JUN 0 8 1988

MEMORANDUM FOR: Ronald L. Ballard, Chief
Technical Review Branch, HLWM

THRU: Philip S. Justus, Section Leader
Geology/Geophysics Section, HLTR

FROM: Charlotte E. Abrams
Geology/Geophysics Section, HLTR

SUBJECT: ATTENDANCE AT HYDROGENIC DEPOSITS SAMPLING TRIP

SCHEDULE AND ITINERARY

Dates of trip: February 22-26, 1988

2/22/88 Observation and sampling in Quaternary soils pits near Forty-Mile Wash and at Trench 14. Visit to U.S. Geological Survey sample facility.
2/23/88 Observation and sampling at Trench 14, 14a, and Busted Butte.
2/24/88 Observation and sampling at Busted Butte sand ramps.
2/25/88 Observation and discussion at hydrogenic deposits, springs, and spring deposits in the Amargosa Desert area, Death valley, and southern Crater Flat.
2/26/88 Observation and discussion at Cane Springs and Calico Hills.

PURPOSE OF TRIP

The field trip was planned for U.S. Geological Survey and Los Alamos National Laboratories investigators assigned to the Yucca Mountain HLW Project to view and sample hydrogenic deposits in the Yucca Mountain region. Samples taken are intended for use in laboratory studies of the hydrogenic deposits. In addition, this trip afforded many of the investigators their first opportunity to view the deposits under investigation.

ATTENDEES

In addition to project investigators from the U.S. Geological Survey (USGS) and Los Alamos (LANL), representatives from Science Applications International (SAIC), Nevada DOE Waste Management Project Office (WMPO), the NRC, and State of Nevada investigators from the Desert Resources Institute (DRI) and Mifflin and Associates were in attendance. Attachment 1 contains the names and affiliations of participants and observers and names, affiliations, and area of technical expertise of investigators.

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SUMMARY

On February 22-26, 1988, Yucca Mountain HLW project investigators for the USGS, LANL, and the State of NV, along with observers from SAIC, WMPO, and NRC participated in field sampling and observation of hydrogenic deposits in the Yucca Mountain region. Investigation of hydrogenic deposits was initiated in response to a need for resolution of the origin and/or implications of calcite/silica deposits exposed in Trenches 14 and 14a across the Bow Ridge fault, east side of Yucca Mountain. In addition to sampling and study of hydrogenic deposits in trenches at and near Yucca Mountain, plans are to sample and study deposits located at Busted Butte, in the Amargosa Desert, and other possible analog deposits in the region.

February 22, 1988

The group met at the USGS sample facility where some background to the deposits study and a general geologic orientation were given to new participants. Sampling procedures were explained to investigators/samplers and sampling tools, labeling and photography equipment, sampling responsibilities, and sampling containers were distributed.

The first stop of the day was at pits FW-3 and FW-4 located in Quaternary soils ranging from 10 to 30K in age near Forty-Mile Wash. The pits were viewed as a comparision with materials in Trench 14. Quaternary deposits at this location were being correlated with deposits identified in the Beatty, NV area. A goal of soils studies is to assess the origin of aeolian deposits in the area. Very little secondary silica is present in the material exposed in pit FW-3. In pit FW-4 there is some secondary silica located on the underside of gravels. In time the silica will form amorphous silica horizons of 10 to 20% opal CT.

The group then moved to the west side of Exile Hill where trenches 14, 14a, b, c and d are located (Figure 1). Trench 14 and 14a were originally excavated to study the Bow Ridge fault at that location. After trenching and discovery of the calcite/silica deposits in trenches 14 and 14a, additional trenches were excavated to attempt to aid in an understanding of the origin and ramifications of the veins deposits. Trench 14b was excavated to look at the Quaternary horizon and trenches 14c and d were excavated to attempt to look at the Bow Ridge fault in colluvium.

The group examined trenches 14 and 14a. Trench 14 has been mapped in detail by Emily Taylor (USGS) and Heather Huckins (F&S) and a trench wall map has been produced at a scale of 1 meter = 2 in. Markers are placed in a gridded pattern along the trench walls in two (2) meter intervals. A page-sized and generalized version of that map is included as Attachment 2.

The vein material may have been emplaced from either above or below along pathways formed by faulting events. Volcanic ash located along these pathways appears to designate the youngest or more recent faulting event as ash appears to cross cut all other veining in the trench and postdates the platey horizon (Unit 3, Attachment 2).

