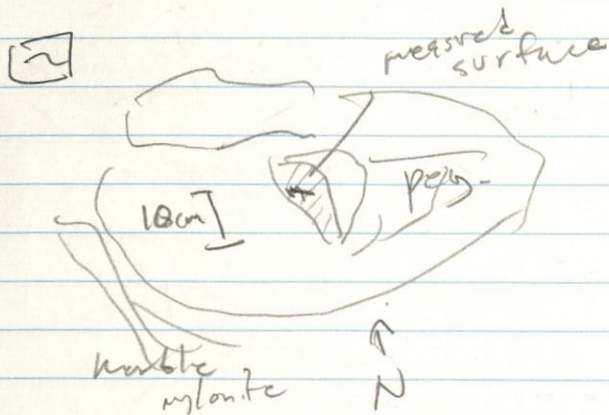
✓ N 25E 24NW

Sample 12 10:15 am  
CJ-16 C2 02

Pegmatite from center of  
peg. clast approx 50cm  
long, 30cm high

☐ Photo 755  
Picture of sample in place  
looking north

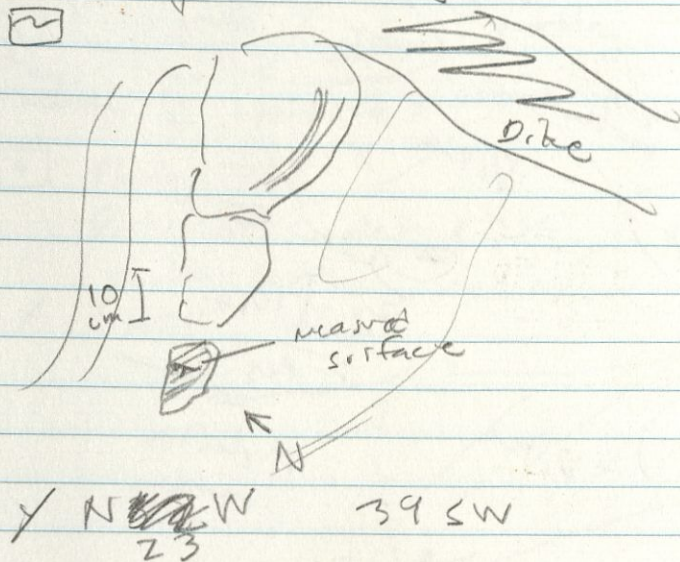
Y N 30 W 64 SW



☐ Sample 13 10:22 am  
CJ-16 C2 03

Mylonite matrix, layered  
~~just~~ just below dike  
~ 2ft

☐ Photo 756  
Picture of sample  
in place looking NB



N70E

☐ Sample 14 10:30 am

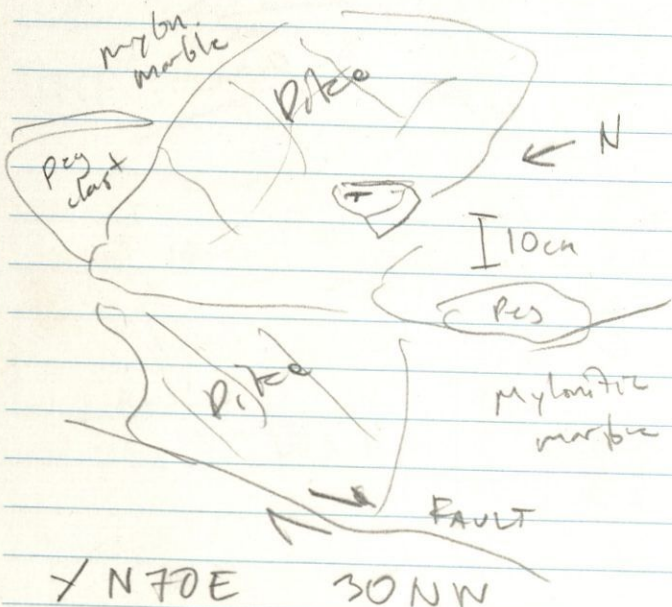
CJ-16 • C2 04

Mafic dike just above  
fault

☐ Photo 757

Picture of sample in place  
looking SSE

☐ Sketch



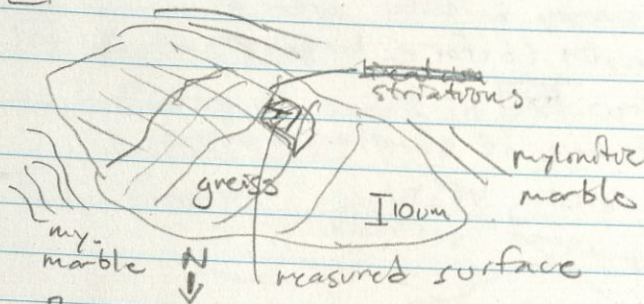
S40E

☐ Sample 15 10:40 am

CJ-16 C2 05

Mylonitic gneiss clast  
near top of clast

☐



☐

Photo 758

Picture of sample in place  
looking south

