#255

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Scientific Notebook # 255: Yucca Mountain Field Work

"Rite in the Rain"®

ALL-WEATHER

Horizontal Line

No. 390 N

#255

R. Fedors

CONTENTS

Yucca Mountain field work January 26-28, 1998 with consultants David Groeneveld, Dani Or, and Stu Stothoff (expected Jan 27th).

Majority of morning spent dealing with logistics - badging, property passes, radios

1. Groeneveld 1 yr badge, video
2. My name added as escort for Dani Or (foreign national) still not completed.
3. Check radios out from field Operations Office (channel YMP-1)
4. Chad Glenn joined us today, he has camera pass and red tag badge for off-road field work
5. Ranch control (at Field Operations Office) has key to NRC's office; overnight storage of samples, equipment
6. For samples we take from Area 29, a radiation check is needed - contact Ranch Control (Della Christie, Loretta Camp 295-5915) or RadSafe Office itself (Scott Roadhouse at 295-5969) to set up Thursday rad check.

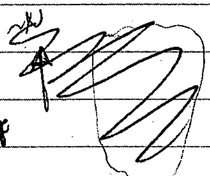
Primary goals at YM are depth measurements of alluvium on north & south facing slopes & fracture-fill observations.

Ghost Dance Fault above ESF
between Whaleback Ridge and Antler Ridge
Parked vehicle on marked road at split (fork)
GPS (11N) UTM 0548618 E
4077770 N

South facing slopes (walking uphill, ~random sites)

(1) surface = mixed soil & rock
surface slope = 19°
bedrock slope = 6°
[next to washed off area (east 3 m)]
~50 m up from alluvium/bottom flat of valley.
27½ cm } upslope
10½ cm } downslope ~40 cm apart

1/27/98 RF



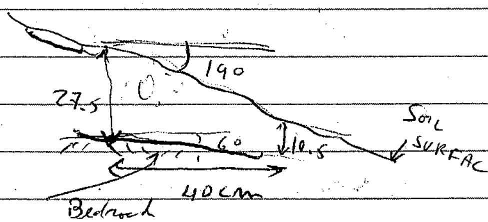
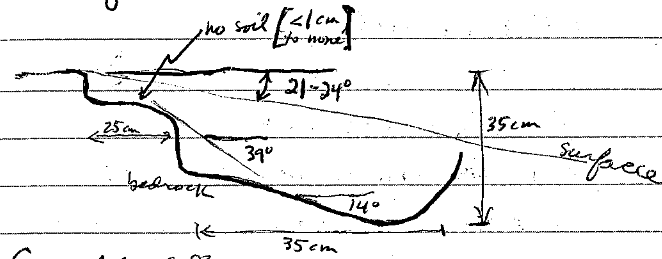


Photo 1-3 (Dani Or) GD-1
bedrock lithophysal, carbonate
filling, no open fractures
soil was wet at contact w/ bedrock
where deeper soil present, at 10 cm
depth spot, soil felt dry.
soil rich portion ~20-30% rock chip by volume
Groeneveld GPS N36°50'.730
W116° 27.196

(2) upslope ~10 m 548729 E
4077787 N } ±100 m

100% talus/scree on surface
near upslope extent of washed area (man-made
clearing of surficial material), ~3 meters
east of washed area



Groeneveld's GPS
N36° 50.770' .703'
W -116° 27.271' .220'

$\frac{35}{60}(35) + \frac{25}{60}(1) = 21$

GD#2 Photos
Soil below scree & w/in scree <10% rock chip
wet only in deeper colluvial portions
bedrock stepped w/ significant jointing leading
to irregular surface for bedrock

Comments on washed off surface
~40 m x 80 m surface

caliche covering surface locally 100%, otherwise along joints/fractures; predominance in depressions of bedrock & along downslope bedrock channel
Conjecture that rain falls, fills alluvial reservoir/storage; caliche forms at bedrock/soil interface; Lateral flow along slope indicated by caliche along channels.

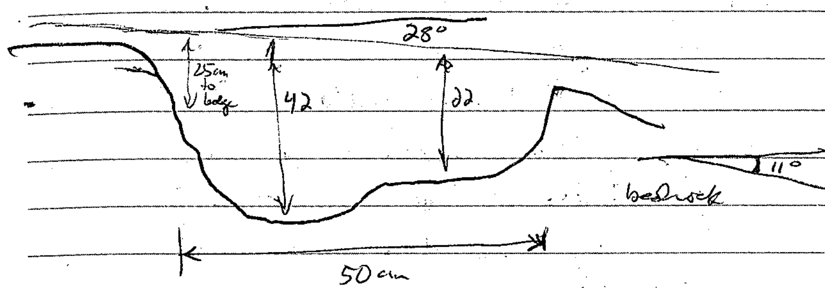
Carbonate appears to form at bedrock/soil interfaces

Flow of water lateral along hillslope since water is absorbed by caliche but not transmitted.
No open fractures noted on entire washed surface

Also note that very little caliche on boulders in top 10 cm of soil; also much less to no caliche on bedrock which is exposed
Much of what caliche is seen in bedrock at surface is in the cavities.

(3.) scree covered surface
~10 m upslope

N36°50.730 (.727)
W 116°27.207 (.232)

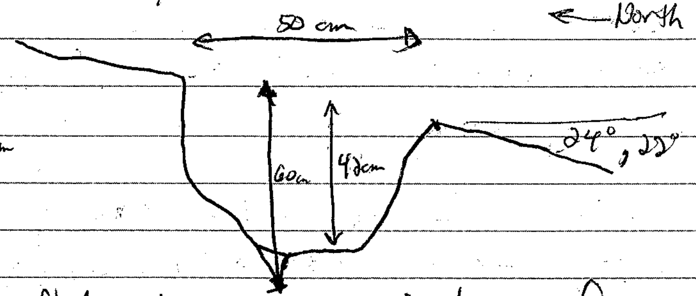


Soil contains ~20% rock chip and some large boulder (calcite on bottom of boulder, then more sediment down to bedrock)

GD#3 Photos
1 prior to digging, 2 after digging

About 30m upslope further, walking directly updip.

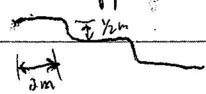
(4) < 10% cobble/boulder on surface
30-40% boulder, chips in soil
Bedrock is much less Lithophysal, more crystals & more volcanic fragments
Groeneveld's GPS N36°50.721' (.706)
W 116° 27.257' (.267)
→ deeper down, soil contains less chips but still boulder jumble
Obviously no or very little caliche in this soil/bedrock area



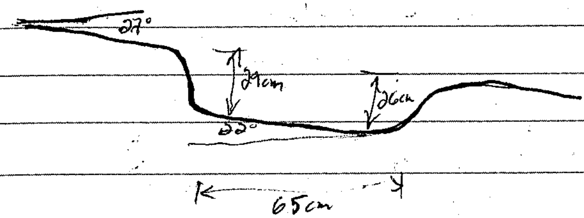
Photos: 1 of root growing through fracture
GD#4 2 other photos? (we're now at picture 12)

It is obvious that simple alluvial depth as estimated by spot checks of ½ m to 1 m dia.
Compilation → stepped bedrock → talus → boulders

This site is at a break in the slope (new unit noted), this is above the break.
It appears to be like the stepped surface noted in the wash area



(5) ~30 meters
Photos #13, 14 GD#5
soil w/ ~30% chip fragment
surface is ~50% covered by boulders/scree



Caliche is back again, maybe it's due to the fact that we're back in a Lithophysal horizon of tuff.

Bedrock is broken apart, caliche fills cracks & fractures, roots entering caliche filled cracks

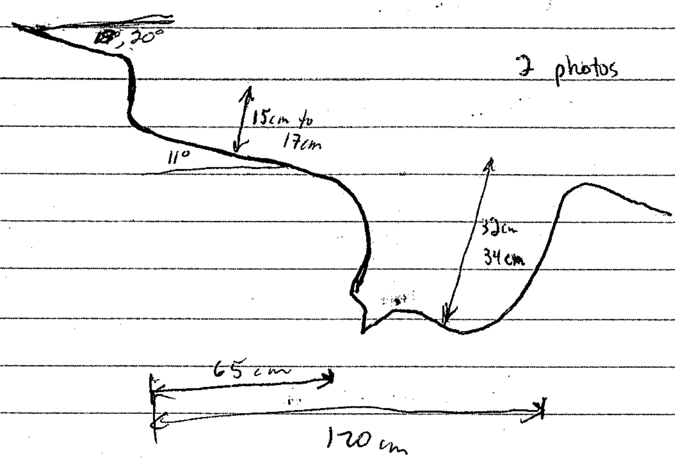
GPS N 36° 50.766
W 116° 27.202

(#6) GD#6 upslope 35 m
(just below ledges, caprock?)
↳ ~10 m

GPS N 36°50.772
W 116°27.212

Soil 10-20% rock chip, some boulders

2 photos



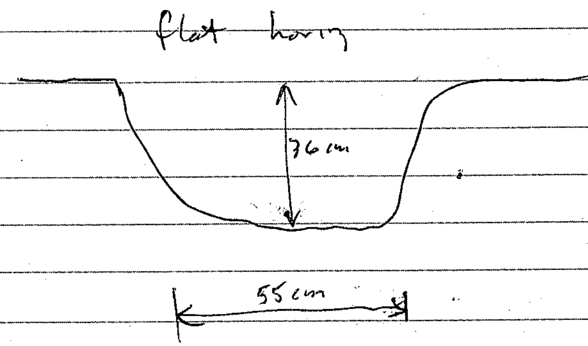
Bedrock, moderate amt of caliche in fractures, non-welded tuff w/o much in the way of cavities

Ledges 10 m upslope are very lithophysal

(7) Top of Ridge (non-welded tuff on top)
~205 m up from wash

Soil very moist up to 5 cm from surface (maybe water not draining off top of ridge) also noted thin caliche-rich layer above bedrock which was dry!
(dry below wet)

2 photos



Soil has 10-20% rock frag

GPS N36° 50.794'
W 116° 27.188'

Some rock frags had abundant calcite on bottom (not top)

Comments

① Refer to David Groeneveld notebook for his work on plants and ~~we~~ his sampling of plant trunks along same line and positions of the hole-digging by Dani & myself RF 8/25/00

② Calcite filling appears to be pervasive on hillslope (exception at 1 hole) both as thick fracture-fill layers as as thick coatings on bedrock/soil interface and as thick coating on bottom of boulders/rock fragments buried in soil but close to bedrock interface.

③ The one hole (#4) without much caliche had, as a prominent feature/difference, a more massive (moderate to small ant fracturing) bedrock of non-lithophysal tuff; this is compared with prominent lithophysal nature of bedrock at other holes.

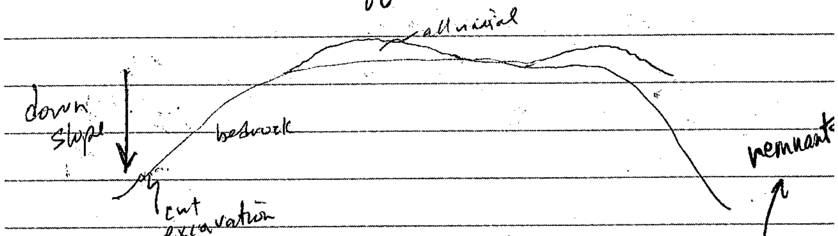
Stop at NRG-5 drill hole
15 m face excavated
Indications of fault area, maybe stress related between fault in Drill hole wash and in next valley to NE

North Portal ESF starts to bend to the west (and later to south) below NRG-7

Stu wanted to look around here since Cl^{36} hits in tunnel

Silica & calcite layers in fractures (along faults, removement noted); in other fractures/joints it was calcite; cavities may have both

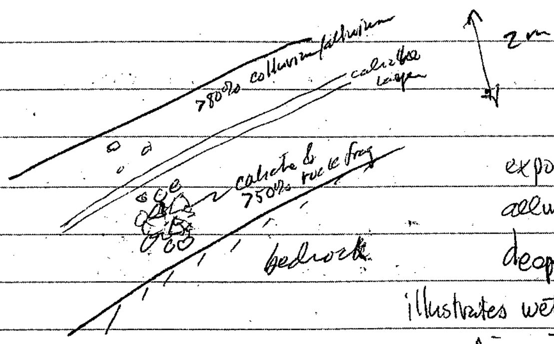
Alluvial fans off steep slope



Groeneveld conjecture that alluvial tops (landform) are erosion feature. These alluvial are the tops of alluvial fans, there is very little storage until about 2/3 of way down the slope, then these fans begin.

RF 8/25/00 7 Photos at NRG-5 including tensiometers, coring location for YMP samples,

Still at NRG-5 (NE side of wash)



exposure of top of alluvial fan, this deeper soil exposure illustrates wetting front depth connection with caliche formation.

tensiometers setup (USGS?) above & below thin caliche layer (2-3 cm) and setup at bedrock interface

Photo Chad Glen, RUF, Green ~~at~~ stop in Drill Hole Wash

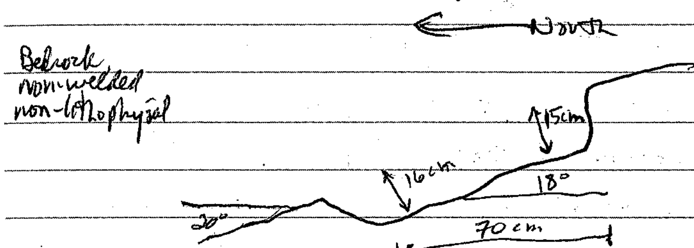
At NRG-6 (SW side of wash)
excavation for drill pad
(scorpions)

RF 8/25/00

pulling boulders from face, (exposure of wet glistening fractures as close ~~as~~ as few cm to surface (evaporation not effective here, this may be representative of exposed bedrock → flow percolation).
No faulting obvious, moderate amt fracturing/jointing in lithophysal unit, moderate carbonate adjacent to alluvium, still some carbonate at bottom of 8 m exposure (in wet fractures, the carb is paste)

North Facing Slope (compliment yesterday's South-facing)
Parked in split wash at SD-4
Will head south, up the north-facing slope
Parked GPS → 0548769 E UTM 11N
4078367 N Eagle GPS
Repeat 548783 E Brunton (14½° declination at YM)
4078373 N
Within ±5° of North-South for our line

1. GDN#1 approx 23m from wash bottom
GPS 548805 E, ~~[illegible]~~ 4078292 N RF 8/25/00
abundant roots at bedrock/soil interface
soil wet to the surface.



