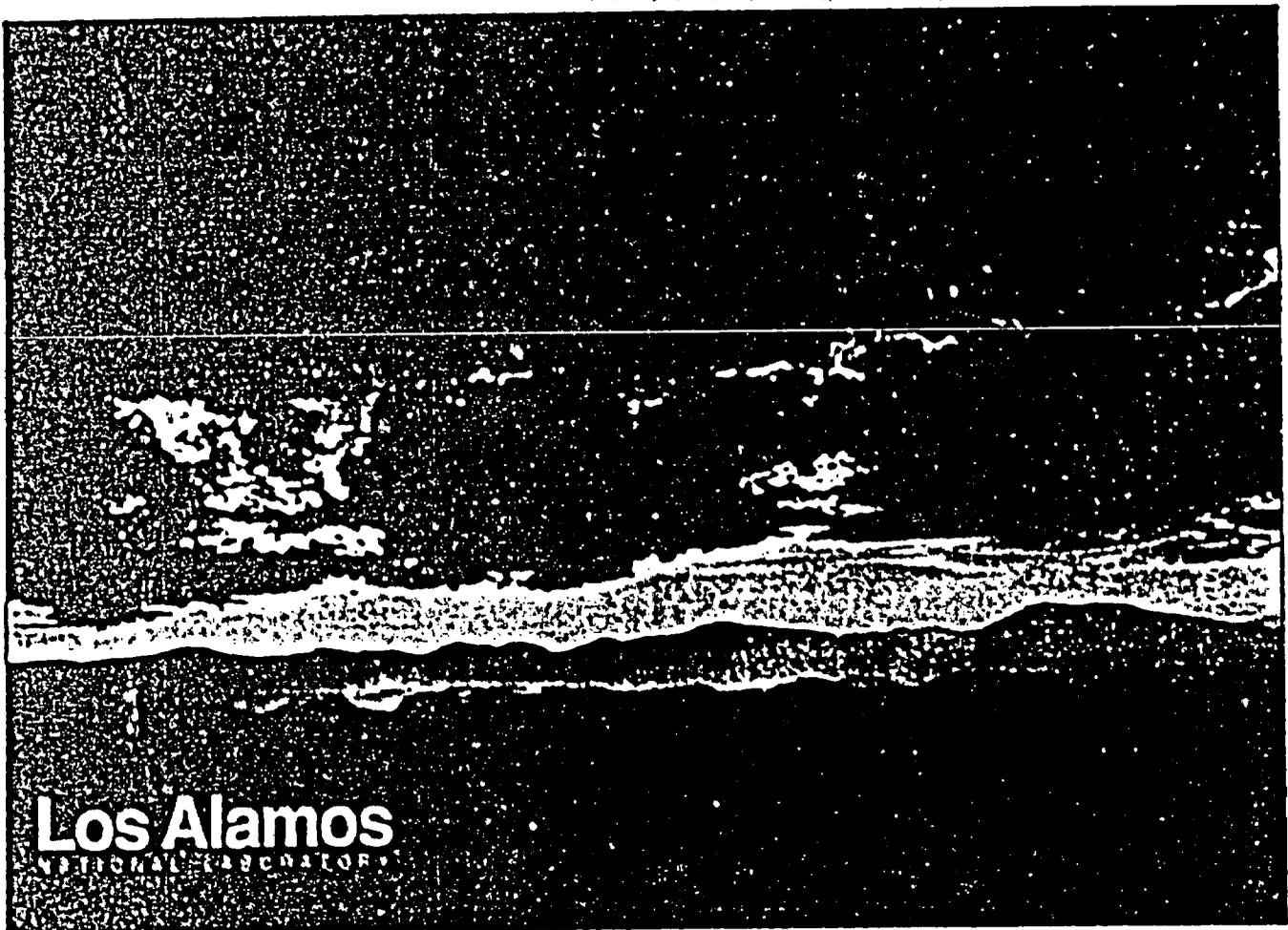


# *Yucca Mountain Site Characterization Project*

## *Monthly Activity Report*

*May 1992*



**Los Alamos**  
NATIONAL LABORATORY

Photograph by Gene J. Ludlum

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*Attachment to TWS-EES-13-07-92-041*

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LOS ALAMOS NATIONAL LABORATORY  
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

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WBS 1.2.1 Systems

**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.

**Technical Data (WBS 1.2.1.3.5)**

**Activities and Accomplishments** Staff submitted a combined Parameter Normalization List to G. Heitland of SAIC.

**Planned Activities** Enter data information for Activities 83.1.2.1.3.2, 83.1.3.6.1.1, and 83.1.3.2.1.3 into the Automated Technical Data Tracking System.  
Enter data for Activities 83.1.2.1.3.2, 83.1.3.6.1.1, and 83.1.3.2.1.3 into the Technical Data Base.  
Work on Technical Data Base parameter screen.  
Finalize OF-43, "Transfer of Data."

**Caisson Experiment (WBS 1.2.1.4.6)**

**Activities and Accomplishments** A Los Alamos Environment, Health, and Safety Oversight Committee meeting was held on 7 May to discuss the caisson experiment; the committee agreed that the only issue that may delay the experiment is the granting of a NEPA categorical exclusion, which must be approved by DOE Albuquerque Operations Office. Filing activities can begin after the NEPA documentation has been obtained. Other issues raised at the meeting will be included in the standard operating procedure (SOP).

DOE OCRWM and M&O personnel toured the caisson experiment on 28 May. Visitors toured the caissons, and a presentation on the objectives, equipment, and experimental procedure was made.

*Continued on next page*

May 1992

A meeting was held with Sandia National Laboratory (SNL) personnel on 29 May to discuss caisson progress. A final design of the lower-boundary condition and a schedule to complete preliminary characterization were reviewed.

Planned Activities

Prepare the caisson for filling.

Revise SOP as dictated by review.

Write manuscript for special issue of *Radioactive Waste Management*.

Publications

E. P. Springer and M. D. Siegel

*An Integrated Intermediate-Scale Caisson Experiment to Validate Models of Fluid Flow and Contaminant Transport in the Unsaturated Zone*

Journal article, *Radioactive Waste Management and the Nuclear Fuel Cycle - Special issue on the Yucca Mountain Project*

In preparation.

Performance Assessment Computational Support (WBS 1.2.1.4.7)

Activities and Accomplishments

Staff attended the Performance Assessment Flow and Transport Modeling Workshop on 5-6 May in Las Vegas, NV. G. Zivoloski presented a talk entitled "Overview of Capabilities of FEHM," and B. Travis presented a talk entitled "Development of Improved Transport Algorithms."

