Department of Energy
Washington, DC 20585

JAN 6 1993

Mr. Joseph J. Holonich, Director
Repository Licensing and Quality Assurance
Project Directorate
Division of High-Level Waste Management
Office of Nuclear Material Safety
and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Holonich:

The enclosed Yucca Mountain Site Characterization Project participant monthly status reports are forwarded for your information. If you have any questions on the enclosed reports, please contact Priscilla Bunton at (202) 586-8365.

Linda J. Desell

Linda J. Desell, Chief
Regulatory Integration Branch
Office of Civilian Radioactive
Waste Management

Enclosures:
(1) EG&G/Energy Measurements Progress Report, November 1992
(2) Los Alamos Monthly Activity Report, October 1992
(3) Los Alamos Monthly Activity Report Highlights, November 1992
(4) REECo Yucca Mountain Project Status Report, September 1992
(5) REECo Yucca Mountain Project Status Report, October 1992
(6) REECo Yucca Mountain Project Status Report, November 1992
(7) USGS Yucca Mountain Project Monthly Summary, October/November 1992

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WM-11 PDR

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cc:w/o encl.
C. Gertz, YMPO
cc: w/encl.
K. Hooks, NRC
R. Loux, State of Nevada
T. J. Hickey, Nevada Legislative Commission
M. Baughman, Lincoln County, NV
J. Bingham, Clark County, NV
B. Raper, Nye County, NV
P. Niedzielski-Eichner, Nye County, NV
G. Derby, Lander County, NV
P. Goicoechea, Eureka, NV
C. Schank, Churchill County, NV
F. Mariani, White Pine County, NV
V. Poe, Mineral County, NV
E. Wright, Lincoln County, NV
J. Pitts, Lincoln County, NV
R. Williams, Lander County, NV
J. Hayes, Esmeralda County, NV
B. Mettam, Inyo County, CA

EG&G ENERGY MEASUREMENTS
Santa Barbara Operations
EG&G ENERGY MEASUREMENTS, INC., 101 CONVENTION CENTER DRIVE, LAS VEGAS, NEVADA 89109 TEL: (702)794-7463

DEC 8 2 43 PM '00

WBS 1.2.13.4
NQA

I-334996

December 3, 1992
L-92-802

Wendy Dixon, Director
Project and Operations Control Division
Yucca Mountain Project Office
DOE Field Office, Nevada
P. O. Box 98518
Las Vegas, NV 89193-8518

NOVEMBER 1992 PROGRESS REPORT

Attached is the November 1992 progress report on biological studies and support activities conducted by EG&G/EM for the Yucca Mountain Site Characterization Project. Please contact Tom O'Farrell (293-7762) or Kent Ostler (794-7474) if you have questions regarding this report.

Joel Jahst, for
James Michael, Manager
NV Program

RG:vk

Attachment

cc: G. Ryder, DOE/YMP
D. Sorensen, SAIC
P. Niles, SAIC

DIVISION: Dixon
CC: 10 RII-w/o
CC: Dyer
CC: Schlueter/Ryder
CC: McCann-SAIC
CC: Brodsky
CC: Bandi/Simmons
CC: Hamilton-Ray
CC: Jones
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CC: Brodsky
CC: Sandi/Simmons
CC: Hamel for Ray
CC: Jones
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1623

ENCLOSURE 1

YUCCA MOUNTAIN PROJECT
BIOLOGICAL RESOURCES PROGRAM
MONTHLY PROGRESS REPORT
NOVEMBER 1992

Summary of Work Accomplished During Report Period

EG&G Energy Measurements (EG&G/EM) conducted work for the Biological Resources task (WBS 1.2.13.4) for the Project Office. Activities included conducting preactivity surveys; continuing site characterization effects studies; support studies for the radiological monitoring program; desert tortoise studies; and habitat reclamation studies; development of work instructions and study designs for new studies; and responding to requests for biological support by Project Office.

Monitoring and Mitigation

- EG&G/EM conducted preactivity surveys during November for:

  1) Seismic reflection studies (#92-020b).
  2) Trench and berm upslope from the North Portal Pad (#92-015b).
  3) Borehole UE-25 NRG-2 (#93-002b).
  4) Casual access for photo tower east of Exile Hill.

- Preactivity survey reports were submitted to Project Office for:

  1) Infiltration tests at borehole UE-25 UZN-85 (#92-030b).
  2) The new location of neutron borehole N-62 (#92-018b).
  3) Shelter at tracer well #3 (92-031b).
  4) Borehole UE-25 NRG-2 (#93-002b).

- Tortoises were monitored throughout the month during construction at:

  1) Borehole UE-25 NRG-6 (#92-019b).
  2) Trench MWVT-7 (#93-001b).
  3) Test pit digging at the proposed borrow pit east of Roy Ridge (#92-023b).
  4) Filling of pits near the North Portal pad.

- Reclamation inventories were completed for boreholes UE-25 NRG-2 (#93-002b) and UE-25 NRG-3 (#93-003b). Site-specific reclamation stipulations were submitted to Project Office for borehole UE-25 NRG-2 (#93-002b).

- Resurveys for tortoises were conducted along the proposed access road to the topsoil and rock storage area (#92-015b) and for the North Portal pad, access road, and diversion ditch (#92-015b) before construction started.

- EG&G/EM (A. Hughes) attended the monthly preactivity survey meeting at the Field Operations Center.

Habitat Reclamation

- Final reclamation plans for well JF-3 and trench A'2 were submitted to Project Office (#NN1-1989-3558).

- Plant seedling density was measured at reclamation site #1 (north end of Yucca Mountain). Topsoil depths were recorded on plots with seedlings. Additional study areas were prepared at site #1 to investigate the effect of topsoil depth on reclamation success. Topsoil was hauled in from the Forty-Mile Wash borrow area. Soil was distributed to create treatment plots with different topsoil depths. Samples of the borrowed soil were shipped to a lab for chemical analysis.

- Trench A'2 and area surrounding well JF-3 were reclaimed (seeded, mulched, and crimped). At well JF-3, plots were established to test the affect of a gravel mulch versus straw mulch on reclamation success. Trench A'2 was mulched only with straw.

Site Characterization Effects Program

- The small mammal trapping data from September were entered into the computer database, and the data were proofed. The data entry also was completed for the reptile mark-recapture data.

- Soil moisture and temperature and weather data were collected once at the 48 ecological study plots (ESPs). The data were entered into a computer database and verified. The precipitation measures recorded at each of the 48 ESPs were summarized for FY92.

- Traffic counts were recorded each week at eight locations. Counters were rotated to different locations each week. Fugitive dust samples were collected from the 48 ESPs and weighed.

Radiological Monitoring Program

- The sixteen radiomarked quail were located once each week except for the last week of the month. All were found in the vicinity of Exile Hill and the subdock in Drill Hole Wash. One radiomarked male was found dead on the west side of Exile Hill. suspected cause of death is predation by a mammalian predator. Coyote tracks were found in the vicinity of the remaining feathers and radio transmitter. Fifteen radiomarked quail are still alive.

- Several small mammal trap stations at NF107 near the North Portal facilities were moved because of the drainage ditch construction upslope from the pad area. Several areas in this sample location may be affected by construction activity.

Desert Tortoise Program

- All radiomarked tortoises were located twice each week except for those scheduled to be located once weekly or biweekly. Because tortoises have started hibernating, the number of locations per week will be reduced during the winter. No more then five radiomarked tortoises have moved during the last two weeks of November.

- Three non-radiomarked tortoises were observed this month. One of the tortoises had been marked previously and was fitted with a radiotransmitter. One of the tortoises had not been marked previously and was marked with only a number. The third tortoise was observed by another YMP contractor on the weekend. This tortoise was not marked.

- The computer databases containing tortoise data were checked for errors. This effort will continue in December and will be completed before data analysis is started.

Support Items

- The October monthly report of Yucca Mountain Site Characterization Project activities and accomplishments was sent to the Project Office.

- Thirteen EG&G/EM scientists completed the annual refresher training for the General Employee Training Program.

- EG&G/EM attended a meeting concerning the agenda for the reclamation tour for the State of Nevada.

- Descriptions of the YMP environmental field programs were reviewed. Comments were provided to SAIC (J. McNeil).

- Preparation of the FY92 annual report for the YMP Biological Resources Monitoring Program continued.

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Santa Barbara Operations
EG&G ENERGY MEASUREMENTS, INC., 101 CONVENTION CENTER DRIVE, LAS VEGAS, NEVADA 89109 TEL (702)794-7463

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James Michael, Manager
NV Program

RG:vk

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P. Niles, SAIC

DIVISION Dixon
CC: 10 Kil - w/o
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CC: Schlueter / Ryder
CC: McCann - SAIC
CC: Brodsky
CC: Sandi / Simmons
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CC: Jones
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ENCLOSURE 1

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Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

DEC 21 3 36 PM '00

WBS 1.2.9.1
QA N/A

December 2, 1992

TWS-EES-13-12-92-013

Mr. Carl P. Gertz, Project Manager
Yucca Mountain Site Characterization Project Office
US Department of Energy
P.O. Box 98608
Las Vegas, NV 89193-8608

Dear Mr. Gertz:

SUBJECT: LOS ALAMOS MONTHLY ACTIVITY REPORT—OCTOBER 1992

Attached is the Los Alamos Monthly Activity Report for October 1992. This internal document describes our technical work in detail; however, the report has not received formal technical or policy review by Los Alamos or the Yucca Mountain Site Characterization Project. Data presented in this document represent work progress, are not referenceable, and are not intended for release from the US Department of Energy. If you have changes to our distribution list, please call me at (505) 667-0916.

Sincerely,

Susan H. Klein

Susan H. Klein

SHK/elm

Attachment: a/s

Cy w/att:
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R. L. Bullock, RSN, Las Vegas, NV
V. J. Cassella, HQ/Washington, DC
U. S. Clanton, YMPO, Las Vegas, NV
W. L. Clarke, LLNL, Livermore, CA
P. L. Cloke, SAIC, Las Vegas, NV
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M. Voegele, SAIC, Las Vegas, NV
RPC File (2), MS M321
TWS-EES-13-File, MS J521

Cy w/o att.:
J. A. Canepa, EES-13, MS J521
S. H. Klein, IS-11, MS J521
CRM-4, MS A150

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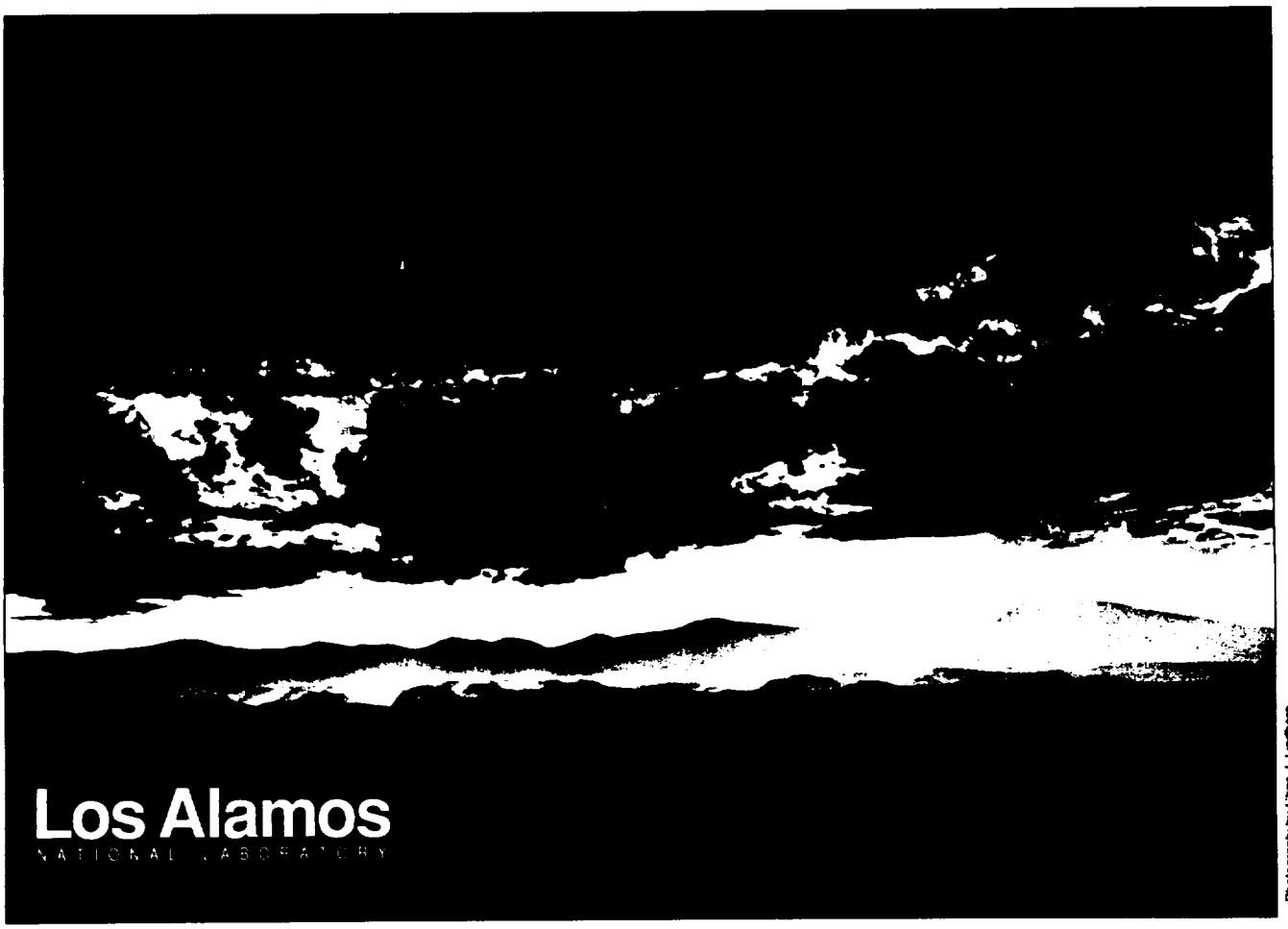
ENCLOSURE 2

Yucca Mountain Site Characterization Project

Monthly Activity Report

Ocotber 1992



Photograph: by Chris J. Lindberg

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Attachment to TWS-EES-13-12-92-031

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CONTENTS

WBS 1.2.1	Systems Engineering (Canepa)	1
WBS 1.2.3.1.1	Site Investigation Coordination and Planning/Site Management (Springer)	2
WBS 1.2.3.1.2	Site Investigation Coordination and Planning/Test Management and Integration (Oliver)	3
WBS 1.2.3.2.1.1.1	Mineralogy, Petrology, and Rock Chemistry of Transport Pathways (Vaniman)	4
WBS 1.2.3.2.1.1.2	Mineralogic and Geochemical Alteration (Levy)	6
WBS 1.2.3.2.1.2	Stability of Minerals and Glasses (Broxton)	8
WBS 1.2.3.2.5	Postclosure Tectonics (Crowe)	9
WBS 1.2.3.3.1.2.2	Water Movement Tracer Tests (Fabryka-Martin)	11
WBS 1.2.3.3.1.2.5	Diffusion Tests in the ESF (Triay)	12
WBS 1.2.3.3.1.3.1	Site Saturated Zone Ground-water Flow System (Robinson)	13
WBS 1.2.3.4.1.1	Ground-water Chemistry Model (Ebinger)	15
WBS 1.2.3.4.1.2.1	Batch Sorption Studies (Triay)	16
WBS 1.2.3.4.1.2.3	Sorption Models (Rogers)	19
WBS 1.2.3.4.1.2.2	Biological Sorption and Transport (Hersman)	20
WBS 1.2.3.4.1.3	Radionuclide Retardation by Precipitation Processes (Morris)	21
WBS 1.2.3.4.1.4	Radionuclide Retardation by Dispersive, Diffusive, and Advective Process (Triay)	25
WBS 1.2.3.4.1.5.1	Retardation Sensitivity Analysis (Zyvoloski)	29
WBS 1.2.3.4.1.5.2	Demonstration of Applicability of Laboratory Data (Springer)	30
WBS 1.2.5.2.2	Site Characterization Program (Springer)	31
WBS 1.2.5.3.5	Technical Data Base Input (Lopez)	33
WBS 1.2.5.4.6	Development and Validation of Flow and Transport Models (Springer)	34
WBS 1.2.5.4.7	Supporting Calculations for Postclosure Performance Analyses (Zyvoloski)	35
WBS 1.2.6	Exploratory Studies Facility (Elkins)	36
WBS 1.2.6.8.4	Integrated Data System (Elkins)	37
WBS 1.2.9.1.2	Technical Project Office Management (Canepa)	38
WBS 1.2.9.2.2	Project Control (Pratt)	39
WBS 1.2.11.2/3/5	Quality Assurance Program Development, Verification, and Engineering (Bolivar)	40
WBS 1.2.12.2/5 1.2.13	Local Records Center Operation/Records Management and Document Control (Pratt)	41
WBS 1.2.15.2	Administrative Support (Pratt)	42
WBS 1.2.15.3	Training (Pratt)	43
Appendix A		44
Appendix B		48

LOS ALAMOS NATIONAL LABORATORY

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

Monthly Activity Report

October 1992

WBS 1.2.1	**Systems Engineering**
Objective	The objective of this task is to integrate systems with the Geologic Repository Program, to describe the Yucca Mountain Site Characterization Project Mined Geologic Disposal System, and to evaluate the performance of the natural, engineered barrier, and total systems for meeting regulatory standards.
Activities and Accomplishments	No significant activity to report this month.
Planned Activities	No planned activities reported this month.
Problem Areas	None

WBS 1.2.3.1.1 Site Investigation Coordination and Planning/ Site Management

Objective

The objective of this task is to manage and coordinate site characterization activities.

Activities and Accomplishments

The proposed FY93 budget for Los Alamos activities in WBS 1.2.3 was reviewed, and statements of work were modified in underfunded and unfunded tasks. The impact of these changes were provided to the M&O on edited PACS summary sheets.

Los Alamos staff met in Salt Lake City on 20-21 October to help organize sessions on geochemistry for the upcoming International High-Level Waste Conference.

Planned Activities

Staff will participate in YMP cost reduction exercise.

Problem Areas

None

WBS 1.2.3.1.2 Site Investigation Coordination and Planning/ Test Management and Integration

Objective

The objective of this task is to manage and integrate ESF and Los Alamos site characterization test activities and to provide coordination for Los Alamos surface-based test planning and package development.

Activities and Accomplishments

Surfaced-based Test Coordination. Staff participated in the two-day workshop to prioritize required YMP Surface-based Testing Program activities. Staff supported several meetings to clarify test planning and JPs.

ESF Testing. Staff monitored and coordinated Fran Ridge JP 92-7 activities and with USGS revised a work order for geologic mapping at the north-portal wall and slot. Staff participated in test integration (TIG) meetings. Staff developed test information for north ramp portal area tests and prepared planning packages for launch-chamber tests.

Staff prepared a report on the Fran Ridge Pit Mapping activity; it appears in Appendix A of this report.

Planned Activities

Surfaced-based Test Coordination. In response to program directives, continue support of the Los Alamos activities in this area.

ESF Testing. Prepare test planning packages for launch-chamber tests. Continue gathering tracers, fluids, and materials information. Prepare Title II test planning packages. Continue ESF sample and test-coordination efforts, participate in TIG meetings, and support the RSED director, as requested.

Problem Areas

None

WBS 1.2.3.2.1.1.1 Mineralogy, Petrology, and Rock Chemistry of Transport Pathways

Objective

The purpose of this activity is to define the important mineralogical and geochemical variables along fracture and rock-matrix transport pathways at Yucca Mountain, in support of performance assessment and to evaluate the impact of repository construction on natural waste-transport barriers.

Activities and Accomplishments

Los Alamos milestone 3137, "Geologic evaluation of six nonwelded tuff sites for a surface–based test facility for the Yucca Mountain Project" was revised following final technical review. This report includes data on hydrologic properties (A. Flint, USGS) and mechanical properties (C. Rautman, SNL), as well as the mineralogical and chemical data collected by LANL.

Instrumental neutron-activation analyses were obtained for fracture calcites from USW G-1 and G-4. These data will be used to broaden the study of fracture calcites beyond cores USW G-2 and GU3/G3. Data obtained from spring-deposited calcites of Death Valley (Travertine Point, Grapevine Spring, and Nevares Spring) will be used to compare these spring compositions with those from Yucca Mountain.

Two abstracts were prepared for presentation at Zeolite '93 to be held in Boise, Idaho in June 1993: "Distribution of Fracture-Lining Zeolites at Yucca Mountain, Nevada" by B. Carlos, S. Chipera, and D. Bish and "Equilibrium Modeling of the Formation of Zeolites in Fractures At Yucca Mountain, Nevada," by S. Chipera, D. Bish and B. Carlos.

Microprobe analyses were obtained on two fracture coatings. Analyses of heulandite from one fracture in drill core UE-25a #1 indicated that the larger tabular crystals have a different composition than coexisting smaller prismatic crystals. The tabular crystals contain more Sr and Na, whereas the smaller crystals contain more Mg. Both have a higher Si : Al ratio and lower Ca than the formula $(Na,K)Ca_4(Al_9Si_{27}O_{72}) \cdot 24H_2O$ specifies. Phillipsite (identified by x-ray diffraction) from the lower Topopah Spring vitrophyre in drill core USW GU3 was also analyzed, and we found that it too has a higher Si : Al ratio and correspondingly fewer cations than analyses in the literature.

Planned Activities

Work planned within the next few months includes the following activities: (1) continue analysis of fracture-coating zeolites in existing drill core and begin analysis of fracture-coating minerals in UE-25 UZ-16; (2) continue analysis of calcites to understand transport and precipitation mechanisms; (3) sample UE-25 UZ-16 for studies of stratigraphic variability in bulk mineralogy.

Problem Areas

None

Milestone Progress

3120
30 June 1992
Calcite in Fractures
Approved by YMPO.

3130
15 December 1992
Fracture Mineralogy of the Paintbrush Tuff
Delayed for Zeolite '93 abstract preparation.

3137
30 September 1992
Mineralogy of Calico Hills for Adit Development
In revision.

Publications

B. Carlos, D. Bish, S. Chipera, and S. Craven
Fracture-Lining Manganese Oxide Minerals in a Silicic Tuff
Journal article, *Chemical Geology*
Approved by YMPO; revised and resubmitted for publication.

B. Carlos, S. Chipera, and D. Bish
Distribution of Fracture-Lining Zeolites at Yucca Mountain, Nevada
Conference paper, *Zeolite '93*
Submitted to TPO.

G. D. Guthrie, D. L. Bish, and B. T. Mossman
Quantitative Analysis of Zeolite-Bearing Dusts Using the Rietveld Method
Journal article, *Science*
Submitted.

D. Vaniman, D. Bish, D. Broxton, B. Carlos, S. Chipera, and S. Levy
Mineralogy as a Factor in Radioactive Waste Transport Through Pyroclastic Rocks at Yucca Mountain, Nevada
Journal article, *Journal of Geophysical Research*
Approved by YMPO.

D. T. Vaniman
Calcite Deposits in Drill Cores USW G-2 and USW GU-3/G-3 at Yucca Mountain, Nevada
La-series report
Submitted to TPO.

WBS 1.2.3.2.1.1.2 Mineralogical and Geochemical Alteration

Objective

The objective of this task is to characterize past and present natural alteration processes that have affected the potential geologic repository and to predict future effects of natural and repository-induced alteration.

Activities and Accomplishments

D. Vaniman evaluated the INAA results for outcrop and plant ash samples. The sample set included a variety of rock and secondary-mineral samples from Trench 14, Busted Butte, and the Calico Hills, as well as from low-temperature ashen roots of plants from near Trench 14 and from piñon-juniper woodlands.

G. WoldeGabriel revised the milestone report on K/Ar dating of zeolites and submitted it for technical review.

Additional text and a glossary were prepared for a YMP position paper on calcite-silica deposits. Staff reviewed a new draft of the paper.

Planned Activities

Chemical and mineralogical characterization of samples of bedrock breccias and hydrothermal deposits exposed at the surface will continue, as will K/Ar and calcite-silica laminated-deposit studies. We will continue work on the YMP topical report on calcite-silica and breccia deposits.

Problem Areas

Mechanical problems with the old electron microprobe continued.

Milestone Progress

3138
30 September 1993
Chemical Transport in Zeolitic Alteration
60% complete.

3141
31 March 1992
Laminated Zone in Trench 14
67% complete; YMPO approval received for a milestone paper.

3142
31 January 1993
K/Ar Dating of Clays and Zeolites
In technical review.

3143
16 March 1992
Experimental Dehydration of Volcanic Glasses
Approved by YMPO.

3150
15 April 1993
Final Report on Bedrock
33% complete.

3341
30 October 1992
Surface-discharging hydrothermal systems at Yucca Mountain -- examining the evidence
In YMPO review process.

Publications

D. Bish and J. Aronson
Paleothermal and Paleohydrologic Conditions in Silicic Tuff from Yucca Mountain, Nevada
Journal article, *Clay and Clay Minerals*
Approved by YMPO; submitted.

S. Levy
Surface-discharging hydrothermal systems at Yucca Mountain -- examining the evidence
Conference paper, *Scientific Basis for Nuclear Waste Management XVI.*
Technical review complete.

S. Levy and C. Naeser
Bedrock Breccias Along Fault Zones near Yucca Mountain, Nevada
Chapter in USGS Bulletin on Yucca Mountain studies
In USGS editorial review.

S. Reneau
Maganese Accumulation in Rock Varnish in a Desert Piedmont, Mojave Desert, California, and Application to Evaluating Varnish Development
Journal article, *Quaternary Research*
Approved by YMPO.

D. Vaniman, D. Bish, and S. Chipera
Dehydration and Rehydration of a Tuff Vitrophyre
Journal article, *Journal of Geophysical Research*
Approved by YMPO.