Bedrock not stepped on small scale but there is bedrock exposure ~3m upslope (lithophysal)
Photo 24 & 25 roll 1

soil had ~30% rock fragment
On surface, no boulders but nearly 100% rock fragments.
Calcite in fractures, no open fractures; calcite is moist and paste, moderate amt calcite, only in fractures/cracks

calcite not on bedrock/soil interface except in cracks/fractures

1/27/98 RF

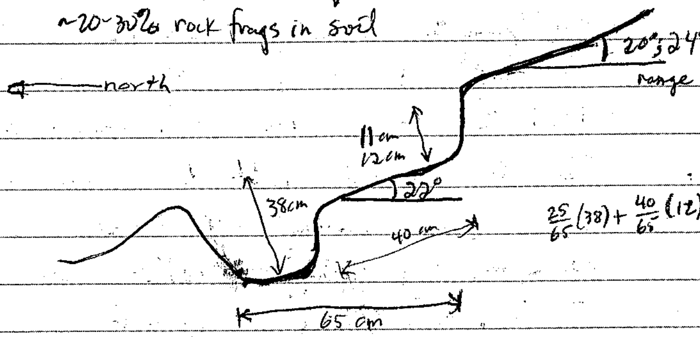
(2) GDN #2 GPS { 548827 E, 4078216 N } ± 100 m

~50 m from wash (measured)

Soil again is moist to surface

On edge of talus pile, some soil beneath rock frags & boulders

~20-30% rock frags in soil



Bedrock non-lithophysal, fracturing present but not prominent; again very little to no calcite at bedrock/soil interface, but the narrow fractures & joints have calcite (paste, moist) and roots

Photos (Roll #2) #1-4

[breaking apart rock, failure planes (with no visible expression – w/ slightly dirty rock surface) have roots exploiting; amazing where the roots are found]

See Stu & Groenevelt sampling up entire slope at measured points for surface mat'l & slope

1/27/98 RF

(3) GDN #3 at 75 m up from wash

GPS { 548805 E, 4078167 N }

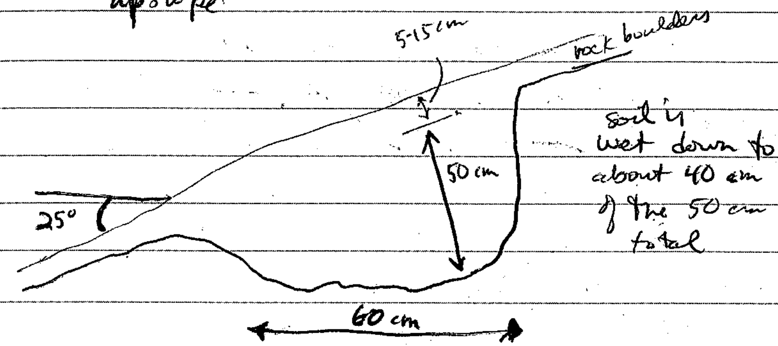
Soil wet to near surface (surface is mix of grass and boulder) but dry below about cm in an apparently homogeneous soil profile → no obvious reason other than last rain(s) did not wet the entire profile

Bedrock exposed w/in 4 meters in 3 direction (not downslope).

Bedrock indistinct, highly fragmented with calcite (dry) covering chips broken off

Non-lithophysal, this is the most calcite seen today.

Some lithophysal (moderately so) a few meters upslope



Photos 5&6 (roll 2)

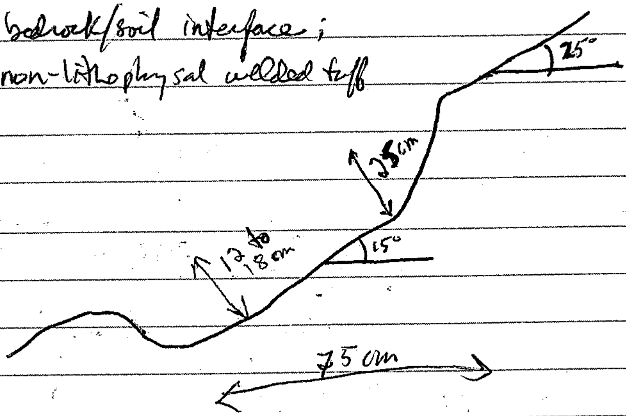
Amt of calcite is still ~ moderate, yesterday we saw lots more in the more highly fractured rocks and lots more along bedrock/soil interface

Here is it more of thin coating, roots still present even in dry bedrock ½ m down.

(4.) GDN #4 ~100 m (measured) up from wash; GPS 548850 E, 4078150 N } ±100 m

Rock frag content in soil < 10%
Sample taken GDN#4 soil labeled
Soil moist to surface
Surface mix of grass on soil and boulders

Bedrock is not highly fractured; calcite in joints & fractures otherwise not on bedrock/soil interface;
non-lithophysal welded tuff



Talus surrounding this site, difficult to tell if any of it is bedrock (probably not)
Photo 7

Radiation meter ~20 meters east of here.

General observation (should be born out in air photos) that the south-facing slope across the wash from here has ~20% scree/boulder cover whereas the north facing slope we are on has >50% scree/boulder as surface cover.

(5.) GDN #5 GPS 548795 E, 4078183 N } ±100 m

Surface mat'l at edge of talus pile and grassy area on soil at upslope portion of hole

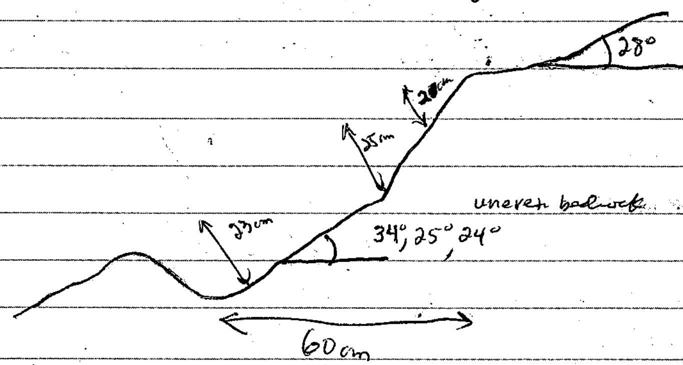


Photo #8,9 (roll 2) Dani Or
Bedrock not highly fractured, little or no calcite at bedrock/soil interface, soil wet nearly to surface
Just usual calcite coating in fractures along w/ roots

(6) GDN# 6 ~150 m (measured) from wash bottom

GPS 548 799 E
4078 190 N

Surface ~75% soil/grass covered, talus upslope and east w/in 2 meters

Calcite along fractures and rock boulders is more abundant here than below sites, thicker fillings (up to ½ cm noted)

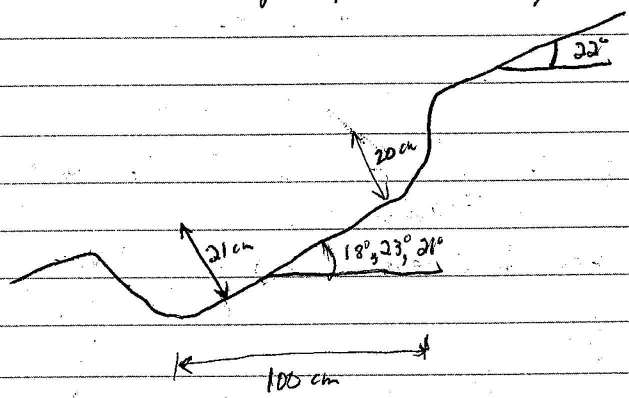


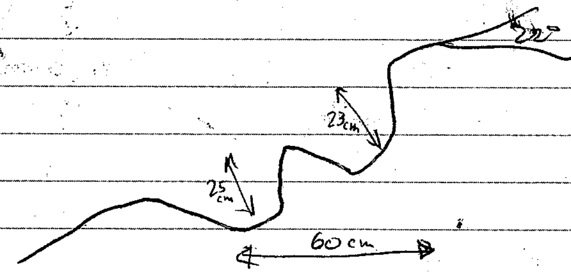
Photo 10

Bedrock exfoliation fractures filled w/ calcite, roots
Some cavities (lithophysal) noted in part of bedrock (hole) but other parts more massive and less calcite

(7) GDN #7 ~175 m upslope from wash

GPS 548839
4078162 } ±100 m

Surface near hole is 50% covered by boulders/ small rock frags, the rest is soil/grass

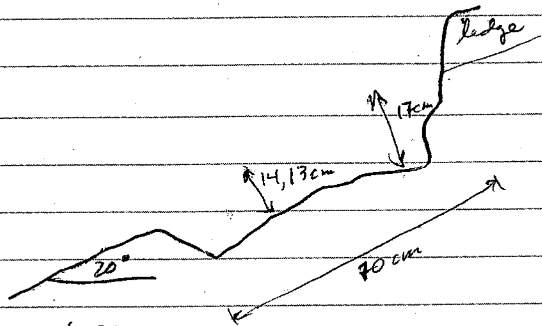


very uneven bedrock, massive, low amt of fractures
non-lithophysal
Soil had ~10% rock frags (below surface)

Photo 11

(8) GDN #8 ~200 m up from wash
at base of ledges near crest of hill

GPS 548 893 } ±100 m
4078091



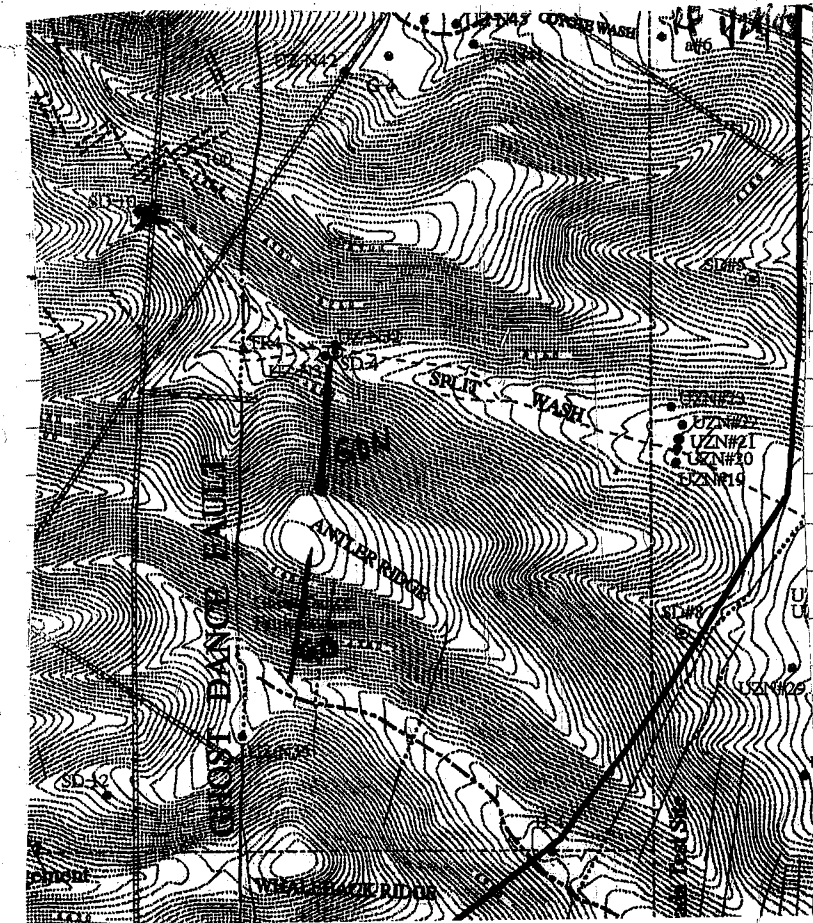
Uneven bedrock

Lithophysal unit in outcrop in ledge
Surface is mix of soil/grass and boulders
Soil contained ~15% rock fragments

Bedrock, some cavities, thin calcite layers
along fractures, not highly fractured
No bedrock/soil interface calcite, but calcite
along fractures is more than a coating

Photo 12

Xerox of map w/ yesterday's and today's lines



From page 11.5 of 1995 Site Atlas
YM Site Characterization Project

Comments on north-south slope

(1) north-facing wetter, less calcite
soil depths — no difference noted

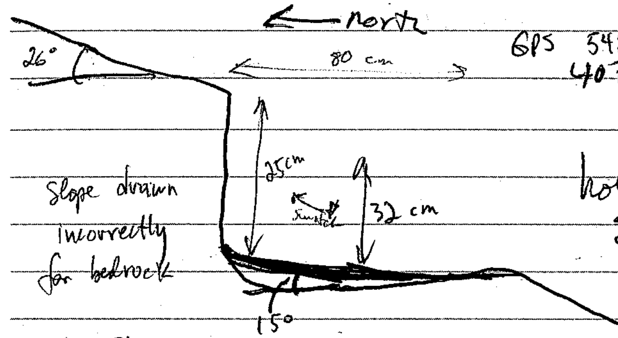
(2) Possible connection w/ lithophysal units and calcite

(3.) Question of whether we happen to hit south facing exposure line which happened to have lots of calcite. There are indications from washed-off surface that there may be channeling of fluids leading to calcite lobes running downslope (lateral subsurface flow). Or, the calcite is more pervasive near fault zones (Hillslope lateral, downdip flow controls channel of subsurface flow; more calcite)

13 photos taken by Stothoff w/ camera
WWNF series of pits
see Stothoff sci ntbk #175 for descriptions of pits

Wren Wash ~50 m west of where we think tunnel projection across this ridge (tunnel curve to north-south coming from north portal). Heading north up the south-facing slope.

(1) WWSF#1 (Wren Wash South Facing)
At break in slope, downward is steep (~43°)
top part of soil dry (top 10 cm)
bedrock blocky, elongated fractured alot (into small chunks), lithophysal (mod amt cavities)
open fractures with soil and with calcite
No/little calcite at bedrock/soil boundary
lots of roots, rock is weathered
cavities in soil (underneath large talus blocks)

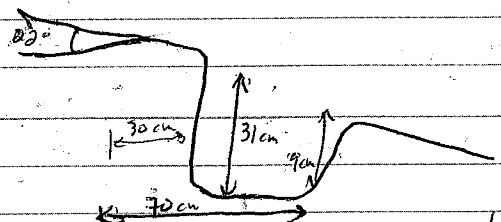


GPS 548564 E
4079447 N } UTM 11 N ± 100 m

hole is approx 25 m (measured) upslope from wash bottom

Photo 13
Surface is covered by mostly rock frags
30-40% rx frags in soil itself
Calcite in fractures is not as prominent as weathering extent of bedrock

(2) Approx 50 m (measured) from wash bottom
hole is adjacent to outcrop (below slope)
of highly lithophysal unit
locality etched and weathered
part of hole is outcrop (exposed)



bedrock in hole is horizontal to sloping
into hill
Soil is 20-25% rx fragments dry

GPS 548553 E
4079517 N } ±100 m

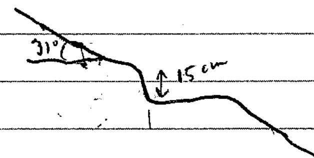
Calcite not abundant

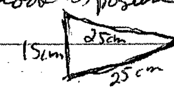
Photos 14,15

WWSF #2

(3) WWSF #3 ~~150~~ 75 m (meas.) from wash bottom

Predominantly bedrock moderately
lithophysal welded tuff, not prominantly
weathered





soil wet in crevasse
calcite in cavities, some calcite also on fractures

GPS 548564 E (523)
4079553 N } ±100 m

Photo 16

See page 37 for transect line on
topo map WWSF line.

(4.) WWSF #4 100 m from wash bottom

GPS 548522 E
4079512 N } ± 100 m

Soil filled fissure (~10 cm depth and 3 to 5 cm across)
Calcite on rock fragments, moderate amt
→ fissure at 20-25 cm depth
Bedrock (or possibly large boulder)
moderately lithophysal

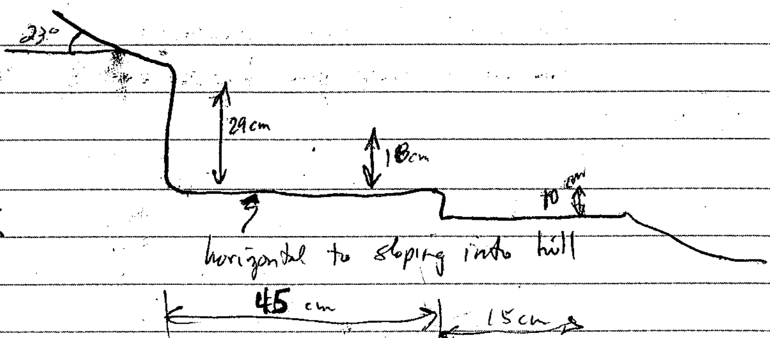


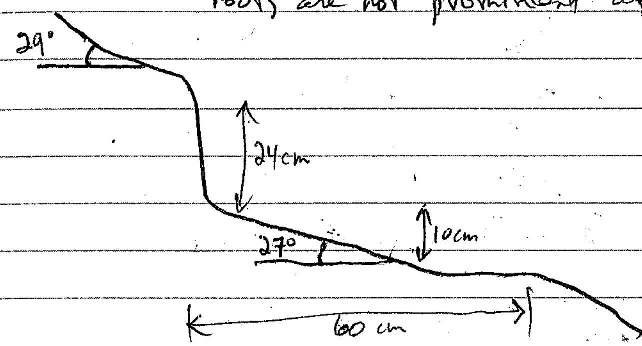
Photo 17 $\frac{45}{60}\left(\frac{29+18}{2}\right)+\frac{15}{60}(10)$

Note that this is 2nd hole this face with tuff bedrock under soil which had surface near horizontal to dipping into hill.