Rock exposed in Trench 14 is Tiva Canyon tuff. Rock is brecciated and brecciation predates veining based on cross cutting relations. The fault breccia is silica cemented and based on preliminary data the temperature of silicification was approxiamtely 145°C. Preliminary U Trend ages yield a maximum of 290,000 years (grab sample from top of platey K horizon) and 90,000 from a grab sample from the b horizon.

One interpretation for formation of the hydrogenic deposits in Trench 14 is that as water washes down the slope of Exile Hill the water moves down the contact between the rock (Tiva Canyon tuff) and colluvium and forms layered deposits of calcite and silica. In Trench 14c no solid rock is present and the fault cuts through colluvim. Along the fault in this trench there is little development of veining. This lack of veining is interpreted to be due to the lack of a well-defined rock/colluvium contact for the water to move down.

Investigators from USGS, LANL, and State of NV examined trenches 14 and 14a to determine types and numbers of samples needed. After a through examination and discussion (several hours) a sampling strategy was decided and sampling began, proceeded by cleaning of the trench walls. Care was taken in sampling to prevent contamination of adjacent samples during excavation and extraction. Among samples taken were those for paleontological study and radiogenic and strontium isotope, petrographic, chlorine 36, and oxygen isotope analyses. State of NV investigators received splits from selected samples for analyses. An attempt to extract several large blocks intact from veins was made by cutting blocks with a circular saw and then applying epoxy to ensure that the block remained intact upon removal. Difficulties arose with the hardening of epoxy due to cooler than normal temperatures and blocks were left overnight to dry before an attempt was made at extraction.

Each sample was numbered and labeled and its location was documented on the large scale trench wall map and by Polariod and 35mm photograph. Sample numbers correspond with a principal locality. A sample description sheet was made for each sample collected (Attachment 3) with the appropriate information supplied. Splits of samples or subsamples were described on a subsample description sheet (Attachment 4). Subsamples were given numerical designations to conform with their sample number (e.g., Sample 42; Subsamples 42-1, 42-2, etc.). A subsample and subsampling data sheet was made for each type of analysis or study to be conducted. Sample information sheets are color coded for easy identification with sample sheets in green and subsample sheets in blue.

February 23, 1988

Project investigators and observers returned to Trench 14 to continue sampling of trench walls. Additional sample blocks were cut. Epoxy on previously cut blocks had not hardened; therefore, it was decided to return to collect the block samples on Friday, February 25.

After sampling procedures were complete at the Trench 14 site, the group moved to the west side of Busted Butte were hydrogenic materials were to be sampled. At Busted Butte Investigators made a detailed examination of the site in preparation for sampling (Figure 2). At Busted Butte probable hydrogenic material appears as veining in sand ramps which lap onto Busted Butte, as platey calcite in sand ramps, carbonate roots (rizoliths), and as cementation in breccia. Carbonate veins present in sand ramps at Busted Butte are most similar to veins seen in trenches 14b, c, and d, rather than Trench 14. Fault breccia located in the sampling area is silica cemented and is similar to fault breccia seen in Trench 14. Questions to be answered with respect to the fault breccia cementation include the age, temperature of formation, and economic implications?

February 24, 1988

On this day the group returned to the Busted Butte area to complete the sampling there. Sample localities were well documented by photographs (Polariod and 35mm) and location descriptions. Figure 2 shows some of the areas sampled. Some mapping has been done at this location, but detailed mapping is planned by Whitney.

Samples were documented and described on sample and subsample sheets and were taken from veins in sand ramps, breccia outcrop, and rhizoliths in carbonate zones. Localities were sampled for paleonotological studies, isotopic analysis, petrographic analysis, and geochemistry. An opal and carbonate vein was block sampled by use of the circular saw.

After sampling was complete the group moved to the top of Yucca Mountain to visit Trench 1 (Attachment 5). The degraded trench at this location appears to cut the Ghost Dance fault. Most of the shallow trench wall has disappeared, but veined Tiva Canyon tuff is visble in the trench floor. The veining most resembles veining in Trench 17 and contains calcite and opal CT according to results of analyses of grab samples by LANL. This trench was not sampled at this time and may be returned to after further work is complete.

The group then attempted to climb down the west side of Yucca Mountain to visit Trench 8. Due to the height and steepness of the slope the attempt was aborted.