Planned Activities

Staff is using the Sandia Thermal/Mechanical model of Yucca Mountain to generate a three-dimensional, finite-element mesh for studying transport of radionuclides in the saturated and unsaturated zones. The dual porosity/dual permeability capability available in FEHMN will be used to model transport through the matrix and fractures separately. These results will be compared to results from analogous calculations using the composite porosity model.

## WBS 1.2.3.1 Site Management and Integration

### Site Management (WBS 1.2.3.1.1)

**Objective** The objective of this task is to manage and integrate site characterization activities.

**Activities and Accomplishments** Site management organized and hosted a visit by the Independent Cost Estimate Team from OCRWM.

Management also organized for OCRWM a facilities tour of the Los Alamos YMP and a geology field trip through the Jemez Mountains.

Management participated in ITE and continued to work on Mission 2001.

**Publications** A. M. Simmons and J. A. Canepa  
*Recent Developments in the Integrated Approach Toward Characteristics of Radionuclide Transport, Yucca Mountain, Nevada*  
 Conference Paper, *Waste Management '92 Symposium*, 2-6 March 1992  
 Published.

### Surface-Based Test Coordination (WBS 1.2.3.1.1)

**Objective** The goal of this investigation is to provide coordination for Los Alamos surface-based test planning package development.

**Activities and Accomplishments** TCO staff identified organization representatives and made assignments at meetings to initiate the development of the Tracers, Fluids, and Materials (TFM) program.

Test Planning and Job Packages were initiated for the ESF Fran Ridge pit mapping activity, which was used to support the development of TFM data base strategies.

Several sample requests were evaluated by the Sample Overview Committee. Test Planning submissions were proposed for future ream-bit cutting samples from neutron-access boreholes for the Water Movement Tracer Tests task, WBS 1.2.3.1.2.2. Criteria were developed by the principal investigator and informally submitted to Sample Management Facility staff for UZ-16 sampling requirements.

R. Oliver attended the May SOC meeting at the Sample Management Facility. Two USGS specimen removal requests were approved, and a request by SAIC for industrial hygiene sampling was disapproved. The committee supported a requirement for input from principal investigators to DOE on the need for archiving core.

**Planned Activities** Continued support of Los Alamos surface-based site characterization activities within Project program directives.

**Problem Areas** None

**Milestones** None

May 1992

## 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 mineralogic 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** We continued to test the new INEL microdiffractometer.

D. Bish and S. Chipera presented invited papers at a National Institute of Standards and Technology symposium entitled "Accuracy in Powder Diffraction Analysis" on 26-29 May in Rockville, MD. They described quantitative x-ray diffraction analysis (XDR) work.

Studies of calcite in fractures are being pursued to determine the role of young calcite deposits in defining unsaturated transport pathways and in potential co-precipitation interactions with transuranic waste. Electron microprobe and scanning electron microscope (SEM) data were collected this month. The electron microprobe data supplement previous trace-element data that indicated distinctive depositional environments for calcite above and below the water table, with indications of a much more oxidizing environment above the water table than below. Microprobe data for calcites below the water table reveal a much higher Mn content compared to calcites of the unsaturated zone. SEM analyses are being used to delimit the amount of dolomite intergrown with calcites below the water table (dolomite does not occur in fractures above the water table).

Milestone 3123, "Fracture-lining Manganese Oxide Minerals in Silicic Tuff, Yucca Mountain, Nevada," by B. Carlos, S. Chipera, D. Bish, and S. Craven was submitted to the TPO.

A fracture mineralogy presentation was prepared for the Joint Geochemistry/Hydrology Integration Meeting entitled "Fast Pathways: Definition and Detection" to be held in San Diego, CA, on 9-11 June.

**Planned Activities** Work planned within the next few months includes the following activities: (1) continue analysis of fracture fillings in the Paintbrush Tuff to determine mineral distribution and factors controlling that distribution and (2) continue analysis of calcites to understand transport and precipitation mechanisms.

**Problem Areas** Milestone 3120 has been delayed by about one month because of (1) redirection of a larger part of the author's effort into calcite-silica studies under WBS 1.2.3.2.1.1.2 and (2) expansion of the scope of the milestone to include more data on calcites below the water table.

**Milestone Progress** 3120  
30 June 1992  
*Calcite in the Upper Paintbrush Tuff*  
70% complete.  
Delayed because author is participating in Calcite-Silica Issue Resolutions Report.

Continued on next page

3130

17 August 1992

*Fracture Mineralogy of the Paintbrush Tuff*

3137

30 September 1992

*Mineralogy of Calico Hills for Adit Development*

95% complete.

Publications

D. E. Broxton

*Chemical Changes Associated with Zeolitization on the Tuffaceous Beds of Calico Hills at Yucca Mountain, Nevada*

Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992

Approved by YMPO.

B. Carlos, D. Bish, S. Chipera, and S. Craven

*Fracture-Lining Manganese Oxide Minerals in a Silicic Tuff*

Journal article, *Chemical Geology*

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*

Draft complete; may be revised for a different journal.

May 1992

## WBS.1.2.3.2.1.1.2 Mineralogic 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** Staff participated in a Yucca Mountain site and facility tour of Los Alamos for DOE OCRWM and M&O personnel.

D. Vaniman, S. Chipera, and D. Bish completed a paper on pedogenesis of siliceous concretions at Yucca Mountain, with a focus on Trench 14 data. The paper is now in internal technical review and will be submitted to *Science*.

Scanning Electron Microscope (SEM) imaging of zeolites and silica from breccia dikes and needle-fiber calcite crystals in fossil roots supported the studies of hydrothermal alteration and laminated concretions.

S. Levy investigated field-scale evidence of former fluid flow at Harper Valley and Busted Butte. She examined outcrops of the lower Tiva Canyon member of the Paintbrush Tuff and the underlying bedded tuffs for presence or absence of alteration related to cooling of the Tiva Canyon tuff and proximity to structural features that could have influenced fluid transport.

**Planned Activities** We will continue analysis of samples from Trench 14 and other surface areas.

We will continue our SEM studies of samples from surface exposures of suspected hydrothermal deposits and materials used for K/Ar analysis.

S. Levy will present a talk on the applicability of alteration history studies to the identification and characterization of fluid "fast paths" at the joint Geochemistry/Hydrology Integration Meeting next month.

**Problem Areas** None

**Milestone Progress**

3138  
30 October 1992  
*Chemical Transport in Zeolitic Alteration*  
60% complete.