(5.) WWSF #5 125 m (measured) from wash bottom

GPS 548599 E
4079584 N } ± 100 m

Surface is top edge of outcrop in a scree pile below grassy soil
Patch of soil between bedrock exposures
Abundant calcite at bedrock/soil interface
very little moisture even at bedrock
(could this be making calcite coating on entire bedrock surface prominent) & roots are not prominent at bedrock



Bedrock is lithophysal, calcite in cavities
Soil contains 40% rx fragments

Photo 18

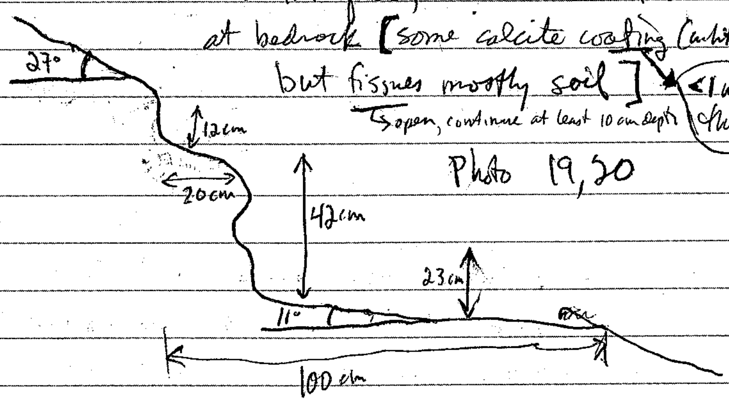
(6) WWSF #6 150 m (meas.) from bottom of wash

GPS 548557 E
4079578 N } ± 100 m

At ledge of caprock (base of ledge)
ledge to east and upslope as well;
bedrock either side (E-W) 1-1½ meters.
Bedrock 1m from hole is lithophysal
(caprock)

Surface at hole is soil with some
rock fragments
Soil is not moist except slightly at
bedrock interface, soil-filled fissures
at bedrock [some calcite coating (white)
but fissures mostly soil] → <1 mm thick
↳ open, continue at least 10 cm depth

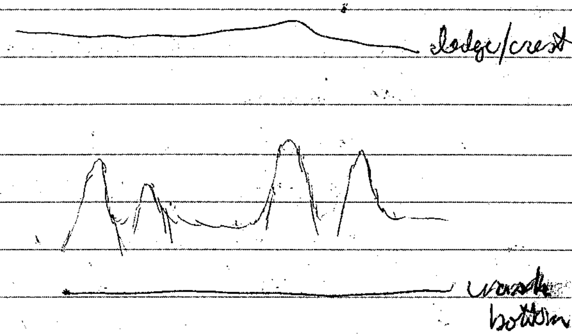
Photo 19, 20



None of holes at Wren Wash South-Facing had abundant
calcite filling fractures, mostly just coating

Comment on alluvial fans reaching up
slopes as lobes. The excavation at NRG-5
appeared to fit with Groeneveld's idea of
these being erosional remnants of larger fans.
However, in Wren Wash, scree piles with
varnish were noted in some lobes. This
leads to an additional idea that the lobes are
mass-wasting (avalanches) rubble piles which
subsequently filled with eolian sediments.
The lobes at Wren wash and in wash
near NRG-5, 6, 7 reach up to ⅓ up the
slope

general sketch of hillside



Also, ask Murphy about silica deposition
in faults at surface exposures whereas caliche (calcite)
is present elsewhere at surface. Presumption is
add'l weathering of rhyolite or water from rock is
re-circulated in fault zones. Why silica not elsewhere?

Shoshone Mountain

Stu, David Groeneveld, Dani Or

Access Mercury Highway to Mine Mtn Rd
(thru Area 14 and into Area 29)

Heading to Shoshone Receiver Site
(Road & Facility Map from Gate 100 Badging Station)

On road up to crest

→ non-welded units thicker than PTn.

→ more non-welded units on Shoshone as compared to Yucca Mtn
(Need to check Geologic Map – Britt Hill)

→ iron staining very prominent in some units and present in tuff (weathered & non-weathered) exposures

More water moving around here

→ frozen ground w/ frozen heaving leading to cracks on surface.

→ iron staining on surface pavement but not below on hill slopes

→ welded units are also more massive
columnar jointing prominent in outcrop

→ soils definitely wetter here both on north & south facing slopes

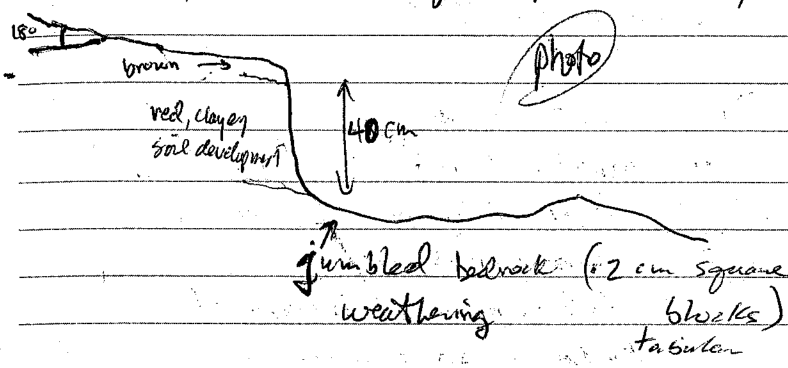
14 photos starting from east of Shoshone Mtn and heading up north side of Mtn to top, some w/ Green tree core sampling

Location → Shoshone Mtn Stop #1

PA 2

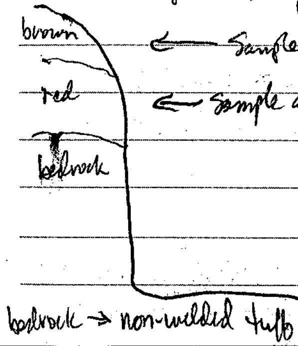
GPS 567967 E
4087731 N } ± 100 m UTM zone 11

About 20 m south of crest/saddle (road)



very prominent iron staining
and abundant silica deposition
wet soil

Pit #1 road cut in spur off main road
fault gouge heavily weathered



← Sample at 30 cm
← Sample at 60 cm } Shoshone Mtn Stop #1 Pit #1
2 photos

weathering very prominent/soil development
wet soil about fault gouge,
silica w/ slicken-slides
very common

Walking along road remainder of way up the crest.

buff units vary welded (crystal-rich, 20% crystals, mostly quartz – 1 mm sized grains commonly) to non-welded units
The non-welded units weather more prominently (iron-staining, clays)
Small projectile frags
Transition along road to a gray tuff of varying degrees of welded-ness, crystal rich (quartz & micas); massive unit bedding not prominent

Varies to lithophysal going up section
Looking more like caprock in weathered ledge exposures
Large (10 cm long) projectile frags noted especially in upper lithophysal unit

3 photos showing contrast in vegetation on north-facing and south-facing slopes, some snow on north-facing

Walking along crest to east
RF 1/28/98

gray to pink ~~vesi~~ splotchy crystal-rich tuff non-welded to moderate welding
Large pumice frags, not all of which are squished
buff tuff } mostly non-welded to moderately welded
pink tuff } crystal-rich fragment (pumice)
gray tuff
→ then back stratigraphically to iron-stained tuff of stop #1
Parked on road → ?
GPS 568418 E } ±100 m
40 87884 N
Walked to north-facing scree slope

→ See Stu's notebook for talus/scree digging [root & sediment (eolian)] in middle of scree, near tree 6½ meters
7 Photos of talus pile, snow, & our pits
→ See Groeneveld notebook for plants
plant density, tree ring counting
growth rates same but density accts for difference → north/south slope

Soil Pit #3 Shoshone Mtn

GPS 568270 E

4087782 N

Near highest point of crest (20 ft elev to top) above unit that weathers like the YM caprock (moderate to non-welded, locally the lithophysal) RF 1/29/98

Here the bedrock is the crystal rich → quartz, biotite ↓ leaches/weathers to bronze color (leaching Fe?)

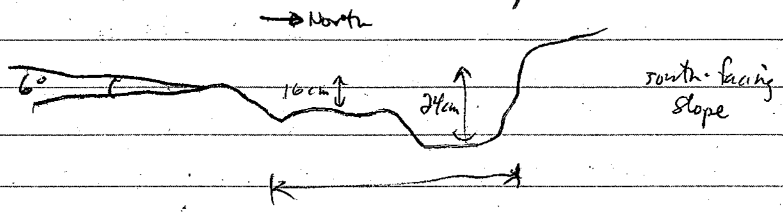
Photos 24-26

→ SM Stop 3 (Shoshone Mtn)

pumice fragments, non-welded

surface slope 80% covered by soil

Burned out area (recent)



Sample of soil @ 10 cm depth ←

⇒ SM #3 → 0-10 cm depth

silt loam brown, slightly moist soil

very little (<10%) rx frag; (eolian?)

⇒ SM#3 above caprock 20-30 cm depth

clayey, slight reddish tinge ⇒ soil development

more rock fragments; weathering

Comments

(1) Homogenization of plants on entire hillslopes regardless of lithology is probably due to availability of water, & maybe more plants keeping more even amt of soil depth (?)

(2) Soils more developed on Shoshone Mtn (more organic matter?), and prominent soil weathering horizon above bedrock (clay is at least 12-15% by cohesiveness)

(3) Calcite development in fractures may be entirely lacking on Shoshone; RF 1/29/98

More massive lithologic units, less fracture fill, most fractures are devoid of mineral or only iron staining; some have slickensided soft mineral (1 mm).

(4) Tuff units more crystal rich, more mica, less welded than YM tuffs

(5) Questionable analog for wetter YM due to tuff units both texturally & chemically different (texturally in terms of both non-welded and in fracture/jointing patterns)

Non-welded units outcrop weather to larger (less fractured) and more rounded than welded units.

Check w/ Larry McKague for better analog (densely welded) (Rainier Mesa, Pahute Mesa)

 1/28/98 RF

Get 50 m tape back from Groeneveld
GPS from Dennigan Stu, Brunton also
Big Map from Stu

(6) Pinon, juniper, pines → their density may lead to highly acidic soils
→ lack of calcite
→ lack of grasses & small brush between trees.
There is a lot of bare soil here whereas at YM, it would be covered w/ grasses

(7) In addition to iron-staining, there is locally a prominent pink-staining on soil, rocks, branches.

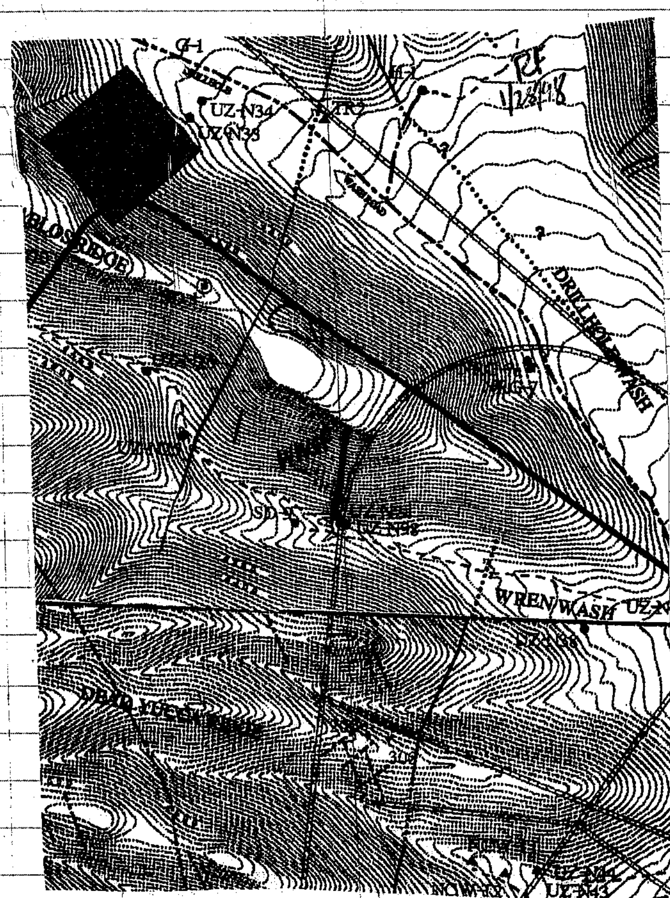
(8) This may be an analog for Prow Pass (caprock) and YM caprock, but not for side slopes and valleys. In terms of soil development, increasing depth, we could bring on a soil scientist who has worked in tuffs to help us predict increased soil depth due to climate change, rate of soil change.

(9) Miklas could help with geomorphology back at YM with respect to alluvial lobe development as an erosional feature or a formational (avalanche) feature; and the possibility of both. How fast do they form, why no plants in talus/scree.

(10) Must define talus differently from scree (don't use "scree" for talus)

RF 1/28/98

Transect line for WWSF fine started on 1/27/98 (see pages 23-28)



From page 11-2 of Site Atlas
YM Site Characterization Project.

5/4/98 YM SITE VISIT

GEOPHYSICS

Purpose is to make sure Chuck Connor, Pete LaFemina, Jim Winterle and crew from Raba-Kistner (3 people) are surveying the correct areas (as I marked on an arcinfo map, Day & others 1997 map as background)

(1) Priority 1 is on Live Yucca Ridge, the cooling joint lineaments in the lower caprock unit of the Tiva Canyon. Instructed Chuck & Pete to survey the Ghost Dance Fault westward across the documented, washed-off pavement across the surface lineaments noted on air photos, and across area where lineaments are no longer prominent. Cooling joints & tectonic fractures both occur on ridge; caliche is not visible at surface and down to ~6" in one cooling joint. The bedrock is exposed along ridge, or just a thin cover in the survey area. Is the caliche all washed down to depth or down the side slope? Cooling joints (fissures) exhibit separation and are filled with soil. The EM will be checked to see the lower limit of its resolution.

(2) Chuck & Pete started the EM and magnetometer survey over the past weekend on the Yucca crest, but south of where I had marked on the map.
For the watershed, it appears that the slope is too steep with too much scree for safe walking with the EM equip. Possibility was left open for a few traverses

Tube structures in cooling joints are a prominent feature within the lower caprock unit. Typically they are sub-horizontal although some smaller tubes at up to 45° angle do connect the larger tubes in some places. Where visible, the tubes are mirrored onto both sides of the cooling joints (does this mean they formed before the joints or maybe at the instant of joint formation?) The tubes vary in size from a couple millimeters to a couple centimeters in diameter. Are these tube structures important hydrologically? They do not create a continuous path; they possibly create more storage in joint and greater surface area for imbibition into matrix. Need to check this but maybe no caliche in cooling joints.

(3) Jim Winterle will traverse the watershed with the differential GPS in order to refine the contours of topography. His base station will be the same one set up for the EM survey of Live Yucca Ridge. Woolhiser's watershed modeling could use the more refined topography.

(4) Solitario Canyon Fault Splay
(near middle of repository footprint)
Too steep for EM survey – Safety.
Suggest work on crest to see if splay extends to crest (presence of Yucca trees along trend of splay at crest may be suggestive of extension of splay). Two or three lines N-S on crest up to H-5 drill pad should pick up splay, then do small grid once splay is found.
At bottom of canyon where splay joins the main fault. Survey will come up the west flank to a safe distance (slope). [margin: up to PTn →]
Will find splay, will check alluvial depths out to main fault; will check alluvial depths paralleling repository on canyon just to get a handle on the variation of alluvium depths.