D. Vaniman, S. Chipera, and D. Bish
Pedogenesis of Siliceous Calcretes at Yucca Mountain, Nevada
Journal article, *Science*
Approved by YMPO.

WBS 1.2.3.2.1.2 Stability of Minerals and Glasses

Objective

The objective of this activity is to produce a model for past and future mineral alteration in Yucca Mountain. The model is intended to explain the natural mineral evolution resulting from the transformation of metastable mineral assemblages to more stable assemblages and the effects of a repository emplacement.

Activities and Accomplishments

This activity has been deferred.

WBS 1.2.3.2.5 Postclosure Tectonics

Objective

The objective of these volcanism studies is to determine the hazards of future volcanic activities with respect to siting a high-level radioactive waste repository at Yucca Mountain.

Activities and Accomplishments

The final draft of Study Plan 8.3.1.8.1.2, "Physical Process of Magmatism and Effects on the Repository," has been submitted to the DOE.

Staff met with D. DePaolo, geochronology advisor for the volcanism task, in Berkeley. They reviewed the geochronology data and established priorities for work in FY93.

Two talks on volcanoes were presented to public audiences in Las Vegas and Pahrump.

A consultant's progress report, "Activities at the University of New Mexico in Support of Volcanism Studies for the Yucca Mountain Project, Fiscal Year 1992," was submitted to Los Alamos management. It is included in Appendix B of this report.

A group of samples collected in the early stages of volcanism studies (pre-1985) were listed in a sample data base and submitted to the Sample Management Facility.

The Lathrop Wells volcanic center was renamed the Cind-R-Lite volcanic center. (The former name was derived from the proximity of the center to the town of Lathrop Wells, which has been renamed Amargosa Valley. Cind-R-Lite volcanic center is the name of the company that has had a patented and operational claim on the center since 1940.)

Documentation on statistical procedures used for estimating the probability of magmatic disruption of a repository were submitted to DOE for forwarding to the NRC. The procedures use modules of SYSTAT to evaluate the spatial variability of the location of basaltic volcanic centers in large high-cone density volcanic fields.

Trench LW-1 at Cind-R-Lite center was deepened using a large, track-mounted back hoe, and the base of the Ql_7 lava flow was exposed on the north end. The stratigraphic relationship between the Ql_7 flow and the Qs_4/Ql_4 units became obvious when the south end of the trench was exposed. The contact between the pyroclastic surge deposit and the Ql_7, Qs_4 Ql_4units could be seen when the LW-1 trench and a newly constructed trench located west of LW-1 were exposed. The pyroclastic surge unit overlies all the lava units on the north flank of the cone; this key stratigraphic relationship was established by the excavation of deep trenches (> 20 ft deep). Two scoria mounds were dissected by trenches (LW-3 and LW-4) to establish the stratigraphic position of the mounds and expose volcanic bombs for sampling for paleomagnetic studies. Following examination of the trenches, staff revised their stratigraphic descriptions of the Cind-R-Lite center, and these descriptions are now consistent with most previously obtained geochronology data. As a result of these revisions, questions about the anomalously young TL age for the Ql_3 lava were resolved.

Planned Activities

If approved by Los Alamos YMP management, the volcanism task will be split into three tasks as outlined in the study plans. G. Valentine will be principal investigator (PI) for Study Plan 8.3.1.8.1.2, B. Crowe will be PI for Study Plan 8.3.1.8.1.1, and a new PI will be named for Study Plan 8.3.1.8.5.1.

The new trench exposures will be sampled; soil and geomorphic studies, paleomagnetic studies, and U-Th, cosmogenic Helium and TL age determinations will be performed.

New stratigraphic information obtained as a result of recent trench exposures will be incorporated in field maps of the north side of the Cind-R-Lite center.

As a result of the DOE/NRC video conference, Study Plan 8.3.1.8.1.1, "Probability of Magmatic Disruption of the Repository," will be revised. These revisions will reflect the changes in definitions of E1 and E2.

Problem Areas

The Issue Resolution report, which was scheduled to be completed by September 1992, will be delayed because we are incorporating significant new stratigraphic data from the October trenching studies at Cind-R-Lite center. The report will be completed by January 1993.

We will delay field mapping of the 3.7 Ma basalt centers of Crater Flat until January in order to concentrate on completion of the Issue Resolution report.

Milestone Progress

8 January 1992
Effects of Magmatic Disruption on the Repository (Study Plan 8.3.1.8.1.2, R0)

3034
30 September 1992
Report on Magma System Dynamics

3109
30 September 1992
Report of Subsurface Effects

3111
30 September 1992
Preliminary Geologic Mapping of Volcanic Centers

3164
30 September 1992
Progress Report on Thermoluminescence

R482
30 October 1992
Issue Resolution report

Publications

B. M. Crowe, *et al.*
Issue Resolution report
First draft complete.

S. G. Wells, *et al.*
Multiple Eruptive Events at Small Volume Basaltic Centers: Evidence From the Cima and Crater Flat Volcanic Fields
Journal article
In preparation.

WBS 1.2.3.3.1.2.2 Water-Movement Tracer Tests

Objective

The objective of the water-movement tracer tests is to obtain measurements of chlorine isotope distributions to help quantify the percolation of precipitation in the unsaturated zone.

Activities and Accomplishments

The University of Rochester and Lawrence Livermore National Laboratory returned results of chlorine-36 analysis of 20 samples from the neutron-access boreholes USW UZ N-37, N-54, and N-55. Analysis of 10 additional samples are expected next month. Staff made the following observations concerning the latest set of analyses:
(1) Rochester and Livermore analyses, performed on four identical samples, agreed within one standard deviation. (2) The unusually high chlorine-36 results obtained previously from the Paintbrush nonwelded unit in N-55 was shown to be reproducible. (3) A profile of chlorine-36 in the N-37 alluvium showed bomb-pulse levels down to 20 feet, with background levels below that depth. (The alluvium here extends to 36.5 feet.)

J. Fabryka-Martin participated in a two-day workshop in Las Vegas on technical requirements and hole prioritization for the surface-based drilling program.

Collection of cutting samples for chlorine-36 analysis from UZ-16 and Phase 2 neutron-access boreholes continued.

Technical and QA reviews were received on the revised draft of LANL-INC-DP-94.

Technical work focused on quality controls and methods for statistically evaluating the acceptability and uncertainty of chloride and bromide analyses for this activity. Valid statistical treatment of these data is critical because the data may be used to correct the chlorine-36 based estimates of water residence time in the unsaturated zone.

Planned Activities

Address study plan review comments; revise existing DPs; prepare new DPs; process soil samples for Cl/Br and chlorine-36/Cl ratios; process cuttings samples from UZ-16 and neutron-access boreholes; collect additional soil samples from Yucca Mountain area as opportunities arise.

Problem Areas

None

Milestone Progress

3191
Procedure for Chlorine-36 Analysis of Unsaturated Zone Samples
30 September 1992
96% complete

Publications

None

WBS 1.2.3.3.1.2.5 Diffusion Tests in the ESF

Objective

The objective of this task is to determine *in situ* the extent to which the nonsorbing tracers diffuse into the water-filled pores of the Topopah Spring welded unit.

Activities and Accomplishments

This task has been deferred because of lack of funding.

WBS 1.2.3.3.1.3.1 Site Saturated Zone Ground-water Flow System (Reactive Tracer Testing)

Objective

Experiments will be conducted at the C-Well complex (holes UE-25c #1, UE-25c #2, and UE-25c #3) and other wells in the vicinity of Yucca Mountain using reactive tracers to characterize retardation and transport properties at a larger scale than currently used in laboratory experiments.

Activities and Accomplishments

Software Qualification. Z. Dash and B. Robinson continued to serve as temporary software configuration manager and CCB chair, respectively.

Modeling. No significant progress because staff attention has been diverted to the SQA effort and other activities.

Two publications were prepared for the special issue on the Yucca Mountain Project of *Radioactive Waste Management and the Nuclear Fuel Cycle*. W. L. Polzer and E. H. Essington submitted a paper, "The Use of Selectivity Coefficients to Estimate Modified Langmuir Isotherm Parameters as a Function of Experimental Conditions." B. A. Robinson will submit a paper, "A Strategy for Validating a Conceptual Model for Radionuclide Migration in the Saturated Zone Beneath Yucca Mountain."

Lithium Batch Sorption Experiments. Analysis continues on the latest suite of batch sorption tests.

Planned Activities

Contribute to the SQA effort by serving as Software Configuration Manager (Z. Dash) and CCB Chair (B. Robinson).

Participate in the upcoming DOE audit of this technical task and the software QA system.

Complete documentation of batch sorption experiments with lithium bromide. Continue modeling studies using FEHMN to support the design of the field tests.

Problem Areas

None

Milestone Progress

3188
30 September 1992
Documentation for SORBEQ
Delayed due to personnel reassignment.

3194
30 September 1992
Batch Sorption Experiments with Lithium

T112
22 June 1992
Final Documentation for FEHMN
Delayed due to personnel reassignment.
3196

27 July 1992
FRACNET Documentation
Delayed due to personnel reassignment.

Milestone Progress (cont.)

R529
Evaluation of Preliminary Application of FEHMN to Yucca Mountain
Completed.

Publications

B. A. Robinson
FRACNET—Fracture Network Model for Water Flow and Solute Transport
LA-series report
In preparation.

B. A. Robinson
SORBEQ—A One-Dimensional Model for Simulating Column Transport Experiments
LA-series report
In preparation.

B. A. Robinson
A Strategy for Validating a Conceptual Model for Radionuclide Migration in the Saturated Zone Beneath Yucca Mountain
Journal article, *Radioactive Waste Management and the Nuclear Fuel Cycle - Special issue on the Yucca Mountain Project*
In preparation.

W. L. Polzer and E. H. Essington
The Use of Selectivity Coefficients to Estimate Modified Langmuir Isotherm Parameters as a Function of Experimental Conditions
Journal article, *Radioactive Waste Management and the Nuclear Fuel Cycle - Special issue on the Yucca Mountain Project*
Submitted to YMPO.

WBS 1.2.3.4.1.1 Ground-water Chemistry Model

Objective

The goal of this investigation is to provide conceptual and mathematical models of the ground-water chemistry at Yucca Mountain. These models will explain the present ground-water composition in relation to interactions of minerals and ground-water and will be used to predict ground-water compositions as a result of anticipated and unanticipated environments.

Activities and Accomplishments

The principal investigator addressed comments on the study plan.

Planned Activities

Continue to address study plan comments.

Problem Areas

None

Milestone Progress

3006
30 October 1992
Eh and pH Buffering Capacity

3415
30 October 1992
Letter report on Most-Active Ground-water Chemistry

Publications

None

WBS 1.2.3.4.1.2.1 Batch Sorption Studies

Objective

The objective of this task is to provide sorption coefficients for elements of interest to predict radionuclide movements from the repository to the accessible environment.

Activities and Accomplishments

In response to a 1987 NRC request for experiments to determine whether batch sorption coefficients (obtained using crushed tuff) could accurately model radionuclide sorption behavior along release pathways, staff conducted experiments and prepared a report ("Dependence of Radionuclide Sorption on Sample Grinding, Surface Area, and Water Composition" by P. S. Z. Rogers). A summary of this report follows.

Fractions of tuff samples (devitrified tuff from the Topopah Springs Member and a zeolitic tuff from Calico Hills) ranging in size from 2-4 mm to less than 38 mm were contacted with water from well J-13 at a ratio of 1 g to 20 mls. The phases were separated and the pre-conditioned solid phases were contacted with solutions prepared with water from the well J-13 and radioactive tracers, Cs-137, Sr-85, and Np-237, and the quantity of radioactive tracer in each phase was determined by gamma spectrometry. The surface area of each sample was determined by BET analysis, and the mineralogy was determined by XRD analysis. The results of these experiments are shown in Tables I and II.

For each particle size fraction, the sorption coefficients were influenced to only a very small extent by particle grinding. When the particle diameter was decreased by over 2 orders of magnitude, the sorption coefficients change by only factors of 2 to 4. Measured BET surface areas of the particle size fractions vary by less than a factor of 1.5 for the zeolitic tuff samples, and by less than a factor of 3 for the devitrified tuffs.

The author's major conclusions were (1) Particle grinding does not influence the sorption behavior of the tuff samples studies until the particle size becomes smaller than about 40 mm. (2) Previous batch sorption experiments using particle size ranging from 63–500 mm or 75–500 mm are experimentally ideal because they provide an optimum compromise between sampling error caused by too large a grain size and creation of active surface area and mineral fractionations caused by excessive grinding. (3) There should be no experimental artifacts caused by sample grinding in previous work as long as the experimental samples were washed after preparation. (4) The BET surface areas of the tuff samples studied are independent of the particle grinding size. (5) Neptunium sorption onto tuff is very limited.

Planned Activities

No planned activities reported this month.

Problem Areas

None

Milestone Progress

3009
30 September 1992
Variation of Water-Rock Ratio Sorption Coefficients on Zeolitic Tuff

3212
30 September 1992
Progress Report on Single Mineral Experiments

Table I. Sorption Data for Devitrified Tuff

Particle Size µm	K_d (ml/g) Np	Cs	Sr	K_d/SA x 10^4 (cm) Np	Cs	Sr	Surface Area (m^2/g)	Percent tridymite	cristobalite	quartz	feldspar
4000 - 2000	.5	190	17	.5	170	15	1.1	3	18	16	60
2000 - 1000	.8	170	12	.8	160	12	1.1	3	18	15	63
1000 - 500	.6	160	17	.7	200	20	0.8	3	18	16	62
500 - 250	.6	190	17	.6	200	18	1.0	3	19	15	64
250 - 106	.7	210	19	.5	150	14	1.4	3	17	15	63
106 - 75	.3	240	21	.3	180	16	1.3	4	17	17	63
75 - 63	.6	300	26	.4	200	17	1.5	2	18	16	66
63 - 38	.7	290	25	.6	230	19	1.3	3	17	16	63
<38	.7	530	42	.3	240	19	2.2	4	18	16	62
<38	1.	490	39	.5	270	22	1.8	5	17	18	62

Table II. Sorption Data for Zeolitic Tuff

Particle Size µm	K_d (ml/g) Np	Cs	Sr	K_d/SA x 10^4 (cm) Np	Cs	Sr	Surface Area (m^2/g)	Percent clinoptilolite	mordenite	quartz	Opal-CT	feldspar
4000 - 2000	13.	17,000	2,400	.6	820	120	20.6	26	15	11	30	19
2000 - 1000	13.	20,000	2,900	.7	1,100	150	19.0	31	16	11	25	17
1000 - 500	7.	22,000	2,600	.3	1,100	130	19.7	26	16	16	24	19
500 - 250	12.	24,000	2,600	.6	1,300	140	19.2	29	16	13	21	19
250 - 106	11.	25,000	2,900	.5	1,300	150	19.9	27	19	11	25	16
106 - 75	4.	26,000	2,700	.2	1,400	140	18.6	29	18	11	24	19
75 - 63	3.	28,000	3,000	.2	1,400	160	19.3	36	18	9	23	13
63 - 38	3.	26,000	3,000	.2	1,400	160	18.7	35	18	9	25	12
<38	3.	28,000	1,800	.1	1,100	72	25.8	37	19	5	30	11

Publications

P. S. Z. Rogers, A. M. Meijer, and K. H. Kung,
Sorption Characteristics of Yucca Mountain Tuffs as a Function of Particle Size
Conference paper, *Fall meeting of the Materials Research Society, November 30 - December 4, 1992*
In preparation.

P. S. Z. Rogers
Dependence of Radionuclide Sorption on Sample Grinding, Surface Area, and Water Composition
In internal review.

WBS 1.2.3.4.1.2.3 Sorption Models

Objective

The objective of this task is to provide sorption models for elements of interest to predict radionuclide movements from the repository to the accessible environment.

Activities and Accomplishments

Atomic force microscopy images of goethite were interpreted using its known structural and crystallographic properties. Atomic resolution scans of the (010) cleavage plane were obtained, and they showed relaxation of the oxygen lattice into a more regular pattern on the cleaved surface. Scans of surfaces corresponding to other crystallographic planes could not achieve atomic resolution; this is probably caused by extremely large depth variation of such surfaces, which consist of alternating groups of atoms separated by empty channels. The AFM tip tended to "catch" on the edge of the surface when exiting these channels, resulting in a loss of resolution; however, excellent images of a (100) cleavage surface were obtained at lower x and y direction resolution. Depth resolution in this case is still very good, being about 3-4 Angstroms, which is the depth of one unit cell. Series of steps can be clearly seen on the surface, with prominent angles corresponding to the intersection of the (010) and (021) planes providing the evidence that this is indeed the (100) surface. Step edges and even the tips of the step angles are sharp on this freshly cleaved surface. A scan of a similar surface, which has been exposed to weathering, shows extreme contrast. All of the step edges and angle tips have been rounded, and clumps of secondary material are visible along the step edges and on the surface.

Planned Activities

Our long-term goal is to perform a series of experiments to determine the sorption site density of hematite and goethite for radionuclides and find out how it is changed by reaction of the mineral surface with ground-water; and this information is a necessary input parameter for most sorption modeling. At this early stage, we are limited by the lack of adequate sample mounting and preparation methods. We will investigate alternatives to standard grinding procedures next month while preparing the goethite results for publication.

C. Ong will work with J. Leckie under the Stanford University contract.

Problem Areas

None

Milestone Progress

3009
30 September 1992
Variation of Water-Rock Ratio Sorption Coefficients on Zeolitic Tuff

3212
30 September 1992
Progress Report on Single Mineral Experiments

Publications

None

WBS 1.2.3.4.1.2.2 Biological Sorption and Transport

Objective

The purpose of this research is to determine whether microbial activity can influence the movement of plutonium in tuff. Because fluids are used extensively in the exploration of locations for a nuclear repository, those micro-organisms capable of utilizing drilling fluids as growth substrates are of special interest.

Activities and Accomplishments

Los Alamos. Staff continued crushed-tuff column studies. To ascertain if sterile conditions within the columns can be maintained for prolonged periods (weeks), the columns were packed with sterile tuff and operated under unsaturated flow conditions.

UC Berkeley. Staff continued studies of microbial mineral dissolution. Pure hematite crystals were synthesized and used in preliminary experiments to qualitatively investigate the role of siderophores in mineral dissolution.

All milestones (3186, 3080, 3177, and 3092) were near completion.

Planned Activities

Staff at Los Alamos and Berkeley will continue crushed-tuff column and mineral dissolution experiments, respectively.

Problem Areas

The crushed tuff used in the column studies was very resistant to autoclaving. Staff found it possible to culture microorganisms from the tuff even after autoclaving for 4 hours every other day for 2 weeks. Apparently the dry conditions in the tuff protected the spores. Sterility was finally achieved by adding water to saturation, and then autoclaving for 4 hours.

Milestone Progress

3080
30 September 1992
Report on Chelation
In preparation.

3092
30 September 1992
Report on Colloidal Agglomeration
In preparation.

3176
30 September 1992
Procedure for Determination of Formation Constants
In preparation.

3177
30 September 1992
Procedure for Determination of Effects on Colloidal Agglomeration
In preparation.

Publications

L. R. Hersman, D. E. Hobart, and T. W. Newton
Preliminary Evidence of Siderophore/Plutonium Complexation
Journal article, *Journal of Applied and Environmental Microbiology*
Resubmitted.

WBS 1.2.3.4.1.3 Radionuclide Retardation by Precipitation Processes

Objective

The objective of the solubility determination task is to determine the solubilities and speciation of important waste elements under conditions characteristic of the repository and along flow paths from the repository into the accessible environment.

Activities and Accomplishments

Speciation Studies. Speciation task members met to plan experimental strategy for FY93; they plan to focus on Np(V) carbonate speciation and hydrolysis using photoacoustic and conventional-electronic absorption spectroscopies and 13-C and 17-O labeled NMR spectroscopy.

To obtain structural information on polymer formation of carbonate complexes in near neutral solution, 17-O NMR experiments were begun. 17-O-enriched samples of uranyl(VI), neptunyl(VI), and neptunyl(V) aquo ions were prepared by electrochemical reduction and reoxidation in 17-O-enriched water. Preliminary results indicate resonances for the actinyl oxygen atoms at 1120, 1220, and 1640 ppm for U(VI), Np(VI), and Np(V) respectively. The neptunium (Np) samples were run at millimolar concentrations and thus signal-to-noise was not exceptional. These spectra will be obtained again at slightly higher concentrations. It appears that coordinated water can also be observed in the Np spectra, and integration should give the hydration number for these ions. In addition, 17-O-enriched bicarbonate was also prepared, and an 17-O resonance was observed at 172 ppm, representing rapid exchange between carbonate and bicarbonate at pH 8.3. Consequently, we now know where to expect the neptunyl, carbonate, and bound-water resonances by 17-O NMR. We plan to prepare samples of neptunyl and uranyl carbonate complexes enriched with 17-O in all sites to gain structural information of the relevant actinyl carbonate complexes. The absorption spectra of each will be compared to PAS data on more dilute samples.

To determine the oxidation state of the Pu species predominant in low bicarbonate concentration (< 0.6 M) solutions, we have expanded the spectral range of our PAS studies to include the 500 to 830 nm region by using a series of laser dyes. We have obtained the spectra of 1.0 M, 0.1 M, and 0.003 M $NaHCO_3$ solutions of 250 nM Pu at pH 8.5, as well as a bona fide 250 nM Pu(VI) carbonate (1.0 M) solution over this spectral range. We have not reached firm conclusions yet because of the high absorbance of water in this region, as well as the low Pu extinction coefficients; however, a strong absorption tail at l < 480 nm for Pu(VI) species may allow us to answer the oxidation state question by expanding to this spectral region (C-460).

Solubility Studies. The Eh of each Np undersaturation experiment in UE-25p #1 water at 60°C was measured. Both the oversaturation and undersaturation experiments provided the same steady-state solution potentials within the uncertainties of the measurement. For both cases, the pH 6 experiment has the most positive redox potential, and the pH 8.5 experiment has the most negative potential.

The Np undersaturation experiment at pH 7 was analyzed for solution species by absorption spectrophotometry. After preconditioning a 4.1 nm filter with 500 microliters of the steady-state Np solution, a 2 milliliter aliquot was filtered at 60°C in a heated centrifuge. The filtrate was then split in half, with one half analyzed by spectrophotometry and the other by nuclear counting. The absorption spectrum shows peaks associated with both NpO_2^+ and $NpO_2(CO_3)_n^{1-2n}$. The spectra are currently being deconvoluted to determine if only the 1:1 carbonate complex is present, or if more highly complexed species are contributing. This portion of the filtrate was acidified to pH 0 to destroy any carbonate complex(es), and the spectrum was reacquired. This result showed that approximately 36% of the total soluble Np was complexed by

Activities and Accomplishments (continued)

carbonate, and 64% existed as NpO_2^+. Because these spectra were acquired without temperature control, the solution speciation may have been perturbed from its 60°C state. We believe that this perturbation was minimal, however, because the cell was promptly stoppered following transfer of the aliquot to eliminate in-gassing of CO_2, and the spectrum was taken immediately after the filtration.

The Np concentration determined from the spectrum of the acidified aliquot agreed very well with that determined from the nuclear counting. (9.52×10^{-5} M vs 9.71×10^{-5} M respectively). After completing the spectral analysis, the pH 7 undersaturation experiment was stopped because the Np concentration had remained stable for approximately 80 days.

Experimental difficulties were encountered in the Np undersaturation experiment at pH 6 at 60°C. The pH was inadvertently allowed to climb to ~7 over a weekend, and some Np solids precipitated. This experiment is being repeated.

Four of the six solids obtained in the plutonium oversaturation experiments were examined by x-ray diffraction. For each solid isolated at pH 6, 7, and 8.5, two samples were prepared; one was simply dried with argon and the other was washed with distilled water and ethanol prior to drying with argon. All three washed samples and the unwashed sample from pH 6 were examined. The only sample that gave a diffraction pattern was the washed solid from pH 8.5, indicating that the solids formed at pH 6 and 7 are amorphous. This was also the case in the 25°C experiments.

Using the same sample preparation technique described above, three unwashed solid samples and one washed sample from the Am/Nd oversaturation experiments were examined by x-ray diffraction. Only the pH 7 unwashed sample gave a diffraction pattern. The washed sample at pH 8.5 showed a diffuse pattern with few distinct lines.

The solubility samples taken in September for the Am/Nd undersaturation experiments are still being analyzed, and these results should be available by the end of November.

Technical review comments for Milestone Report 3329, "Measured Solubilities and Speciations from Oversaturation Experiments of Neptunium, Plutonium, and Americium in UE-25p #1 Well Water from the Yucca Mountain Region" were returned to staff at Lawrence Berkeley Laboratory (LBL). Reviewer comments are also being addressed for two new detailed technical procedures, "Operating and Calibrating the Mettler H6T Analytical Balance," and "Concentration Determination of Soluble Radionuclides from Data Provided by a Low-energy Gamma-ray Counting System."

Planned Activities

The LBL team is preparing for the 1992 Los Alamos internal QA audit scheduled for 16-17 November at LBL.

Efforts in all areas will continue.

Problem Areas

None

Milestone Progress

3010
30 June 1991
Report on Measured Solubilities of Pu, Am, and Np in J-13 Ground-water from Oversaturation Conditions
Submitted 7/29/91
YMPO comments were addressed.

3031
30 September 1992
Actinide(IV) and Actinide(VI) Carbonate Speciation Studies by NMR and PAS Spectroscopies
Submitted for technical review.

3329
30 September 1992
Measured Solubilities and Speciations from Oversaturation Experiments of Neptunium, Plutonium, and Americium in UE25p #1 Well Water from the Yucca Mountain Region
Technical review completed, and reviewer comments returned to LBL.

3330
1 January 1993
Evaluation of Alternative Detection Schemes in Photoacoustic Spectroscopy
In preparation.