February 25, 1988

The intinerary for this day was planned to acquaint investigators in the group who were unfamilar with the area with spring and carbonate deposits south and west of the NTS. With Joe Downey (USGS) as the leader, the group visited active and inactive spring deposits in the Amargosa Desert, Death Valley, and southern Crater Flat (Attahment 6).

The first stop was at clay pits in the Amargosa area. Due to an active mining operation the group remained on the periphery of the main area of the pits.

There Rick Forester (USGS) told the group that the carbonate deposits at this location appeared to be ground water deposited based on evidence from three species of ostracods observed from this locality.

The second stop of the day was at Devil's Hole in an area where geologic mapping was conducted by Will Carr. The water level in Devil's Hole was at one time approximately 50 feet higher than today and water once discharged at the land's surface. Devil's Hole is a limestone cavern approximately 300 to 400 feet deep and is the home of the desert pupfish (Cyprinoon diabolis). Ike Winograd and other investigators have conducted studies in Devil's Hole which include calcite dating of the wall material and underwater coring. Devil's Hole is interpreted to lie along a possibly fault controlled spring line. Water temperatures are 94°F and waters are probably not from the Yucca Mountain area, but do move toward the Amargosa Desert.

Stop three was at Crystal Spring, an active spring in the Amargosa area where springs are also located along a fault and pufish are also present. At Crystal Spring the group viewed active deposition of spring deposits. Water temperatures are 92°F and discharge is approximately 1500 gallons per minute.

The trip moved toward Death Valley where vein deposits at Furnace Creek Wash were observed by the group. A geologic map of the area is planned to be released soon by Ike Winograd and W. Carr. The deposits here are paleospring deposits and are planned to be used as a possible analog deposit in the study of deposits in Trench 14. Sampling was planned for a later date.

Stop five was at what is known as the Rabbit Tooth or Horse Tooth paleospring deposits in southern Crater Flat near the southern end of Yucca Mountain and Highway 95. In addition to rabbit and horse teeth and mamoth fragments the material present at this site is made up of carbonate, diatamaceous earth, and ash making up low mounds. A short distance to the northwest of the site is an opening that appears to be a sink hole.

The last stop of the day was at what was termed as the Rock Valley fault cutting highway 95. At this location the group viewed a wide natural cut in carbonate rock which contains some carbonate veining. The location does not appear to lie upon the trace of the Rock Valley fault, but could be a splay off the main fault in this area.

<u>February 26, 1988</u>

On Friday the group split into two factions with the smaller returning to Trench 14 to remove the intact blocks from the trench wall and the larger group of investigators going to Cane Spring to observe the spring deposits there. At Cane Spring carbonate deposits are less well developed than those observed in the Amargosa Desert area. Cane Spring is located along the Cane Spring fault and was once the location of a coach stop. The spring has been dug out and in the spring area carbonate can be observed as coating on root along the ceiling and walls. At this location some grab samples were taken for paleontological analysis to assess whether further sampling is warranted.

After Cane Spring the group broke up to return to the USGS facility in Mercury. Dave Vaniman, Schoen Levey, Charlotte Abrams, Ted Norris, Dr. Tanaka and Bill Hughes were escorted by Bill Simmons, a graduate student working for the USGS, to the Calico Hills area. There Simmons, who is doing geologic field work in the area, took the group on a short trip through silicified units of Pah Canyon to Topopah Springs tuff. As the group moved upward in elevation through a domal structure silicification increased to where tuff was cut with white quartz veins and became highly silicified. The locality is interpreted as a hydrothermally altered vent deposit. Simmons has sampled the rock for whole rock and trace element analyses and for assays for gold and silver. LANL personnel took grab samples for possible dating and x-ray analysis. Rock contains red staining which may indicate the presence of cinabar. Simmons stated that these possible sinters at Calico Hills correspond well with aeromagnetic anomalies in the area. The Calico Hills deposits represent possible analogs for study of the veins in Trench 14.

CONCLUSIONS AND RECOMMENDATIONS

The sampling approach at Trench 14 and Busted Butte by project investigators appeared to be thorough and well documented. Possible analog areas observed on the field trip may also represent areas for study of known spring and hydrothermal deposits and should be sampled at a later date. In the event that ostracods are present in the deposits, paleontological studies should provide useful information with respect to temperature and environment of deposits when active.