(5) C-wells Area
Map out the faults inferred on the Day et al 1997 map. Focus on identifying NW-trending features from c-well pump test results. This may help Jim Winterle for his re-analysis of the C-wells data.

5/14/98 Watershed (Upper Split Wash)

Measurements in small, upper wash for watershed modeling linked to unsat modeling. Stu, Dani Or, D. Groeneveld, David Woolhiser and Oliver Chadwick

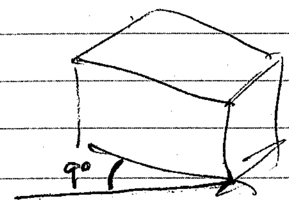
Scoping the watershed, the prominent feature not previously noted is the glacial terraces forming below the headwall of the valley and tapering off downslope (disappearing)

Two rains in 2 days prior to our arrival left the roads eroded, pools of water remained. There is

Plastic box (cut out bottom) FIRST Site
Box #1 site marked on map
UTM coordinates

Bare bedrock in stream channel
strongly lithophysal unit of Tiva Canyon
D. Or camera used for photo

Silicone seal squeezed in place, will set by tomorrow for testing



5/14/98

RF

More bedrock in channel, the further upslope you go
Terraces still evident up to headwall but are not as flat (they follow the bedrock/topography more).

(1) Trace along the wash: bedrock vs alluvial & measure terrace for volume.
(2) traverse for soil depth across headwall
(3) traverse both slopes near box #1 site
(4) Woolhiser measurements in lower portion in channel (width, shape, recent runoff volume)

5/15/98
RF

Transects with Oliver in headwall of watershed (Oliver Chadwick)

S = soil
C = scree
T = talus
B = bare bedrock
S_p = Soil with rock cover ~>75% (pavement)

Start of transect on northern edge of watershed to cross north fork of headwall (start is on Live Yucca Ridge).

Tape measurements of ½ m S, C, T, B characterization between each digging for soil depth. We will tie into Stu & Dan's measurement position along wash
First hole 10 meters from where I visually determined the watershed divide to be.

top = 0 m

S — — S_p
S — — S_p → 10 meters
S_p — —
S_p — —
S_p — S
S_p — S

~4° slope

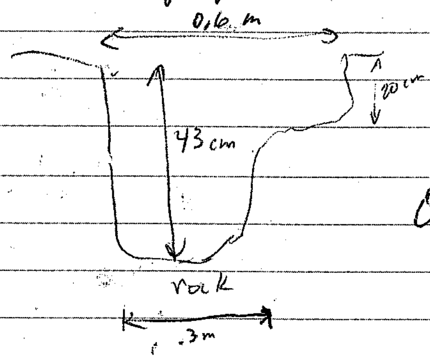
5/15/98

RF

HWW ⇒ transect (Head Wall - Watershed)

HWW1 10 m

caprock fragments in soil exhibit more weathering than I saw on transects of slopes further down the wash. Possibly the relatively flat ridgetop combined with less densely welded caprock may lead to more weathering; there is more opal/silica than calcite in white caliche on the ridgetop



Sandy loam down to rock, this just

Oliver noted 3 horizons
0-9 cm A-horizon
9-25 cm
25-43 cm

area around hole is soil with pavement (rock cover)

Rock fragment near bottom of pit contain calcite/caliche (HCl effervesence)

All measurements between holes and along ½ m transect cover mat'l. do not account for slope angle [horizontal distance / our measurements]

5/15/98
RF

0 m

0 m →	→ 10 m	→	→ 20 m	→ 25 m
Sp	Sp	B	B	Sp
Sp	-	-	B	-
Sp	-	-	B	-
-	-	-	Sp	-
Sp	-	-	Sp	-
B	-	-	B	-
-	-	-	B	B
-	B	S	Sp	B
Sp	B	S	-	Sp
Sp	B	Sp	-	B
Sp				

10m 20m 25m

~8° slope 0-15 m
16° slope 15-30 m

Bedrock fracturing
sub horizontal (exfoliation) is prominent
cooling joints ~1-2 m scale
vertical fracturing not evident

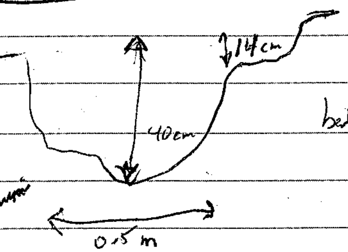
25 m B (caprock ledge)
↓
39 vertical
31° slope

39 m - 45 m ⇒ Sp
45 m - 49 m ⇒ B
49 m - 50 m ⇒ Sp

low fracture = LF
Mod fracture = MF
high fracture = HF

low joint = LK
mod joint = MF
cooling joint

HWW2 At 60 m (or 50 m from HWW1)



fine sandy loam
in profile

bedrock

horizons
0-7 cm A horizon some organic
7-20 cm tan, B-horizon
20-40 cm slightly darker

trying to read
through moisture
changes

use max depth of soil measured as a minimum due to rock boulders

soil avg ≈ 29 cm thick

rock frags in 20-40 cm
depth have caliche
(but soil does not
effervesce)

0-2 m Sp
2-4 m T
4-5 B low fracture
5-6½ Sp
6½-9 B (LF)
→12 Sp
→25 B (MJ / MF) { plants with ~~minimal~~ minimal soil at 16-16½ m, 20-21 m

large lithophysae

HWW3 - 25 m downslope from HWW2

small pocket w/in mainly bedrock
exposure
max depth 22 cm — 0-6 A-horizon, 6-22
Sandy loam
wedge shape pocket of soil — ~1 m² area avg ~5 cm thick

0-3 m B large lithophysae, MF to HF
caliche prominent in fractures
3-15 m Talus { except 9-10 → Sp, 13½-15 → Sp

~1 meter thick

Talus is adjacent to a colluvial lobe (raised), is this a remnant feature. There are 2 or 3 prominent lobes 5-6 m wide and extending ~25 m up from wash channel. They show up well on air photo. There are more colluvial remnants on this hillslope, but less prominent. Immediately on other side of channel is bedrock & talus but further downslope, the north-facing slope also appears to has remnant colluvial lobes

HWW4 15 m downslope from HWW3

within a few meters of channel (5 meters)
22 cm to rock — 0-9 A horizon, 9-22
hole is in a small colluvial wedge — soil matrix is carbonate-bearing throughout
avg depth ≈ 8 cm
0-5 m ⇒ Sp then channel is bedrock

Tie-in to Stu & Dani measurement down wash channel; we crossed channel at 281 m (their 300 m flag was downslope 19 m).

Heading up middle of headwall channel to bedrock

0-1 Sp
1-2½ B (LF, MJ, large lithophysae)
-8 T
-9 Sp
-10½ T
-12½ C
RF 5/15/98
-13½ B (MF, LJ, ~~Ms~~ smaller lithophysae)
-15 C

HWW5 at 15 m from channel

0-10 cm scree — immediately adjacent to bedrock
10-15 cm soil — very thin scree pile
at 15 cm rock

RF 5/15/98

~~[S]~~ (29°) ~~[E]~~ straight downslope angle

Our line is running [S20°W] on Brunton compass direction except that declination was set back to 0° & I seem to remember a declination of about 14° E

0-½ m C
-2 B (Small lithophysae, MF
some calcite in fractures)
-2½ C
-4 B
-7 T
-8 C
-10 B
-12½ Sp
-15 T

HWW6 15 m from HWW5 (30 m south from channel)

Middle of a talus pile, ~27° hillslope angle

0-30 cm Talus
Sandy loam ~~30~~-45 cm Soil → Soil Sample HWW6
RF 5/15/98 45 bedrock

0-5 T
-6 B
-9½ C
-10½ Sp
-12 T
-14 Sp
-15 Sp

RF 5/15/98

HWW 7 15m south of (approx) HWW6 (45 m from channel)

In scree pile/lobe ← RF 5/15/98

0-15 cm } soil horizons sandy loam
15-35 cm }

35 rock [avg depth ~ 30 cm]

30° hillslope

meters from last hole

0-½ Sp
-2 C
-2½ B (LF, lithophysal)
-3 C
-4 B
-6 C
-10 B (MJ, LF)
12½ C
-14½ T
-15 Sp

HWW8 15 m from HWW7

at junction of talus pile, scree, and pavement

0-5 cm pavement
5-20 soil (sandy loam)
20 rock [avg depth ~10 cm]

Small amt of calcite in buried rock frags & rubble although no effervescence occurred.

33° hillslope

RF 5/15/98

meters from last hole

0-3½ T
-5 Sp
-8 C
-10 Sp
-13½ T
-15 C

HWW9 15 m from HWW8

At edge of scree & talus & pavement

0-5 pavement
5-20 soil sandy loam
20 rock [avg. depth ~8 cm]

C = Scree = predominantly boulder covering either bedrock or bedrock & thin colluvium RF 5/15/98

T = Talus = lobes of boulders, desert ~~[illegible]~~ varnish thickness unknown

Sp = soil w/ pavement; silt/sand with cover of rock frags & chips on the order of 50% of surface

S = Soil = colluvium w/ lesser amts rock chips covering surface

0-5½ T
-7 Sp
-8 C
-9½ T
-12½ Sp
-13½ C
-15 Sp

HWW10 15 m from HWW9

0-10 cm A-horizon 70% rx frag
fine sandy loam ~~10~~-26 BW 50% rx frag
26-46 BK1 50% rx frag
46-55 cm BK2, more carb, 60% rx frag
27° aspect to hillslope 55 rock [avg. depth ≈ 40 cm]

K = carbonate modified
W = weakly formed (B-horizon) ?
pedogenic alteration of eolian dust

(HWW10) sample for particle distribution & water content
from soil depth 26-46 cm

On headwall face, next we will do a transect approx N70°E [w/ brunton at 0° declination] directly down the headwall face to the fork confluence

Going upslope from HWW10
meters
0-4½ Sp
-6½ ~~B~~ C KF 5/15/98
-8½ Sp
-9½ B highly broken up, ? bedrock
-18½ Sp
-20 B maybe large boulder
-21 C
-23½ Sp
-25 C

"Headwall direct in Watershed" transect
(this ties in with HWW10)

HDW1 25 meters upslope from HWW10

0-6 A-horizon
6-12 sandy loam
12 rock

12 cm soil

air in open fissures of rock at bottom
rock fractures have carbonates
some bare bedrock

meters heading upslope

0-½	Sp	-11	Sp
-2	C	-12½	C
-4	T	-15	Sp
-6	Sp	-17 ~~16½~~	C
-9	C	-22	Sp
		break in slope → -25	B

} 29° hillslope

KF 5/15/98

caprock ledge subhorizontal joints blocks 1-2 m in diameter

2nd hole on transect HDW is site HWW10
From HWW10, heading down the headwall
HWW10 = HDW2

meters below HWW10 (also named HDW2)

0 - 8 m Sp
-10½ m C
-15½ T
-17 C
-19 Sp
-23 T
-25 m C

} 26° hillslope

HDW3
25 m downslope from HDW2/HWW10
0-5 pavement/scree
5-10 sandy loam

in scree just below talus pile

meters below HDW3

0-1 C
-1½ Sp
-4 C
RF 5/15/98 ~~-11~~ 12 Sp
-13½ C
-15 Sp
-19 T
-20½ C
-21½ B (MF, Lithophysal)
-25 Sp

26° hillslope

HDW4
25 m down slope from HDW3
0-2 pavement
2-12 sandy loam
12 rock

no caliche

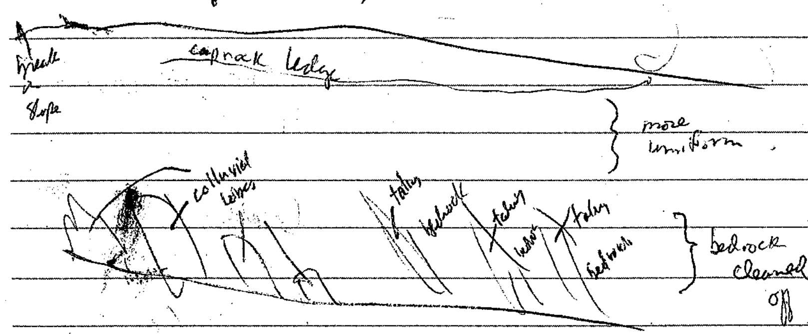
Still heading for junction of (confluence) of upper fork

RF 5/15/98

0 - ½ ~~C~~ Sp
-6 ~~Sp~~ C
-13½ Sp
-16 m C
-~~24~~ Sp
-25 T

} 26° hillslope

North facing slopes have stable talus piles
More erosion on south facing slopes
South face of watershed, looking north



bedrock is cleaned off (no varnish) on South face

HDW5 25 m downslope of HDW4

0-20 talus (blocks/frags)
~~20~~-25 sandy loam in rock
25 rock
carbonate in ~~[illegible]~~ fractures

Old Talus pile being filled in ← RF 5/15/98

0-1½	T	22° hillslope
-3	C	
-5	Sp	
-8	C	
-11	Sp	
-13	C	
-25	Sp	

HDW6 25 m downslope (~ Eastward)

small talus pile 1 m to north
but this is in a lobe of colluvium
with a pavement

0-1 pavement
1-10 sandy loam A-horizon
10-19 sandy loam BW1, "peds"
19-28 " BW2 smaller/weaker peds
28 rock, no carbonate

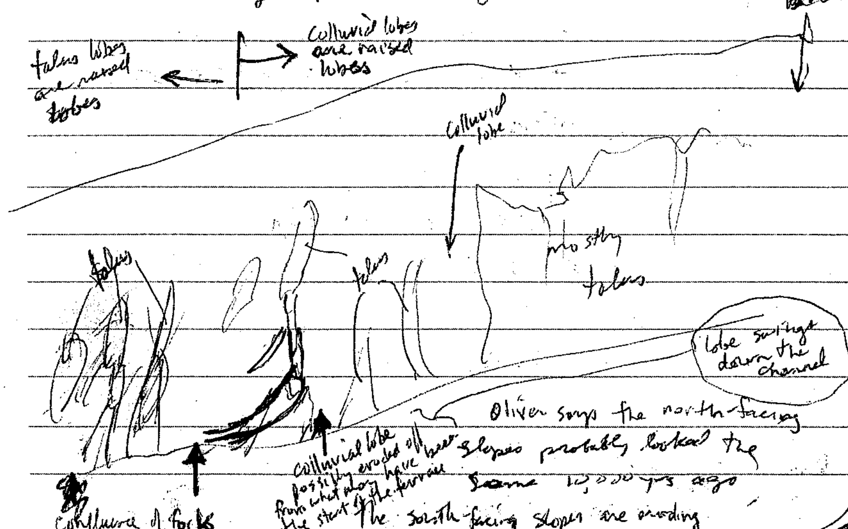
peds - aggregated structure of soil, breaks into clumps derived from organics & clays

0-6½	Sp	21° hillslope
-7½	C	
-8½	B (~~RF~~, low lithophyle)	
-10	C	
-12	Sp	
-13½	C	
-25	- Sp	

HDW7 25 m downslope

0-1 cm pavement
1-~~10~~ A-horizon sandy loam
10-20 BW
20 cm rock, carbonates in fractures
(HDW7) soil sample 10-20 cm depth

North-facing slope (looking south)



Oliver says the north-facing slopes probably looked the same 10,000 yrs ago
The south-facing slopes are eroding

Age of terrace is probably a minimum age for colluvial deposits up higher in wash due to system re-equilibrating (northern fork)

0-3	Sp	21° hillslope
-5	C	
-16	Sp	
-17½	C	
-21	Sp	
-23	C	
-24	B (ME)	
-25	Sp	

HDW 8 25 m down slope
some carbonate in fractures

0-3	pavement	
3-11	A-horizon sandy loam	no carbonate
11-21	Bw	no carbonate
21	rock, carbonate	

70-80% of soil volume is rx frags (as usual)

0-2 Sp	5-9 C	-19 B
2-4 C	-16 Sp	-23 Sp
4-5 Sp	-17 B (MJ, LF) low lithophy	-24½ B
	18 Sp	25 C

HDW 9 25 meters downslope towards confluence

0-1	pavement
1-6	A-horizon sandy loam
6	rock (bedrock connected to outcrop)

The 2 channels (fork) are 6-7 meters to either side here.