Letter Report
Spectroscopic Studies of the Hydrolysis of UCl_4: Spectral Effects of Ligand Exchange
In preparation.

Publications

D. L. Clark, D. E. Hobart, P. D. Palmer, J. C. Sullivan, and B. E. Stout
Carbon-13 NMR Characterization of Plutonyl(VI) Aqueous Carbonate Complexes
Journal article, *Journal of the American Chemical Society*
In preparation.

D. L. Clark, C. D. Tait, D. E. Morris, D. E. Hobart, S. A. Ekberg, and P. D. *Palmer*
Actinide(IV) and Actinide(VI) Carbonate Speciation Studies by NMR and PAS Spectroscopies
LA-series report
In preparation.

D. L. Clark, J. G. Watkin, D. E. Morris, and J. M. Berg
Molecular Models for Actinide Speciation
LA-series report
In preparation.

L. E. Hersman, P. D. Palmer, and D. E. Hobart,
Preliminary Evidence of a Siderophore/Plutonium Complex
Journal article, *Journal of Applied and Environmental Microbiology*
In preparation.

D. E. Hobart, D. L. Clark, P. D. Palmer, J. C. Sullivan, and B. E. Stout
Carbon-13 NMR Characterization of Americyl(VI) Aqueous Carbonate Complexes
Journal article, *Inorganic Chemistry*
In preparation.

D. E. Morris and D. L. Clark
Spectroscopic Studies of the Hydrolysis of UCl_4: Spectral Effects of Ligand Exchange
LA-series report.
In preparation.

D. E. Morris, C.D. Tait, S. A. Ekberg, and P. D. Palmer
Speciation of Plutonium in Carbonate Media
Conference abstract, *Materials Research Society Fall 1992 Meeting*
Approved by YMPO.

H. Nitsche, R. C. Gatti, E. M. Standifer, S. C. Lee A. Miller, T. Prussin,
R. S. Deinhammer, H. Maurer, K. Becraft, S. Leung, and S. A. Carpenter
Measured Solubilities and Speciations of Neptunium, Plutonium, and Americium in a Typical Ground-water (J-13) from the Yucca Mountain Region
LA-series report
In YMPO review.

C. D. Tait, D. E. Morris, J. M. Berg and W. H. Woodruff
Evaluation of Alternative Detection Schemes in Photoacoustic Spectroscopy
Journal article, *Analytical Chemistry* or *Reviews of Scientific Instrumentation*
In preparation.

C. D. Tait, S. A. Ekberg, and P. D. Palmer, and D. E. Morris
Plutonium (IV) Carbonate Speciation Changes
Journal article, *Inorganic Chemistry*
In preparation.

WBS 1.2.3.4.1.4 Radionuclide Retardation by Dispersive, Diffusive, and Advective Processes

Objective

The objectives of this task are to determine the rate of radionuclide movement along the potential flow paths to the accessible environment and to examine the effect of diffusion, adsorption, dispersion, anion exclusion, sorption kinetics, and colloid movements in the flow geometries and hydrologic conditions expected to exist along the flow path to the accessible environment in the scenarios used for perform assessment.

Activities and Accomplishments

Neptunium (Np) is highly soluble in Yucca Mountain ground-water, and nuclear reactors produce ^{237}Np, which has a half-life of 2.14 x 10^6 years. Consequently, the transport of ^{237}Np through tuff is of major importance in assessing the performance of a potential high-level nuclear waste repository at Yucca Mountain. We have designed experiments to determine how Np retardation is influenced by minerals in Yucca Mountain tuff as a function of ground-water chemistry (elemental composition, pH, and Eh).

Batch sorption measurements were performed by preconditioning solid phases with ground-water for two weeks; following preconditioning, solutions of ^{237}Np in ground-water were added to the solid phases and the solutions were equilibrated for an additional three weeks. The two phases were then separated by centrifugation and the quantity of Np in each phase was determined by liquid scintillation counting.

In column experiments, in which crushed tuff and pure mineral separates were used, tritiated water was eluted through the columns to determine each column's hydrologic parameters; following this, ^{237}Np solutions in J-13 UE-25p #1 ground-water were eluted, and the amount of Np retardation by the tuff was determined. The Np solutions were prepared by adding an aliquot of a well-characterized Np(V) acidic stock to the ground-water (filtered through a 0.05 mm filter). The chemical composition of the filtered ground-waters may be seen in Table I. Both waters are oxidizing with an Eh larger than 200 mV. The initial Np solutions were 10^{-5} M.

The solid phases used for these experiments were tuffs from the Topopah Spring Member (G4-275) and Calico Hills (G4-1530) and the minerals quartz, clinoptilolite, montmorillonite, and hematite. Tuff G4-275 consists of 61% feldspar, 24% tridymite, 11% cristobalite, 1% hematite, 1% quartz, and traces of smectite and mica. Tuff G4-1530 consists of 55% clinoptilolite, 16% opal-CT, 12% mordenite, 7% quartz, 7% feldspar, and 2% smectite. The tuff particles ranged from 75 to 500 mm. Properties of the minerals are given in Table II. The ^{237}Np sorption coefficients obtained by batch sorption experiments are given in Table III.

Inspection of Table III indicates that Np sorption increases as the pH of the water increases in cases where surface complexation is thought to be the dominant sorption mechanism (such as in the case of quartz and hematite). This observation is in agreement with previous experiments, indicating that Np sorption onto goethite has an

Activities and Accomplishments (cont.)

adsorption edge in the pH range from 6-8. Oxide minerals (such as hematite), even at trace levels, can result in a significant amount of Np retardation in tuff provided the oxide minerals are accessible to the Np in solution. The fact that quartz is capable of retarding Np is significant because of the large amount of silica in the tuffs.

The sorption of Np onto minerals that are capable of ion exchange (such as clinoptilolite and montmorillonite) seems to be insensitive to changes in the ionic strength of the ground-waters and to changes in pH; consequently ion exchange does not seem to be an important mechanism for Np sorption. Preliminary results from our column experiments (see May '92 monthly report) indicate that the elution of approximately 35% of the Np in J-13 injected into the column made of tuff G4-1530 can be fitted with a K_d of approximately 3 ml/g. Sixty-five percent of the Np was not eluted even after 24 free column volumes were eluted (which corresponds to a K_d larger than 17 ml/g). Reduction of Np is suspected as the reason for this observation. We are in the process of collecting Np transport data using columns with different flow velocities to elucidate discrepancies between column and batch data.

Following examination of the data, we concluded that Np sorption is measurable in tuffs and pure minerals and increases rapidly with increasing pH for minerals that sorb actinides by surface complexation. Oxide minerals (such as hematite) that exist as trace minerals in Yucca Mountain tuffs may provide significant quantity of Np retardation because of their high Np sorption coefficients in ground-waters from Yucca Mountain. The vast quantity of silicates in Yucca Mountain tuffs may also provide significant Np retardation due their sorption properties. The dependence of Np sorption on pH can be observed in the sorption behavior of tuff G4-275 and minerals such as quartz and hematite that sorb by surface complexation.

Planned Activities

Continue all work discussed above.

Problem Areas

None

Table I. Chemical Composition of Ground-waters (Concentrations in mg/L)

	J-13	UE-25p #1		J-13	UE-25 p#1
Si	20.00	14.0	CO_3^{-2}	2.0	31.0
Mg	2.00	32.0	HCO_3^-	119.0	303.0
Ca	13.00	8.0	F^-	2.0	4.0
Na	47.00	148.0	Cl^-	7.0	25.0
K	5.00	11.0	SO_4^{-2}	27.0	162.0
Li	0.04	0.5	NO_3^-	9.0	0.5
TOC	0.60	2.0	pH	8.4	9.0

Table II. Properties of Minerals used in Batch Sorption Experiments

Mineral	XRD Results	Surface Area (m^2/g)	Size, mm	Zeta Potential in J-13, mV
quartz	No impurities	0.1	204	-40
clinoptilolite	No impurities	21.0	7	-70
montmorillonite	+99% pure, trace of quartz	77.0	16	-22
hematite	No impurities	9.0	1	-33

Table III. Sorption Results

	K_d (ml/g)		pH of water following sorption	
	J-13	UE-25#1	J-13	UE-25p #1
quartz		110	8.5	8.9
clinoptilolite	42	48	8.6	9.0
montmorillonite	100	130	8.5	8.7
hematite	2800	3100	8.5	8.7
G4-275	25	170	8.5	8.9
G4-1530	38	41	8.4	8.9

Milestone Progress

3040
15 November 1992
Kinetics of Sorption on Columns of Pure Minerals
In preparation.

3044
31 August 1992
Letter Report on Assessment of Available Techniques for Unsaturated Column Transport Experiments
In preparation.

Publications

I. R. Triay
Radionuclide Migration in Tuff under Diffusive Conditions
Conference Paper, *Proceedings of the Migration '91, Jerez de la Frontera, Spain, 14–18 October 1991*
Approved by YMPO.

I. R. Triay, M. A. Ott, A. J. Mitchell, and C. M. Overly
Transport of Np through Yucca Mountain Tuffs
Conference paper, *Proceedings of the fall meeting of the Materials Research Society, November 30 - December 4, 1992*.
In preparation.

A. Meijer
Far-Field Transport of Carbon Dioxide: Retardation Mechanisms and Possible Validation Experiments
Los Alamos letter report
In internal review.

J. Conca
Measurement of Unsaturated Hydraulic Conductivity in Yucca Mountain Tuff
LA-series report
In internal review.

WBS 1.2.3.4.1.5.1 Retardation Sensitivity Analysis

Objective

The objectives of this task are to construct a geochemical/geophysical model of Yucca Mountain and to use this model to examine the physical and chemical controls on radionuclide transport along flow paths to the assessable environment.

Activities and Accomplishments

Transport Models and Related Support. Work continued, using FEHMN, to generate an unstructured mesh of the repository region, including surface features. Work on the three degrees-of-freedom double porosity/double permeability model continued. Using three-dimensional flow and transport examples and the Jornada trench problem, verification runs of TRACRN and other codes continued.

QA and Programmatic. Certification of TRACRN continued. The Implementation Phase Baseline was reviewed, and RIDS were generated. All documents have been completed except for incorporation of RID responses. This certification will be completed in November.

Physical/Chemical Processes Affecting Transport. Staff met with J. Fabryka-Martin to discuss Cl-36 transport at Yucca Mountain.

Planned Activities

Start calculations for 36-Cl transport. Complete certification of TRACRN.

Problem Areas

Milestone 3052 will be delayed.

Milestone Progress

3052
30 November 1992
Baseline Documentation for TRACRN

Publications

K. Birdsell, K. Eggert, and B. Travis
Three-Dimensional Simulations of Radionuclide Transport at Yucca Mountain
Journal article, *Radioactive Waste Management and the Nuclear Fuel Cycle - Special issue on the Yucca Mountain Project*
Approved by YMPO; submitted.

WBS 1.2.3.4.1.5.2 Demonstration of Applicability of Laboratory Data

Objective

The purpose of this study is to design and conduct experiments to evaluate the applicability of laboratory data and to test models used in the Radionuclide Transport Program to determine far field radionuclide transport. Both intermediate- and field-scale experiments and natural analogs will be assessed for their potential to provide the required data.

Activities and Accomplishments

This task has been deferred because of lack of funds.

Publications

C. Loeven
A Summary and Discussion of Hydrologic Data from the Calico Hills Nonwelded Hydrogeologic Unit at Yucca Mountain, Nevada (LA-12376-MS, 1992)
LA-series report
In press.

WBS 1.2.5.2.2 Site Characterization Program

Objective

The purpose of this task is to coordinate the regulatory Project requirements within the Los Alamos programmatic structure. The focus of this coordination effort is on the integration of the technical work within the regulatory framework.

Management and Integration

Staff continued their support of the Erosion, Calcite-Silica, and Volcanism Issue Resolution reports.

Study Plans

Water Movement Test, R1 (8.3.1.2.2.2). Review comments on Rev. 1 of the Study Plan were received from the YMPO in May 1992; they are now being addressed.

Diffusion Test in the Exploratory Studies Facility, R0 (8.3.1.2.2.5). In April 1992 this study plan was accepted by DOE and in June of 1992 it was submitted to the NRC for review.

Testing of the C-Hole Sites With Reactive Tracers, R0 (8.3.1.2.3.1.7). In February 1990 DOE/HQ issued the study plan as a controlled document; it was then sent to the NRC for comments. In January 1992 we were requested by DOE to review revised NRC comments addressed by the USGS. The revision was completed and all comments were accepted by LANL.

Ground Water Chemistry Modeling, R0 (8.3.1.3.1.1). This study plan was returned in May 1992 from YMPO review; comments are now being addressed.

Mineralogy, Petrology, and Chemistry of Transport Pathways, R0 (8.3.1.3.2.1). In January 1992 we submitted revised NRC comments to T. Bjerstedt. In August 1992 YMPO requested that we do the actual word processing revision; that revision is in progress.

History of Mineralogy and Geochemical Alteration at Yucca Mountain, R0 (8.3.1.3.2.2). Project Office approved the study plan on 18 December 1991 and submitted it to the NRC on 31 January 1992.

Natural Analog Hydrothermal System in Tuff (8.3.1.3.3.1). This is an out-year activity.

Kinetics and Thermodynamics of Mineral Evolution and Conceptual Model of Mineral Evolution, R0 (8.3.1.3.3.2; 8.3.1.3.3.3). No progress during the reporting period due to lack of funding.

Sorption Studies and Sorption Modeling, R0 (8.3.1.3.4.1; 8.3.1.3.4.3). A new draft of the study plan was submitted to DOE for review in Oct. 1992.

Biological Sorption and Transport, R0 (8.3.1.3.4.2). A revision addressing the Exploratory Shaft Design was submitted in September 1992.

Dissolved Species Concentration Limits, and Colloid Formation and Stability, R0 (8.3.1.3.5.1; 8.3.1.3.5.2). All YMPO comments on the study plan were resolved by the principal investigator in September 1992. Rev. 0 will be submitted to YMPO for comment resolution verification and approval.

Study Plans (cont.)

Dynamic Transport Column Experiments, R0 (8.3.1.3.6.1). All YMPO comments on the study plan were resolved by the principal investigator in September 1992. Rev. 0 will be submitted to YMPO for comment resolution verification and approval.

Diffusion, R0 (8.3.1.3.6.2). All YMPO comments on the study plan were resolved by the principal investigator in September 1992. Rev. 0 will be submitted to YMPO for comment resolution verification and approval.

Retardation Sensitivity Analysis, R0 (8.3.1.3.7.1). This study plan was approved by the DOE and sent to the NRC for review in July 1992. It was released by the DOE in September 1992.

Demonstration of the Applicability of Laboratory Data to Repository Transport Calculations, R O (8.3.1.3.7.2). This study plan is in preparation.

Gaseous Radionuclide Transport Calculations and Measurements, (8.3.1.3.8.1). Funds have not been allocated.

Probability of Magmatic Disruption of the Repository, R0 (8.3.1.8.1.1). A detailed technical review was complete in July 1992 by the NRC. In August 1992, a one-day video conference was held with the NRC to discuss their technical review comments. Their comments are now being addressed.

Physical Processes of Magmatisim and the Effects on the Repository, R0 (8.3.1.8.1.2). A draft study plan was submitted to DOE for review in Oct. 1992.

Characterization of Volcanic Features, R0 (8.3.1.8.5.1). Accepted by NRC on 4 September 1990.

WBS 1.2.5.3.5 Technical Data Base Input

Objective

The objective of this task is to coordinate input of technical data to the Project Technical Data Bases and the Automatic Technical Data Tracking System.

Activities and Accomplishments

Staff inputted data information from Activity 8.3.1.3.2.2.1 into the Automated Technical Tracking System.

Planned Activities

Submit data from Activities 8.3.1.8.1.3.2, 8.3.1.3.6.1.1, and 8.3.1.3.2.1.3 to the Technical Data Base (TDB) as soon as it starts to accept data.

Submit calcite data to the TDB.

Submit erosion data to the TDB.

Problem Areas

None

WBS 1.2.5.4.6 Development and Validation of Flow and Transport Models

Objective

Model testing is necessary to assess performance at Yucca Mountain. This task will conduct an experiment in a caisson facility to provide a baseline of confidence in models for transport.

Activities and Accomplishments

In preparation for installation of the lower-boundary device, the caisson was filled with sand and the sand was compacted.

M. Siegel of SNL visited Los Alamos on 8 October to discuss solution sampling and in-line pH measurements for the individual solution samplers. A design using individual pH meters attached to a plastic bottle was generated, and Los Alamos staff began fabrication.

R. Glass of SNL visited Los Alamos on 15 October to discuss testing and installation of the lower-boundary device. Testing of the cups has been delayed because it was necessary to add a fitting to strengthen the connection to the fill tube. A total of 264 cups will be used.

Planned Activities

Complete tests for porous cup assemblies for lower boundary before installing in the caisson.

Obtain material to construct solution samplers for caisson.

Complete fabrication of the in-line pH measuring system.

Problem Areas

None

Milestone Progress

No FY91 milestones.

Publications

None

WBS 1.2.5.4.7 Supporting Calculations for Postclosure Performance Analyses

Objective

This task will provide documentation and results of calculations used in analyses of postclosure performance that supports design of repository, seals, and waste package and perform calculations of postclosure performance needed to support activities carried out under other performance assessment WBS elements.

Activities and Accomplishments

G. Zyvoloski met with B. Nelson and J. Houseworth of INTERA to discuss FEHMN code development. A copy of the latest version of FEHMN was given to Nelson and Houseworth.

Planned Activities

No planned activity reported this month.

Problem Areas

None

Milestone Progress

None

Publications

None

WBS 1.2.6 Exploratory Studies Facility

Objective

These Exploratory Studies Facility (ESF) tasks address the issues and information needs associated with the ES-based characterization of Yucca Mountain to determine the suitability of permanently isolating high-level nuclear waste from biosphere in a geologic repository.

Activities and Accomplishments

Staff continued to gather information on the use of tracers, fluids, and materials (TFM) used at Yucca Mountain with emphasis on FY93 ESF-related activities. Staff responded to requests from the M&O for waste-isolation impact and test interference analysis for the TFMs. Staff prepared briefings and attended biweekly ESF Management meetings. Staff developed new set of milestones to facilitate start of north ramp construction. Staff prepared material for the Nuclear Waste Technical Review Board meeting on 5–6 November in Las Vegas.

Planned Activities

Staff continued to develop information on design for launch-chamber tests. We will continue to support integration meetings such as ESF design, TIG, SMF, and to support surface-based testing and its interface with ESF testing. We are developing ESF testing networks integrated with test planning, ESF design, and ESF construction. We will continue to support, as needed, the ED&D effort in developing rationale and justification for prototype test facility for Yucca Mountain. We will revise and update the PSAR as required.

Problem Areas

None

WBS 1.2.6.8.4 Integrated Data System

Objective

The integrated data system (IDS) supports the Exploratory Studies Facility (ESF) test program by providing a central facility to automatically measure and control aspects of the ESF tests. The primary purposes of the IDS are to assist the principal investigators (PI's) in acquiring high-quality test data in a uniform, controlled fashion and to transfer those data to the PI's organizations for data management and analysis.

Activities and Accomplishments

Staff met with representatives of the M&O to discuss plans for the Integrated Data System.

Planned Activities

No planned activities reported this month.

Problem Areas

None

WBS 1.2.9.1.2 Technical Project Office Management

Objective

The objective of this task is to manage the Los Alamos Yucca Mountain Project Site Characterization Program.

Activities and Accomplishments

Staff toured Yucca Mountain with the Director of Los Alamos National Laboratory (LANL) and the LANL Associate Director for Energy and the Environment.

Staff presented budget briefing/appeal on FY93 work.

Staff supported the NWTRB meeting on the ESF.

WBS 1.2.9.2.2 Project Control

Objective

The objective of this task is to support management's efforts in planning, scheduling, and controlling the technical work. This task will develop, implement, and maintain computerized cost, schedule, and technical milestone data bases and develop strategies to meet management information requirements.

Activities and Accomplishments

D. Holmes attended the Planning and Control Steering Committee on 1 October in Denver.

End-of-year costs were uploaded on 5 October.

Planned Activities

D. Holmes will submit a FY92 end-of-year status report to V. Iiori of DOE. Emphasis will be placed on explanation of variances at year end. Lessons learned will also be a key requirement of the analysis.

Problem Areas

Staff is concerned that response time for miscellaneous Project Control requirements and deliverables is too short.

WBS 1.2.11.2/3 Quality Assurance Program Development, Verification, and Engineering

Objective

The Quality Assurance (QA) Program supports Los Alamos Yucca Mountain Site Characterization Project participants and ensures that their efforts provide data and evidence admissible for the repository-licensing process.

WBS 1.2.11.2 Program Development

Personnel. A meeting was held to notify staff of a number of upcoming changes. R. Shay was hired as quality assurance liaison (QAL) for INC Division, D. Williams as QAL for EES-13, and S. Noel as QAL for EES-5. P. Gillespie was hired for the position of quality assurance specialist, assigned to the QAPL.

Travel. S. Bolivar and J. Day attended the QARD comment resolution and Project Quality Assurance Committee meetings in Las Vegas.

Procedure Revisions. Twenty-five quality administrative procedures (QPs) were in various stages of revision; QP-6.1, -6.2 and -3.5 were almost complete. Detailed Technical Procedure LANL-INC-DP-87, R2, "Identification, Storage, and Handling of Samples at HydroGeoChem," was in revision. The Test Coordination Office has developed an ESF Administrative Test Tracking Information System (ATTIS) to streamline tracking of test planning packages, job package development, and other Project documents.

Training. M. Clevenger, S. Bolivar and T. Morgan attend a series of QPO seminars: NQA-1 Overview, The Xerox Quality Story, and 5700.6C.

WBS 1.2.11.3 Audits and Surveys

The audit schedule was revised; INC Division and its contractors will be audited next month. The QAPL reviewed the annual management assessment report and found no outstanding deficiencies. The TPO is reviewing the report's recommendations. Corrective actions for stop work order SWO-03 have been completed and await verification. The trend report for July-September was completed and awaits verification; it was submitted to the TPO. Survey reports SR-92-002 and SR-92-004 were completed and issued.

WBS 1.2.11.5 Quality Engineering

Software. A software configuration management status report was distributed.

Planned Activities. A DOE audit will be held 2–5 November. Audit plans will be written for internal audits of INC Division and its contractors (Lawrence Berkeley Laboratory and HydroGeoChem). One outstanding audit report will be completed. QP revisions will continue; the notebook procedure, QP-03.5, will be issued. The completion of corrective actions for stop work order SWO-03 will be verified, and the stop work order will be closed.

Problem Areas

None

Publications

S. Bolivar and J. Day
The Quality Assurance Liaison—Combined Technical and Quality Assurance Support
Conference abstracts
In preparation.

WBS 1.2.12.2/2.5 1.2.13 Local Records Center Operations/Records Management and Document Control

Objective

The objective of this task is to satisfy the records management requirements of the YMP and NQA-1.

Activities and Accomplishments

Sixty records and/or record packages were received by the RPC; eight of these were returned to the originators for corrections.

The CRF rejected three records and/or record packages and returned them to the RPC for corrections. The RPC resubmitted 14 records, which had been previously returned for corrections, to the CRF.

Planned Activities

No planned activities reported this month.

Problem Areas

None

WBS 1.2.15.2 Administrative Support

Objective

The objective of this task is to provide administrative support for Group EES-13 and the YMPO.

Activities and Accomplishments

To ensure consistency, compatibility, and flexibility throughout the Los Alamos office, an initiative to upgrade personal computers and install the Windows operating system was begun.

Planned Activities

Continue to install appropriate software packages and upgrade personal computers.

Problem Areas

None

WBS 1.2.15.3 Training

Objective

The objective of this task is to fulfill the training requirements of the Yucca Mountain Project and maintain appropriate training records.

Activities and Accomplishments

Twelve people attended a Project orientation class at Lawrence Berkeley Laboratory.

Staff assisted QALs in purging unnecessary YMP training records.

Planned Activities

We plan to update the material presented at the YMP orientation class. We also plan to establish a new class to teach correct record handling procedures.

Problem Areas

None

Appendix A

WBS 1.2.3.1
"QA"

Los Alamos

Los Alamos National Laboratory
P.O. Box O Mercury, Nev. 89023

memorandum

TWS-EES-13-LV-11-92-02
Page 1 of 3

November 2, 1992
702/794-7095
M/S 527

TO: N. Elkins, EES-13/LV

FROM: R. Oliver, EES-13/LV

SUBJECT: FRAN RIDGE PIT MAPPING - EXPLORATORY STUDIES FACILITY TESTING ACTIVITY REPORT - MONTH ENDING OCTOBER 30, 1992, (JP 92-7 - DRC-018)

REFERENCES:
1. YMP/TPP 92-07, REV. 0, "FRAN RIDGE PIT MAPPING," AUGUST 1992 (CONTROLLED)
2. YMP/JP 92-7, REV. 0, "FRAN RIDGE PIT MAPPING," AUGUST 1992 (CONTROLLED)

TECHNICAL ACTIVITY SUMMARY

Construction support at the Fran Ridge site is limited to maintenance. Surface foundation network studies on the cleaned pavement surfaces are underway on a time available basis. The area photography and survey target installation necessary for the surface foundation network studies are complete. The safety-related mapping platform modifications proposed by the construction contractor Reynolds Electrical and Engineering Company, Inc. (REECo) are completed. The "Man Lift" rated slings have been received by construction, and the tentative date for pit mapping using the mapping platform is November 17, 1992, as provided by the United States Bureau of Reclamation (USBR) principal investigator (PI). The participants that provided products during the period were the United States Geological Survey (USGS)/USBR, REECo, Raytheon Services Nevada (RSN), and Science Applications International Corporation (SAIC) as defined by the Job Package (JP). The Test Coordination Office (TCO) working schedule is attached. Surface foundation network studies results are being collected per USGS Procedure QMP-5.05, "Preparation of Scientific Notebooks."