3141  
31 March 1992 (delayed due to participation in the issue resolution process)  
*Laminated Zone in Trench 14*  
60% complete.

3142  
31 July 1992  
*K/Ar Dating of Clays and Zeolites*  
Revision in internal technical review.

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Continued on next page

3143  
30 April 1992  
*Experimental Dehydration of Volcanic Glasses*  
Submitted to TPO.

3150  
15 April 1993  
*Final Report on Bedrock*  
24% complete.

Publications

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.

D. Vaniman, D. Bish, and S. Chipera  
*Dehydration and Rehydration of a Tuff Vitrophyre*  
Journal article, *Journal of Geophysical Research*  
Submitted to TPO.

D. Vaniman, et. al  
*Precipitation of Calcite, Dolomite, Sepiolite, and Silica from Evaporated Carbonate and Tuffaceous Waters of Southern Nevada*  
Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium, July 1992*  
Approved by YMPO.

G. WoldeGabriel, et. al.  
*Preliminary Assessment of Clinoptilolite KJAR Results from Yucca Mountain, Nevada: a Potential High-Level Radioactive Waste Repository Site*  
Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium, July 1992*  
Approved by YMPO.

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May 1992

### WBS 1.2.3.2.1.2 Stability of Minerals and Gases

**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.

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## 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	<p>We received review comments on Study Plan 8.3.1.8.1.2, "Physical Process of Magmatic Activity and Effects on a Repository," and made appropriate changes. It will be submitted to the DOE shortly.</p> <p>Calibration analyses of thermoluminescence (TL) age estimates for a sample suite from the Snake River Plains were completed. The TL age estimates agree with calendar-corrected <math>^{14}\text{C}</math> and K-Ar age determinations (within two sigma error bars). This analyses gives us increased confidence in the reliability of TL age estimates.</p> <p>We developed a worksheet to reduce uranium-thorium (U-Th) mass spectrometry data and to calculate and plot isochrons.</p> <p>The review and comment resolution have been completed for the detailed technical procedure (DP) for cosmogenic helium studies.</p> <p>We received twelve analyses of the isotopic composition of Pb for samples from the basalt of Crater Flat from the University of Colorado.</p> <p>Staff attended the Los Alamos YMP orientation program.</p> <p>Work In Progress. The first draft of the introductory chapter of the Issue Resolution Report for volcanism was completed. The section on geologic setting of basaltic volcanism in the Yucca Mountain region is approximately 70% complete.</p> <p>We continued field work at Piute Ridge and collected additional samples for paleomagnetic studies and for evaluating hydrothermal alteration proximal to intrusions.</p> <p>We revised the standard operating procedures (SOPs) for trenching of volcanic centers, and they were reviewed by Los Alamos management.</p> <p>We are re-analyzing the sample collected below the Q1<sub>1</sub> lava for TL age estimates. Thirty samples were processed and submitted for major element analysis by the XRF method. Twelve samples were submitted for thin-sectioning as part of processing samples for K-Ar age determinations. Thirty-nine samples were processed for INAA.</p>
Planned Activities	Trenching will resume at the Lathrop Wells Center as soon as SOPs are approved.
Problem Areas	<p>U-Th work has been delayed because of a restriction by Los Alamos on generation of mixed wastes, which are generated in the chemical separations used to process samples for U-Th disequilibrium age determinations.</p> <p>The Issue Resolution Report will be completed in July. We have expanded the scope to include sections on basalt petrogenesis and magma system dynamics. We need additional staff to complete these sections and are waiting for hiring actions to be processed.</p>

Continued on next page

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Samples collected in March for TL age determinations do not contain a sufficient quantity of a fine-grained component (4-11 microns) for analysis. In order to process these samples we will have to test laboratory methods for TL age estimates of coarse-grained samples.

Milestone Progress

3174  
8 January 1992  
*Effects of Magmatic Disruption on the Repository (Study Plan 8.3.1.8.1.2, R0)*  
Submitted to TPO.

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*

Publications

B. M. Crowe, et al.  
*Issue Resolution Report*  
In preparation.

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.

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**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	<p>The subcontractor, Hydro Geo Chem, leached about 40 samples of cuttings and soil profiles for Cl/Br analysis.</p> <p>Two detailed technical procedures (DPs) were revised following technical and QA reviews. They are in the final approval process.</p> <p>Review comments were received from the YMPO on the study plan. J. Fabryka-Martin has addressed approximately 90% of the 118 comments.</p>
Planned Activities	Complete additional DPs; process soil samples for Cl/Br and chlorine-36/Cl ratios; process cuttings samples from neutron-access boreholes; and collect additional soil samples from Yucca Mountain area as opportunities arise.
Problem Areas	None
Milestone Progress	<p>3191</p> <p><i>Procedure for Chlorine-36 Analysis of Unsaturated Zone Samples</i></p> <p>30 September 1992</p> <p>85% complete.</p>

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May 1992

### WBS 1.2.3.3.1.2.5 Diffusion Tests In the ESF

Objective	The objective of this task is to determine <i>in situ</i> the extent to which the nonsorbing tracers diffuse into the water-filled pores of the Topopah Spring welded unit.
Activities and Accomplishments	No significant activity in this study.
Milestone Progress	No Level II milestones are planned this fiscal year.

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### 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-25 c#1, UE-25 c#2, and UE-25 c#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 Certification.** Review comments on the FEHMN application are currently being addressed. The cdtools application has been certified for use. Work continued on the GZSOLVE and genplot applications, but no new baselines have been completed.

**Lithium Bromide Studies.** We evaluated the precision of our ion chromatograph for measuring lithium ion concentration and found (1) a relative standard deviation of less than 1% for lithium concentration of 10 ppm and (2) a relative standard deviation of 3% for a concentration of 0.1 ppm. These values are lower than the manufacturer's specification for the instrument.

We began our first set of lithium sorption and desorption experiments at 38°C, using a ratio of 1 g rock to 1 ml J-13 water at 10 different concentrations ranging from 0 to 2000 ppm lithium. At this time, we are washing the rock samples with J-13 water until the fluid comes to equilibrium with the rock. When this phase is complete, lithium bromide will be added to the samples and sorption and desorption will be measured.

**Modeling.** The FEHMN application is being used to perform non-quality-affecting analyses of flow and transport in the saturated zone. The results of the transport calculations (a sensitivity analysis assessing the impact of matrix diffusion on radionuclide migration in the saturated zone) will be reported in a paper by B. Robinson.