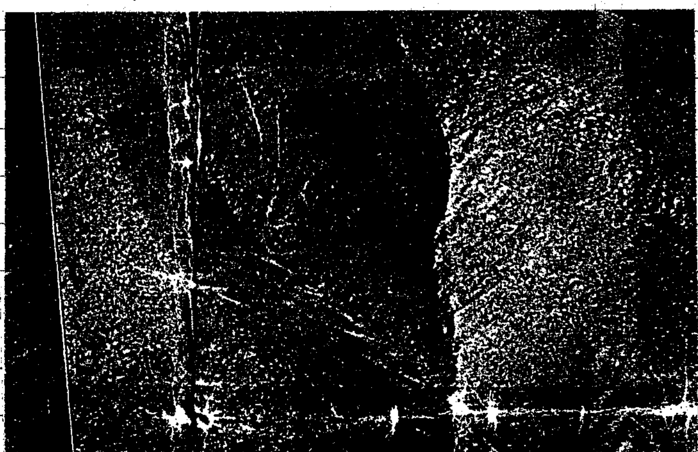
The lobe (colluvial) mentioned on page 59 as a possible terrace is immediately south of here. It has the appearance of being eroded along channel; other colluvial lobes up gradient drop directly to channel

North fork of upper watershed is definitely larger than southern fork. Area on crest above north fork is washed off / disturbed (not so for south fork). Both of these probably contribute to signs of runoff in north fork, and lack thereof in south fork (bottom of south fork is choked)

See Stu's notebook for his comments on differences between wash channels.

0-5 Sp
5-6 C
-12½ B (LF) mod amt lithophysae
-14 C
-16 B (MF) low amt lithophysae
-17 C
46 B MF, large lithophysae

at channel of confluence of fork of small sub-washes near headwall
additional 6 meters to flag left by Stu & Dani in channel (but they did not mark it's distance ~~from~~ from road along crests).
PF 5/15/98 → Flag (Dani & Stu) is at 500 m from road, coincidentally going up either channel of fork.
PF 5/20/98 Xerox of air photo with HDW & HWW transects:



Grapevine Mtn (Phinney Canyon)

Infestation lower in channel

36° 57' 07 N } ± 100 m
117° 06' 51 W } 7043 ft elev. ±

Road marginally drivable due to runoff stream in channel; origin is from seep on north facing slope but also has contributions from small north-facing drainage channels. Seep may be indicative of bedrock focusing of lateral subsurface flow in these otherwise wooded slopes

South-facing slope is a Sp, soil w/ pavement w/o much veg between clumps & large plants (pinon / juniper?)

36 57 07 N } ± 100 m
117 06 51 W } 7049 ft elev. ±

mid-slope 27° hillslope - south-facing slope

Hole dug to 55 cm in soil cover w/ pavement
19° hillslope
volcanic rock gray micro-crystaline (tuff or flow?)
but abundant crystals (qtz, some feldspar 50%)
If it is an air fall, than it is densely to
moderately welded
But the irregular (at fine scale) that the
rock breaks apart makes me think this
is a flow, probably dacitic.

PHA1 Phinney Analog
soil samples

little soil around channels on slope but solifluction-type lobes (up to 5 cm height) mottle the slope

mid slope, m from road at valley bottom

36°57'09 N
117°06'56 W } ± 100 m

6985 ft elev ± feets
7105

0-8 sandy loam A-horizon
8-21 loam BT1 T clay trans-location
21-33 loam BT2
33 47 sandy loam BT3
55 sandy loam B4.
55+ rock debris

color change

Samples at top 4 layers

Predicting soil development at YM
when glacial soil evidence is completely
erased. Look at Fortymile Wash
USGS at alluvium for a record &
Peterson et al paper of Crater Flat
Have Chadwick pull this together
Also using Ruby Marsh climatic data, and
Las Vegas Wash climatic data
The USGS did the studies, but no one has
made the next step to predict

Stu said that there are no colluvial/alluvial
soil measurements of retention curves at YM
We could do some, but a first step is to
RF 5/16/98 Look at the variability from a table like
Carsel & Parrish, or as Dani said that
there was a table by Salinity lab which
also had K_{sat}.
Larger samples would be needed for retention due to
sieving out >2 mm fragments; estimate of porosity
should be for soil matrix plus space created by rock
frag (but how?) & repacking to proper density
will be another problematic issue.

More clay (from alteration) here in soil matrix
But no iron-rich C-horizon (intensely weathered).

PHA2 upslope 25 m from PHA1

samples of middle 2 horizons

apparent field textures			rx frag	clay
0-14 cm	fine sandy loam		40 %	8%
14-31	loam	BT1	50 %	18%
31-45	loam	BT2 color change	60 %	22%
45-60	loam	BT3	60 %	22%

60+ fractured/rubble

rock frags are not highly weathered

approx 20 m below ridge

top of ridge is marked by dike features

Top is 2 knobs with light to med grey felsic intrusive (?) similar to rock described on p.64.

However there are some rock frag / talus near top of ridge which are felsic air fall mod to densely welded, pumice frags squeezed at least 4 (to 1) and a matrix very similar to the rock described above qtz & feldspar crystals are also present.

The intrusive would have similar hydraulic properties, low porosity, not readily altered, and fractures would provide most of the fluid pathways

Brunton compass set to 14°E declination

32 m up from road

PHA3 25 m below PHA1

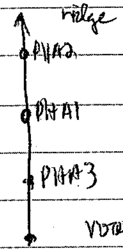
PF 5/16/98

		clay %	rx frag %	
0-10	sandy loam	16	40	A-horizon
10-24	loam	22	50	BT1
-34	clay loam	28	60	2
-52	↓	30	80	3
62		35	50	2BT1B
78		35	40	2BT2B

(2BT1B, 2BT2B: buried soil)

78+ rock frag/rubble

again no carbonate



given the lack of carbonate, this may be wetter than the past at YM

Pinon trees predominate on this slope but there are a scattered few junipers. (junipers are generally lower & on sideslopes)

Access to Phinney Canyon
Beatty to Springdale on 95
then 1+ mile further NW for dirt road access through closed gate

Heading on a continuation over the ridge top from the south-facing slope w/ transect PHA#

North-facing slope

PHB 1   25 m below crest (top 1/5 of slope)

			Clay %	Rx %
0-6 cm	Sandy loam	A1	16 ±5	20
6-14	"	A2	18	30
14-33	clay loam	BT1	30	25
33-57	loam	BT2	25	25
57-72	loam	CR1	30	30
72-90 cm	clay loam	CR2 (weathered rock) saprolite	35	30

maybe really B-horizons? (57-72, 72-90)

completely weathered, very little iron staining visible except in small pockets so probably reducing (near saturated column may lead to reducing)

CR = C-horizon in weathered rock
C-horizon ⇒ parent matl

Check Stu's notebook for other details since I was with Groenevelt during this transect.

PHB2   25 meters further downslope

			Clay %	Rx frag %
0-15 cm	Sandy loam	A	16	45
15-35	loam	BT1	~~20~~	40
35-50	loam	BT2	22	60
50-70	loam	BT3	26	70%

70+ still in interlocking angular frags not completely filled w/ soil (no iron staining either)

PHB3   25 m further downslope (3/5 way down slope)

			Clay %	Rx frag %
0-10	Sandy loam	A	12 ±5	20
10-23	Loam	BT1	22	40
23-35	loam	BT2	24	40
35-52	clay loam	BT3	30	35
52-68	Sandy loam	2BT4	18	40
68-85+	Sandy loam	2BT5	16	40

not as wet (52-68, 68-85+)

2BT# ⇒ 2 refers to soil forming in soil/gravel hence discontinuity w/ above nearly saturated layers

With Oliver in small watershed in upper Split Wash. Starting a transect on top of north-facing slope. This transect is further east than the HAW transect of 2 days ago.

HDN transect (Headwall north-facing)

HDN1 2 meters north of ridge top

(6° hillslope)

			Clay %	Rx frag %
0-11 cm	fine sandy loam	A	8	40
11-20	silt loam	2BT	16	50
20-24	Loam	2BTK	24	70
24 +	rock (big boulder / bedrock)			

Soil sample HDN1 (particle size) → 20-24

The "2BT" uses "2" to distinguish between/from the eolian dust of A-horizon and the probable Pleistocene B-horiz.
Definite clay alteration in low portion of profile
Carbonate on clasts, very thick layers around rock (2-3 mm) as opposed to thin calcite on undersides of frags on hillslopes
Sample of Rx fragments also taken (Oliver's sample)
Walking up the ridge to the location of transect it was noted that the outcrop ledges were lithophysal (all the way up from confluence were we parked the trucks)
Location = N24°E to confluence
Eolian dust accumulates in Holocene, any soil development like in HDN1 is Pleistocene (a more stable slope)

Oliver believes on the north-facing slopes, the soils are more stable than on south-facing slopes during the dry periods like now
(during wet periods, is this difference as great?)
Eolian dust predominates during dry periods, and is significantly reduced during wet periods.

We'd expect unweathered eolian dust (sandy loam) deposited during dry periods, alteration to loam during wet periods (Pleistocene)
This should be a cyclical feature, hence, the stable soils on YM may show the loam deposits (Ridge tops) and the unstable (eroding off during dry periods) periods get rid of the loam
RF 5/17/98
During wet periods little eolian dust would be deposited
The thick carbonate buildup on the rock frags is likely Pleistocene (Oliver sampled this for possible ^{14}C/U check).

Moderately lithophysal debris & outcrop (surface outcrop) with the debris likely spalling off in place creating talus piles

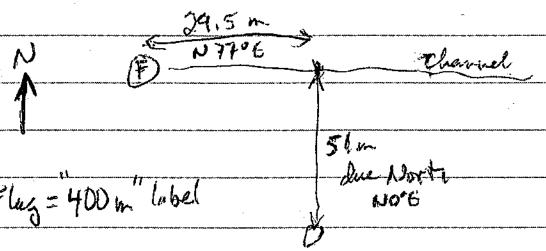
Single Creosote bush further upslope just off onto south-facing slope

Walked up ridge to broad slope, low angle coming off crest (before headwall).
Pavement on soil, most boulders are flush with surface

On broad slope of crest

RTW1 location is in reference to Stu & Dani line along wash channel.

Ridge Top Watershed

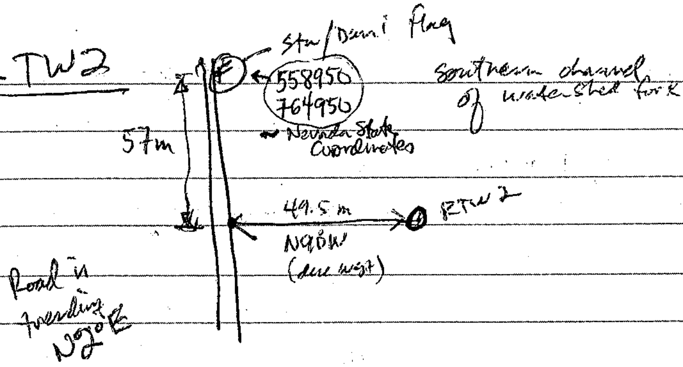


			Clay %	rx frag %
0-5 cm	fine sandy loam	A	10	≤30
5-20	"	BW	14	40
20-30	loam	2BT	25	50
2BTK 3-40 cm	clay ~~loam~~	2BTK	30	60
40+	apparent rock/bed			

2BT, 2BTK are older truncated (eroded off) soil
Clasts are moderately to strongly weathered
(rx frags 1½ cm thick is completely altered to white/beige clay)

Carbonate as thin coating on rx frags (maybe Holocene?)
→ caliche superimposed on Pleistocene soil?

RTW2



Stronger soil development than we saw further down slope at RTW1
Also note that there are boulders & frags with caliche (calcite ± opal) on surface

		Clay %	Rx %	
0-9	fine sandy loam	15	30	A
9-20	sandy loam	20	30	BW
20-30	clay loam	35	40	2BT
30-50	clay loam	35	50	2BTK
50+	rock (bedrock/boulder)			

Caliche on bottoms of rx frags is thin coating (? Holocene)
Strong Pleistocene soil (clay weathering not accomplished in <5000 yrs.)

Development of soil on broad slope argues that Pleistocene soils have been eroded off steeper slopes. Think of YM as domains of different erosional stabilities

Samples for water retention < 0-9 cm eolian; 20-50 cm Pleistocene clay loam

On 5/18/98 ?
Dani Orr disk infiltrometer test in eolian, top pavement cleared.

Look into possibility of getting a backhoe to dig into broad crest slope

1. more evidence to support caliche Pleistocene / Holocene distinction
2. Look into caliche distribution
3. better soil development profiling to bedrock (we don't always hand dig to bedrock, it may just be a boulder).
4. lift top layer of bedrock to observe fissure / fracture fill material to depth & to get samples for Ksat estimates

DOE request?; NPDES permit?

Oliver will write-up soil comments for trip report (caliche development, erosion cycling, look into USGS papers on Fortymile Wash alluvium).

Back to HDN.1 for completion of transect on north-facing slope

HDN1 is at 2 m from ridge top
meters downslope from ridgetop

0-10 m Sp [with large rx frag (not really a scree)]
10-17 Sp small frags
-19½ C
-25 Sp
-27 C
-36 Sp
-37½ C
-48 Sp
-49 C
-50 T

(-25 to -50: 23° Hillslope)

HDN2 50m ~~down~~ from ridgetop heading N7°E (using Brunton set at 14°E declination)

In talus pile; talus piles seem to be a good catchment for eolian dust, possibly explaining the appearance that talus piles are being invaded / filled in.

0-30 cm talus only
30-50 mixed talus & fine sandy loam
50-70 fine sandy loam w/ talus
70 +

plenty of roots

5/17/98 RF

meters downslope from HON 2

0-2 m	T	
-3 m	B	lithophysal
-5	S_p	
-8	C	
-10½	T	
-12	C	25° hillslope
13½	S_p	
-18	C	
-19	S_p	
24	C	
37	S_p	
-39	C	
-46	T	
50	S_p	

HON 3 50 m down from HON 2

surrounded by talus but in a lobe of scree / soil pavement

rx frags		
40%	0-6 cm	pavement
70%	0-32 cm	fine sandy loam in boulders
	32+	rock (probably boulders/talus)

abundant caliche (carbonate) in soil matrix and in rock frags ~~and~~ as thin coating

hillslope = 25°

↑ RF 5/17/98

RF 5/17/98

35 m to channel bottom of south fork (above confluence)

It is 39.5 m down the channel from Stu/Dani flag = 100 in south fork

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Randy only (Oliver left for California)

NFW transect North Facing in Watershed
South heading North

NFW 1 on top of ridge, south side of watershed

		rx frags %
0-4	pavement	
~~16-26~~ ← RF 5/18/98		
4-16	fine sandy loam tan	40%
~~16~~-26	fine sandy loam orange tinge	50%

I can't discern any clay difference but color change is strong

hillslope here is ~14° down the ridge but ~ perpendicular to transect

small amt caliche in spots on rock frags, none in soil

Heading N18°E down the slope towards the subdrainage channel which does not show up on topo map (on south-facing slope).