ADMINISTRATIVE ACTIVITY SUMMARY

The TCO staff was not present at the site during this period.

A second revision of the work order was approved by the Field Operations Center Manager to allow completion of the planned construction support and testing objectives.

This report is limited to test coordination activities and is not intended to fulfill Field Operating Instructions and JP identified scientific and Exploratory Studies Facility (ESF) test organization reporting requirements. Discussions concerning Technical Data

RECEIVED NOV 1 3 1992

Information Form submission strategy and data flow are continuing with the supporting participants.

Assignment of a Job Package Records Coordinator (JPRC) as defined by YMP-AP-6.22Q remains open. A copy of the Document and Records Center (DRC) records assembled under tracking number DRC-018 were requested and received. We noted that these TCO reports were not included in the package. The reports were resubmitted to the DRC as a records package segment on October 26, 1992.

ISSUES

No issues were identified during the reporting period.

RECOMMENDATIONS

All matters that are not worked out by the personnel responsible for their particular portion of the activity should be resolved with the involvement of the Project Engineer and Field Test Coordinator.

Each issue that is identified during this ESF field activity will be evaluated using the following criteria: 1) Does the issue or concern involve safety? If so, has clear responsibility been assigned? 2) Does the issue or concern impact, in a primary way, the ability of the site to isolate waste or to be characterized? If so, has clear responsibility been assigned? 3) Will the record from the activity appear in the license application arena as a first or second order document? If so, has clear responsibility been assigned?

RDO:kq74

Attachment

Cy: U. Clanton, DOE/YMPO, MS 523
R. Dyer, DOE/YMPO, MS 523
A. Girdley, DOE/YMPO, MS 523
W. Simecka, DOE/YMPO, MS 523
A. Simmons, DOE/YMPO, MS 523
R. Spence, DOE/YMPO, MS 523
W. Wilson, DOE/YMPO, MS 523
K. Skipper, DOE/YMPO, MS 523
T. Leonard, REECo, MS 408
B. Stanley, RSN, MS 403
R. Schneider, SAIC, MS 517
R. Craig, USGS/LV, MS 509
D. Edwards, USGS/LV, MS 509
R. Spengler, USGS, Denver, CO

Cy: S. Beason, USBR, Denver, CO
DRC - Attention, DRC-018, FOC, MS 717
J. Canepa, LANL, EES-13, MS J521
E. Springer, LANL, EES-13, MS J521
H. Kalia, LANL, EES-13/LV, MS 527
EES-13/LV, LANL, MS 527
CRMO, LANL, MS A150

Appendix B

WBS 1.2.3.2
"QA"

Los Alamos

Los Alamos National Laboratory
P.O. Box O Mercury, Nev. 89023

memorandum

TWS-EES-13-LV-10-92-17
Page 1 of 1

October 26, 1992
702/794-7096
M/S 527

TO: J. Canepa, Group Leader, EES-13

FROM: B. Crowe, EES-13/LV B. Crowe

SUBJECT: UNIVERSITY OF NEW MEXICO/CONSULTANT'S REPORT

Attached with this memorandum is the annual report of the consultant and contract participants in the volcanism studies. The report was prepared by F. Perry, J. Geissman, L. McFadden, and S. Wells. The report presents the results of another successful year of support studies for the volcanism task. Now if we can just focus and began to close topics, I will be satisfied.

BMC:kq16

Attachment

Cy: F. Perry, UNM, Albuquerque, NM, w/o attach.
J. Geissman, UNM, Albuquerque, NM, w/o attach.
L. McFadden, UNM, Albuquerque, NM, w/o attach.
S. Wells, Running Springs, CA, w/o attach.
EES-13/LV, LANL, MS 527
RPC Files, LATA, MS M321 (2)
CRMO, LANL, MS A150

TWS-EES-13-LV-10-92-17
ATTACHMENT
108 PAGES

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The University of New Mexico

Department of Geology
Northrop Hall
Albuquerque, NM 87131-1116 U.S.A.
Telephone (505) 277-4204
FAX (505) 277-8843

October 6, 1992

Dr. Bruce M. Crowe
Los Alamos National Laboratory
101 Convention Center Drive, Suite 820
Valley Bank Center
Las Vegas, NV 89109

Dear Bruce,

The attached report summarizes activities carried on at the University of New Mexico during fiscal year 1992 in support of the volcanism task for the Yucca Mountain Project. This report fulfills a level III milestone, "Consultant's Progress Reports", and the reporting requirements of Ordering Agreement No. 9-X60-D1200-1, Task order No. 7. If you find this report satisfactory, please forward it to the Program Office.

Sincerely,

Frank Perry

Frank V. Perry

ACTIVITIES AT THE UNIVERSITY OF NEW MEXICO IN SUPPORT OF VOLCANISM STUDIES FOR THE YUCCA MOUNTAIN PROJECT, FISCAL YEAR 1992

F.V. PERRY
L. D. McFADDEN
J. W. GEISSMAN

This report provides a summary of the progress during fiscal year 1992 for studies at the Department of Geology of the University of New Mexico in support of the volcanism task for the Yucca Mountain Project. This task is attempting to determine the hazards of future volcanism with respect to location of a facility for geologic disposal of high-level radioactive waste at Yucca Mountain. Los Alamos National Laboratory has the primary responsibility for the volcanism work (B.M. Crowe, Principal Investigator).

Work for the volcanism task is supported through studies by F.V. Perry and J. W. Geissman of the University of New Mexico (Ordering Agreement No. 9-X60-D1200-1, Task Order No. 7), and by Geoprofile, Inc. Activities for this work include:

1. Petrologic and geochemical studies of volcanic centers of the Yucca Mountain region (F. V. Perry).

2. Field and laboratory studies of soil formation of volcanic features (L. D. McFadden).

3. Paleomagnetic studies of volcanic centers of the Yucca Mountain region (J. W. Geissman)

4. Compliance with the Quality Assurance requirements of the Yucca Mountain project.

PETROLOGIC AND GEOCHEMICAL STUDIES OF QUATERNARY VOLCANIC CENTERS OF THE YUCCA MOUNTAIN REGION (F. V. PERRY)

Presentations

- Presented a paper entitled "Geochemical evidence for waning magmatism and polycyclic volcanism at Crater Flat, Nevada", at the High-Level Radioactive Waste Management Conference, Las Vegas, Nevada, April 12-16, 1992.
- Presented geochemical evidence for the eruption of multiple magma batches at the Black Cone and Lathrop Wells volcanic center to the United States Nuclear Waste Technical Review Board , in Las Vegas, September 14-16, 1992.

Sampling and Analytical Progress

- Sixteen additional bomb, scoria, and lava samples were collected from the Lathrop Wells volcanic center, primarily in coordination with trenching studies. Four new samples were collected from the 3.7 Ma eruptive episode in Crater Flat.
- Thirty nine INAA trace-element analyses of flows, scoria, and bombs from the Lathrop Wells and Black Cone volcanic centers were received from Washington University .
- Ten samples from the Sleeping Butte and Black cone volcanic centers were submitted to the University of Colorado for isotopic analysis of Sr, Nd, and Pb. Results are expected in early FY 1993.
- Twelve samples from Crater Flat, Nellis Air Force Base, Lathrop Wells, and the aeromagnetic anomaly in Armagosa Valley were submitted to Lehigh University for dating by the $^{40}Ar/^{39}Ar$ method. Results are expected in early FY 1993.
- Samples submitted to the XRF facility at Los Alamo have not yet been analyzed for major- and trace-element compositions. Results are expected in early FY 1993.

Geochemistry of Quaternary Volcanic Centers

A fundamental question regarding the Quaternary volcanic centers in the Yucca Mountain region is whether they are monogenetic, formed during one eruptive episode, or polycyclic, formed by a series of eruptive episodes separated by significant time periods. The formation of a monogenetic volcano represents the formation, ascent, and eruption of a single batch of magma, and takes place over a period of days to several years. Polycyclic volcanoes may formed by the eruption of multiple magma batches over periods of hundreds to thousands of years. Resolution of this question is important for determining whether a volcanic event intersecting the proposed repository will involve a single magmatic pulse or multiple pulses of magma that may be separated in time by hundreds or thousands of years.

Trace element variations among eruptive units can ascertain whether different eruptive units at a particular volcanic center represent a single or multiple magma batches. Patterns of trace-element variations that occur within a single, evolving magma batch are predictable from knowledge of mineral/melt partition coefficients. Violation of these patterns indicates the involvement of multiple magma batches, each having a unique trace-element composition. As an example, isotope dilution measurements of Rb and Nd from eruptive units at Lathrop Wells define an array with a largely negative slope (Fig. 1). Fractionation of minerals likely to be involved in the evolution of these magmas (olivine, clinopyroxene, plagioclase, magnetite) will produce a *positive* slope on this diagram, as both Rb and Nd are incompatible elements in these minerals. A negative slope indicates that several magma batches are involved, each having initially different Rb/Nd ratios.

A similar relationship is seen for eruptive units at the Black Cone center in Crater Flat. Rb and Ce compositions of the two eruptive units sampled thus far define a negative slope (Fig. 2), which rules out derivation of these units from a single magma batch.

Trace-element data has also proven useful in understanding details of the eruptive history at Lathrop Wells. Debate on soil-bounded tephra units exposed in the Lathrop Wells quarry has centered on whether they represent primary volcanic deposits or mass flow deposits derived from the main cinder cone. The monogenetic model is favored if the tephra units in the quarry are

derived by erosion of the main cone, while the polycyclic model is favored if these units represent different eruptive events. Trace-element data shows that one of the soil-bounded tephra units (represented by sample 78) is chemically distinct from tephra and volcanic bombs of the main cinder cone (Figs. 3 and 4), ruling out derivation of this unit by erosion of the main cinder cone. Tephra in this unit also has different Rb/Th than the underlying tephra units, indicating that soil-bounded tephras exposed within the quarry are not derived from a single magma batch. These data, combined with the interpretation that quarry soils represent hiatuses of several thousands of years between deposition of tephras, constitute the simplest and most compelling evidence for polycyclic volcanism at Lathrop Wells.

Trace-element and petrographic data has also allowed recognition of the vent for lava flow Ql_6 at Lathrop Wells, one of the oldest eruptive units at the center. This vent is buried by the main cinder cone, but the two vents are clearly distinguished by trace element data (e.g., Fig. 4).

Evolution of Basaltic Volcanic Fields

The evolutionary state of the Crater Flat volcanic field is being evaluated as one of the factors used in determining volcanic risk for the proposed nuclear waste repository at Yucca Mountain. The objective is to assess whether long-term eruptive activity is increasing, decreasing, or remaining steady. This information will be factored into probability calculations. Evidence for long-term waning of eruptive activity at Crater Flat was summarized in a paper presented at the High-Level Radioactive Waste Management Conference in Las Vegas (see publication list).

We have begun a systematic comparison of the evolution of the Crater Flat volcanic field to other basaltic volcanic fields of the southwestern United States in order to gain a perspective on the overall magmatic evolution of the Crater Flat field. The 4 Ma lifetime of the Crater Flat field is typical of other long-lived basalt fields in the western United States, which generally have total lifetimes of 1-8 Ma. We have compiled the eruption duration and eruption volume for 15 reasonably well characterized late Cenozoic basalt fields of the southwestern United States (Fig. 5), in order to place long-term eruption rates at Crater Flat in a wider geologic perspective . It is apparent that volcanic fields located at major physiographic boundaries (e.g., Colorado Plateau-Basin and Range transition zone) have the highest long-term eruption rates, while fields within the Basin and Range interior (including Crater Flat) have much lower long-term eruption rates. Crater Flat has among the lowest eruption rate of any long-lived volcanic field considered.

SOILS STUDIES OF QUATERNARY VOLCANIC CENTERS OF THE YUCCA MOUNTAIN REGION (L. D. McFADDEN)

Presentations

- Presented an overview of recent results of soils and geomorphic investigations at Lathrop Wells and in the Cima area to the United States Nuclear Waste Technical Review Board , in Las Vegas, September 14-16, 1992.

Field Activities

- Three trips to the Lathrop Wells cinder cone, Nevada, to excavate, describe, and sample soil horizons in soils formed in tephra and eolian sand deposits.
- Two trips to Cima volcanic field, southern California, to excavate, describe, and sample soils associated with Late Quaternary cinder cones.

Sampling and Analytical Progress

- Formal permission to excavate trenches and pits in selected sits in the Cima and Lathrop Wells areas was obtained in 1991, thereby permitting a significant increase in the pace of field studies involving soils characterization. A large number of samples have been described, sampled, and prepared for subsequent soil characterization.
- Twenty nine samples were submitted to Inter-Mountain Laboratories, Inc. to characterize textural and chemical properties of soils described and sampled during field studies. The final results of these analyses were received in September, 1992.

Soils Studies

Preliminary analysis of soils formed in tephra show that incorporation of fine eolian dust enriched in carbonates and salts significantly influence soil-forming processes in volcanic tephra, as shown by the abundance of silt sand clay, high carbonate, and high electroconductivities in the soil profile (Figs. 6, 7, and 8). Such data can be used to further elucidate processes of erosion and deposition affecting volcanic landscapes in the Yucca Mountain region, constrain surface ages, and refine stratigraphic analysis in volcaniclastic and pyroclastic deposits.

Collaboration continued in 1992 with Dr. Ron Amundson (University of California, Berkeley) and Oliver Chadwick (Jet Propulsion Laboratory, Pasadena), to analyze pedogenic calcite in desert soils in order to attain numerical ages from the carbon - 14 and environmental data from carbon and oxygen isotopic ratios in the calcite. As noted in the 1990-91 annual report, preliminary data from an area in which extensive studies have provided calibration for experimental age-dating of soils (the Silver Lake playa area, 10 km north of the Cima volcanic field) are very encouraging, indicating that isotopic and radiocarbon dating of soil calcite in volcanic materials have the potential to provide important independent age constraints on volcanic tephras. Isotopic data indicate precipitation of soil calcite in isotopic equilibrium with the soil atmosphere, which provides (1) important data regarding the influence of plant-produced CO2 on calcite precipitation; and (2) significant information regarding the interpretation of the accelerator dates on soil calcite. Ron Amundson has prepared a draft of a paper reporting our results, which will be submitted to Geochemica Cosmochimica Acta. On the basis of these encouraging results, we have excavated a trench in tephra exposed on a stable surface on the north flank of the Blank Tank cinder cone in the Cima volcanic field, and sampled the soil carbonate for isotopic and radiocarbon age analysis. The data can be compared with other age determinations obtained in previous studies in this area to further constrain the age of most recent volcanic activity at this site. We intend to use this technique to provide age estimates for soils formed in tephra at the Lathrop Wells and Sleeping Butte volcanic centers in theYucca Mountain region.

Preliminary Data-Do Not Reference

Collaboration also continued in the investigation in the utility of cosmogenic age dating (He^3/He^4) of volcanic flow surfaces and associated stone pavements (with Dr. Chad Ollinger, LANL, Dr. Steve Wells, U.C. Riverside, and Jane Poths, LANL). Preliminary results are very encouraging and support previous studies of McFadden and Wells concerning the origin of pavements and soils on volcanic landforms, which have played a key role in the interpretations of the timing and nature of late Quaternary volcanism in the Lathrop Wells/Crater Flat area. We will present the most recent results of our research in a Poster Session to be presented at the Annual Meetings of the Geological Society of America in October, 1992, at Cincinnati, Ohio.

PALEOMAGNETIC STUDIES OF VOLCANIC CENTERS OF THE YUCCA MOUNTAIN REGION (J. GEISSMAN)

Presentations

- Summarized the results of paleomagnetic investigations at Lathrop Wells to the United States Nuclear Waste Technical Review Board , in Las Vegas, September 14-16, 1992.

Paleomagnetism Studies

In May, 1991, the Principal Investigator and Dr. Bruce Crowe established a total of ten paleomagnetic sampling sites at the Lathrop Wells volcanic center (Figure 9) . Each sampling site consists of from eight to twelve independently oriented samples, collected as small cylinders using a portable drilling apparatus, distributed over at least m3. Four sites were located in Ql_6, four in Ql_5, and two in the "buried" lava flow on the northeast flank of the main cone. The sampling strategy was not intended to directly duplicate that of previous/ongoing work at Lathrop Wells (i.e. Turrin et al., 1991, *Science*, *253*, 654). For most sites, at least one specimen per independently oriented sample has been subjected to progressive alternating field demagnetization, the technique most commonly used to assess the direction and relative intensity of all components of magnetization in magnetite-bearing rocks. Examples of response to demagnetization are shown in conventional demagnetization diagrams in Figure 10; in most cases a well-defined, univectoral decay of the magnetization to the origin of the demagnetization diagram occurs. This magnetization is interpreted to be the primary, thermoremanent magnetization acquired in the initial cooling of each lava flow. The directions of primary magnetizations have been calculated after visual inspection of demagnetization diagrams using a form of three-dimensional least-squares fitting. The between-site dispersion of directions of the primary magnetizations differs considerably (Figure 11) and this is interpreted to be due principally to one of two problems associated with sampling surface exposures of young basaltic lavas. The first reflects the difficulty in sampling intact material, an example of which is shown in Figure 12. Samples in one or a series of adjacent and out of place blocks may give directions of magnetization that are internally consistent yet discrepant in comparison to those from samples collected from another portion of the site. The other problem leading to increased dispersion of paleomagnetic directions is lightning strikes, where an artificial, generally randomly dispersed magnetization is superimposed on a primary, well-grouped magnetization. In some cases, the

Preliminary Data-Do Not Reference

artificial magnetization can be fully removed in alternating field demagnetization; in others it cannot be removed.

Several sites yield well-grouped, interpretable paleomagnetic data. Sites LW1 and LW2, in Ql_6, give site mean directions of magnetization (Decl. = 2.7°, Incl.=53.5°, a95= 5.3°, k = 93.2 , N= 9 independent samples; and Decl. =13.8°, Incl.= 53.3° , a95= 3.5° , k= 210.9 , N= 9 independent samples, respectively) that are statistically indistinguishable, at minimally a 95 percent level of confidence, from those reported by Turrin et al. (1991) for the Ql_3 event. The other two sites in Ql_6 give dispersed paleomagnetic data (e.g., Figure 12). Finding intact material in the Ql_5 event proved difficult, but it appears on the basis on directions of natural remnant magnetization (without progressive demagnetization applied) that sites LW7 and LW8 may give well-grouped primary magnetizations, the site means for which may be determined at a high level of confidence. We are in the final stages of demagnetization work on these sites. Results from sites LW9 and LW10, in the buried flow, vary in dispersion. Given the nature of natural exposures of material from this eruptive event, it is unlikely that a well-grouped direction of magnetization may be obtained for this flow.

In general, the paleomagnetic data obtained from the initial phase of sampling at Lathrop Wells are not dissimilar from those reported by Turrin et al. (1991) (Figure 13). Importantly, there is no indication of a single volcanic event occurring during a relatively unusual geomagnetic field. This observation, however, is not to be interpreted to support the conclusion reached by Turrin et al. (1991) that the Lathrop Wells center is essentially a monogenetic feature and that the age difference between the Ql_3 and Qs_5 eruptive events is "about 100 years".

COMPLIANCE WITH THE QUALITY ASSURANCE REQUIREMENTS OF THE YUCCA MOUNTAIN PROJECT

Internal audits of activities at UNM were conducted on October 2-4, 1991, and on March 23-April 3, 1992, by LATA personnel. The audit reports are included in Appendix 1. A "Procedure for preparation of splits and Powders form Soil Samples" (LANL-EES 13-DP-608, RO) was prepared and became effective 1/27/92. This procedure describes the manner in which soil samples are to be prepared prior to submittal to a laboratory for soil characterization. Project participants from UNM met all training requirements of the Project.

PUBLICATIONS (see Appendix 2)

Crowe, B. M., Valentine, G., Morley, R., and F. V. Perry, Recent progress in volcanism studies: site characterization activities for the Yucca Mountain Site Characterization Project, Waste Management '92, Volume 1-Proceedings of the Symposium on Waste Management, R.G. Post and M.E. Wacks, eds., 921-928, 1992.

Crowe, B., Morley, R., Wells, S., Geissman, J., McDonald, E., McFadden, L., Perry, F. Murrell, M., Poths, J., and S. Forman, The Lathrop Wells volcanic center: status of field and geochronology studies, Proceedings High-Level Radioactive Waste Management Conference, American Nuclear Society, 1997-2013, 1992.

Crowe, B. M., Picard, R., Valentine, G., and F. V. Perry, Recurrence models of volcanic events: applications to volcanic risk assessment, Proceedings High-Level Radioactive Waste Management Conference, American Nuclear Society, 2344-2355, 1992.

Perry, F. V., and B. M. Crowe, Geochemical evidence for waning magmatism and polycyclic volcanism at Crater Flat, Nevada, Proceedings High-Level Radioactive Waste Management Conference, American Nuclear Society, 2356-2365, 1992.

Valentine, G. A., Crowe, B. M., and F. V. Perry, Physical processes and effects of magmatism in the Yucca Mountain region, Proceedings High-Level Radioactive Waste Management Conference, American Nuclear Society, 2014-2024, 1992.

Wells, S. G., B. M. Crowe, and L. D. McFadden, Measuring the age of the Lathrop Wells volcanic center at Yucca Mountain, Science, 257, 555-556, 1992.

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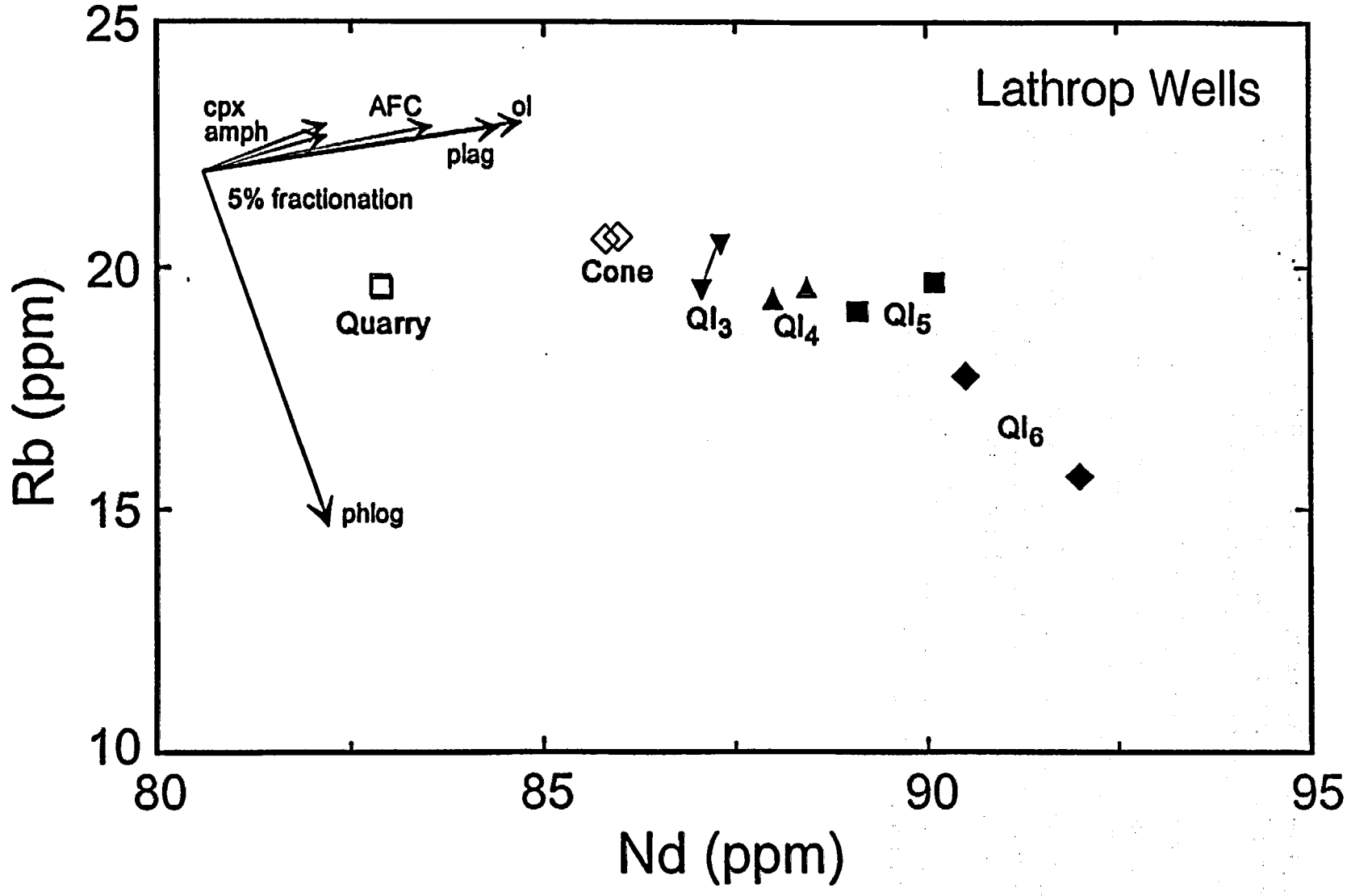