To assess the amount of time required for the fractures and matrix to come into pressure equilibrium during a well test, we are using the dual-porosity feature of the model. Our results will guide our design of field tests to ensure that the pressure in the fractures reach equilibrium with fluid in the matrix before the tracer is injected.

**Other.** B. Newman and P. Reimus visited the Sample Management Facility to examine C-Well core for possible use in future laboratory experiments.

#### Planned Activities

Continue to bring the computer codes FRACNET, FEHMN, GZSOLVE, and SORBEQ and other software into compliance with the SOAP. This consists of compiling existing documentation on these codes and writing new material required by the SOAP where necessary.

Continue batch-sorption experiments with lithium bromide.

Continue development of techniques for measuring the concentration of polystyrene microspheres in solution.

Complete paper on a validation strategy for the matrix diffusion conceptual model.

Continue modeling studies using FEHMN to support the design of the field tests.

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Problem Areas

Because of the lack of staff assigned to the SQAP activity, we are unable to complete the SORBEQ certification effort or progress past the requirements phase for FEHMN. We are also concerned that the GZSOLVE effort will be delayed once we submit the detailed design baseline.

Publication

W. L. Polzer, E. H. Essington

*The Use of Selectivity Coefficients to Estimate Modified Langmuir Isotherm Parameters as a Function of Experimental Conditions*

*Radioactive Waste Management and the Nuclear Fuel Cycle*, Special issue on the Yucca Mountain Project

Journal article

In preparation.

W. L. Polzer, M. G. Rao, H. R. Fuentes, and R. J. Beckman

*Thermodynamically Derived Relationships Between the Modified Langmuir Isotherm and Experimental Parameters*

Journal article, *Environmental Science and Technology*

Undergoing revision.

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 Radioactive Waste Management and the Nuclear Fuel Cycle*, Special issue on the Yucca Mountain Project

Journal article

In preparation.

Milestones

3188

30 September 1992

*Documentation for SORBEQ*

3194

30 September 1992

*Batch Sorption Experiments with Lithium*

T112

22 June 1992

*Final Documentation for FEHMN*

3196

27 July 1992

*FRACNET Documentation*

## WBS 1.2.3.4.1.1 Groundwater Chemistry Model

Objective	The goal of this investigation is to provide conceptual and mathematical models of the groundwater chemistry at Yucca Mountain. These models will explain the present groundwater composition in relation to interactions of minerals and groundwater and will be used to predict groundwater compositions as a result of anticipated and unanticipated environments.
Activities and Accomplishments	We continued developing the test matrix for geochemical model runs supporting most-active groundwater determination. We plan to use different compositions of groundwater from Yucca Mountain to simulate radionuclide dissolution and possible changes in water composition.  QA Activities. No additional progress to report on the IMOU between LLNL and Los Alamos. IMOU is in review in Las Vegas.
Planned Activities	We will begin resolving YMPO comments on the study plan.  We will continue USGS collaboration; however, delays in delivery of material and equipment for the USGS down-hole sampler could slow down testing of conceptual models of groundwater chemistry at Yucca Mountain. We are considering measuring dissolved gases from Yucca Mountain groundwaters for Eh using a gas chromatograph; work in this area could begin this summer.  Continue support of QA efforts. Continue tracking IMOU mentioned above.
Problem Areas	None
Milestones Progress	3006 31 August 1992 <i>Eh and pH Buffering Capacity</i>  3415 30 September 1992 <i>Letter Report: Most-Active Groundwater Chemistry</i>
Publications	M. Ebinger <i>Water-Rock Interactions and the pH Stability of Groundwaters from Yucca Mountain, Nevada</i> Conference paper, <i>Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium</i> , July 1992 Approved by YMPO.  D. Vaniman, D. Bish, M. Ebinger, S. Chipera <i>Precipitation of Calcite, Dolomite, Sepiolite, and Silica from Evaporated Carbonate and Tuffaceous Waters of Southern Nevada</i> Conference paper, <i>Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium</i> , July 1992 Approved by YMPO.

May 1992

## WBS 1.2.3.4.1.2.1/3 Batch-Sorption Studies and Sorption Models

**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** M. Hawley presented a poster on the current status of our atomic-force microscopy (AFM) and scanning-tunneling microscopy (STM) work to DOE OCRWM and M&O personnel who toured Los Alamos. Of particular interest was a series of photos and AFM scans of devitrified tuff from Yucca Mountain taken at increasingly higher levels of magnification. The devitrified ground mass appears almost featureless under an optical microscope, but microcrystalline structure on the  $10^4\text{m}$  scale is clear in low-resolution AFM images. High-resolution AFM images show a complex structure of intergrown minerals within the microcrystalline structure. These data are consistent with surface area measurements, indicating that the accessible surface area of the tuff does not increase substantially as the sample is ground into finer and finer particles. In other words, the high surface area of the devitrified tuff is due to the microcrystalline nature of the ground mass, and it can not be increased by grinding unless the ground particle size becomes less than one micrometer.

K. Kung has joined this task; he has a strong background in sorption studies, particularly in organic compound sorption reactions.

**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** A. Meijer  
*A Strategy for the Derivation and Use of Sorption Coefficients in Performance Assessment Calculations for the Yucca Mountain Site*  
Conference proceedings, *Proceedings of the DOE/Yucca Mountain Site Characterization Project Radionuclide Adsorption Workshop at Los Alamos National Laboratory September 11-12, 1990.*  
In press.

## 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	<p>Work continued on the characterization of the siderophore(s) produced by microorganism 11c. In addition to the bioassay performed last month, work has begun on determining microbial enhanced mineral dissolution. The purpose of this work is to gain a better understanding of the metabolic activities of microorganisms in the subsurface environment, as such activities apply to radionuclide transport.</p> <p>The number of microorganisms in J-13 well water was determined to be between <math>6.2 \times 10^2</math> and <math>9.0 \times 10^1</math> microorganisms per milliliter of water, as determined by the dilution pour plate method.</p> <p>Work has continued on writing milestones 3080, "Report on Chelation," and 3092, "Report on Colloidal Agglomeration."</p> <p>L. Hersman attended the Annual Meeting of the American Society for Microbiology in New Orleans, LA, 26-30 May.</p>
Planned Activities	<p>Continue plutonium <math>K_d</math> experiments.</p> <p>Continue colloidal agglomeration experiments.</p>
Problem Areas	None
Milestone Progress	<p>3080 30 September 1992 <i>Report on Chelation</i> In preparation.</p> <p>3092 30 September 1992 <i>Report on Colloidal Agglomeration</i> In preparation.</p> <p>3176 30 September 1992 <i>Procedure for Determination of Formation Constants</i> In progress.</p> <p>3177 30 September 1992 <i>Procedure for Determination of Effects on Colloidal Agglomeration</i> In preparation.</p>
Publications	L. R. Hersman, D. E. Hobart, and T. W. Newton <i>Preliminary Evidence of Siderophore/Plutonium Complexation</i> Journal article, <i>Journal of Applied and Environmental Microbiology</i> Resubmitted.