The stringer talus piles may have originated as large boulders or ledges which spalled or slumped lower down the hill, or may be in place; then rock frags continually break off moving downslope;
the stringer talus piles come off of rather shallow slopes and do not appear to be formed by avalanche off a steep slope

meters from NFW1

0 - 2½	Sp
- 6½	C
- 7½	Sp
- 10½	C
- 15	Sp
- 16	C
- 17½	Sp
- 18½	C
- 19½	Sp
- 21	C
- 25	T

NFW2 25 m down slope from NFW1
near edge of talus pile
next to small rodent nest w/ droppings in talus
lots of small sticks & needles/leaves in nest
0-23 cm talus
23-31 mix of talus & fine sandy loam
max 31 + boulders / ? [avg. depth ≈ 25 cm]

meters down from NFW1 (Not from last hole)

25-28	Talus	RF 5/17/98
- 30½	C	RF 5/17/98; 24° hillslope
- 31	Sp	
- 32	C	
- 34	Sp	
- 35	C	
- 36	B	MF (but small exposure) small Mod lithophase outcrop
- 37½	Sp	22° hillslope
- 43	C	
45½	Sp	
47½	C	
50	Sp	

NFW3 25 m downslope from NWF2
large boulder in soil, dry soil in center beneath it, boulder has thin discontinuous calcite

RF 5/17/98

continued; NFW3

0-9 organic component, fine sandy loam

9-40 fine sandy loam

orange tinge, carbonates

max. 40+ boulders?, maybe old talus pile

The deeper the frag, the thicker the caliche on the bottom side

[avg depth ≈ 35 cm]

meters from NFW3

0-12 Sp

-13½ C

-16 T

-19 C

-21½ T

-22½ C

-24½ T

-25 ~~T~~ Sp

NFW4 25 m downslope from NFW3

0.6 x 0.7 m hole

0-7 cm fine sandy loam organic / some pavement

7-38 fine sandy loam mixed in boulders

max 38+ 98% of bottom of hole is boulders

Appears to be filled in talus pile, rest of pile is 1 m east

⇒ sample taken for water retention

NFW4 sample ~N765150 E560840 ft

RF 5/17/98

meters downslope from NFW4

0-2½ Sp

-3 C

-4½ Sp

-6 C

-8½ ~~6~~ T RF 5/17/98

-10 Sp

-11½ C

14½ Sp T

NFW5 25 m downslope of NFW5

toe of colluvial lobe, talus just ½ m down slope

rx frag		
70	0-26	fine sandy loam, organic, lots fine roots
70	26-43	fine sandy loam, rx frags are larger
	43+	boulder/bedrock?

small amt of caliche on a few fragments down lower, whole profile is drier than any I've seen today.

Old talus piles filled in will have abundant large boulders/frags; colluvial lobes contain a wide range of rock frag sizes but predominance on smaller sizes

meters below NFW5

0 - 2½ Talus
- 3 C
- 4 Sp
- 10 T
- 11 C
- 19 Sp
- 23½ C
RF 5/18/98 → - ~~24~~ B moderately fractured, highly lithophysal
- 25 → middle of channel (≈ Nevada State Coordinates N765380, E 560870 ft)

RF 5/18/98 this is location of Dani Or's infiltration tests in channel; 710 (ft) from crest road, and 340(ft) from truck parking confluence (along wash) — meters

Assisted Dani in disk infiltrometer & ponded (large bucket) infiltration tests

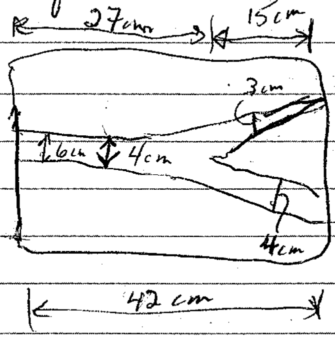
Stu drove off to search watersheds for hot spots. as per our discussion last night, he will know a hot spot when feels right. As best as we could define, we wanted him to check for channels being clogged or cleaned out. This is also something I can see on Groeneveld's air photos, so maybe Stu is winging it will find other features. Stu did mention looking for highly fractured

unit below the lithophysal unit when it intersects channel. How to spatially delineate these in each watershed by a quick walk through a bunch of watersheds seems to be a tough task that Stu argued that he could. The fractures should be dependent on proximity to structural features.

North channel of upper fork in
upper Split Wash Watershed

site where Groenevald/Or set up 2
tub infiltration

Site 1



area of ponded water is in fissure only

fissure

Site of green tub

from crest road

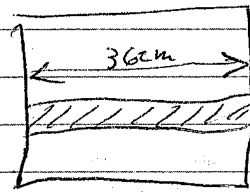
green tub covers fissure during test

This is upper site (5 m above flag = 500)
of 2 sites; other site is at flag in channel,
initially wet

Time	Ponded height
add H_2O 9:53:26	
:54	29.8 cm
10:03:45	29.5 cm
10:20:30	29.0 cm
10:37:45	28.4 cm

Dani Or photo #9 of roll
↑ PF 5/18/99

Site 2 at Flag = 500 m (from crest road)
in channel; site of clear plastic tub



6
5½ } avg. aperature
7 } width about 6 cm

Tub is removed, silicon & mud from around tub is still in place

Pond water in fissure only

Water poured into into fissure with measuring ruler sticking in fissure mud, water filled into an initially wet fissure (soil filled)

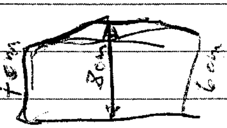
Time	Ponded height (cm)
10:06:00	69.9 cm
10:19:45	68.7
10:28:00	68.1
10:35:00	67.6

Dani Or photo #8 of roll

Walking up channel in the low to mod. fractured portion of non-lithophysal unit exposed in north channel of fork → Wicking of salts noted in 30-40 cm zone above runoff channel, in colluvial lobe; above that zones there are no salts on the soil surface. This is on a nearly vertical profile of stream bank (north side of stream bank). This appears to be an indication of lateral flow downslope in the colluvial lobe, but the amount of water in lobe is being nearly depleted (since salts go nearly to channel level). The salts are white, globular, possibly calcium oxides or sulphates (not carbonates)

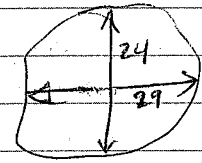
Two small joint/ponded infiltration tests

11:32:00	5.0 cm
36:00	4.7 cm
38:00	4.5 cm
42:30	4.1
48:00	3.8



Moderate fractured, lithophysal bedrock in stream channel

Site 2a - Large cavity w/ fractures/joints crossing it, bowl-shaped



24x29 cm oval

Shaded by brush but wind may be evaporating H_2O; (mod, <10 mph wind)

Time	Ponded height
11:37:00	4.0 cm
:40:00	3.9 cm
:45:00	3.9½
:52:00	3.8

Above these sites, the unit with little or no lithophysae crops out in the stream channel; it is also the steep part of the channel, maybe due to the fracturing of the nonlithophysal unit leading to greater erosion; the lithophysal units generally are the bedrock on the hillslopes which are exposed.
There is no place to easily do a ponded fissure infiltration test in this steep channel.

5/18/98 RF

— Much greater exposure of bedrock on south-facing slope, how does this relate to caliche distribution? flushing Dani's theory of uniform caliche distribution & none being formed now, we are only seeing caliche where boulders recently moved. I disagree with conclusion that no caliche being formed now & that only remnant from Pleistocene is here now. I believe in micro-topography/bedrock control of hydrology is dictating where caliche is presently being formed - hence a heterogeneous distribution in the top 1½ meters

11/3/98 RF

Zeolites

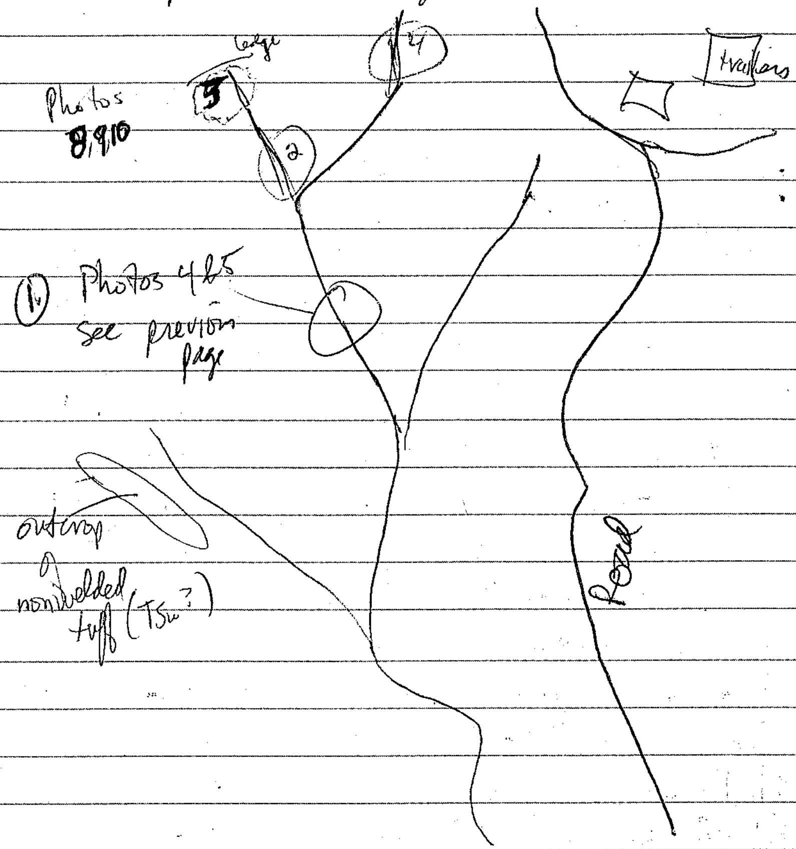
With Larry McKague, trip to look at cores & surface outcrops of Calico Hills & nearby non-welded units

First stop Busted Butte transport studies facility

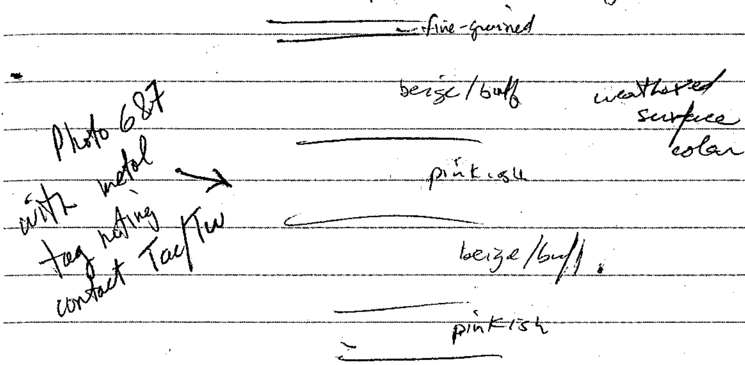
Walking up ravine that goes just west of drift
- dissected alluvium with multiple caliche horizons (paleo?)
→ looking for 1st occurrence of outcrop vitrophyre horizon, highly fractured weathers black
further up is a feldspar (flow) tuff magenta/beige, welded
→ 6 foot ledge of vitrophyre w/ flattened pumice, all surfaces (including any fracture surface as the rock breaks) weather to buff/beige
- further up is the zeolitically altered unit that quickly grades into sandstone green alteration in matrix, pumice to buff color (montmorillinite according to Larry).

Roll 1, shots 4&5 basal sandstone (reworked tuff)
(1.) lenses of thin, white weathers stringers subparallel with slope (maybe secondary in origin); bedding planes not readily discernable; weathered surface is buff, greenish tinge to quote "fresh" surface

Poorly indurated, easily carved by water in runoff channel (arches); see photo;
Rock crumbles in your hands, feels like burnt ash from fireplace; salt & pepper appearance due to up to 5% biotite flacks
Up to 2 meters of outcrop thickness



(2) Still in reworked section sand to cobble size in matrix
Alteration (?) leading to color differences that are approx stratabound (though the patterns are irregular
1-2 meter layers alternating



Apparently we've been walking through Wemonie tuff (Tw); Larry says that explains the biotite below here since Wemonie was more mafic
Hence we are finally in the Calico Hills
Hydraulically speaking the unit (Tw) should be highly sorptive & not transmissive
Fractures present in qty significant to affect flow (locally 2-3/ft) but is this a near-surface phenomena

n/3/98 RF

(3.) u/in Tac sedimentary unit (still no prominent bedding — massive sandstone)

There occurs a 1ft thick zone of 1 to 2 layers of highly silicic, indurated material that weathers to pink to pinkish brown

Photos { 7 fine-grained (ash fall) layers (2-3" thick)
8 headwall
9 fractures in nonwelded

(Photos 8, 9, 10 instead)

There is no distinct sedimentary layering in this unit. According to Larry, the pinkish weathering appears to be assoc with periods of ~~no~~ accumulation (weathering at surface) then sudden addition of ash fall or ash flow; This beige to pink coloring sequence appears often in YM area / NTS

Based on outcrops in numerous valleys here, the paleo surface was undulating, slumping is occuring, or faulting is slightly offsetting the units, based on the stratigraphic strike & dip, the layers do no align very well

The Tac is apparently only about 20-30 m thick here, if Larry is correct that the headwall at (3.) is

11/3/98 RF

lower, non-welded TSw ash flow with lithic (< 1%) and pumice (5-10%)

Also, there has not been any green zeolitic alteration in the Tac and only slightly green in the Wenorgie. Larry would like an x-ray diffraction analyses of sample from (4)

(4.) Sharp contact with reworked tuff below flow w/ pumice (weathers brown with pinkish pumice standing out).

Ran into Gilles Bussod at trailers, very friendly and helpful. Gilles pointed out the area at our stop (3) as the block test. The injection is generally in the TSw nonwelded and the lower collectors in below the thin silicic (fine-grained) layers of Photo #7

11/4/98 RF

Core Library near FOC
Chris Lewis ?
w/ Larry McKague

SD-9 RF 11/4/98

1424 - 1432 vitric ~~partially~~ moderately welded, gray
1432 - 1437 pink, dense mod. welded
high zeol x-ray
to 1448 moderately welded vitric
porosity should still be high (30% ?)
to 1450 grades to less welded
lighter color, φ maybe increasing
lithic & pumice frags
to 1464 still some vitric frags

Larry noted mottled alteration
pinkish & buff hence not uniform
alteration on scale of centimeters
below 1464 non-welded highly altered
no reason to believe biased sampling
missed low zeol alteration zones
1508 - 1581 massive little/no evidence of layers
soft non-welded altered tuff. buff to pinkish
1581 - 1590 - frags (see LANL doc)
appears to be becoming more indurated
to 1764 hydraulically speaking the units of Calico
above here → friable near top of Chn

11/4/98 RF

massive in Tac w/ zones of increased frags
but no obvious stratification to control flow

1777 finally more pervasive greenish tinge to
alteration

bedded tuff appears to be more of the
same (as above) but possibly more rounded
frags & overall more finer grained
RF 11/4/98
1809 ~~18~~ 1812 more distinct layering & finer
(Sands)
1815 arkosic sand
These latter two zones may have strat. features
that would affect flow

Prow Pass top ~~in~~ non-welded, buff/pinkish tinge
(becomes gray ~1864 ← RF 11/4/98
reworked top, then fissile zones (ash fall?)
shaley in appearance
much less frags & pumice as compared to Chn
but overall impression is similar hydraulically
w/ possible strat control of flow at top of Prow
More much variability in Prow than in Chn
but dense. Frags to increase lower in Prow

Nothing was more than partially welded in Prow though welding did increase slightly to ~2000' depth then back to non-welded (from partially welded)
In summary for SD-9, from the partially welded vitric TS on to the bottom of the hole.