Figure 1

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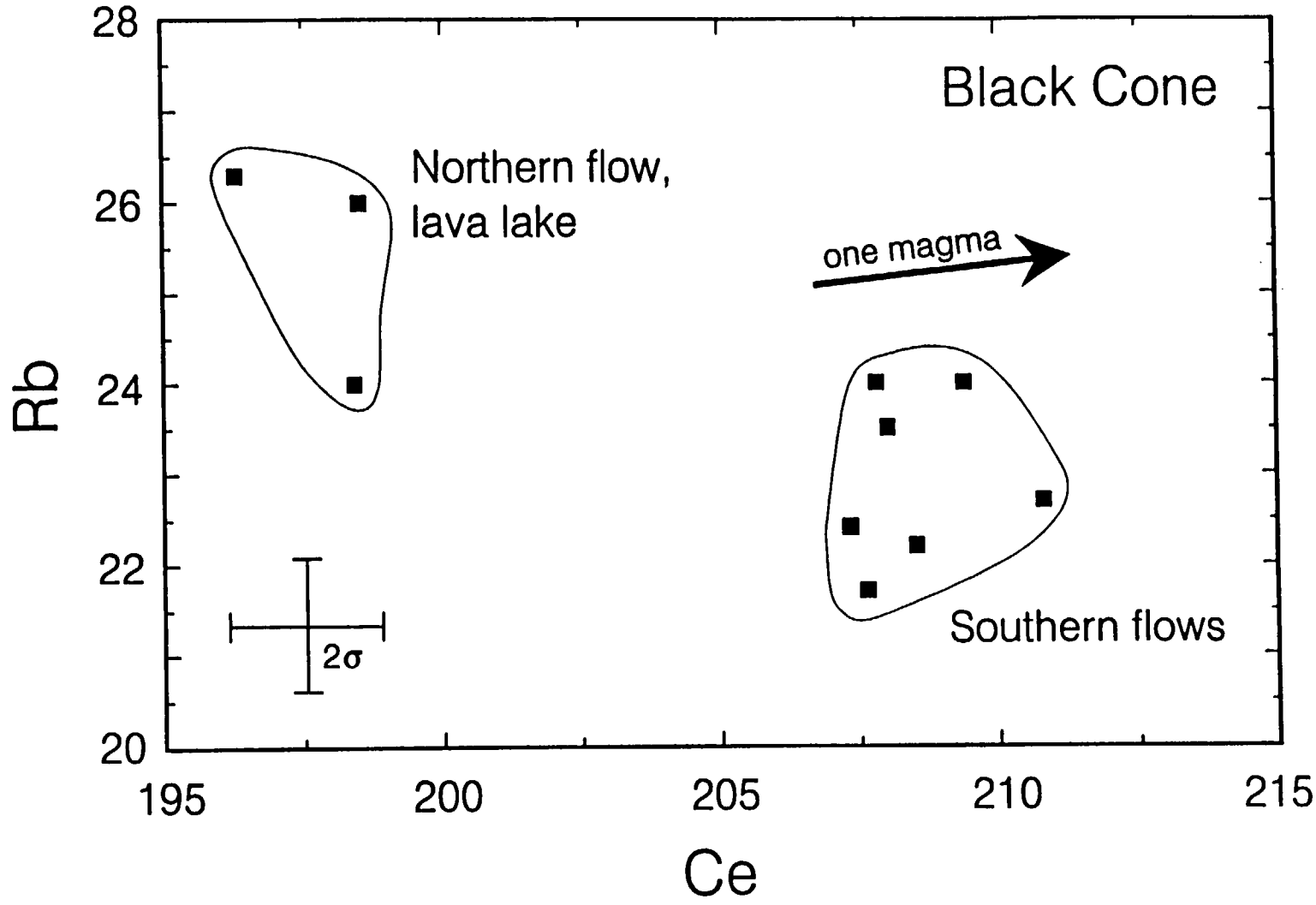

Figure 2

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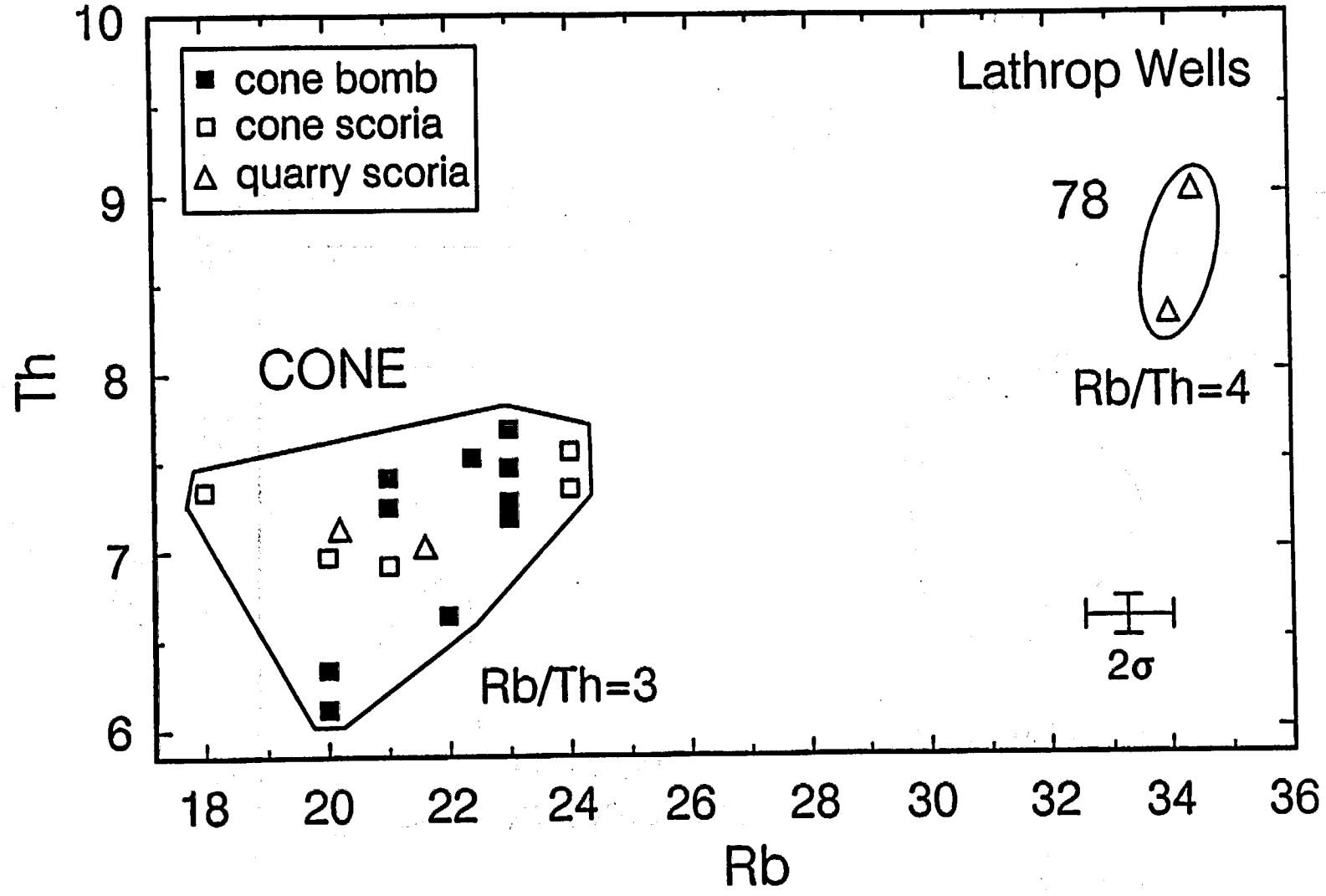

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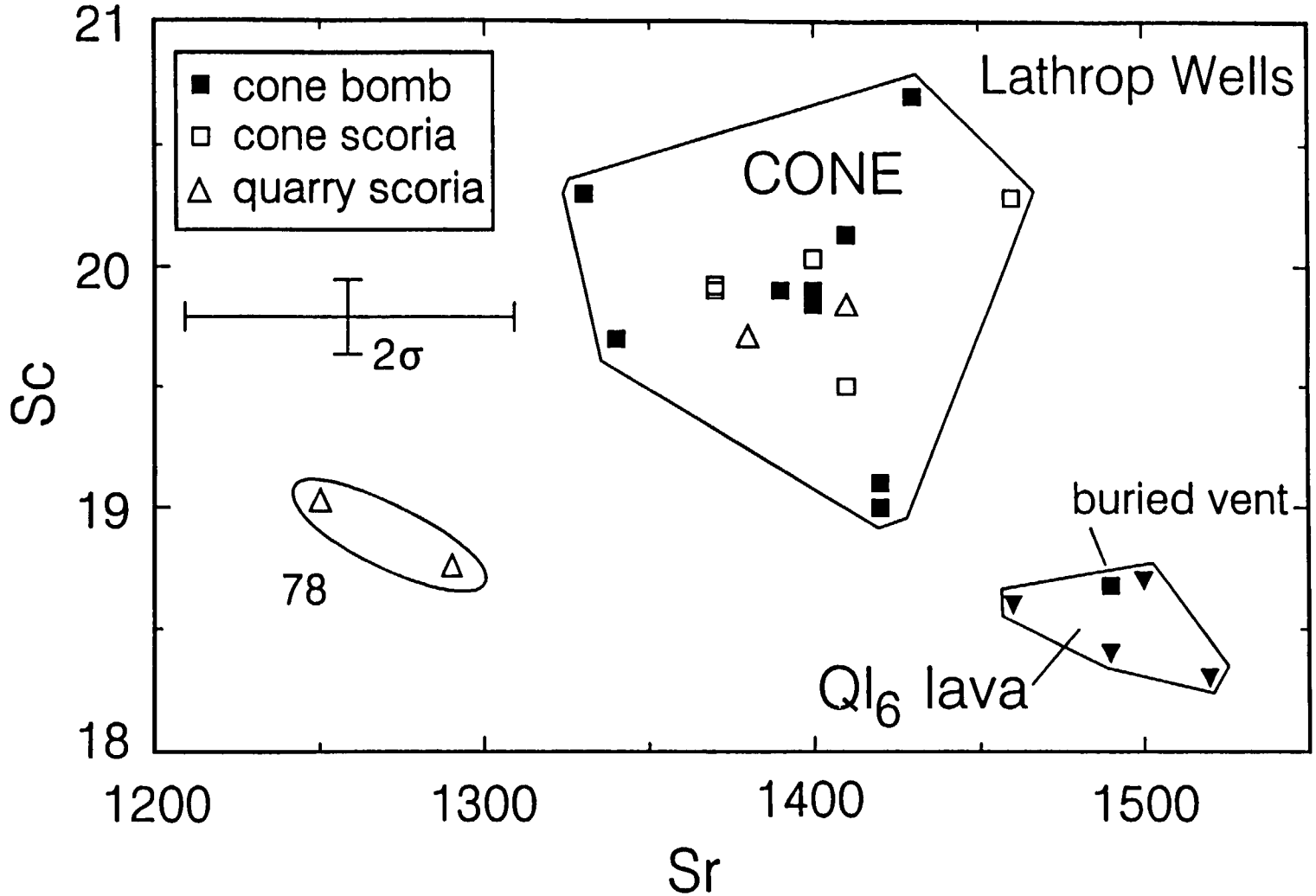

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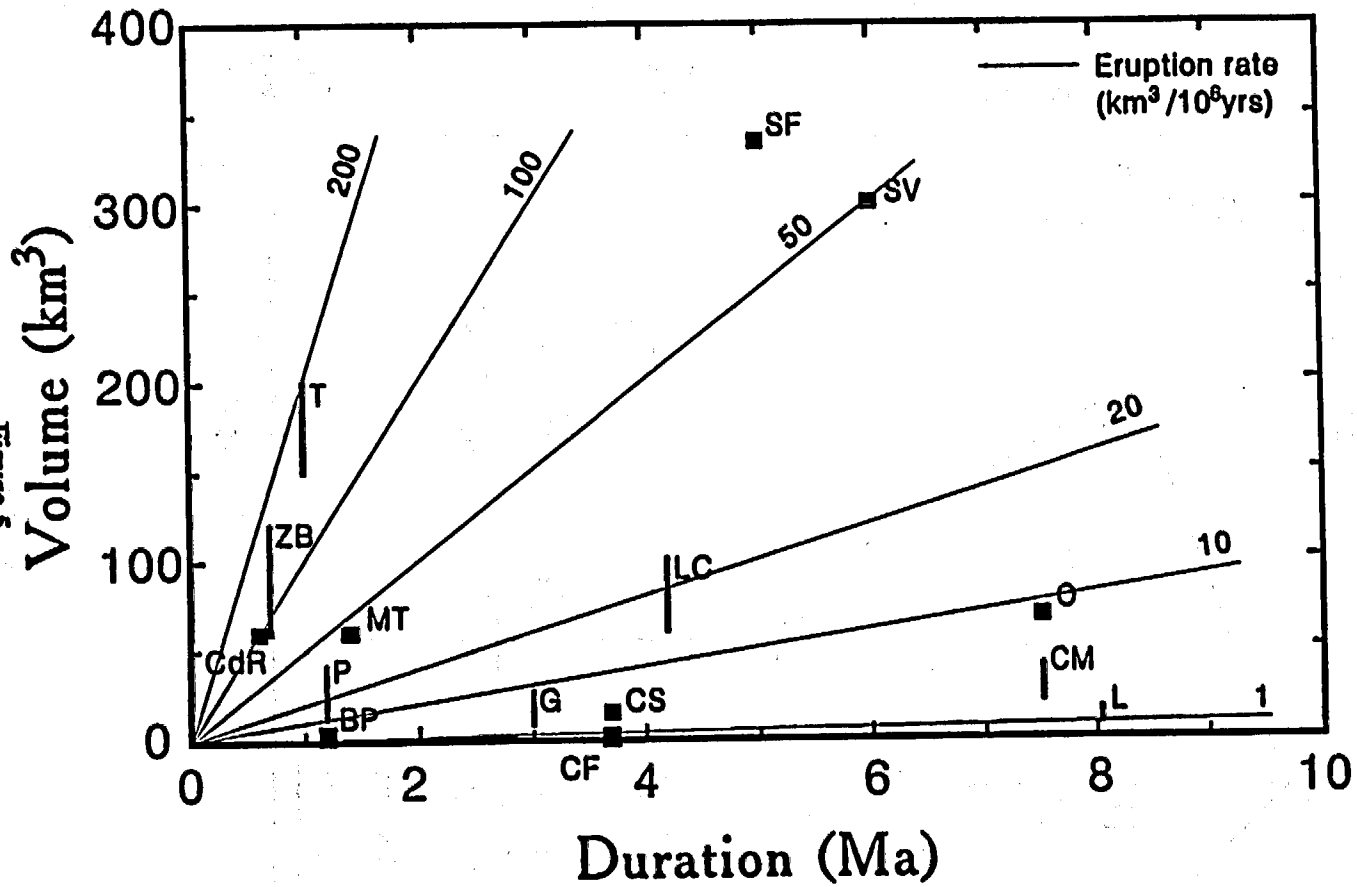

SF=San Francisco
SV=Springerville
T=Taos
CdR=Cerros del Rio
MT=Mount Taylor
ZB=Zuni-Bandera
L=Lucero
BP=Big Pine
P=Potrillo
G=Geronimo
LC=Lunar Crater
CM=Cima
CF=Crater Flat
O=Ocate
CS=Coso

Figure 5

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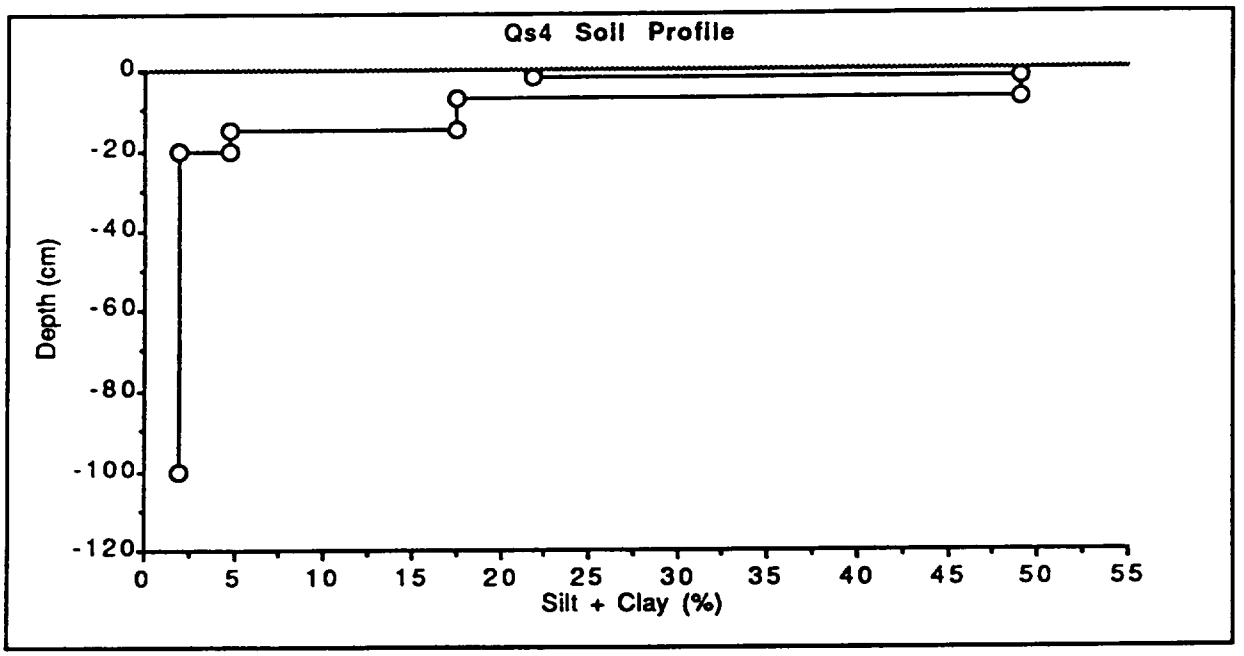

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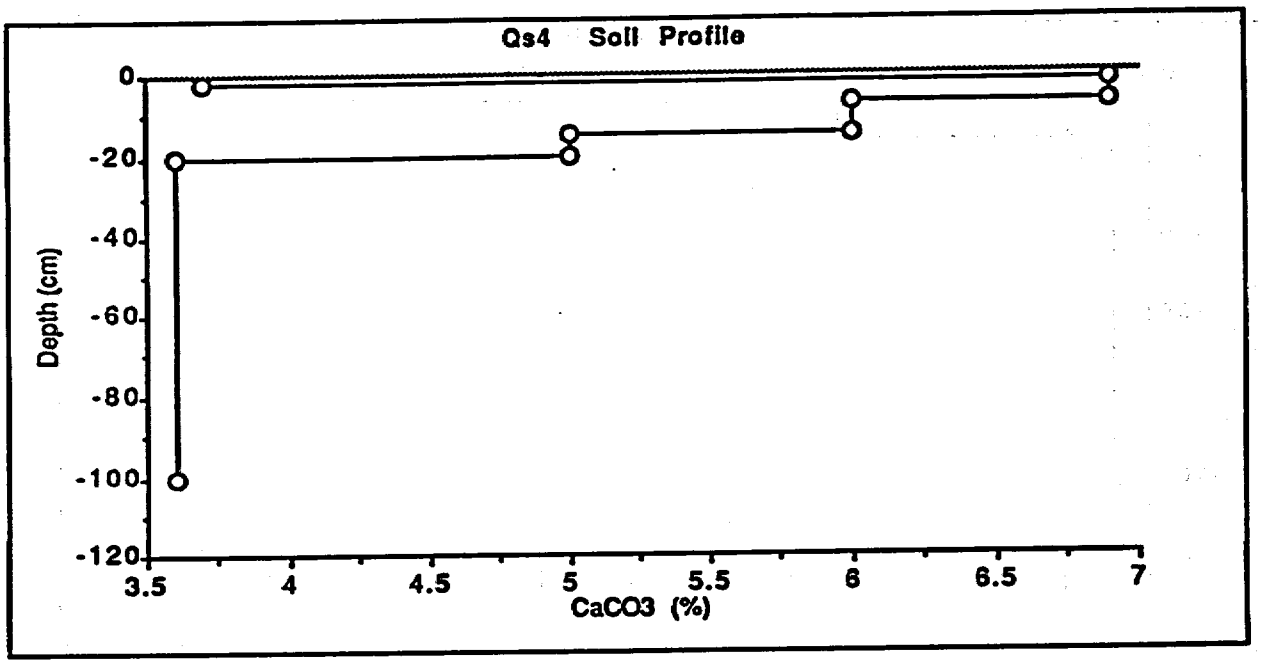

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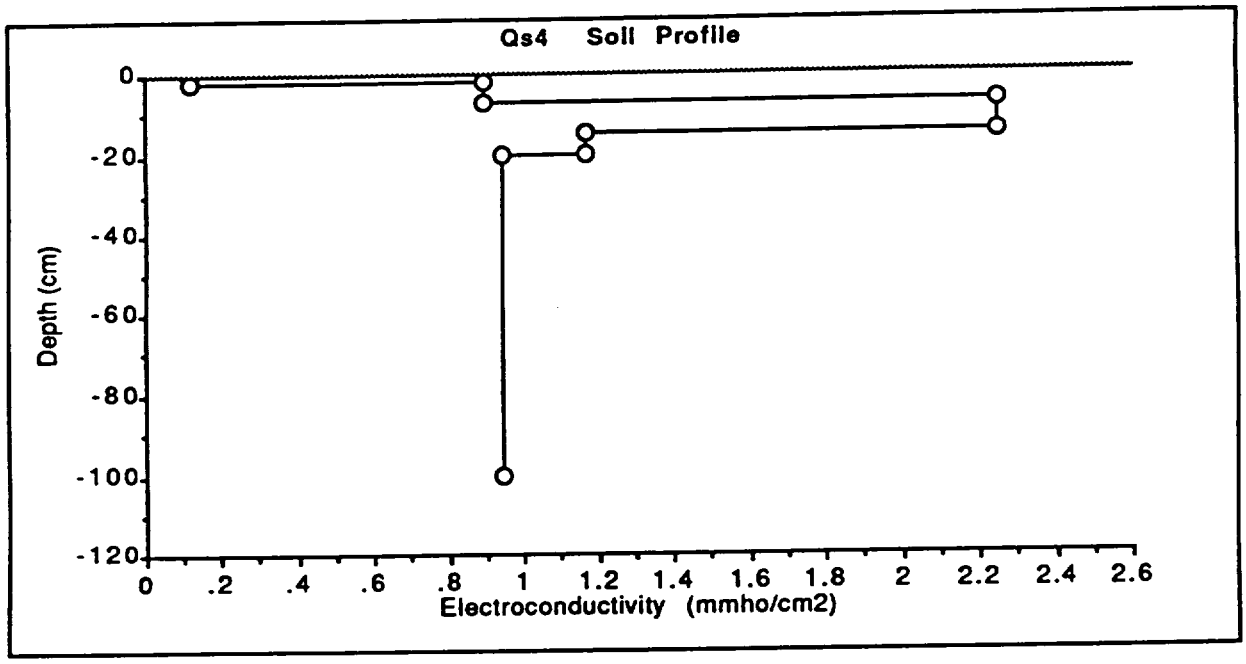

Figure 8

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Figure Captions (Paleomagnetism)

Figure 9. Generalized geologic map of the Lathrop Wells center showing the location of the ten (10) paleomagnetic sampling locations, referred to in the discussion as LW1 to LW10.

Figure 10. (a,b) Modified orthogonal demagnetization diagrams showing the endpoint of the magnetization vector projected onto the horizontal (E-W,N-S) plane (filled circles) and the true vertical (horizontal, U-D) plane for samples A and B from site LW1, in Ql6.. Each projection shows the magnetization vector measured after 40 milliTesla (mT) as well as higher peak inductions in alternating field demagnetization. Both examples display an essentially univectorial decay of the magnetization vector to the origin; the direction of the magnetization isolated over the interval from about 40 mT to over 100 mT is determined with a high degree of confidence.

Figure 11. (a,b,c,d). Equal area projections of sample magnetization directions, determined from results of progressive demagnetization, from sites LW1, LW2, LW9, and LW10. In all equal area projections, lower hemisphere projections are indicated in solid symbols and upper hemisphere projections in open symbols.

Figure 12. Equal area projection of sample magnetization directions from site LW4, in Ql6

Figure 13. Equal area projection of paleomagnetic data reported by Turrin et al. (1991) compared with the time-averaged, axial geocentric dipole (spin-axis) field direction for the Lathrop Wells locality and the 1985 IGRF/USGS field direction for Lathrop Wells.