May 1992

### 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

We continued to revise the study plan in response to YMPO review. We have addressed approximately half of the 86 review comments and expect to complete the revision by 15 August.

D. Clark, D. Morris, and D. Tait represented this task at an information exchange in Los Alamos between the YMPO and the Swedish SKB on 26-27 May. Morris presented a brief overview of this task's accomplishments since the last information exchange meeting in November 1990 and explained some of H. Nitsche's solubility determinations in J-13 water. Tait discussed recent progress with Pu(IV) speciation using photoacoustic spectroscopy (PAS), and Clark presented recent results concerning the carbonate ligand exchange processes for uranium, plutonium, and americium actinyl species.

Clark, Morris, and Tait presented three posters to DOE OCRWM and M&O personnel who toured Los Alamos.

Speciation Studies. Work-up of the experimental PAS data for the Pu(IV) carbonate system continues in preparation for the milestone report due at the end of October. Data have been collected as a function of pH, carbonate concentration, plutonium concentration, temperature, and presence/absence of Pu(IV) colloid. A small number of additional experiments using smaller particle-size colloids are planned to complete this effort. Unfortunately, the PAS effort has been suspended for the past several weeks because of the Los Alamos moratorium on the generation of mixed waste. As soon as the moratorium is lifted, we plan to begin analysis of these data with the intent of extracting thermodynamic parameters. We continue to prepare a certified software package for the PAS system.

D. Clark is completing a paper on plutonium carbonate NMR results to be submitted to the *Journal of the American Chemical Society*. We have begun the certification process for commercial NMR software.

We have stopped synthesis of model complexes because of the Los Alamos moratorium on generating mixed waste. The letter report on model complex studies has been prepared to be published as an LA-series report.

P. Palmer prepared Pu(IV) aquo ion and Pu(IV) colloid solutions and shipped them to Task 1.2.3.4.1.4 for sorption studies.

D. Clark, P. Palmer, and D. Hobart are preparing an additional 13-C NMR experiment on Am(VI) carbonate to verify earlier data analysis.

We began Am(III) experiments; a fresh sample of  $^{243}\text{Am}$  was dissolved and analyzed. We also obtained  $^{17}\text{O}$ -enriched  $\text{H}_2\text{O}$  for future  $^{17}\text{O}$ -NMR studies on Am(III). A sample of this Am(III) solution will be made available for PTS and sorption analysis.

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Continued on next page

Preliminary Data—Do Not Reference

Solubility Studies. Our most recent sampling of the Np undersaturation experiments in UE-25 p#1 at 60°C reconfirms that our two approaches to solubility assessment, oversaturation and undersaturation, will provide the same results. By day 15, the Np undersaturation experiment at pH 7 had reached the same concentration as the oversaturation experiment. For the pH 8.5 experiment, 43 days was required to reach the same concentration as in the oversaturation experiment. The experiment at pH 6 is taking an even longer time period, which is understandable because the solubility of Np is more than two orders of magnitude higher at a pH of 6. These experiments will continue for some time to ensure that steady-state has been attained.

Gamma-pulse height analysis continued for the three americium/neodymium oversaturation experiments in UE-25 p#1 at 60°C. When these experiments are completed, we will prepare approach-to-equilibrium plots for each; if the results show stable steady-state concentrations, the oxidation-state distribution and Eh will be determined, and the solids will be analyzed.

We are preparing for our oxidation-state determinations, which will be followed by undersaturation experiments using solids from the oversaturation experiments. Using oversaturation, we recently sampled plutonium in UE-25 p#1 water at 60°C, and we are working up the data. Updated approach-to-equilibrium plots for plutonium will be included with our June monthly report.

Regarding the Lawrence Berkeley Laboratory QA effort, the procedure, "Operating and Calibrating a Low-Energy Gamma-Ray Counting System" (LANL-LBL-DP-02, R1), has been revised, and T. Morgan has agreed to perform the required QA review. The detailed technical procedure, "Concentration Determination of Soluble Radionuclides from Data Provided by a Low-Energy Gamma Counting System," is still being revised and should be completed by the end of June.

#### Planned Activities

Efforts in all above mentioned areas will continue.

D. Tait will attend the Rocky Mountain Regional Meeting of the American Chemical Society and present a talk at the Chemistry and Environmental Issues topical session.

#### Problem Areas

The loss of support personnel in the Software Quality Assurance Program at Los Alamos could significantly impact our efforts in this task. The Laboratory's moratorium on generation of mixed waste has effectively shut down the use of the PAS system because of the stipulation that any chemicals entering our laboratories are potentially contaminated with radioactivity. Thus, our waste laser-dye solutions are presently considered mixed waste. Hopefully this issue will be resolved soon.

#### Milestone Progress

3031

30 September 1992

*Plutonium(IV) and Plutonium(VI) Carbonate Speciation Studies by NMR and PAS Spectroscopies*  
On schedule.

3329

30 September 1992

*Report on Neptunium, Plutonium, and Americium Solubility Experiments in UE-25 p#1 Water from Oversaturation.*  
On schedule.

3330

1 January 1993

*Evaluation of Alternative Detection Schemes in Photoacoustic Spectroscopy*

Early completion anticipated.

## 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  
*Plutonium(IV) and Plutonium(VI) Carbonate Speciation Studies by NMR and PAS Spectroscopies*  
 LA-series report  
 In preparation.

D. L. Clark, J. G. Watkins, 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  $UCl_6$ : Spectral Effects of Ligand Exchange*  
 LA-series report.  
 In preparation.

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 Groundwater (J-13) from the Yucca Mountain Region*  
 LA-series report  
 In revision.

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.

Continued on next page

May 1992

C. D. Tait, D. E. Morris, S. A. Ekberg, P. D. Palmer, and J. M. Berg

*Plutonium Carbonate Speciation Changes with pH*

Conference abstract, *American Chemical Society National Meeting Program*, April 1992

Approved by YMPO.