It is recommended that work by DOE and State of NV investigators on the hydrogenic deposits should be followed closely by the NRC technical staff. Observation of various analyses would be useful to evaluate and understand various studies and new techniques. Areas which warrant further attention are tracking of analog sampling, work by Simmons in the Calico Hills area, isotope studies, and palenotological studies. Some familiarization with the realitively new technique of Chlorine 36 analysis is also recommended.

/S/

Charlotte E. Abrams
Geology/Geophysics Section, HLTR

DISTRIBUTION

Central File	NMSS RF	RBrowning, HLWM	JBunting, HLSE
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OFC: HLTR	:HLTR	:	:	:	:	:
NAME:CAbrams/lw	:PJustus	:	:	:	:	:
DATE: 88/06/08	: 88/06/08	:	:	:	:	:

OFFICIAL RECORD COPY

ATTACHMENT 1 - LIST OF PARTICIPANTS FOR HYDROGENIC DEPOSITS FIELD ACTIVITIES, 2/22/88 to 2/26/88

USGS

Z.E. Peterman	Radio isotopes
John Stuckless	Oxygen isotopes, project coordinator
Dave Adam	Paleonotology
Tom Chaney	Quality Assurance
Joe Downey	Hydrology
Rick Forester	Paleonotology
K. Futa	Radio isotopes
Ed Gutentag	Hydrology
B. Marshall	Radio isotopes
Dan Muhs	Radio isotopes
Robert Rye	Stable isoptopes
Emily Taylor	Quaternary soils
J. Whelan	Stable isotopes
Tony Buono	Operations Representative

LANL

Ted Norris	Chlorine 36
Schon Levy	Mineralogy/Petrology
Dr. Tanaka	Electronic Spin Resonance
Dave Vaniman	Mineralogy/Petrology

SAIC

Jack Kepper	Quality Assurance
August Mattusen	
Steve Mattson	

WMPO

Bill Hughes

NRC

Charlotte Abrams

DRI

Jonathan Davis
Doug Rennie

Mifflin and Asso.

Maury Morgenstein

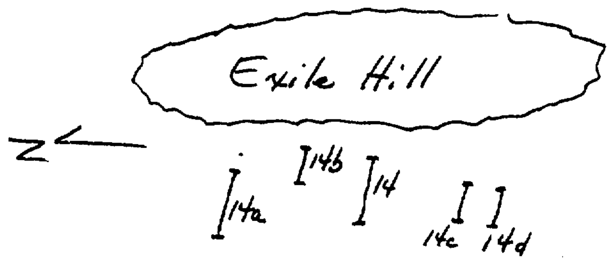


Fig 1. Generalized locations of trenches 14, 14a, b, c, and d along west slope of Exile Hill.