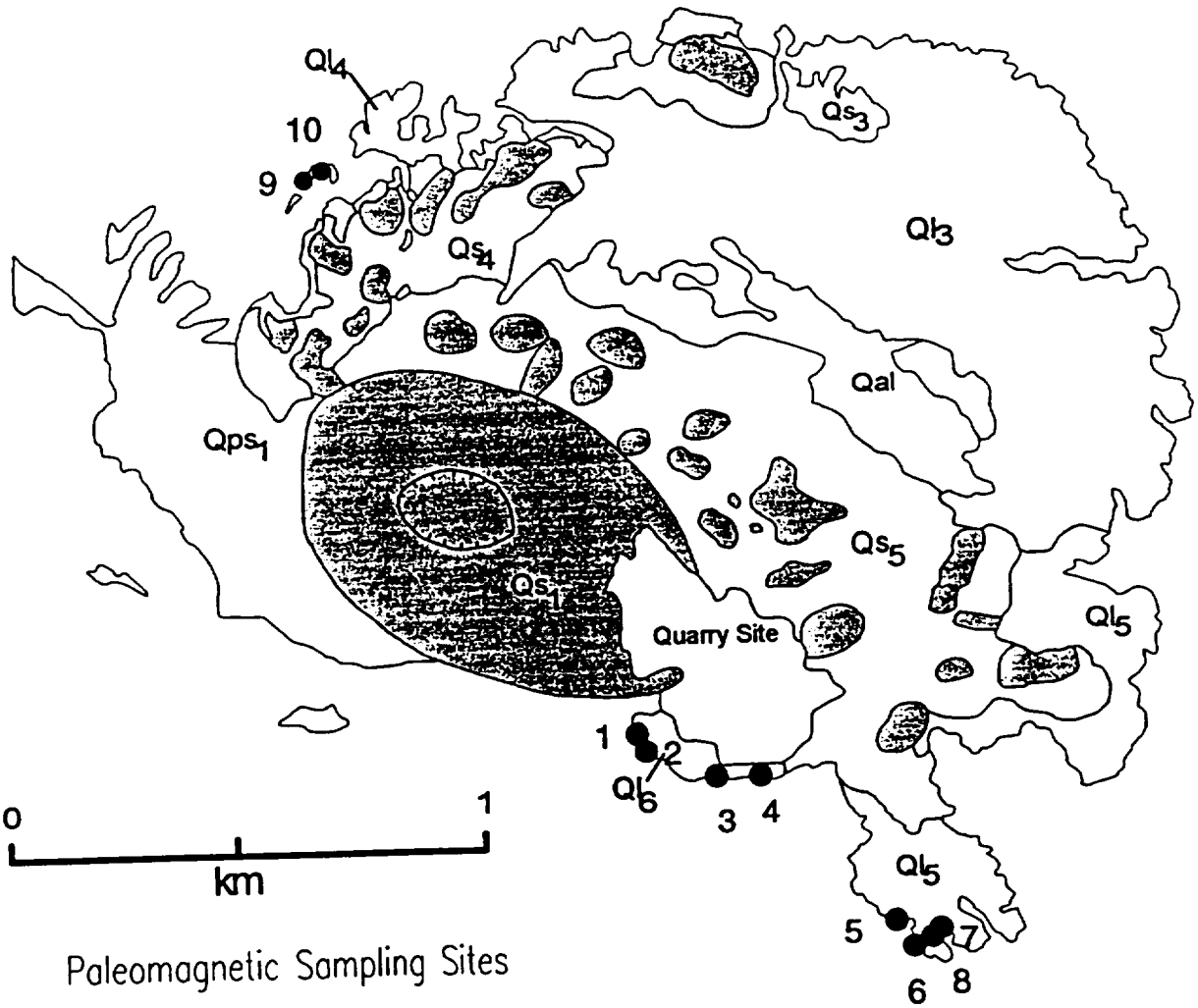

Figure 9

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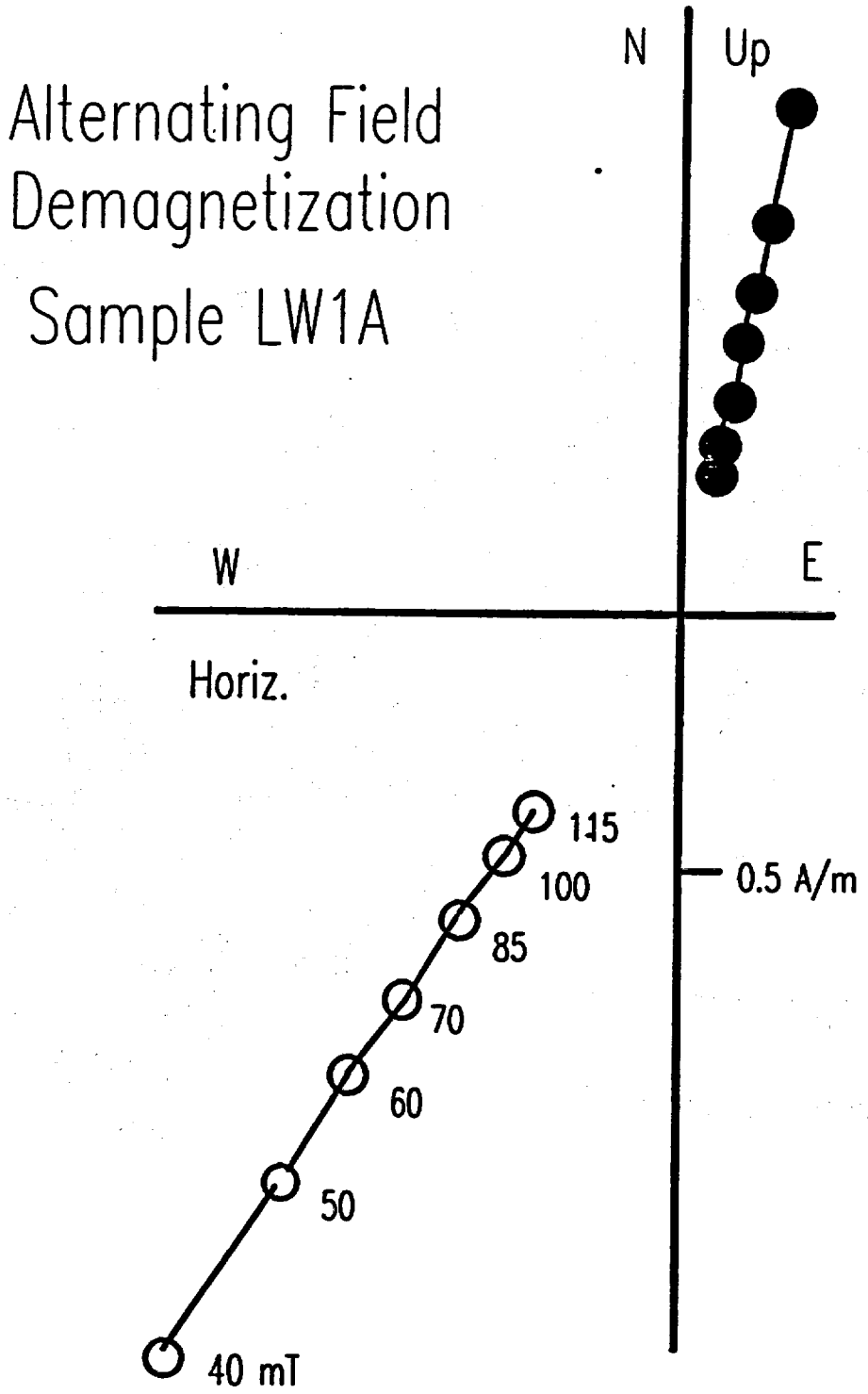

Figure 10a

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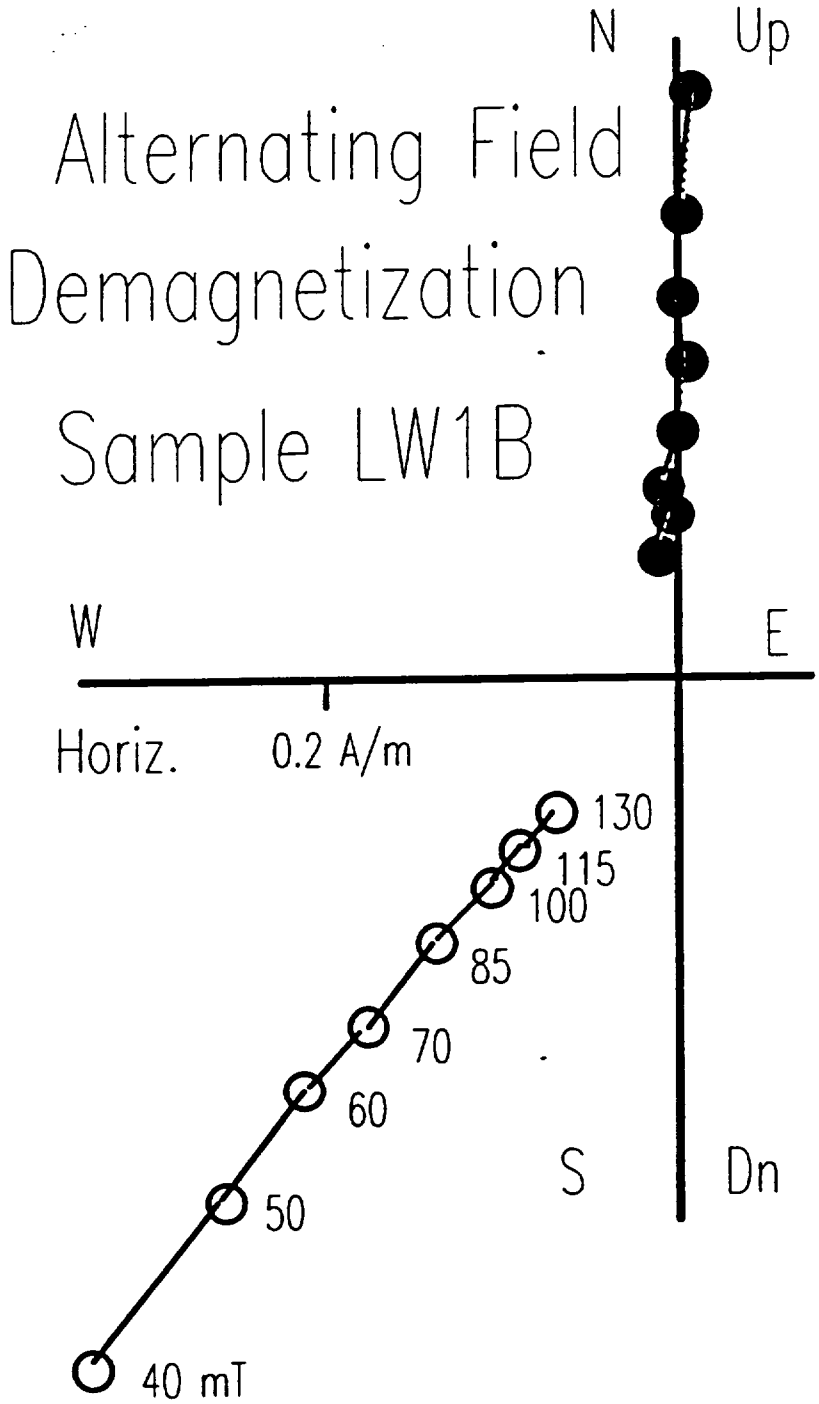

Figure 10b

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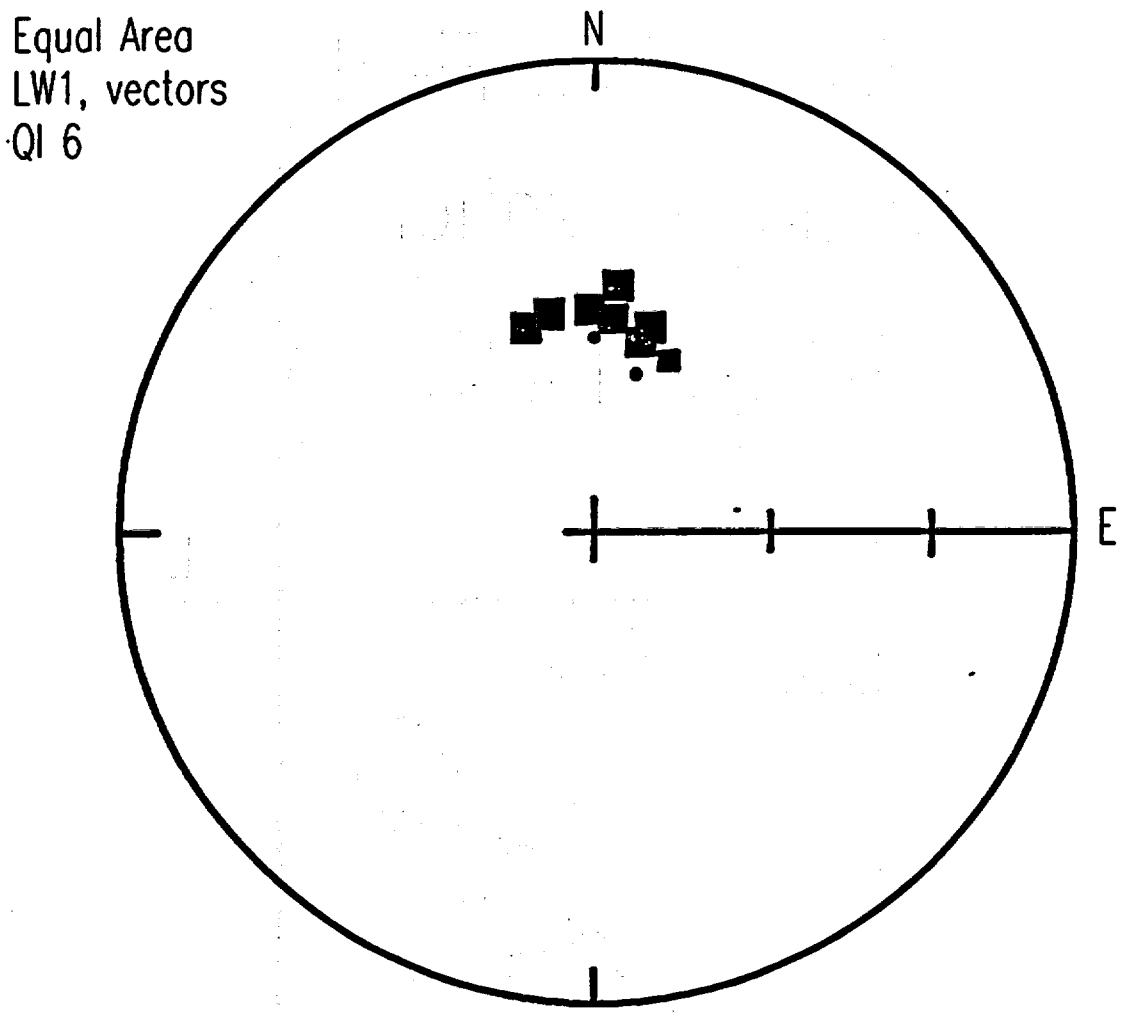

Figure 11a

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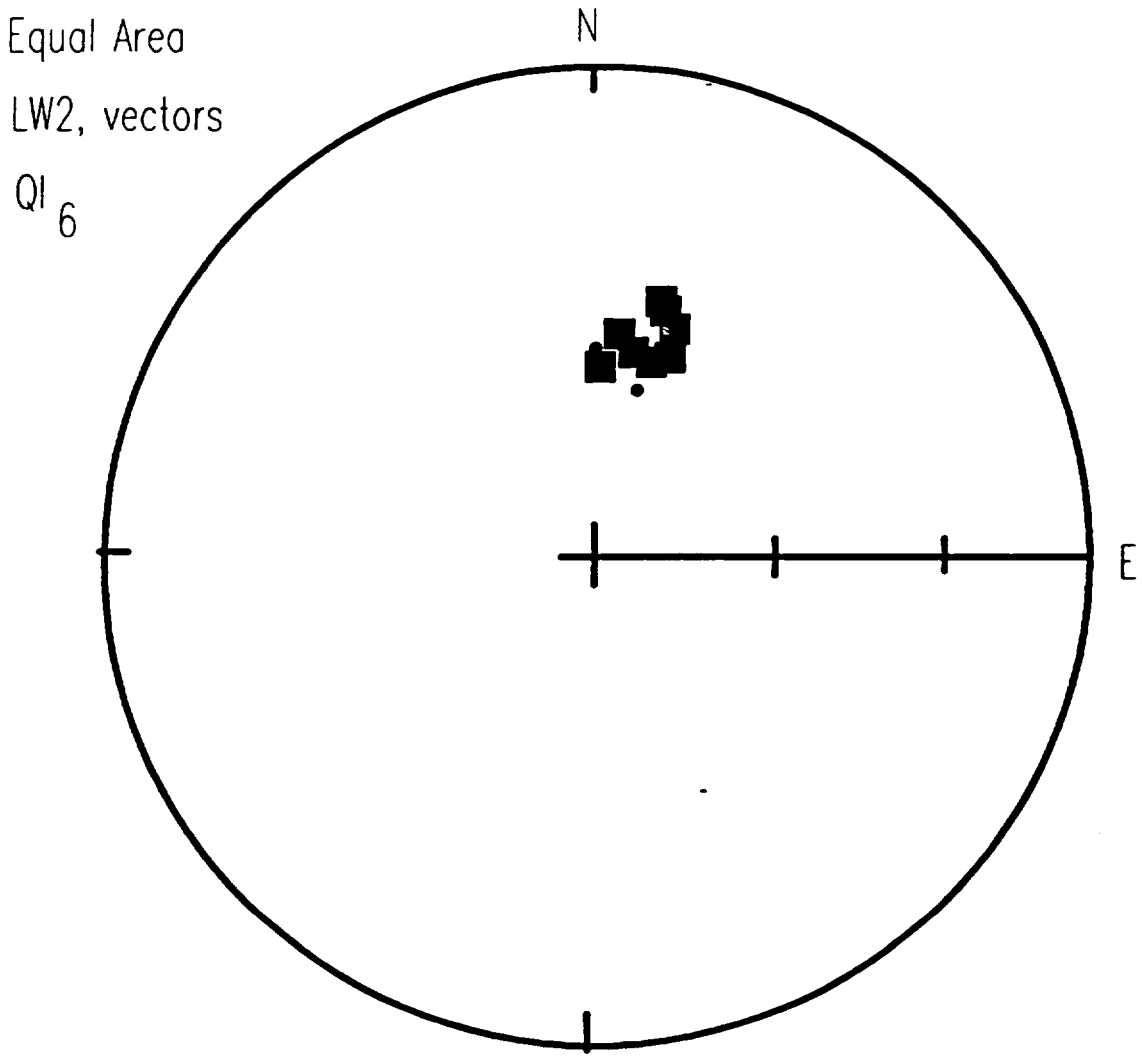

Figure 11b

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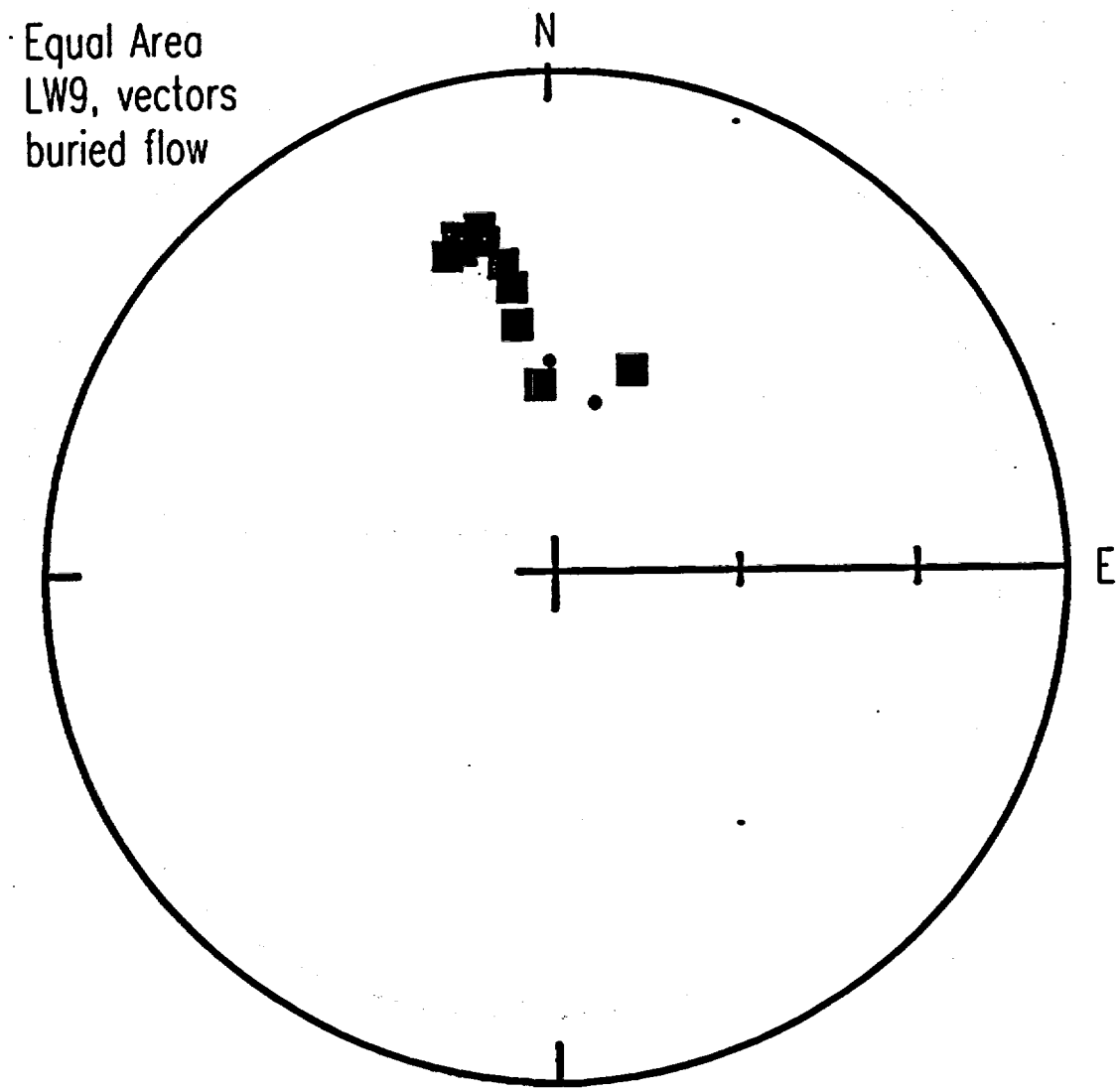

Figure 11c

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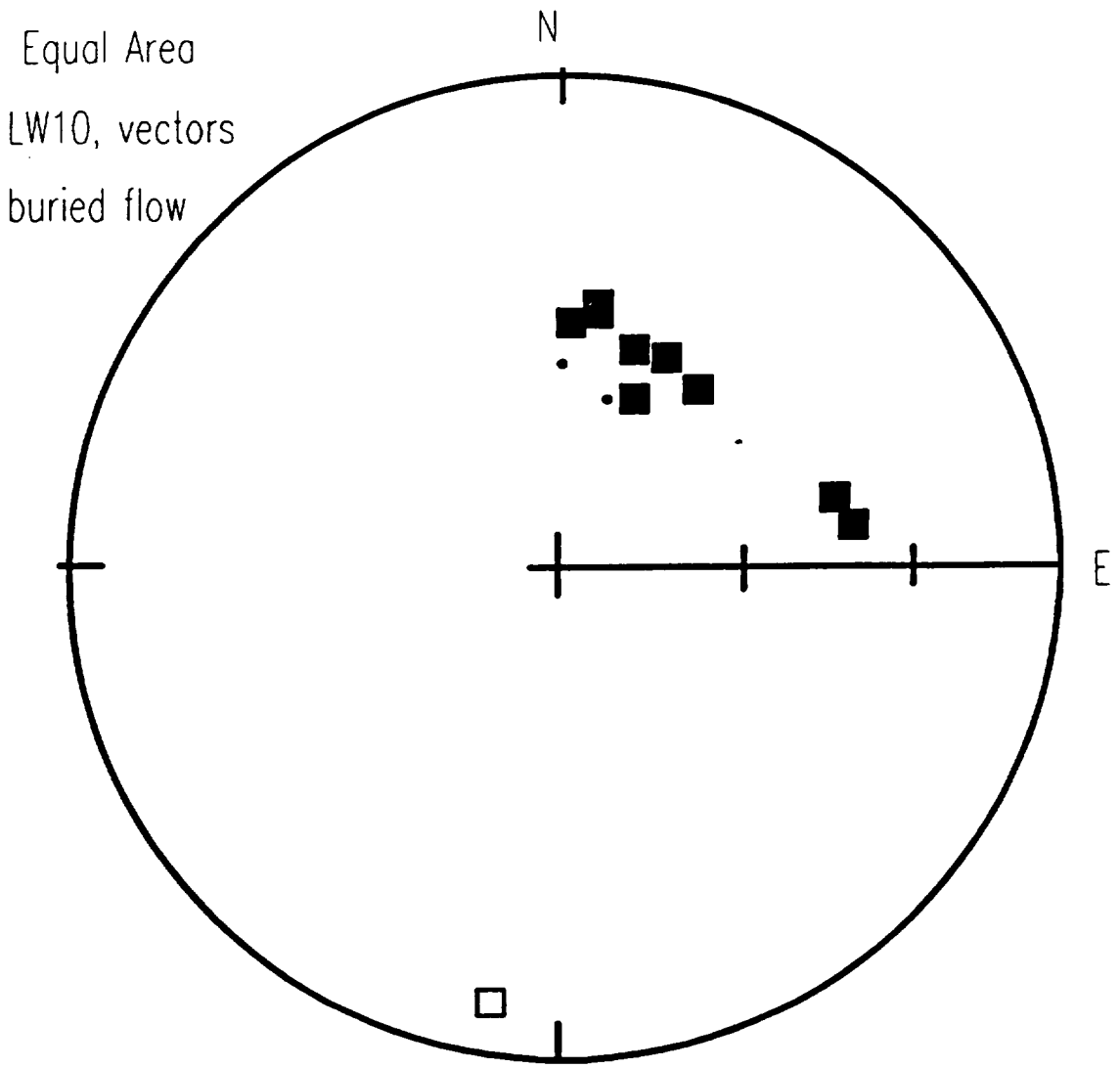