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May 1992

## 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 performance assessment.

### Activities and Accomplishments

This month we continued Np transport work using crushed-tuff columns made from tuff G4-1530.3. The column measured 1816.1 mm long and 4.72 mm in diameter, with a flow rate of 1 ml/hr; the dry weight of the tuff in the column was 31.4g.

Figure 1 shows the cumulative activity of tritiated water eluted through the column (A/At) versus the cumulative volume eluted. Figure 2 shows the cumulative activity of neptunium eluted through the column versus the cumulative volume eluted. The column was injected with 0.5 ml of tritiated water or 0.5 ml of neptunium solution with a molarity of  $4 \times 10^{-3}$ . As reported last month, we noticed that the column has a distinct amount of black material at the bottom. We separated the two fractions of crushed tuff G4-1530 with a magnetic separator and sent these two fractions for chemical and XRD analysis. The results are given in Tables 1-2.

Table 1: Chemical Analysis (in Weight Percent)

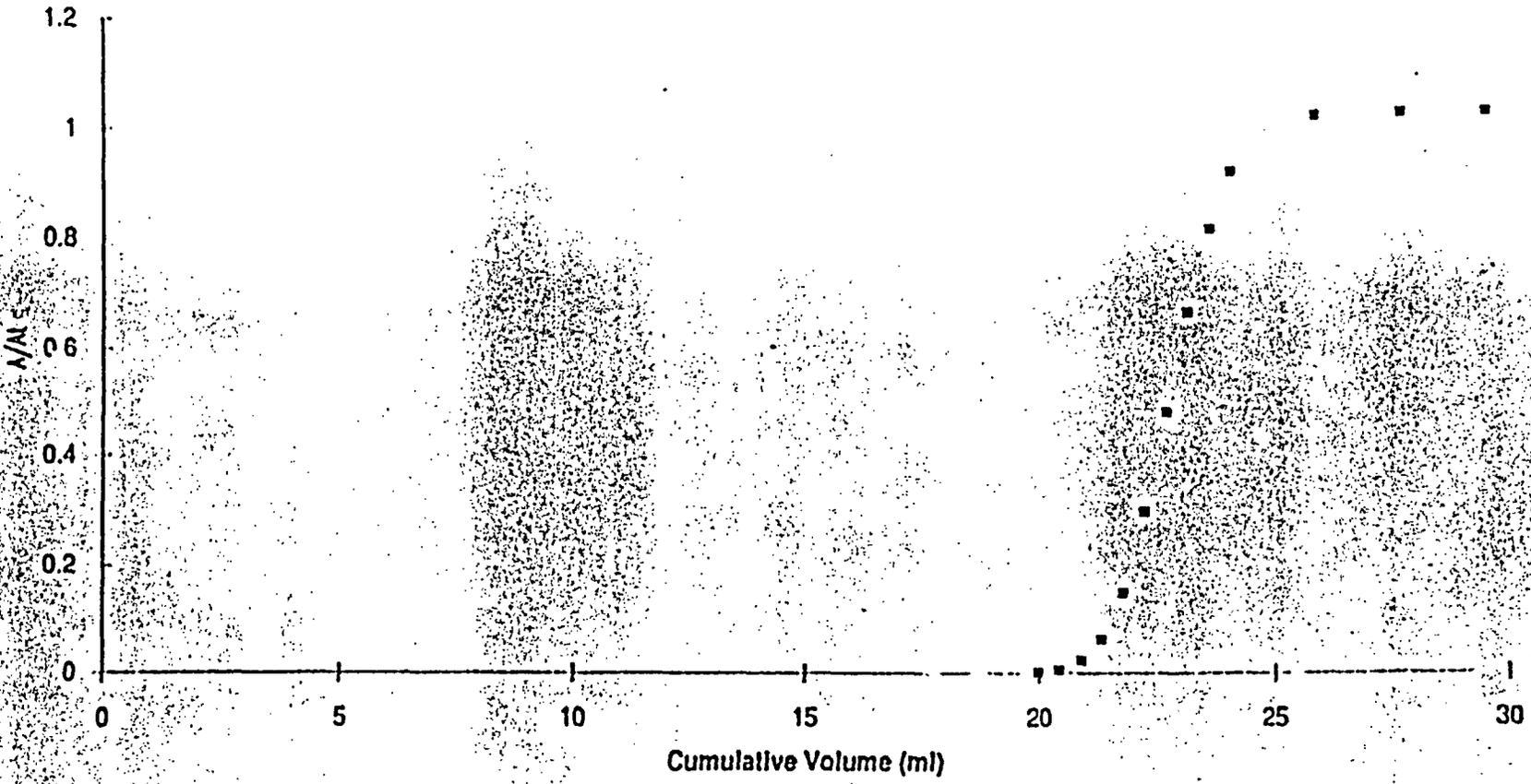
G4-1530.3 <9 Amps fraction	G4-1530.3 >9 Amps fraction
Ferric Oxide 0.47	Ferric Oxide 1.46
Ferrous Oxide <0.01	Ferrous Oxide <0.01
Manganese Oxide 0.022	Manganese Oxide 0.34

Table 2: Semi-quantitative XRD Analysis (in Weight Percent)

G4-1530.3 <9 Amps fraction	G4-1530.3 >9 Amps fraction
smectite trace	smectite trace
quartz ~4	mica trace
clinoptilolite ~68	quartz ~16
mordenite ~14	crystalite ~12
opal-Ct ~12	clinoptilolite ~28
feldspar ~2	mordenite ~8
	feldspar ~33
	magnetite/maghemite ~3

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### Trillated Water Elution Through Tuff G4-1530