(1.) hydraulically there are slight variations in matrix properties expected but nothing to impart a control on flow
(2.) Contacts & variations.
Tac / Tprow contact is abrupt
TS / Tac is not abrupt
TS vitric / TS nonwelded/altered is abrupt
(3.) alteration appears to be pervasive in basal TS, Chn, Prow; little/no reason to expect wide variation in zeolitic %s
(4.) Larry noted Tcp3 x-ray data seems to be incorrect, we requested sample at 1862.5 ft depth in zone that appears homogeneous with respect to LANL x-ray data locations

SD-7 using Rautman & Engstrom 1996 (SNL) SAND96-1474

1268 densely welded "caprock", vitric
grades into non-welded by ~1300
note water content drop at 1310' ft depth
to 1356 non-welded, vitric tuff
1357-1381 supposed bedded tuff, very poor recovery & abundant sampling
RF 11/4/98 strict quartz sandstone to arkosic sandstone
~~by 1397 it looks more like the reworked tuff~~
Calico Hills at 1405 according to SNL report (SANDIA has it wrong, so my comment above is still valid, bedded tuff, pre TSw, 1357-1405
RF 11/4/98

Top of Calico is devitrified? No
Larry ⇒ if devitrified (early on), then glass crystallizes to qtz & feldspar and the feldspars may alter to argillic clays
Randy → non-welded, devitrified appears that it would have same hydraulic properties as a non-welded vitric; partially welded would be expected to have similar hydro properties also

see next page

Upper portion of Calico is devitrified w/ feldspars to argillic clays, there are some <5% vitric fragments in the matrix of qtz & argillic/feldspars. ~~The feldspars are not alte~~ RF 11/4/98

The vitric frags are present & pumice is still vitric than matrix probably not devitrified, and still glassy. Hence top of Calico is vitric (fine granules are vitric

Note large discrepancy between Carey et al 1997 & Rautman & Engstrom (1996) on position of Tptb1/Tac contact (difference = 25 ft)

Poor recovery at bedded intervals, also generally oversampled, i.e. 1517-1523

Need to look at interval 1490 to 1567 in more detail, try to find geophysical logs that match changes in glass & zeolite. They are flip flopping over that section. At a cursory glance, no obvious feature to delineate The resistivity might be matching it.

Difficult to tell vitric from qtz w/ handlens

1493 peak zeol assoc. w/ thin (0.1 ft) bedded
RF 11/4/98 → basal of Tac3 w/ fine ashy layers
1519 peak zeol next bedded subunit, basal of Tac2 as in above unit, described as coarse-grained, lithic-rich pumice fall; except this basal

subunit has fine-grained volcaniclastic sandstone and then more lithic/pumice fall.

The next peak transitions more gradually as it approaches the Tacbt (1567 ft depth) contact

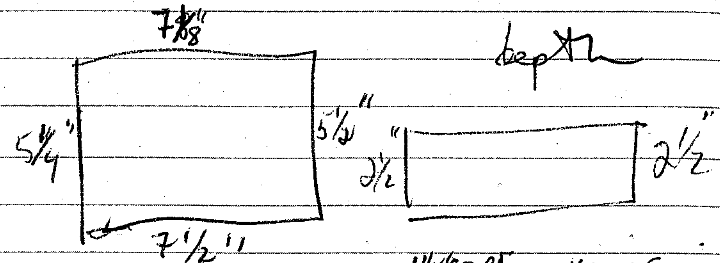
In these transitional zones, alternating zeol contents may be reflected by the bedded units (more reworked, more readily moving water). Question is, how much of the ash flow tuff is altered, ⇒ just near the base and top as in peripheral alteration near bedded tuffs

The transitions from bedded tuffs to ash flow should presumably be sharp. These are generally poor recovery areas so it is hard to tell

I have not seen a "devitrified" rock yet, otherwise the hydraulic properties are going to depend on the degree of welding and the degree of zeolitic alteration By the time something is moderately welded, it appears to be pretty tight.

RTW 20 (see page 73)

Re-sampling to get field bulk density of 20-50 horizon (cm)



Plan view

11/5/98 RF VOLUME

7 1/4" x 5 3/8" x 2 1/2" = 97.42 in^3

= 1596.46 cm^3

Horizon starting from 7 1/2" depth
sampled 2-2 1/2" ~~lower~~

Mercury dorms & restaurant/cafeteria

Mercury Housing Office (702) 295-6921
7:00 AM to 10:00 PM Monday-Thursday
Across from Steak House

At core library again
(across from FOC)

Looking at G-3 core
1265 — 2101 ft depth
water table is at ~2463 ft depth
but the section from 2100' to 2463' is moderate to densely welded portion of the Bullfrog (upper welded Tcbuw)
There is zeolitic alteration in the lower non-welded unit of the Bullfrog below the water table (80-100 ft below water table)

1256.6 vitrophyre (densely welded, black glass throughout
weathered surface illustrates fragments
sparse feldspar crystals (white)

~1270 transition to vitric tuff that weathers to buff matrix is a mixture of black glass and a translucent, fine-grained glass(?) brown to yellow under magnification, larger brown glass also present
Black glass decreasing component of matrix

1299 Tptpv2 / Tptpv1 contact
decrease in welding starts in Tptpv2
Placement of contact appears arbitrary
partially to non-welded by 1303,

Non welded by 1310, and crumbles
by 1329 ft depth
3 or 4 measurements indicate 65% glass
in These buff colored with lithic fragments
and some locally present pumice
1338 - 1426 core boxes contain trays of
crumbled sand/cobbles with the lithic
fragments being the most indurated
1376 change from brownish to grayish buff color

1406 bedded tuffs at base of TB
although there is clear indications of reworking
above this point (10 ft above)
gray color, looks like cement, though
very friable, crumbles readily
1412.9 contact appears to be change in color
at Top of Tac; hydraulically, little difference
is expected
to 1500 still vitric in Tac, non welded crumbles readily
pumice appears to be devitrified (feldspar & qtz (white)) though
matrix still contain abundant glass
1506.8 bedded unit of Tac is more indurated than
- 1553.9 tuffs above, bedding structures present
(coarse zone interlayed w/ fine zones) Though
most of the unit appears massive, again pumice are
devitrified, but abundant glass still present (though
smectite → clays as alteration are present per Vaniman et al.)

Tcpunw 1553 - 1570
Tcpuw 1570 - 1790
The "contact" at 1570 ft depth appears
meaningless, the rock appears to be same to
~ 1601; an altered appearance (devitrified ?)
fine grained, qtz readily identifiable &
pumice especially appears to be altered & "melding"
into matrix (shape of color change, fragments or
pumice could be).

1601-1602 abrupt appearance of indurated, moderately
welded, vesicular tuff w/ frags and pumice.
vesicular part may be due to pumice being
etched out (dissolved) since there are partial
instances; This sudden change is reflected
in the glass content (1598' → 45% glass;
1603 ft depth has 0%)

1603 — Sudden change back to non-weld/partially
slightly friable (partially welded)
whitish grayish, devitrified and appears to be
further altered to clays; white chalk on hands
from touching samples, qtz grains, very small
biotite (not identifiable w/ 14x handlens, had
to use microscope in lab
1650 becoming more welded (mod welded here)

Larry says the devitrified rocks are generally indurated/moderately welded; the softer stuff is probably alteration of devitrified (feldspar) mineral to clays

to ~1767 moderately welded
pumice frags devitrified but structure still evident, though more buff (less grey) & more biotite the 1749-1760 section;
Becomes less welded by 1776 and contact Tcpuv/Tcplnw is at 1790; could easily be 10 feet higher in section (the contact that is).
The biotites, just noted, are fine grained but the flecky appearance is not prominent, they look almost blocky but the oily sheen on the large faces are present. hornblende?
The pumice fragments, devitrified, altered, and commonly etched completely away in this section giving the rock a vesicular appearance
1790 lower non-welded Prow
Alteration begins in this zone and ends around 2040. Hence, look closely at logs from 1790-2040 geophys. According to Vaniman et al 1989, alteration stops at 2022'
Check Epithermal neutron, resistivity & induction resistivity (RILD), and water contents from logs.

1780 - 1810 is low water content

1901 pumice devitrified, instance of zoned pumice green fringe, white in middle, still had pumice structure
matrix has mottled pinkish & whitish colors (alteration, non-uniform)

glass supposedly present in the top 40 ft of zone (to about 1850'); I couldn't tell, plus the pumices were destroyed

Moderately indurated (partially welded)
Grades from non-welded at top of Tcpuvw to partially welded by 1830' depth & then slightly less welded by 1850
1877 pinkish caste to matrix & locally greenish fringe especially in pumices & around mafic fragments or minerals; the pinkish caste is mottled at a finer scale (hand lens) mixed w/ whitish or brownish castes to the alteration; occasionally I was reminded of flow patterns through the rocks leaving the mottled appearance; non-welded; mottled pinkish, whitish, greenish is pervasive down to 1992
1992 bedded unit at base of Prow Pass tuff

1992 Bedded unit is sudden change to reddish rock
↓ (appears to be staining between grains)
2004 Zeolite alteration (& possibly large minerals
of) is present

2004
↓ top of Bullfrog non to partially welded
2040 grayish, but slight pinkish tinge & occasional
greenish pumice indicates alteration still
present though not as pervasive as in
lower flow units. Within a couple
feet the pinkish hue to the rock comes
back & the zeolitic alteration is

By 2021 the green alteration is
no longer visible. At 2022 the
rock is almost white but below that the
pinkish hue (no green) comes back until
near the contact w/ the upper welded
Bullfrog. The welded upper Bullfrog
appears to be fairly to partially non-welded
at least until 2090' depth (no more boxes)

The transition zone at 2022 is marked by a 1 foot
section of vesicular rock that looks bleached & altered.
There appears to be some alternating layers from
2-10 feet thick where water was preferentially

flowing here, just based on alteration colors of
the rock core

Larry agreed that there didn't appear to be
any glass at 1827' or vicinity. We also
noted that the Vaniman et al 1984 report did
not have glass in that sample, only the Lacey et al.
1997 report. Apparently Nelson & Kibler (who
created the log summary report that we had in the
core library) also used the erroneous data

GPS location w/ Pete LaFemina
(trucked on down the hill from the fracture mapping on pavements on Live Yucca Ridge
(see Pete LaFemina's notebook for GPS
UTM meters NAD83

infilt test in bottom of channel over fractures in bedrock
(between bottom of small watershed

2 locations w/ silicon remnant ~4 meters apart

~~downstream~~ site 548202 Easting
↑ RF 6/22/99 4078651 Northing
1326.24 meters elev.

Upstream site 548200 Easting
4078648 Northing
1326.60 m. elev.

RF 8/4/99 EarthVision's Nad83 to NAD27 is incorrect!!!
See Pete LaFemina's notebook, he used the package "Softserve by Novatel" to convert these to: downstream 548281 E 4078453 N
upstream 548279 E 4078449 N
But he believes his benchmark data site is off (~2-5m)

Upper Split Wash @ Yucca Mountain
Checking channel characteristics for Woolhiser watershed modeling, in particular, channel elements 64 & 69. They are the lower, sediment choked reaches of the south branch in our upper watershed model area (Dave Ferrill & Bill Dunne also present)

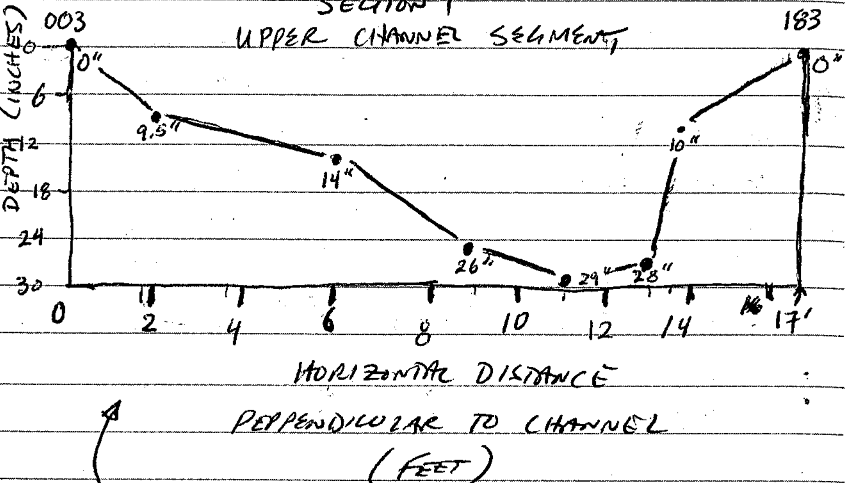
Starting from the junction
Stu & Dani had flagged this junction for their channel transect

Tcpll (lower lithophysal) is cropping out at the junction

(1.) First section heading upchannel ~100 (using tape measure) not accounting for slope (hence this is not exactly a map distance
Brunton ⇒ 15° slope for this section
~70% outcrop of lithophysal unit in channel with interspersed thin wedges of alluvium at steps in outcrop; guesstimate of 20 cm max except where large boulders are present

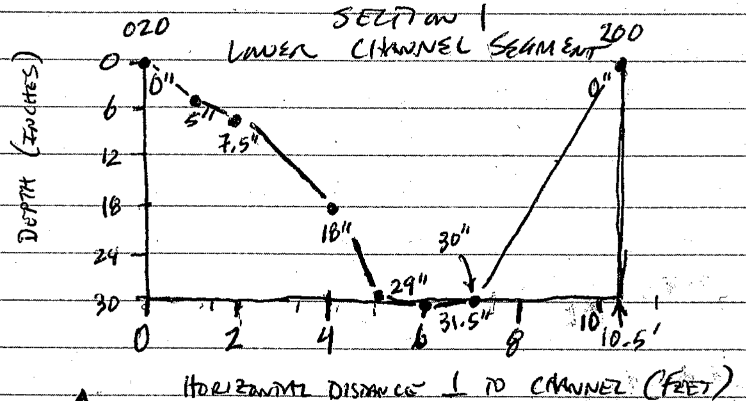
Channel shapes for section ①

SECTION 1
UPPER CHANNEL SEGMENT



CHANNEL SHAPE REPRESENTATIVE OF upper ≥ HALF THE LENGTH OF CHANNEL.

SECTION 1
LOWER CHANNEL SEGMENT



CHANNEL SHAPE REPRESENTATIVE OF LOWER <50% OF LENGTH OF CHANNEL

ABOVE CHANNEL PROFILES ARE REPRESENTATIVE OF CHANNEL SHAPE IN FIRST 100' OF CHANNEL UPSTREAM ALONG SOUTH BRANCH OF SPLIT WASH, UPSTREAM OF CONFLUENCE OF NORTH AND SOUTH BRANCHES OF SPLIT WASH

RF 8/25/00
END

SECTION 2 — FROM UPSTREAM END OF SECTION 1 (AT 100' FROM CONFLUENCE) TO 223.5' FROM CONFLUENCE

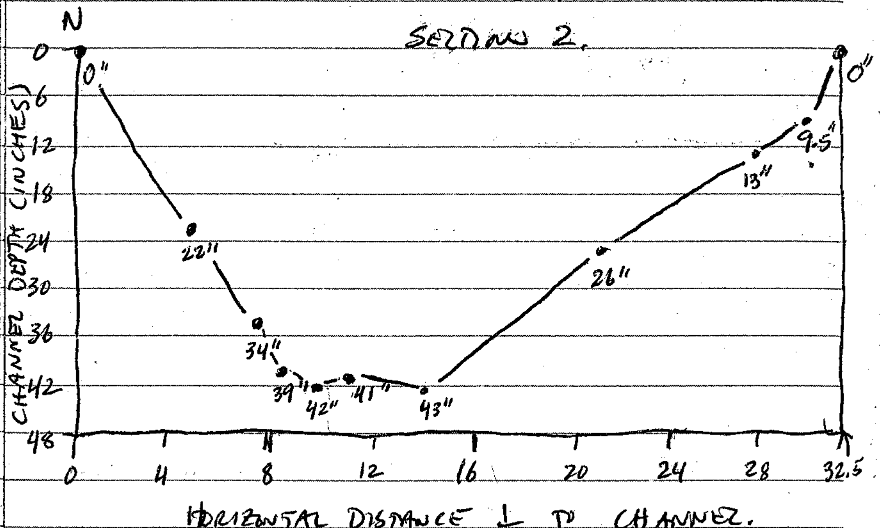
RF 8/25/00

CHANNEL ~~TREND~~ TREND FROM 100' TO 223.5' = 062/242 AZIMUTH

Channel valley broadens out and is chocked with alluvium/rx frag mixture
Talus debris feeding into channel from north side; on the north side of wide channel, the alluvium/rxfrag mixture (~50% ??) appears > 1 meter thick (maybe up to 2 meters → check the extreme case of bringing slopes down to a point! north side ~32; south side slope ~25°)
Where water flows, mostly on north side of channel, the alluvium thickness varies from about 10 cm to max measured at 30 cm —
RF 6/25/99 use 50 cm as upper end noting that small storms will see less and large storms will see more.