Figure 11d

LW4q16 3.000A- 13.000A
Geog Coordinates
Equal-Area

LEAST
Wed. 7 Oct. 1992

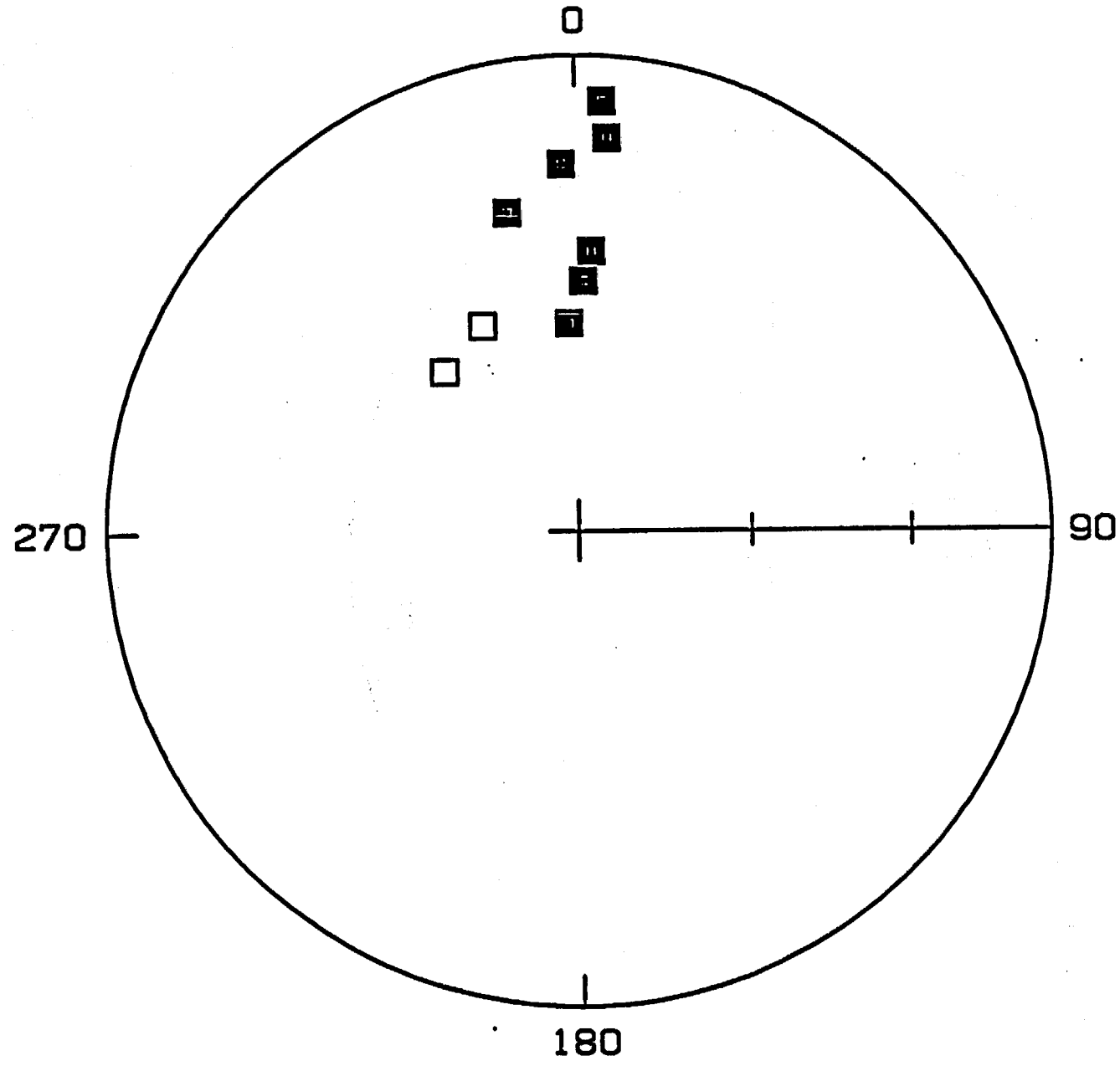

Figure 12

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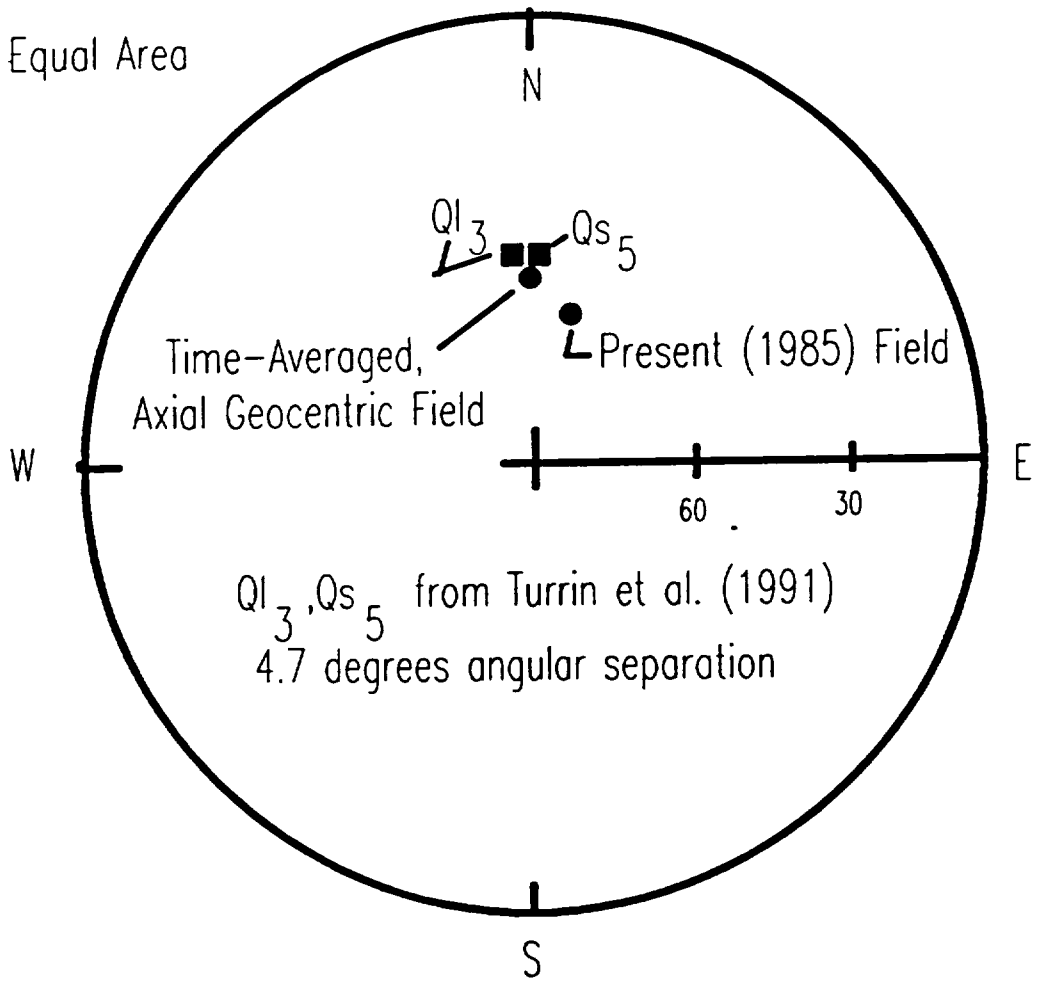
Equal Area
N
Ql 3
Qs 5
Time-Averaged,
Axial Geocentric Field
Present (1985) Field
W
E
60
30
Ql 3 ,Qs 5 from Turrin et al. (1991)
4.7 degrees angular separation
S

Figure 13

-335064

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

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December 4, 1992

TWS-EES-13-12-92-015

Mr. Carl P. Gertz, Project Manager
Yucca Mountain Site Characterization Project Office
US Department of Energy
P.O. Box 98608
Las Vegas, NV 89193-8608

Dear Mr. Gertz:

SUBJECT: HIGHLIGHTS OF THE LOS ALAMOS MONTHLY ACTIVITY REPORT—NOVEMBER 1992

Attached are the highlights of the Los Alamos Monthly Activity Report for November 1992. This internal document describes our technical work; however, the report has not received formal technical or policy review by Los Alamos or the Yucca Mountain Site Characterization Project. Data presented in this document represent work progress, are not referenceable, and are not intended for release from the US Department of Energy. If you have changes to our distribution list, please call me at (505) 667-0916.

Sincerely,

Susan H. Klein

Susan H. Klein

SHK/elm

Attachment: a/s

Cy w/att:
M. B. Blanchard, YMPO, Las Vegas, NV
T. E. Blejwas, SNL, Albuquerque, NM
J. A. Canepa, EES-13, MS J521
W. L. Clarke, LLNL, Livermore, CA
W. R. Dixon, YMPO, Las Vegas, NV
J. R. Dyer, YMPO, Las Vegas, NV
N. Z. Elkins, EES-13/LV, MS J900/527
L. D. Foust, CRWMS, M&O/TRW, Las Vegas, NV
L. R. Hayes, USGS, Denver, CO
V. F. Iorii, YMPO, Las Vegas, NV
M. Martin, M&O/TRW, Las Vegas, NV
A. R. Pratt, EES-13, MS J521
E. P. Springer, EES-13, MS J521
M. Voegele, SAIC, Las Vegas, NV
RPC File (2), MS M321
TWS-EES-13-File, MS J521

Cy w/o att.:
CRM-4, MS A150

ENCLOSURE 3

Los Alamos November 1992 Highlights

Publications
An article by S. Levy, "Natural gels in the Yucca Mountain area, Nevada, USA," was published in *Applied Clay Science* 7, 79-85 (1992).

A conference abstract by B. Carlos, "Distribution of Fracture-Lining Zeolites at Yucca Mountain, Nevada," was approved by YMPO (Zeolite '93 conference).

A conference paper by S. Levy, "Surface-Discharging Hydrothermal Systems at Yucca Mountain—Examining the Evidence," was approved by YMPO (Materials Research Society Symposium on the Scientific Basis for Nuclear Waste Management XVI).

WBS 1.2.3.2.1.1.1 Mineralogy, Petrology, and Rock Chemistry of Transport Pathways
Mineralogy and petrology was audited, and there were no findings. The auditors praised the group for their technical efforts. An abstract by B. Carlos was approved by YMPO. (See publications section.)

WBS 1.2.3.2.1.1.2 Mineralogic and Geochemical Alteration
The alteration history study was audited, and there were no findings. The first phase of long-term steam-heating experiments got underway. Powdered samples of Yucca Mountain materials used included devitrified tuff, vitric nonwelded tuff, vitrophyre, smectite-rich altered tuff, and zeolitic altered nonwelded tuff. A paper by S. Levy was approved by YMPO. A journal article by Levy was published. (See publications section.)

WBS 1.2.3.2.5 Postclosure Tectonics
A field trip was held to observe the geochronology of Cind-R-Lite volcanic center and to coordinate the volcanism studies with the tectonic studies of the USGS. Trench LW-1 at Cind-R-Lite volcanic center was deepened to allow for paleomagnetic sampling and for sampling to determine cosmogenic helium ages.

WBS 1.2.3.3.1.2.2 Water Movement Tracer Tests
Chlorine-36 results were received for 15 samples. The samples included ream-bit cuttings from USW-UZ-N37, soils from 5 Midway Valley trenches, and ground-water from USW-H1. All results were at or slightly below meteoric background values, as expected. This task was audited, and there were no findings.

WBS 1.2.5.2.2 Site Characterization Program
D. Vaniman and S. Levy completed their input to the draft YMP paper on calcite-silica deposits in Trench 14 and at Busted Butte. The paper will now undergo internal YMP review.

Support for the topical report on erosion rates at Yucca Mountain continued. The technical section of the preliminary draft was revised and Draft A of the report was submitted to the formal review process. TDIFs were submitted for (1) "Rock Varnish Cation Ratio Age Estimates of Boulder Deposits" and (2) "Calibration Rock Varnish Cation Ratio Data to Support the Rock Varnish Dating Curve for Yucca Mountain."

WBS 1.2.9.1.2 Technical Project Office Management
Environment, Safety, and Health questionnaire and self-assessments were provided to the DOE for RW/YMP work at Los Alamos. Staff participated in several cost evaluation study groups (site, ESF, early decision).

WBS 1.2.9.2.2 Project Control
Project Control staff hosted an on-site visit from the M&O.

WBS 1.2.11.2/3/5 Quality Assurance Program Development, Verification, and Engineering
The DOE YMP Audit 93-02 was conducted. Corrective Action Reports (CARs) YM 93-018 and YM 93-019 were issued for minor infractions against the software process. No CARs were issued for the technical activities.

WBS 1.2.15.3 Training
Staff is developing a customized training data base, which is expected to be in place by the end of the calendar year.

Reynolds Electrical & Engineering Co., Inc.

Post Office Box 98521 • Las Vegas, NV 89193-8521

OCT 15 2 15 PM '00

RPTS 5

IN REPLY REFER TO:
580-01-036

WBS 1.2.9.1
QA: N/A

October 13, 1992

Carl P. Gertz, Project Manager
Yucca Mountain Site Characterization
Project Office
U.S. Department of Energy
Post Office Box, 98608
Las Vegas, NV 89193-8608

I-333080

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT (YMP) STATUS REPORT (SCP: N/A)

Attached is the September YMP Status Report for Reynolds Electrical & Engineering Co., Inc.'s participation in the YMP.

If further information is required, please contact Sandra L. Hughes at 794-7192.

10/13/92

RF Pritchett

R. F. Pritchett, Manager
Yucca Mountain Project Division
YMP Technical Project Officer

RFP:SLH:mab

Enclosure
Status Report (3 pages)

cy: See page 2

Gertz
See Distribution
Lost (YMP)
Harrison

10/15/92

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ENCLOSURE 4

cy w/encl.
Information Services Center, M/S 408
C. E. Hampton, DOE/NV, M/S 505
L. M. Smith, DOE/NV, M/S 505
M. B. Blanchard, DOE/YMP, M/S 523
U. S. Clanton, DOE/YMP, M/S 523
M. O. Cloninger, DOE/YMP, M/S 523
W. R. Dixon, DOE/YMP, M/S 523
J. R. Dyer, DOE/YMP, M/S 523
B. D. Hutchinson, DOE/YMP, M/S 523
V. F. Iorii, DOE/YMP, M/S 523
E. H. Petrie, DOE/YMP, M/S 523
W. B. Simecka, DOE/YMP, M/S 523
W. A. Wilson, DOE/YMP, M/S 717
L. D. Foust, M&O, M/S 423
M. M. Martin, M&O, M/S 423
R. L. Robertson, M&O/Fairfax, VA
P. Prestholt, NRC/Las Vegas, NV
B. R. Gardella, REECo, M/S 408
W. J. Glasser, REECo, M/S 408
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R. A. Adams, SAIC, M/S 517
M. Brodeur, SAIC, M/S 517/T-23
R. D. Hutton, SAIC, M/S 517
S. C. Smith, SAIC, M/S 517/T-10
J. W. Teak, SAIC, M/S 517
J. E. Therien, SAIC, M/S 517

REYNOLDS ELECTRICAL & ENGINEERING CO., INC.
(REECo)

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT (YMP)

SEPTEMBER 1992 - STATUS REPORT

Reeco has no reportable Level 0 or Level 1 Milestones.

SITE (1.2.3)
WBS 1.2.3.2
Task: USGS Integrated Data Acquisition System (IDAS)

Continued support of IDAS to include receipt of Gemlink replacement equipment, technical inspection, equipment testing, maintenance and repairs.

Task: Fran Ridge Test Pits (Job Package 92-7)

Completed excavation to 20 foot depth of the northern pit. Cleaned bedrock with air-water blow pipes, backhoe and grader. Continued providing support as required.

WBS 1.2.3.5
Task: Capital Equipment to support Drilling Programs

Procurement is in process for the following drilling support equipment: Cuttings/handling system, hydraulic casing jacks and bag house, data recorder and monitors, and Class XIII drill rig. The drill rig was awarded to George E. Failing Company with a delivery date of December 16, 1992.

Task: Neutron Access Holes (Job Package 91-9)

Constructed road and pad for UZ-N31 and UZ-N32; constructed road for UZ-N35. Completed drilling/coring UZ-N31 at a total depth of 192 feet. Currently drilling/coring on UZ-N32, the fifth of 12 holes to be drilled in Phase II of the Neutron Access Boreholes. Present depth of the core hole is 48 feet. The 6-inch Odex casing is at 40 feet.

Task: North Portal Drill Hole and Surface Facility Test Pits (Job Package 92-2)

Completed cleaning bedrock with air-water blow pipe. Moved the CME-550 drill rig and associated equipment to NRG-1. Tripped in the hole to 28 feet; drove boulder (obstruction) to 142 feet. Upon DOE/YMP approval, left 8 feet of fill on the bottom. This task was accomplished using the LM-300 rig crew during the repair period on the LM-300 drill rig.

Task: UZ-16 Drilling and Testing (Job Package 92-3)

Resumed drilling operations on September 14, 1992, after suspension of operations on August 27, 1992 due to equipment failure. The Allison transmission on the LM-300 drill rig had to be replaced. Present depth of the core hole is 799 feet, and the present depth of the 12 1/4-inch ream hole is 759 feet.

Overheating problems with the Haz-Vac unit's engine have not been experienced due to cooler weather. Parts for a permanent fix are on order.

Task: Midway Valley Trenching (Job Package 92-5)

No field activity during this period.

Task: Soil & Rock Properties Test Pits Phase II (Job Package 92-8)

Completed excavation of all pits and roping of test pits.

Task: Quaternary Faulting (Job Package 92-12)

Completed excavation and fencing of four trenches south of Stagecoach Road; completed fencing of four trenches in Crater Flats.

Task: Lathrop Wells Trenching

Mobilized and completed two connecting perpendicular trenches and two safety catch benches totaling 4,000 BCY north of the cinder cone on two lava flows. Completed rope fencing of excavation.

EXPLORATORY STUDIES (1.2.6)
WBS 1.2.6.1
Task: Exploratory Studies Facility (ESF)

Source Evaluation Board continued evaluation of the proposals submitted for the Technical Support and Underground Excavation for the ESF.

Continued administrative support for ESF activities to include planning, scheduling, management and Title II design review. Participated in the Office of Civilian Radioactive Waste Management Construction Readiness Review of Package 1A.

FIELD OPERATIONS (1.2.7.4)
Task: Administrative & Maintenance Support

Continued support to W. A. Wilson, Yucca Mountain Site Manager to include: processing of purchase requisitions for Field Operations Center (FOC) Site Office requirements; providing support services to participants and maintenance on YMP utilized facilities, equipment and roads in Area 25; and providing logistical and support services to management contractor.

Provided support for the Yucca Mountain Site Office open house and public tours. Eight tours were held during this period with 345 people attending. Support included but was not limited to; arrangements for buses, registration of guests, coordination of lunches/beverages, medical service, furniture, mechanical service. Continued preparations for upcoming tours.

PROJECT MANAGEMENT (1.2.9)
WBS 1.2.9.1
Task: Management and Administrative Support

Continued coordination and staffing of YMP displays at meetings, exhibits, conferences and tours including the National Association of Regulatory Utility Commissioners tour and the American Society for Quality Control Conference; staffed and supported the Public Reading Room of the Research and Study Center.

Task: Site Characterization Plan (SCP) Distribution

Two SCP sets were distributed during this period. Two hundred copies each of the Overview and Progress Report #5 were provided to the Technical Information Section for distribution at professional conferences.

Task: Long Range Planning (LRP)

Continued status and update of Planning and Control System in support of Mission 2001; assisted in production of Title II Design Package 1A and construction schedules for Readiness Review; completed cost estimates as required.

WBS 1.2.9.3
Task: Quality Assurance (QA)

Continued actions to resolve Corrective Action Report CA-92-002 dealing with document control deficiencies. Corrective actions are scheduled to be completed by November 1, 1992.

Initiated planning for implementation of the first line Quality Control Inspection Program.

Reynolds Electrical & Engineering Co., Inc.

Post Office Box 98521 • Las Vegas, NV 89193-8521

I-334073

IN REPLY REFER TO:
580-01-089

WBS 1.2.9.1
QA: N/A

November 10, 1992

Carl P. Gertz, Project Manager
Yucca Mountain Site Characterization
Project Office
U.S. Department of Energy
Post Office Box, 98608
Las Vegas, NV 89193-8608

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT (YMP) STATUS REPORT (SCP: N/A)

Attached is the October YMP Status Report for Reynolds Electrical & Engineering Co., Inc.'s participation in the YMP.

If further information is required, please contact Sandra L. Hughes at 794-7192.

for R. F. Pritchett, Manager
Yucca Mountain Project Division
YMP Technical Project Officer

RFP:SLH:mab

Enclosure
Status Report (3 pages)

cy: See page 2

GERTZ
HAMPTON/SIMECKA
BLANCHARD/WILSON
CLANTON/HARRISON
DIXON
DYER
HUTCHINSON
JORII
PETRIE

11/12/92

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ENCLOSURE 5

cy w/encl.
Information Services Center, M/S 408
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M. B. Blanchard, DOE/YMP, M/S 523
U. S. Clanton, DOE/YMP, M/S 523
M. O. Cloninger, DOE/YMP, M/S 523
W. R. Dixon, DOE/YMP, M/S 523
J. R. Dyer, DOE/YMP, M/S 523
B. D. Hutchinson, DOE/YMP, M/S 523
V. F. Iorii, DOE/YMP, M/S 523
E. H. Petrie, DOE/YMP, M/S 523
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S. C. Smith, SAIC, M/S 517/T-10
J. W. Teak, SAIC, M/S 517
J. E. Therien, SAIC, M/S 517

REYNOLDS ELECTRICAL & ENGINEERING CO., INC.
(REECo)

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT (YMP)

OCTOBER 1992 - STATUS REPORT

Reeco has no reportable Level 0 or Level 1 Milestones.

SITE (1.2.3)
WBS 1.2.3.2
Task: USGS Integrated Data Acquisition System (IDAS)

Continued support of IDAS to include technical support, equipment testing, maintenance and repairs. At USGS request, purchased Gemlink replacement equipment after successful performance testing.

Task: Fran Ridge Test Pits (Job Package 92-7)

Provided one day of photographic support.

WBS 1.2.3.5
Task: Capital Equipment to support Drilling Programs

Procurement is in progress for the following drilling support equipment: Cuttings/handling system, hydraulic casing jacks and bag house, data recorder and monitors, and Class XIII drill rig. Delivery date for the drill rig is December 16, 1992. A Letter of Protest was received from Longyear Co. and has been submitted for legal review and determination.

Task: Neutron Access Holes (Job Package 91-9)

Completed site preparation for borehole N-35. Began site preparation for neutron boreholes N-57, N-58, N-59 and N-61. Completed drilling/coring of UZ-N32 at a total depth of 207 feet. Completed drilling/coring UZ-N35 at a total depth of 175 feet. Currently drilling/coring on UZ-N57 at 45 feet. UZ-N57 is the seventh of twelve boreholes to be drilled in Phase II of the Neutron Access Borehole Program.

Task: North Portal Drill Hole and Surface Facility Test Pits (Job Package 92-2)

The CME-550 drill rig and associated equipment remains on the NRG-1 borehole awaiting geophysical logging. It is anticipated that the borehole will need to be cleaned out prior to logging.

Task: UZ-16 Drilling and Testing (Job Package 92-3)

Drilling/coring operations continue. Present depth of the core hole and the 12 1/4-inch reamed hole is 919 feet. Progress has been slowed somewhat due to an attempt to control the borehole deviation. The deviation at 759 feet was 2 degrees - 10 minutes. Utilizing the deviation control reaming method,

deviation surveys indicate the borehole angle has stabilized and/or has been slightly reduced. Coring will continue to be limited to 20 feet ahead of the reamed hole. Reaming will now be accomplished with the 12 1/4-inch open-centered bit, thus eliminating tripping of the dual-wall drill pipe. Progress should improve.

Task: Midway Valley Trenching (Job Package 92-5)

Began work on Trench 7 at Midway Valley.

Task: Soil & Rock Properties Test Pits Phase II (Job Package 92-8)

Completed roping of test pits.

Task: Quaternary Faulting (Job Package 92-12)

No activity during this period.

Task: Lathrop Wells Trenching

Completed trench excavation of the Lathrop Wells cinder cone.

Task: Borehole Security Program

Completed Program #1 consisting of capping and locking 30 boreholes.

EXPLORATORY STUDIES (1.2.6)
WBS 1.2.6.1
Task: Exploratory Studies Facility (ESF)

Source Evaluation Board conducted meetings with potential subcontractors on Request for Proposal 1-DH-92, Technical Support and Underground Excavation for the ESF. Any amended proposals are due on or before 4 p.m, November 18, 1992.

Continued administrative support for ESF activities to include; planning, scheduling, management and Title II design review. Participated in Raytheon Services Nevada Management (RSN) and Technical Review of the ESF Ramp and Main Drift Sizing Analysis, verified comments made on the ESF Title II Design Package 1A for North Ramp Area; conducted a site visit to inspect the 19′ Robbins Tunnel Boring Machine for potential use on the ESF.

FIELD OPERATIONS (1.2.7.4)
Task: Administrative & Maintenance Support

Continued support to W. A. Wilson, Yucca Mountain Site Manager to include: processing of purchase requisitions for Field Operations Center (FOC) Site Office requirements; providing support services to participants and maintenance on YMP utilized facilities, equipment and roads in Area 25; and providing logistical and support services to management contractor.

Provided support for the Yucca Mountain Site Office open house and public tours. Thirteen tours were held during this period with 673 people attending. Support included but was not limited to; arrangements for buses, registration of guests, coordination of lunches/beverages, medical service, furniture, mechanical service. Continued preparations for upcoming tours.

PROJECT MANAGEMENT (1.2.9)

WBS 1.2.9.1

Task: Management and Administrative Support

Continued coordination and staffing of YMP displays at meetings, exhibits, conferences and tours including the 1992 Jaycee State Fair and the Geological Society of America Conference; staffed and supported the Public Reading Room of the Research and Study Center.

Task: Site Characterization Plan (SCP) Distribution

Four SCP sets and seventeen copies each of Progress Reports 2, 3, 4 and 5 were distributed during this period.

Task: Long Range Planning (LRP)

Continued status and update of Planning and Control System (PACS) in support of FY 1993 planning; supported Title II Design Package 1A schedules and completed cost estimates as required.

WBS 1.2.9.3

Task: Quality Assurance (QA)

Arranged for personnel to attend initial training for Soils and Concrete inspection personnel arranged by CRWMS/M&O.

Identified personnel requirements to support near term first line inspections. Initiated and approved work orders to obtain field and material testing services from RSN or other acceptable suppliers.

Reynolds Electrical & Engineering Co., Inc.

Post Office Box 98521 • Las Vegas, NV 89193-8521

DEC 11 10 25 AM '00

I-335117 ST

IN REPLY REFER TO:
580-01-145

WBS 1.2.9.1
QA: N/A

December 12, 1992

Carl P. Gertz, Project Manager
Yucca Mountain Site Characterization
Project Office
U.S. Department of Energy
Post Office Box, 98608
Las Vegas, NV 89193-8608

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT (YMP) STATUS REPORT (SCP: N/A)

Attached is the November YMP Status Report for Reynolds Electrical & Engineering Co., Inc.'s participation in the YMP.