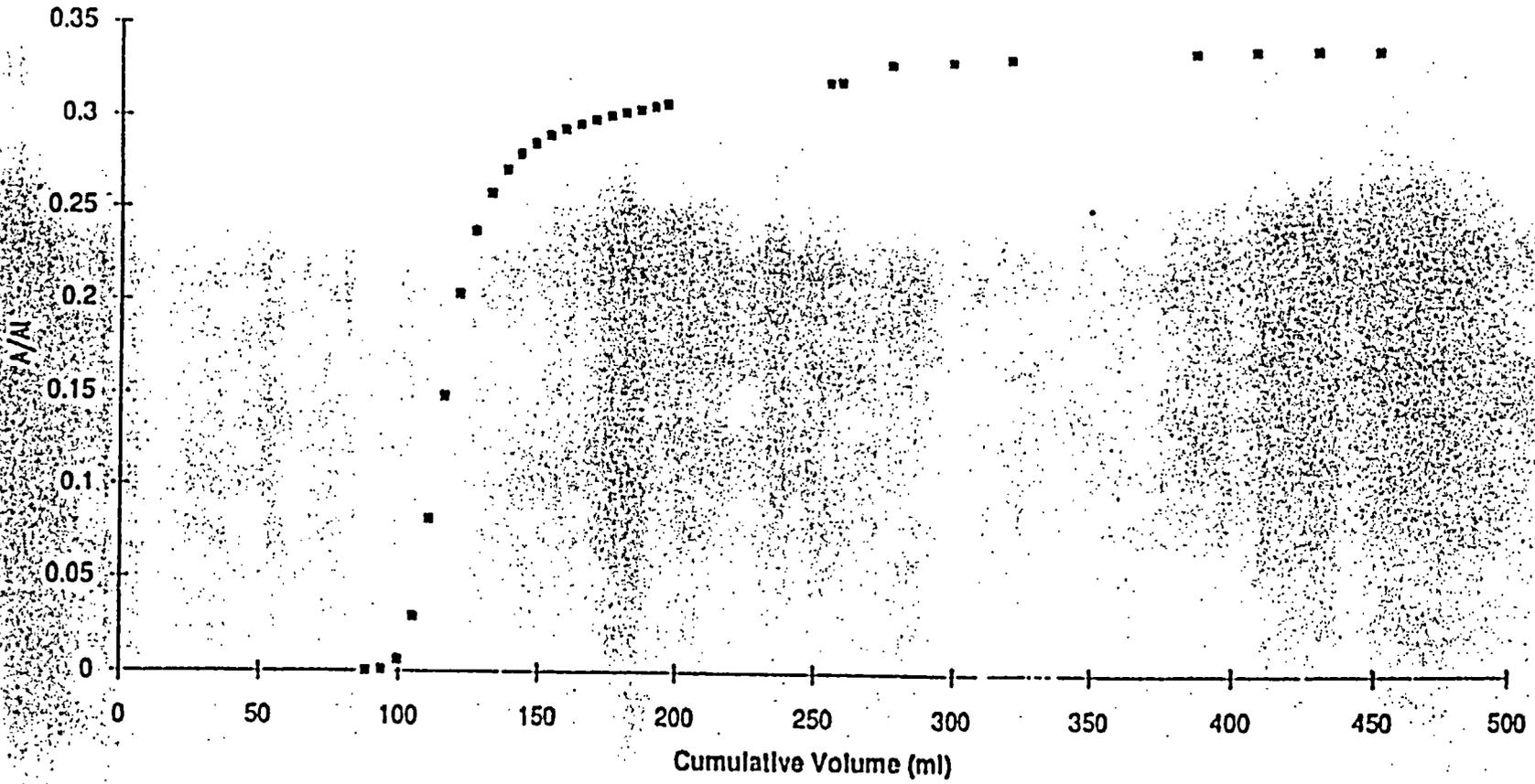


Preliminary Data - Do Not Reference

Figure #7

### Np-237 Elution Through Tuff G4-1530

Preliminary Data—Do Not Reference



May 1992

At this time we do not have an explanation for why only 35% of the Np eluted through tuff G4-1530.3 (which corresponds to a  $K_d$  of ~ 17 ml/g). Consequently, we observed a retardation of Np. Sixty-five percent of the Np was not eluted even after 24 free column volumes were eluted (which corresponds to a  $K_d$  of ~ 17 ml/g), and we suspect the reduction of Np as the cause. Whether this reduction is caused by microbial activity or a chemical agent in the tuff is not clear.

We continued Np batch-sorption experiments with tuffs G4-1530 and G4-275 with USWH-3 and UE-25 p#1 waters to support our transport experiments. We have begun Np batch-sorption experiments with tuff G4-1530 and G4-275 with the recently collected J-13 water (which was tested for microbial activity and found to be free of microbial contamination).

The members of the transport and diffusion tasks made presentations to DOE OCRWM and M&O personnel who toured Los Alamos.

I. Triay participated in a DOE/SKB interaction.

Planned Activities

Continue work described above.

Problem Areas

None

Milestone Progress

3040

30 September 1992

*Kinetics of Sorption on Columns of Pure Minerals*

3044

31 August 1992

*Letter Report on Assessment of Available Techniques for Unsaturated Column Transport Experiments*

In preparation.

3027

31 March 1992

*Report on Sorption by Batch and Column Techniques*

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*

In preparation.

I. R. Triay, A. J. Mitchell, and M. A. Ott

*Radionuclide Migration Studies for Validating Sorption Data—Past, Present, and Future*

Conference paper, *Proceedings of the DOE/Yucca Mountain Site Characterization Project Radionuclide Adsorption Workshop at Los Alamos National Laboratory September 11-12, 1990.*

Responding to YMPO comments.

May 1992

## 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	<p>QA and Programmatic. Certification of TRACRN continued, and the Design phase was submitted on 12 May. The Verification and Validation Plan was almost completed, and sections on input/output, restart capability, and dynamic memory management were added. The saturated-water flow verification problems were completed and written up in the verification report. One of these problems compares solutions between TRACRN and FEHMN, and results of the two codes compare very well. Comparisons between the two codes for unsaturated-zone flow (water only and air/water) problems is in process. The saturated-water flow verification problems were added to a program that automatically reruns and verifies the verification problems. The user's manual is almost complete.</p> <p>Task members hosted tours of the Los Alamos Advanced Computing Laboratory and presented their work to DOE OCRWM and M&amp;O personnel.</p> <p>Team members participated in an internal audit, LANL-AR-92-06, from 11-15 May. Our work was found to be satisfactory.</p> <p>L. Trease attended a meeting of the Software Advisory Group in Las Vegas on 28-29 May.</p> <p>Team members attended the YMP Project Orientation class.</p>
Problem Areas	None
Milestone Progress	3052 31 July 1992 <i>Baseline Documentation for TRACRN</i>
Publications	<p>K. Birdsell, K. Eggert, and B. Travis <i>Three-Dimensional Simulations of Radionuclide Transport at Yucca Mountain</i> Journal article, Special issue of <i>Radioactive Waste Management and The Nuclear Fuel Cycle</i> Submitted revised version to TPO.</p> <p>K. Birdsell, K. Campbell, K. Eggert, and B. Travis <i>Sensitivity Analysis of Integrated Radionuclide Transport Based on a Three-dimensional Geochemical/Geophysical Model</i> Conference proceedings, <i>Proceedings of the DOE/Yucca Mountain Site Characterization Project Radionuclide Adsorption Workshop at Los Alamos National Laboratory September 11-12, 1990.</i> In press.</p>

**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 analogues will be assessed for their potential to provide the required data.