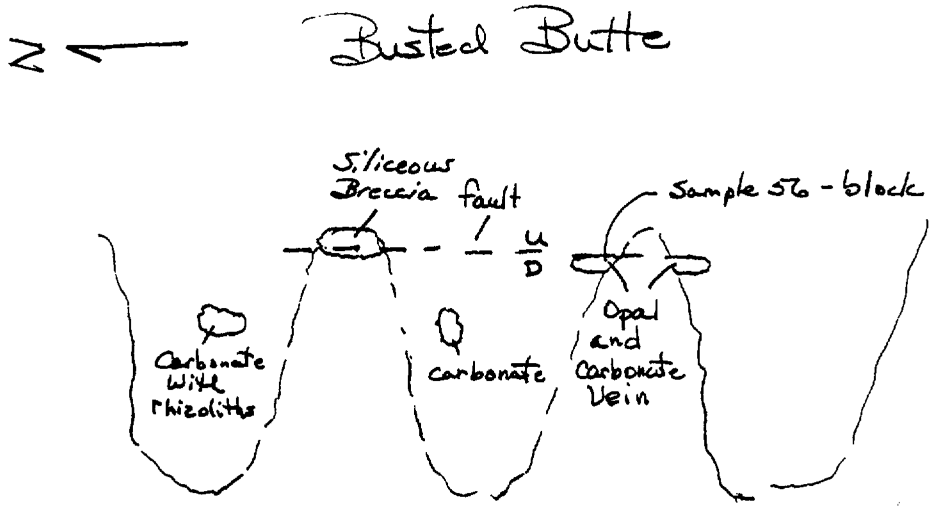


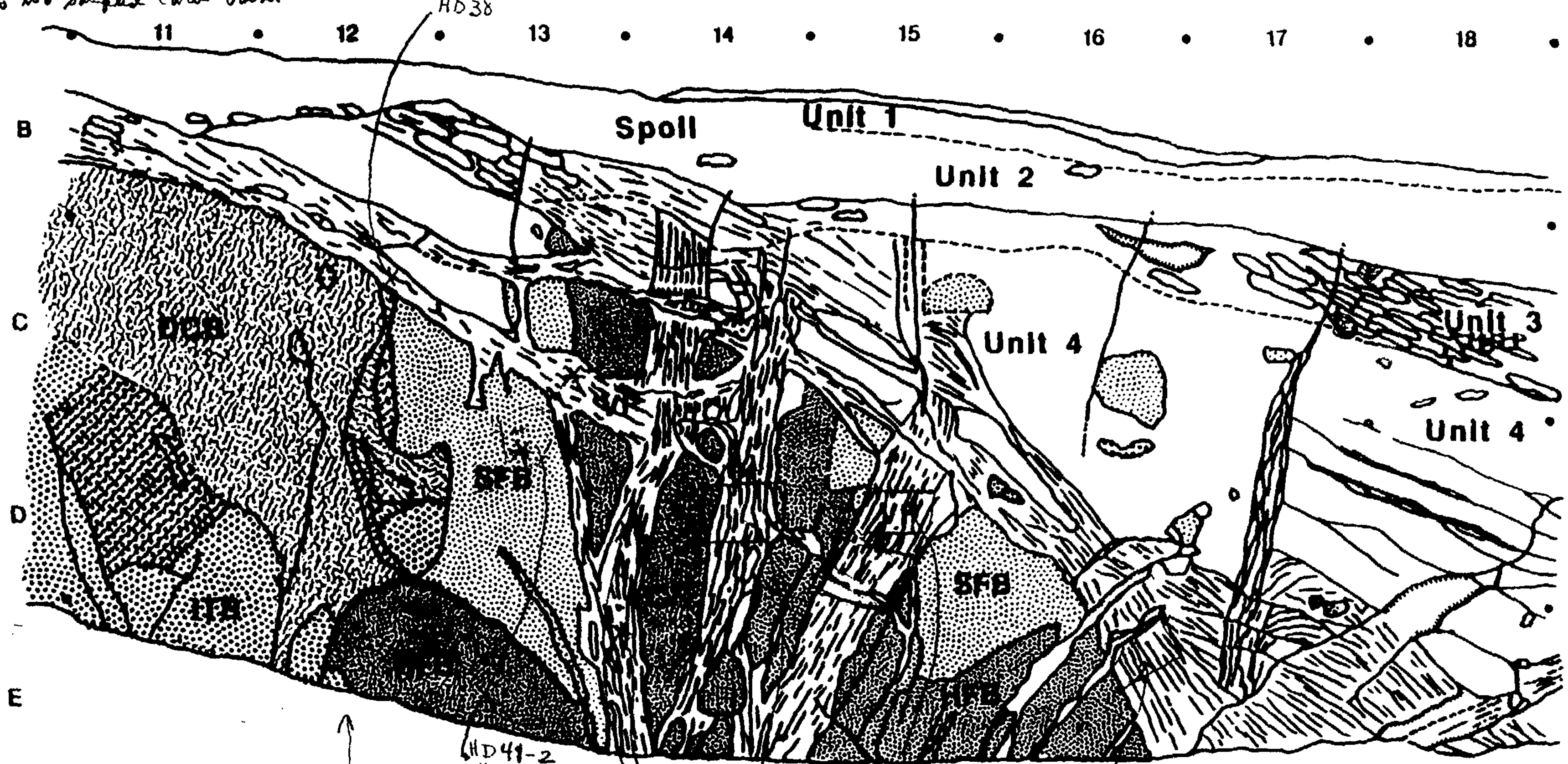
Fig 2. Generalized diagram of Busted Butte sampling area.