X S40E 43SE

SWW

☐ Sample 16 10:52 am

UJ-16 C206

Mylonitic marble and  
small pegmatite clasts  
in sandy matrix area of  
canyon (before large peg.)

☐ Photo 759

Picture of sample in place  
looking WSW

☐ measured surface



✓ S11W 34SE

☐ Sample 17 Nam

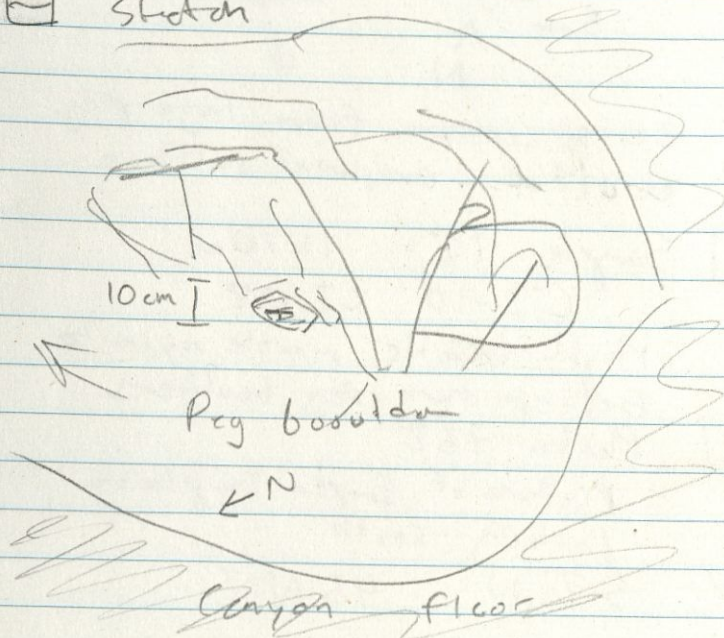
UJ-16 C207

Pegmatite from edge of  
large peg boulder outcrop

☐ Photo 760

Picture of sample in place  
looking SSE

☐ Sketch

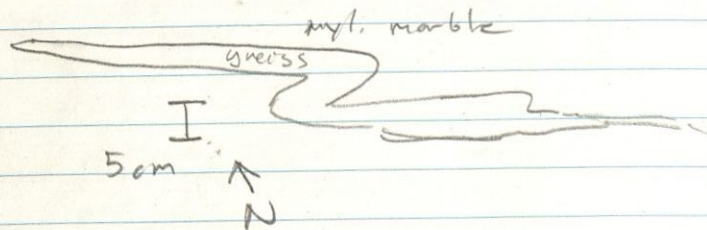


✓ N43E 65NW

☐ Photo 761

Small, folded gneiss layer  
in marble looking NE

☐ Sketch of folded gneiss



across canyon from large peg.  
boulder, erosional surface

☐ Sample 18 11:20am  
C3-16 C208

Highly friable marble mylonite  
between two peg boulders

☐ Photo 762

Picture of sample in place  
looking south

✓ S 21 W 45 NW