Slopes of sections 1 & 2 are about 12-15° and there is a steep transition between them over a distance of the last 15-20 feet of section 1.

REPRESENTATIVE CHANNEL PROFILE ACROSS SECTION 2.



In general, measurements taken at breaks in slope (some measurements also taken along same slope angle)

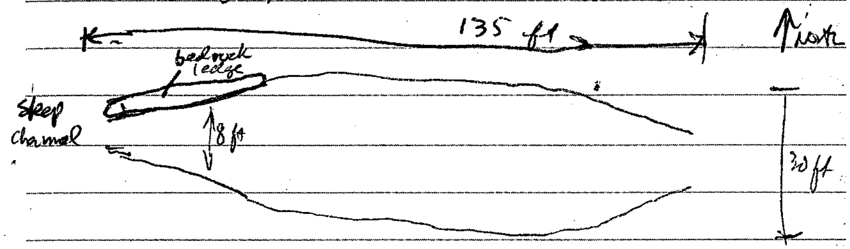
Upchannel from section 2 is another steep transition. This transition contained boulders and alluvium (~20 cm thick. The shape of the channel in the

transition zone is similar to that in the steep portion above here (narrow V-shaped)

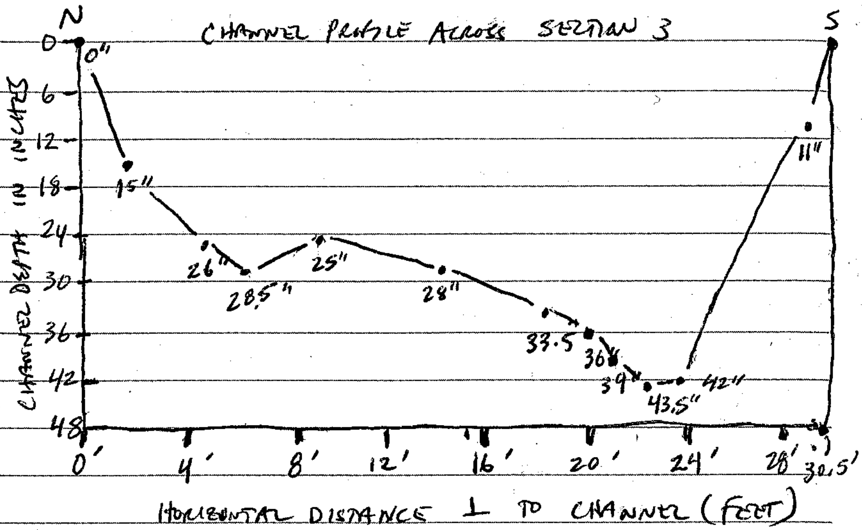
(3) Section 3 135 foot length (200 - 335 feet from junction)

Transition is ~ last 20 feet of section 2 and first 30 feet of section 3

SECTION 3 AZIMUTH = 063 - 243.



Talus spilling into channel from south side of channel; Main water flow starts on north side of channel & switches to south side, talus goes all the way to the water flow area. Alluvium probably maxes out at 2 meter thickness, though in small flow channel the thickness is as little as 20 cm in a soil/rx frag mixture (50% frags or more)



RAINIER MESA

Groeneveld, Stothoff, Crocco, Fedors

Determine vegetation, soil, bedrock types relative to YM

A4 37° 11.4' 116° 11.88'

light gray crystal-rich (qtz, biotite, feldspar in order of abundance)
surface outcrops & small ridges that could be different subunits ↳ lithophysae,
blocky to fissile (in horizontal)

Check Bechtel fracture study of NTS (Jeff sent it)

This area is adjacent (just north ~50m) from borehole U12 b,07 -4 PPS
N 892,869.53 E 634,181.00
elev. 7367.30 ft

A4 transmission line (marked on map) that runs west of borehole,
The hillslope has oak, juniper, high density
Soils on hillslope (midslope) on undisturbed ridge crest going down the hill, soils >30-35 cm deep, not wet, fine silty loam, no profile development (no lithophysae); transition to pinkish tuff, w/little biotite

 10/4/99: RF

Other side of valley (north central end of mesa)

soil thickness >2 ft locally (blocky pink densely welded tuff)

soil seems more uniformly thick and has a root mass (matte) in top 6–8 inches

eolian dust w/ ~50% rx frag.

RF 10/5/99

3 – Springs Basin, Kawich Range

Walked up north ridge of watershed

- bedrock weathers pinkish, knobby appearance, crystal of qtz, feldspar biotite jointing prominent

soils have locally abundant biomass matte, otherwise fine silty loams w/ abundant rx frag; dry

Steep slopes, sparse veg between pinyon-juniper, some sage & small tufts of grass (~80% cover in scree/soil) RF 3/30/03

Tkr - overlies the Tkt

Tkr ↓: greyish, streaked, crystal-rich

Tkt ↓: weathers pink, massive to laminated, fissile

willow, cottonwood in alluvium high up in streams

10/5/99 RF

NE of corner of Kawich Peak 1 mi² section on 7½" quad

regolith (dry, crumbly) with roots concentrating more in regolith than top 10-15 cm of eolian fine silty loam.

regolith ⇒ highly altered rx frags

(two photos by Groenewold)

10/6/99
RF

Timber Mountain

Non to partially welded ash fall tuffs, purplish to white matrix, altered.
Also crumbly highly altered, weathers rounded outcrops (like granites); weathered surfaces appear to exhibit feldspars that would comprise

RF 3/30/03

 3/30/03 RF

The next 3 pages (p.120-122) contain a table of scanned photos stored on the attached cdrom. The file names on the cdrom are keyed into the appropriate page of Sci Ntbk #255.

Photographs scanned and stored on cdrom attached to scientific notebook #255. [R. Fedors]

File Name	Page Number in Sci Ntbk
D0009 209	NRG-5, see page 11/12
D0009 210	NRG-5, see page 11/12
D0009 211	NRG-5, see page 11/12
D0009 212	NRG-5, see page 11/12
D0009 213	NRG-5, see page 11/12
D0009 214	NRG-5, see page 11/12
D0009 215	NRG-5, see page 11/12
D0009 216	Drill Hole Wash, see page 12
D0009 217	GDN-1, page 13
D0009 218	GDN-1, page 13
D0009 219	GDN-2, page 14
D0009 220	GDN-2, page 14
D0009 221	GDN-3, page 15
D0009 222	GDN-3, page 15
D0009 223	GDN-4, page 16
D0009 224	GDN-5, page 17
D0009 225	GDN-5, page 17
D0009 226	GDN-6, page 18
D0009 227	GDN-7, page 19
D0009 228	GDN-8, page 20
D0009 229	WWSF-1, page 23
D0009 230	WWSF-2, page 24
D0009 231	WWSF-2, page 24
D0009 232	WWSF-3, page 25
D0009 233	WWSF-4, page 26
D0009 234	WWSF-5, page 27
D0009 235	WWSF-6, page 28

RF 3/30/03

D0009 236	Shoshone Mountain, page 30
D0009 237	Shoshone Mountain, page 30
D0009 238	Shoshone Mountain, page 30
D0009 239	Shoshone Mountain, page 30
D0009 240	Shoshone Mountain, page 30
D0009 241	Shoshone Mountain, page 30
D0009 242	Shoshone Mountain, page 30
D0009 243	Shoshone Mountain, page 30
D0009 244	Shoshone Mountain, page 30
D0009 245	Shoshone Mountain, page 30
D0009 246	Shoshone Mountain, page 30
D0009 247	Shoshone Mountain, page 30
D0009 248	Shoshone Mountain, page 30
D0009 249	Shoshone Mountain, page 30
D0009 250	Shoshone pit, page 31
D0009 251	Shoshone roadcut pit, bottom page 31
D0009 252	Shoshone roadcut pit, bottom page 31
D0009 253	Shoshone pit #3, page 34
D0009 254	Shoshone pit #3, page 34
D0009 255	Shoshone pit #3, page 34
D0009 256	Shoshone vegetation, page 32
D0009 257	Shoshone vegetation, page 32
D0009 258	Shoshone vegetation, page 32
D0009 259	Talus and pits on Shoshone Mountain, page 33
D0009 260	Talus and pits on Shoshone Mountain, page 33
D0009 261	Talus and pits on Shoshone Mountain, page 33
D0009 262	Talus and pits on Shoshone Mountain, page 33
D0009 263	Talus and pits on Shoshone Mountain, page 33
D0009 264	Talus and pits on Shoshone Mountain, page 33
D0009 265	Talus and pits on Shoshone Mountain, page 33

RF 3/30/03

RF 3/30/03

D0009 266	WWNF transect, page 22, refers to Stothoff Sci Ntbk #175
D0009 267	WWNF transect, page 22, refers to Stothoff Sci Ntbk #175
D0009 268	WWNF transect, page 22, refers to Stothoff Sci Ntbk #175
D0009 269	WWNF transect, page 22, refers to Stothoff Sci Ntbk #175
D0009 270	WWNF transect, page 22, refers to Stothoff Sci Ntbk #175
D0009 271	WWNF transect, page 22, refers to Stothoff Sci Ntbk #175
D0009 272	WWNF transect, page 22, refers to Stothoff Sci Ntbk #175
D0009 273	WWNF transect, page 22, refers to Stothoff Sci Ntbk #175
D0009 274	WWNF transect, page 22, refers to Stothoff Sci Ntbk #175
D0009 275	WWNF transect, page 22, refers to Stothoff Sci Ntbk #175
D0009 276	GD-6, page 8
D0009 277	GD-6, page 8
D0009 278	GD-7, page 9
D0009 279	GD-7, page 9
D0009 280	GD-1, page 2
D0009 281	GD-1, page 2
D0009 282	GD-1, page 2
D0009 283	GD-2, page 3
D0009 284	GD-2, page 3
D0009 285	GD-3, page 5
D0009 286	GD-3, page 5
D0009 287	GD-3, page 5
D0009 288	GD-4, page 6
D0009 289	GD-4, page 6
D0009 290	GD-5, page 7
D0009 291	GD-5, page 7

RF 3/30/03

The next 8 pages (p. 124-131) contain photos from the Busted Butte trip with Larry McKague on November 4-5, 1998 (see pages 89-107 of this scientific notebook.

RF 3/30/03

Photo from page 89

RF 3/30/03

Photo from page 89

S ←

RF 3/30/03

Photo from page 91

RF
3/30/03

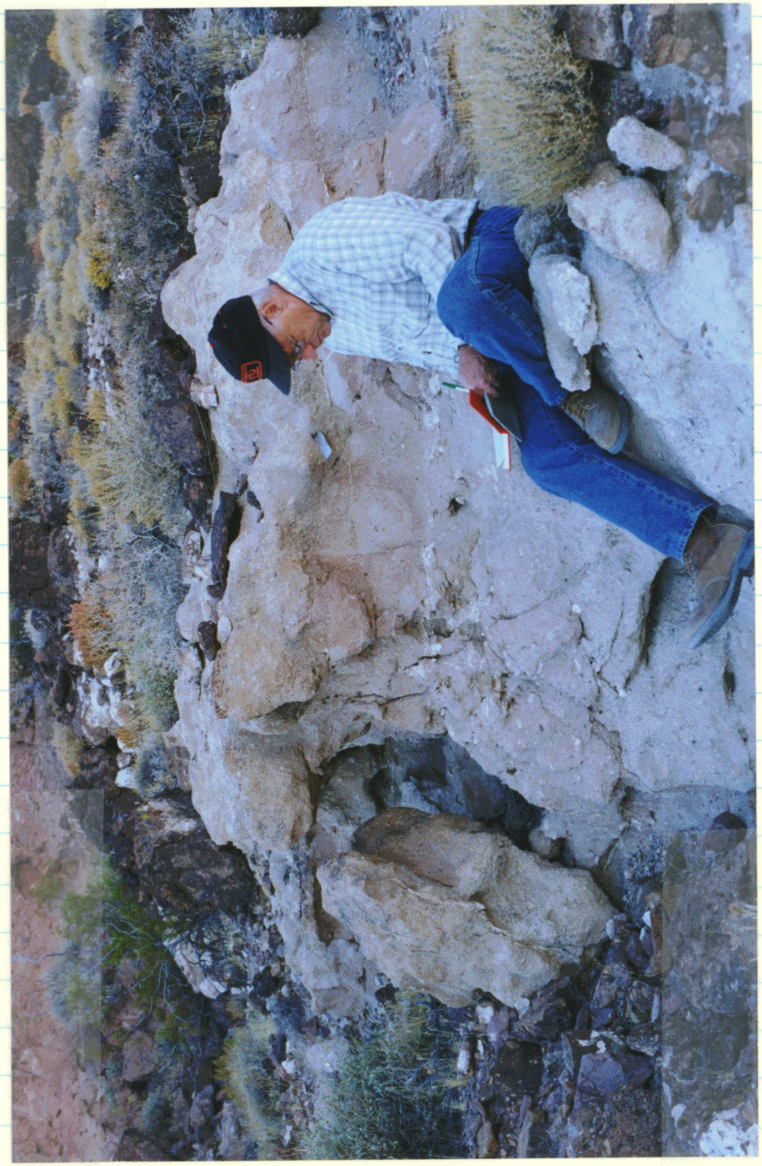


Photo from page 91

RF
3/30/03

 RF 3/30/03 Photo 7(8) page 92

3 ←

Photo 8(9) page 92 RF 3/30/03

 RF 3/30/03

Photo 9(10) page 92

S ←

Photo of Butte Butte
Looking ESE

3/30/03 RF

Last entry
Ready to close out RF 3/31/03

I have reviewed this scientific notebook and find it in agreement with QAP-001. There is sufficient information regarding methods used for conducting tests, acquiring and analyzing data so that another qualified individual could repeat the activity.

E. C. Pearcy
4/1/2003

ADDITIONAL INFORMATION FOR SCIENTIFIC NOTEBOOK #: 255

Document Date:	01/26/1998
Availability:	Southwest Research Institute® Center for Nuclear Waste Regulatory Analyses 6220 Culebra Road San Antonio, Texas 78228
Contact:	Southwest Research Institute® Center for Nuclear Waste Regulatory Analyses 6220 Culebra Road San Antonio, TX 78228-5166 Attn.: Director of Administration 210.522.5054
Data Sensitivity:	■"Non-Sensitive" □ Sensitive □"Non-Sensitive - Copyright" □ Sensitive - Copyright
Date Generated:	10/01/2000
Operating System: (including version number)	Windows, IRIX (SGI), SUN OS, LINUX, Mac
Application Used: (including version number)	NA
Media Type: (CDs, 3 1/2, 5 1/4 disks, etc.)	1 CD
File Types: (.exe, .bat, .zip, etc.)	jpg
Remarks: (computer runs, etc.)	Media contains: scanned photos in jpg format which is public domain-format readable by many software packages on listed operating systems.