Top of trench north wall and south wall
unaltered rock for radioiso - drill samples
along metered grid
radioiso (*) grabs
radio iso sampled carb veins

Paleo
1 unit 2
1 unit 1
2 from platy K (3)
will use blocks
grabs from veins 1)

20 samples for Chlor 36

Samples at
... peaks ...
down ... →
2/3 ... intact
and ... 3 Radio-isotopes
Paleo sampled units 1 and 2



HD41-2
Hit Opal (Maury)
HD 52
HD35
+ Maury Opal A prob
HD37
Drusy Qtz sampled on
North Wall ~ across from this pt.
fragmented sample
large ash ... contact ? X-cut by carbonate 42-1 42-3 42-2 carb. and ... rock 42-5 Maury 42-7
61 (Chlor 36)
HD 15...

Figure 3.5-3. Map of the southern wall of Trench 14 as viewed from the north. Dots around the edge of the map form a 1-meter grid. Bedrock (in various states of induration) is shown by patterns; colluvium is not patterned; calcite- (and minor opaline-silica) filled fractures are shown by light subparallel lines; ash-filled fractures are indicated by heavy, broad, irregular, and subvertical lines. Descriptions of identified units are in the appendix.

Sample 36 ... Ma

Attachment 2

Attachment 3

location on sheet
block
i.e. 42

Hydrogenic Deposits Project
*Sample Description Sheet
Project Sample Number: **HD-** ________

Field Collection Number:________________ Date and time sampled: ___/___/1988, ___:___ AM PM

Collected by: D.P. Adam B. Carlos J.S. Downey R.M. Forester S.S. Levy D.R. Muhs C.W. Naeser Z.E. Peterman R.O. Rye J.S. Stuckless E.M. Taylor B.D. Turrin D.L. Vaniman J.F. Whelan
Other (specify): ________________

Locality description:

Site name: ________________

Elevation: ________ feet meters

Latitude: ______° ______' ______" N

Longitude: ______° ______' ______" W

Quadrangle: ________________

7.5' 15' 2° Other: ________________

Other reference point(s): ________________

Photo numbers: ________________

Sketch numbers: ________________

Sample description (required): ________________

Sample described by: ________ (initials)

Type of material: vein filling soil water bedrock breccia alluvium sediment Other: ________

Color (optional): Wet: ________ Dry: ________ ☐ Munsell ☐ Rock Color Chart

Subsampling data sheets:

blue sheet for each box

☐ Paleontology	☐ Petrography	☐ Major element chemistry
☐ Assay	☐ Geochronology	☐ Minor element chemistry
☐ Fluid inclusions	☐ Stable isotopes	☐ Tracer isotopes
☐ No subsample sheets	☐ Soils	☐ Other (see notes)

A subsample data sheet exists for each item checked. The information on this form is included by reference for each such form

Notes: ________________

☐ If checked, notes continue oversheet

Attachment 4

i.e. 42-1
also for splits

Hydrogenic Deposits Project
Subsample Description Sheet
Project Sample Number: **HD-** ________ - ________
Subsample suffix

Field Collection Number: ______________ (How sample is labeled)

Collected by: D.P. Adam B. Carlos J.S. Downey R.M. Forester S.S. Levy D.R. Muhs C.W. Naeser Z.E. Peterman R.O. Rye J.S. Stuckless E.M. Taylor B.D. Turrin D.L. Vaniman J.F. Whelan

Other (specify): ______________

Probable use:

- ☐ Soils
- ☐ Assay
- ☐ Fluid inclusions
- ☐ Water sample
- ☐ Petrography
- ☐ Geochronology
- ☐ Stable isotopes
- ☐ Other: ______________
- ☐ Major element chemistry
- ☐ Minor element chemistry
- ☐ Tracer isotopes