If further information is required, please contact Sandra L. Hughes at 794-7192.

RF Pritchett

R. F. Pritchett, Manager
Yucca Mountain Project Division
YMP Technical Project Officer

RFP:SLH:mab

Enclosure
Status Report (4 pages)

cy: See page 2

DIVISION Gertz
CC: See Distribution
CC: List (YMP)
CC: Berkof
CC: Brodsky
CC: Jones, S
CC: Walters
CC: Stucker - LWSB
CC:

REC'D IN YMP
12/11/92

cy w/encl.
Information Services Center, M/S 408
C. E. Hampton, DOE/NV, M/S 505
L. M. Smith, DOE/NV, M/S 505
M. B. Blanchard, DOE/YMP, M/S 523
M. O. Cloninger, DOE/YMP, M/S 523
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B. D. Hutchinson, DOE/YMP, M/S 523
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S. C. Smith, SAIC, M/S 517/T-10
J. W. Teak, SAIC, M/S 517
J. E. Therien, SAIC, M/S 517

REYNOLDS ELECTRICAL & ENGINEERING CO., INC.
(REECo)

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT (YMP)

NOVEMBER 1992 - STATUS REPORT

Reeco has no reportable Level 0 or Level 1 Milestones.

SITE (1.2.3)
WBS 1.2.3.2
Task: USGS Integrated Data Acquisition System (IDAS)

Continued support of IDAS to include technical support, equipment testing, maintenance and repairs.

WBS 1.2.3.5
Task: Capital Equipment to support Drilling Programs

Procurement is in progress for the following drilling support equipment: Cuttings/handling system, hydraulic casing jacks and bag house, data recorder and monitors, and Class XIII drill rig. Delivery date for the drill rig is December 16, 1992. The Letter of Protest received from Longyear Co. was reviewed by Legal and resolved.

Task: Neutron Access Holes (Job Package 91-9)

Completed drilling/coring UZ-N57 and UZ-N58 at a total depth of 119 feet. The CME-850 drill rig and crew are presently drilling/coring on UZ-N59 at 12 feet. UZ-N59 is the tenth of twelve boreholes in the Phase II program.

Task: North Portal Drill Hole and Surface Facility Test Pits (Job Package 92-2)

Utilizing the CME-850 drill crew, cleaned out the North Portal Ramp Borehole to 148 feet in preparation for geophysical logging. Fished lead weight out of the hole after it was inadvertently lost during logging operations by the U.S. Bureau of Reclamation. Plugged the hole from total depth to the surface with neat cement. Demobilized the CME-550 drill rig and associated equipment.

Task: UZ-16 Drilling and Testing (Job Package 92-3)

Continued drilling/coring operations. Present depth of the core hole is 1096 feet, and depth of the 12 1/4-inch reamed hole is 1089 feet. Borehole deviation remains stabilized at 2 degrees.

Task: Midway Valley Trenching (Job Package 92-5)

Completed dozer excavation of trench MVW-T7. Provided labor support to Principal Investigator for MWV-T7 and MWV-T5A. Completed backfill of Trench MWV-T7, MWV-T5A, and MWV-T6.

Task: Soil & Rock Properties Test Pits Phase II (Job Package 92-8)

No activity during this period.

Task: NRG-6 Drill Pad and Access Road (Job Package 92-10)

Completed access road and drill pad.

Task: NRG-6 Drilling and Testing (Job Package 92-11)

Mobilized the Joy 1 drill rig and the third day shift drill crew at NRG-6 on November 18, 1992. Present depth of the core hole is 22 feet. The 6 5/8-inch casing is at 11 feet. NRG-6 is scheduled to be drilled to a total depth of 1100 feet plus or minus 50 feet.

Task: Quaternary Faulting (Job Package 92-12)

No activity during this period.

Task: Borehole Security Program

Completed plugging and abandonment of boreholes UE-25, RF-9, RF-10, and RF-11 in accordance with the Borehole Security Work Program. Boreholes were plugged from total depth to the surface with neat cement in preparation for the Exploratory Studies Facility (ESF) pad construction.

REGULATORY (1.2.5)
WBS 1.2.5.2.4
Task: Site Characterization Plan (SCP) Reference Library and Database

Distributed five SCP sets during this period.

EXPLORATORY STUDIES (1.2.6)
WBS 1.2.6.1
Task: Exploratory Studies Facility (ESF)

Continued administrative support for ESF activities to include; planning, scheduling, management and Title II design review. Completed the Title II Management and Independent Review of the second half of Design Package 1A.

Issued the Request for Proposal (RFP) for crushing aggregate and conducted a preproposal conference. The RFP closing date has been extended to December 17, 1992.

Completed preparations to procure a new or remanufactured Tunnel Boring Machine, and submitted the purchasing requisition and specifications to Procurement on December 1, 1992. Submitted the Procurement Package to DOE/NV on December 7, 1992, for review and approval.

Source Evaluation Board received and began review of amended proposals from prospective subcontractors for Request for Proposal 1-DH-92, Technical Support and Underground Excavation for the ESF.

Task: ESF North Portal Pad & Facilities

Mobilized equipment and manpower and commenced construction on November 30, 1992, Milestone RM645.

TEST FACILITIES (1.2.7)
Task: Field Operations Support

Continued logistical and tour support for DOE Yucca Mountain Site (YMSO) staff. Eight tours were held during this period with 400 people attending. Support included but was not limited to; arrangements for buses, registration of guests, coordination of lunches/beverages, medical service, furniture, mechanical service. Continued preparations for upcoming tours.

Continued support services to participants; and maintenance of YMP utilized facilities, utilities, equipment and roads in Area 25. Issued RFP and held preproposal conference for removal and repair of broken windows in Building 4015 in Area 25. The RFP closing date is December 9, 1992.

PROJECT MANAGEMENT (1.2.9)
WBS 1.2.9
Task: Technical Project Office Management/Project Control

Continued normal administrative level of effort support. Continued status and update of Planning and Control System (PACS) in support of FY 1993 planning; supported Title II Design Package 1A schedules and completed cost estimates as required.

QUALITY ASSURANCE (1.2.11)
WBS 1.2.11
Task: Quality Assurance

Continued normal administrative level of effort support. Continued planning for implementation of first line quality control inspection program to include procedure

completion, revision and approval. Completed all actions to resolve Corrective Action Report CA-92-001 on Document Control deficiencies.

ENVIRONMENT, SAFETY & HEALTH (1.2.13)
WBS 1.2.13
Task: Safety & Occupational Health

Provided medical, occupational safety, industrial hygiene and fire protection support.

SUPPORT SERVICES (1.2.15)
WBS 1.2.15
Task: Administrative Support and Training

Continued to provide procurement, logistical, and information management administrative level of effort support; continued support services to various YMP participants.

United States Department of the Interior

GEOLOGICAL SURVEY
BOX 25046 M.S. _____
DENVER FEDERAL CENTER
DENVER, COLORADO 80225

TAKE PRIDE IN AMERICA

DEC 17 2 33 PM '92

IN REPLY REFER TO:

WBS: 1.2.9.2
QA: N/A

December 11, 1992

Carl P. Gertz, Project Manager
Yucca Mountain Site Characterization Project Office
U.S. Department of Energy
P.O. Box 98608
Las Vegas, Nevada 89193-8608

SUBJECT: U.S. Geological Survey Yucca Mountain Project Monthly Summary for October/November, 1992.

Dear Carl:

In compliance with the revised Yucca Mountain Project monthly reporting procedures, following is the YMP USGS input for October/November, 1992. If you have any questions, please contact Raye Ritchey at (303)236-0517.

I-335391

WBS 1.2.3 - SITE INVESTIGATIONS

The following study plans were submitted for DOE/YMPO review during November:

8.3.1.2.2.4, Characterization of UZ Percolation, ESF Study
8.3.1.2.2.7, Unsaturated Zone Hydrochemistry
8.3.1.2.2.8, Fluid Flow in Unsaturated Fractured Rock

The HIP reports and publications section is currently processing 94 YMP-HIP scientific publications, 61 YMP-GSP scientific publications, 7 YMP-LBL scientific publications, and 29 abstracts.

USGS staff participated in YMPO workshops to formulate strategies for prioritizing and reducing the life-time costs of various parts of the overall site characterization program.

In support of precipitation and meteorological monitoring activities, all synoptic and site meteorological data for FY 92 were collected for entry into the PDA. The synoptic data (weather charts and maps and satellite imagery) are in the process of being reviewed and analyzed to determine which of the six category types occurred during the year and the frequency of each type. During November, no precipitation activity occurred in the Yucca Mountain region. New 8" gauges were installed at several locations to fill in gaps in the collection gauge network.

#210-A

ENCLOSURE 7

The surface water runoff project reports that proposed locations of three planned continuous-recording gauges in upper Fortymile Wash were relocated to selected sites on Yucca Mountain to provide surface-water data in support of current ground-water studies in the unsaturated zone. Applications for prerequisite surveys are being prepared. A large regional storm from the Pacific moved through southern Nevada in late October; no flow was observed to have occurred within washes at and in the vicinity of Yucca Mountain. Minor flow was observed in upper Fortymile Wash at the continuous recording gauge near Rattlesnake Ridge.

Staff from the regional potentiometric levels project obtained hydrochemical samples from a 1500′-deep well in the Amargosa Desert using a modular jack pump. Field analyses indicated that the waters from different depths had markedly different chemistries. During the pumping of the deep piezometer, water levels were observed not to change in the shallow piezometer, in spite of the fact that 500′ of drawdown was achieved in the deep piezometer. This observation confirmed the vertical isolation of the two piezometers.

In support of regional hydrologic system synthesis and modeling, statistical correlations were investigated between saturated hydraulic conductivity, porosity and unsaturated hydraulic parameters used to characterize the moisture retention properties. A paper is being written summarizing the results.

Work began on the regional potentiometric surface map. Surface geology and 3-D cross sections were analyzed to determine where lithology and structure impede regional ground-water flow. Interbasinal flux boundaries were delineated. Diffuse discharge and phreatophyte areas were mapped. Spring locations were plotted and well locations with depth to water data were incorporated.

Staff from the surficial materials project began an experimental sampling project by collecting small grab samples from the surface soils near each neutron hole on the regular monitoring schedule. These bulk samples then are processed in the laboratory to determine water potential, gravimetric water content, particle size analysis, and particle density, which will be used to develop a soil water characteristic curve for field conditions to be compared with a laboratory determined one.

In support of natural infiltration studies, current work on the water balance studies involves estimating surface evaporation for upper boundary conditions for the small scale watershed model. Bowen ratio data from the last year has been organized and analyzed for accuracy by comparing it with estimates using the Priestley Taylor equation for actual evapotranspiration (ET) which incorporates soil water content. Soil water content was estimated for the year from neutron log values in the top meter of the soil at N-14, which is located next to the Bowen ration station. These methods have matched each other fairly well and correspond reasonably with rainfall data and high radiation/high ET days. A

one-dimensional small scale watershed model was developed for one neutron hole, N-7, which is calibrated against the neutron log profile using 1984 data, in which there was a runoff event and obvious downward infiltration pulses and loss to the surface through evaporation. Weather data from Desert Rock for the past 60 years is being used as input to estimate water content profiles during that time. This model will be expanded to evaluate its use on other boreholes and will eventually be applied to a 3-D small watershed. A model was developed to look at one-dimensional net infiltration as it is affected by long and short term climatic changes from the surface to the water table. Preliminary results have shown that Yucca Mountain is not in steady state and that the Paintbrush nonwelded tuffs are probably not a capillary barrier while the Topopah Spring caprock and basal vitrophyre are, more than likely, flow barriers.

The artificial infiltration project reports that the exposed alluvial profile at neutron access hole N-85 was measured, described, and sampled. Bulk samples were taken from each horizon and will be used to characterize selected physical and chemical properties of the site. Samples also were taken so that the water content and water potential of each horizon could be determined. The large infiltration ring was installed around the neutron hole in an effort to prevent any surface disturbance of the area.

In support of matrix hydrologic properties testing, measurements were concluded on the canned core samples from USW-UZN-55 borehole with the completion of high-temperature drying of the rocks at approximately 800 degrees C. Physical property measurements on the USW-UZN-54 canned core samples are nearing completion. These cores also are undergoing high temperature drying, but it is proceeding to 800 degrees C in steps of 200 degrees C, with a gravimetric water content measurement taken at each. Plans call for an indication of the dehydration rates of various clay and zeolite minerals to be determined from the data, as well as showing the temperatures at which non-refractory minerals, such as carbonate, dissociate and significantly change the weight of the samples. Permeability measurements on transect samples are continuing. Saturated hydraulic conductivity analyses were completed on plugs from the traverse through the Tiva Canyon shardy base.

Drilling of UZ-16 continued throughout October and November. The depth of the borehole at the end of November was approximately 1100 feet. Problems with control of borehole deviation appear to have been resolved, with the borehole maintaining a stable 2 degree deviation. Nine hundred feet of UZ-16 core were logged. Preliminary logging emphasis is on identifying and describing fractures and fracture fillings. Twenty-three core samples from the first 540 feet of UZ-16 core were identified and tagged for velocity measurements. Additional samples (from 540 to 1100 feet) will be identified and tagged for velocity measurements in December.

The integrated data acquisition system (IDAS) project reports that

successful testing of the 10 MHZ telemetry systems was completed. These units will replace the GEMLink 23 GHZ systems which proved to be unsatisfactory for use in a multi-drop communications network. The integration test plan for the IDAS was completed.

In support of intact fracture testing, the north test pit (#1) at Fran Ridge has been inspected and could be used as a possible sampling site. There are areas in the test pit which could yield cores suitable for testing. When the mapping work is complete, the bottom of the test pit will be mucked out entirely, and possibly some surfaces of the walls disturbed to enhance evaluation of the sampling sites.

In support of radial borehole testing, the requirements of the downhole liner-packer system were defined. The units must operate in 318 inch holes up to 150 feet in length, and isolate a minimum of 15 test intervals. The test intervals must be connected to the surface with teflon tubing to allow gas sampling and pressure monitoring.

The gaseous phase circulation study reports that plans for conducting convergent-flow tests in borehole USW UZ-6s were formulated and preparations for conducting these tests scheduled to begin in December, are underway. Results from these tests will be used to model $^{14}CO_2$ and other gaseous radionuclide emanations from the repository to the atmosphere.

Unsaturated zone hydrochemistry staff are performing tracer injection at UZ-16, NRG-6 and NRG-1, including the setup of injection systems and sampling ports, and collecting and analyzing drilling air samples. The flow volume of the drilling air is measured and calculated and the appropriate concentrations of tracer gas added to the drilling air by adjusting the mass flow controller. The mass flow controller can be adjusted rapidly to match changes in the flow volume of drilling air.

Staff from the aqueous phase chemical investigations project performed chemical analysis of pore-water extracted from a one-dimensional compression test using the M1-442 Potassium Microelectrode. Tests were performed on suites of pore-water samples extracted from different pressure loads from a partially welded tuff core sample. Data from these tests will be used to evaluate the concentrations of dissolved potassium ions in the pore-water and to use as a check on contract laboratory results.

In support of the natural hydrogeologic system simulations, data on moisture retention and capillary pressure vs. saturation were compiled and evaluated. Different sources were considered. New capillary pressure functions were defined for the 17 sublayers of the vertical grid based on values from UZ-16. Simulations were run successfully for four 2-D cross-sections with steady state conditions achieved without flow at the surface, as well as with low infiltration rates. Further work will include runs with

increased infiltration rates, and various fault characteristics to study their effect on numerical results.

Staff from the site saturated zone ground-water flow system monitored 21 zones in 21 wells on a monthly basis; 17 zones in 12 wells on an hourly basis; obtained real-time data on 17 zones in 12 wells using DCPs; evaluated status of network; monitored real-time data on an daily basis, looking for water-level excursions; calibrated transducers at eight wells, replaced transducers at two wells; continued investigation of water-level and fluid-pressure responses to earthquakes; and reprogrammed two 21x data loggers.

In support of the development of the fracture network model, as part of preliminary statistical investigation of borehole fracture data from c-holes, graphical methods of estimating fracture density in boreholes were developed to examine correlation between changes in fracture characteristics, such as density, strike, and dip.

Staff from the surface and subsurface stratigraphic studies compiled partial and preliminary core logs for ten unsaturated zone neutron (UZN) holes, focusing on the interval in the Paintbrush Tuff from the base of the Tiva Canyon member. The elevations of stratigraphic contacts and unit thicknesses will be used to develop structure contour and isopach maps of the units and incorporated as constraints in the 3-D lithostratigraphic model of Yucca Mountain. Local stratigraphic variations and offsets across faults can be evaluated where two or more drill holes are located within 500 feet of each other. They also compiled nine cross sections of the north portal, south portal, and the main Topopah-level drift beneath Yucca Mountain, which incorporate lithologically significant subdivisions of the Topopah Springs formation and mapped subdivisions of the Tiva Canyon formation. They will be used in tunnel design and incorporated into the digitized data base for detailed 3-D modeling.

In support of surface based geophysics, four of the five E-W detailed gravity and magnetic profiles across Midway Valley were reduced and show significant offsets across two of the faults in this region.

Staff conducting geologic mapping of zonal features completed chemical analyses of 22 Crater Flat volcanic rock samples. Rock chemistry is being used to check field correlations. Initial results indicate that some rock units frequently difficult to distinguish in hand specimen are notably different in trace-element abundances, including elements that virtually are immobile during weak hydrothermal alteration. Investigations continued into the depositional environments of the stratified tuffaceous beds in the rhyolitic rocks of the Calico Hills. Interpretation of a 1:12,000 scale aerial photograph continued, and locations of field photographs and the largest unconformities were transferred to a 1:4,000 scale base map. These unconformities probably represent large erosional channels and are locally up to 20 meters deep, but the complete geometry and genesis of these features are still under

investigation.

The surface fracture network studies project reports that NRG-2 pavement fracture data acquisition is complete and analysis is underway. This activity was accelerated by DOE/YMPO in order for starter tunnel construction to begin.

In support of geologic mapping of the ES and drifts, photogrammetry control points were set around the perimeter of the north Fran Ridge test pits. The targets and wall rock were photographed. Stereophotos were taken from the prototype shaft mapping platform, suspended from a crane, and lowered into the pit. USGS and USBR hosted a two day working meeting, attended by personnel from DOE, LANL, RSN, and the M&O, to re-examine the techniques and approaches for use in underground geologic mapping. Funding constraints and changes in the ESF and construction schedule affect future planning. Actions from the meeting included submitting a revised Study Plan in time to allow DOE time to process it before construction of the north ramp starter tunnel. It was decided that the most feasible mapping scheme, given funding and schedule realities, is to photogrammetrically map the starter tunnel and the first 200 feet of the TBM ramp. The mapping would shift to conventional mapping in the TBM ramp, while an evaluation of the photogrammetric process is complete. Most drill/blast portions of the ESF will be mapped photogrammetrically regardless of the decision for TBM excavations. A memo will be written to the PIs requesting notice if special data need to be gathered by the underground mapping team beyond the normal fracture and stratigraphic information.

In support of climate studies, a manuscript is being revised on the late glacial and Holocene limnological and climate history from Lake Michigan. This will provide important information on the timing of deglaciation and thus the time when the polar jet, the rain maker, would establish an annual average position well north of Yucca Mountain.

Staff from the surficial deposits mapping project collected samples of felsic ash exposed along Yucca Wash in older alluvium of working stratigraphic sequences for isotopic analysis. Identification of the ash will constrain age estimates on much of the surficial stratigraphic sequence. Samples of calcite rhizoliths associated with paleosol found in an older eolian unit below high Fortymile Wash alluvial terrace were collected for U/Th analysis and age control, which could constrain the age of the Fortymile alluvial sequence.

Staff supporting regional paleoflood evaluation began preparation of precipitation, evaporation, and area measurement maps of the Amargosa River and Fortymile Wash drainage basins. Landsat spectral images, aerial photographs, and digital elevation models, needed or geomorphometric analysis of paleoflood features in the Yucca Mountain region, also are being prepared. Runoff data for 1968 to 1983 have been compiled. These runoff data, when complete,

will be compared with daily precipitation for the region to establish modern precipitation-runoff relationships. Numerical parameters for specific historic runoff events will be used to evaluate regional paleoflood conditions.

In support of analog recharge studies, 70 soil subsamples were prepared for Cl content measurement; 24 soil chloride samples were measured with the teflon diffusion cell method and 33 with an ion selective electrode; 26 caliche samples, 2 bulk samples, and 6 boulder leachates were measured for total Cl content using teflon diffusion cell; gravimetric water content and fraction of fines was measured from 14 samples; total Cl content of 50 caliche subsamples was measured with ion selective electrode; 3 boulder samples were measured for total Cl content; 8 Cl-36 dates were run; 30 whole rock and 27 B and Gd analyses were performed; 14 soil leachates were measured for Cl on the ion chromatograph; and 8 caliche samples were measured for ^{18}O and ^{13}C in the carbonate fraction. Preliminary data were assembled on vegetation type and cover density to characterize the physical description of 47 cells to be used in the application of the balance method for Kawich Creek watershed. Kawich data reduction is essentially complete, and results will be used to refine the preliminary cover density estimates.

In support of calcite silica studies, E. Roedder (Harvard) reports that crushing stage experiments on individual vapor-phase inclusions from the unsaturated zone of USW G-1 indicate that the inclusions are filled with air and/or CO_2 and water vapor. The inclusions are at less than atmospheric pressures due to the post-entrapment condensation of water on the inclusion walls. Estimates of the inclusion pressure allow calculation of the original water vapor content, which in turn permits estimates of the temperature at the time of inclusion formation. These temperature estimates range from 50 to 100 degrees C, generally near 60 to 70 degrees C, and are compatible with formation of the calcite from a vadose environment. The very large negative pressures that would e expected if the calcite had formed in a boiling system have not been observed. Stable isotopic conditions were determined of 33 samples of pedogenic calcrete and rhizolithic calcite from Busted Butte, Eleanna Trench, Trenches 1 and 16, and Yucca Crest. Determination of past climate conditions from the stable isotopic composition of soil carbonates is critical to paleoclimatic reconstructions and relies heavily on the assumption that the "present is the key to the past".

The surface facilities exploration program reports that NRG-1 core is at the USBR laboratory. A Scientific Notebook Plan for the engineering, geophysical logging, and check shot of NRG-1 was written and approved, and the field work to accomplish mapping and logging work was completed. The drill hole was unstable so the density log was not run because of the danger of losing the nuclear source - density data will be obtained from the core. A caliper log was run; the hole is exceedingly rough, due in part to numerous

lithophysal. The checkshot was completed, and field data are being finalized. Density data and checkshot data will be used to determine dynamic moduli for the rock and alluvium.

In support of detachment fault studies, six days of field work mapping Paleozoic rocks and examining low angle fault structures in the Paleozoic core of the Calico Hills dome were completed. Paleozoic stratigraphy in the upper plate of a postulated thrust structure was established.

Staff from the Quaternary faulting project spent three days in the field mapping the surface expression of the northern Windy Wash fault, from Prow Pass south. Three more days were spent mapping the southern extension of the Windy Wash fault, south of Stagecoach Road. Field logs were completed for both north and south faces of Trench 8. Stratigraphic units and features haves been mapped and described; data is being compiled and evaluated. Exposure number 4 on the west side of Busted Butte was re-cleaned and fault trace and main stratigraphic units were flagged. Preliminary interpretation of fault events are in progress. Preliminary stages of geophotogrammetric mapping were completed at CF-1, TR-8, SCR-T1 and SCR-T3, including cleaning exposures, planning photographic targets, photographing targeted trench walls, and surveying targets.

WBS 1.2.5 - REGULATORY

In support of performance assessment modeling activities, a 1-D matrix model has been developed, using data from rock outcrop studies, for both USW UZN-55 and UE25 UZ-16 as part of the INTRAVAL test case. The model uses varying input conditions to look at the influence of climate change and the interactions of rock matrix properties and changing water saturations. Simulations cover a 700,000 year time span.

Staff from the supporting calculations for postclosure performance analysis report that over 100 core samples from the Topopah Springs nonlithophysal unit and the Calico Hills units have been tested in the laboratory to determine the effect of high temperature on hydrologic properties. The high temperatures have a definite effect on rock properties. Bulk properties are significantly altered but recover upon rewetting. Flow properties are also significantly altered, but do not recover upon rewetting.

WBS 1.2.9 - PROJECT MANAGEMENT

USGS management staff planned and coordinated the simplification of PACS schedules for FY 93-94, achieving the goal of fewer than 10 scheduled activities per year per summary account. Particular care was taken to ensure that schedules document all planned transmittals to the YMP-USGS Participant Data Archive. Level of effort (LOE) accounts were established to encompass all work performed by technical staff in support of project control, procurement, personnel, training, quality assurance implementation,

technical and administrative meetings, YMP task groups, YMP tours and public briefings, administrative tasks, and repetitive monitoring activities. These measures were implemented to ensure that future schedule variances are more realistic and defensible.

WBS 1.2.13 - ENVIRONMENTAL

The water resources monitoring project reports that ground-water levels were measured at 55 sites and ground-water discharge at 6 sites. Two reference points were established at site AD-16 and land surveys conducted to determine altitude of the reference points. The recently installed USFWS flume at site SP-1 (Fairbanks Spring) was checked with a rod and level. Calibration of water-level recording equipment at JF-3 was checked. Staff evaluated evidence submitted by the USGS-YMPB-HIP that might indicate adequate baseline water quality data exists and will be collected to provide for monitoring of ground water quality. Water level data were not collected at MV-1 or AD-6.

Sincerely,

Larry R. Hayes
for Technical Project Officer
Yucca Mountain Project
U.S. Geological Survey

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