Collection details

Any field processing steps? yes no

Sieving: ☐ yes ☐ no

Sieve sizes: ______ ______ ______

☐ metric

☐ U.S. Standard

Filtering: ☐ yes ☐ no

Filter: Diameter ______ mm , pore size ______ µm

Filter saved: ☐ yes ☐ no

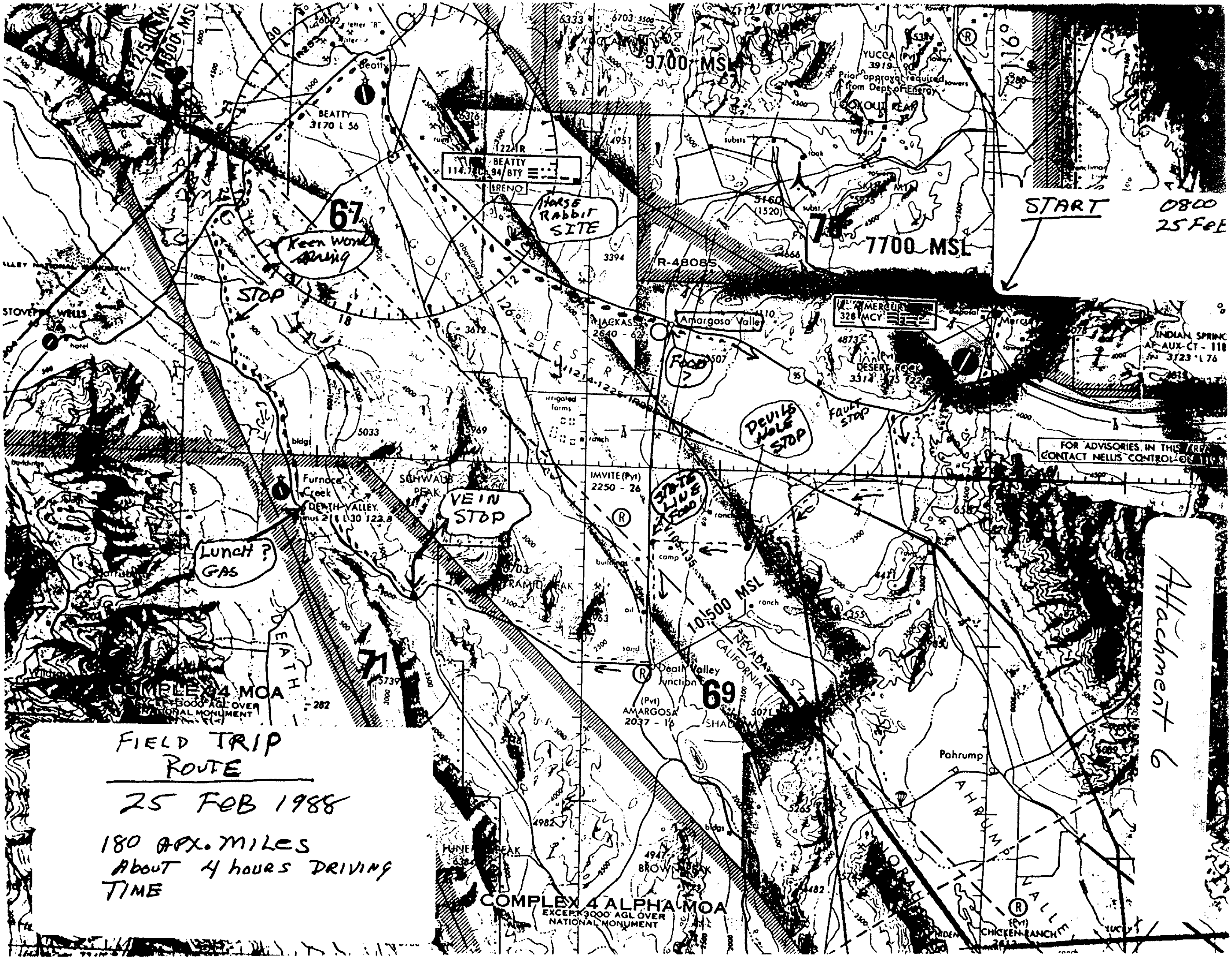
Water saved: ☐ yes ☐ no

Water acidified? ☐ yes ☐ no

Notes: ______________

☐ If checked, notes continue oversheet

Attachment 5



FIELD TRIP ROUTE
25 FEB 1988
180 APX. MILES
About 4 hours DRIVING TIME
START
0800
25 FEB
Horse Rabbit SITE
STOP
FOOD ?
DEVILS HOLE STOP
FAULT STOP
STATE LINE FOOD
VEIN STOP
Lunch ? GAS
Attachment 6
9700 MSL
7700 MSL
10,500 MSL
BEATTY
Amargosa Valley
MERCURY
DESERT ROCK
Furnace Creek
DEATH VALLEY
STOVEPIPE WELLS
Death Valley Junction
AMARGOSA
Pahrump
NEVADA
CALIFORNIA
COMPLEX 4 MOA
COMPLEX 4 ALPHA MOA
R-4808S
INDIAN SPRINGS
FOR ADVISORIES IN THIS AREA CONTACT NELLIS CONTROL
CHICKEN RANCH