**Activities and Accomplishments** Schedule and costs for this activity were reviewed as part of the Mission 2001 exercise, and input was modified and submitted to planning and scheduling personnel at Los Alamos.

Staff from Lawrence Berkeley Laboratory (LBL) and Los Alamos represented this task during the 28 May site visit by DOE OCRWM and M&O personnel. The presentation was made by LBL personnel.

**Planned Activities** Continue to develop study plan.

Support LB on Mission 2001 PACS input.

**Problem Areas** None

**Milestone Progress** No FY91 milestones.

**Publications** C. Loeven  
*A Summary and Discussion of Hydrologic Data from the Calico Hills Nonwelded Hydrogeologic Unit at Yucca Mountain, Nevada*  
LA-series report  
Approved by YMPO.  
Accession numbers for references are being obtained.

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May 1992

## WBS 1.2.5 Regulatory and Institutional

- Objective** The purpose of this task is to coordinate the regulatory and institutional 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 and institutional framework.
- Management and Integration** Significant effort was made to put forth changes to the SCP Baseline. In particular, the rock-varnish work to support volcanism, erosion, and neotectonic studies was identified discretely. PACs changes were initiated. Work began to evaluate rock-varnish data in support of the erosion issue resolution.
- Study Plans**
- Water Movement Test, R1 (8.3.1.2.2.2). R1 has been approved by DOE but not by NRC. A revision incorporating NRC and State of Nevada comments was submitted to the YMPO on 17 October 1991.
- Diffusion Test in the Exploratory Studies Facility, R0 (8.3.1.2.2.5). A revision incorporating DOE/HQ and Project Office comments was submitted to Dr. Dobson in June 1991.
- Testing of the C-Hole Sites With Reactive Tracers, R1 (8.3.1.2.3.1.7). In February 1990 DOE/HQ issued this study plan as a controlled document; it was then sent to the NRC for comments. In January 1992 we were requested by DOE to revise NRC comments. The revision is in progress.
- Ground Water Chemistry Modeling, R0 (8.3.1.3.1.1). In March 1991 this study plan was submitted to the project office for review.
- Mineralogy, Petrology, and Chemistry of Transport Pathways, R3 (8.3.1.3.2.1). In August 1990 the NRC approved the study plan. In October 1991 we were asked to revise the study plan; in January 1992 we submitted revised comments to T. Bjerstedt.
- History of Mineralogy and Geochemical Alteration at Yucca Mountain, R0 (8.3.1.3.2.2). The Project Office approved the study plan in December 1991 and submitted it to the NRC in January 1992 for comments.
- Natural Analogue 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). A comment resolution meeting for DOE/HQ and Project Office comments was held in March 1990; revision on this activity has been deferred because funds have not been allocated.
- Sorption Studies and Sorption Modeling, R0 (8.3.1.3.4.1; 8.3.1.3.4.3). A new study plan has been issued for internal review.
- Biological Sorption and Transport, R1 (8.3.1.3.4.2). Revisions incorporating DOE/HQ and Project Office comments were submitted in May 1991. Additional revised text were submitted in August 1991.

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Dissolved Species Concentration Limits, and Colloid Formation and Stability, R0 (8.3.1.3.5.1; 8.3.1.3.5.2). In November 1990 the project office submitted comments to Los Alamos to revise; that revision is in progress.

Dynamic Transport Column Experiments, R0 (8.3.1.3.6.1). A comment resolution meeting for DOE/HQ and Project Office comments was held in August 1990; revisions are in progress and are expected to be completed by June 1992.

Diffusion, R0 (8.3.1.3.6.2). A comment resolution meeting for DOE/HQ and Project Office comments was held in August 1990; revisions are in progress and are expected to be completed by June 1992.

Retardation Sensitivity Analysis, R0 (8.3.1.3.7.1). A revision incorporating DOE/HQ and Project Office comments was submitted in June 1991. In October additional comments were received from SAIC, P. Cloke. The comments have been addressed and were submitted to the P. Cloke in March 1992.

Demonstration of the Applicability of Laboratory Data to Repository Transport Calculations, R0 (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). This study plan was approved by the Project Office in September 1990 and by the NRC in October 1991.

Effects of a Volcanic Eruption Penetrating the Repository, R0 (8.3.1.8.1.2). In preparation, expected target date is May 1992.

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

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May 1992

## 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	<p>Continued to develop Tracers, Fluids, and Materials (TFM) management program consistent with plan issued by the Project (YM 91-23) and prepared by Los Alamos.</p> <p>Briefed YMPO on Yucca Mountain Prototype Test Facility (YMTF). Completed draft documentation for Prototype Test Facility rationale and justification.</p> <p>Prepared briefings for bi-weekly ESF management meeting on Fridays.</p> <p>Attended bi-weekly ESF ED&amp;D meetings.</p> <p>Participated in various budget discussion meetings.</p>
Planned Activities	<p>We will continue to develop definitive design related information for tests to be performed in the launch chamber.</p> <p>We will continue to support integration meetings such as ESF design, TIG, SMF surface-based testing and its interface with ESF testing.</p> <p>We will support ED&amp;D effort in developing rationale and justification for the need to have a prototype test facility for Yucca Mountain.</p> <p>Develop interfaces for testing and the ESF design.</p> <p>We will revise and update PSAR as required.</p> <p>Start identifying Project Integrated Data System (IDS) planning.</p> <p>Initiate work to develop new networks for ESF testing.</p> <p>Complete YMP Prototype concept paper with recommendations.</p>
Problem Areas	None
Milestone Progress	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**

This activity has been deferred.

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May 1992

#### V/BS 1.2.9.1.2.4 Technical Software Management

**Objective**

The purpose of this activity is to manage the development, implementation, and use of all software employed on activities that will support a license application; to manage the configurations of all software and computational data; and to provide tools and procedures that support these activities. Technical software management continued to perform the quality assurance, configuration management, and engineering tasks that are required by the Los Alamos Software Quality Assurance Plan for the Yucca Mountain Project.

**Activities and Accomplishments**

This activity has been deferred because of lack of funds.

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#### WBS 1.2.9.1.4 Records Management

**Objective**

The objective of this task is to manage records and documents related to the licensing of a geologic repository for the disposal of high-level radioactive waste by developing, implementing, and maintaining a comprehensive, automated, and integrated information management system.

**Activities and Accomplishments**

The Records Processing Center (RPC) received 51 records and records packages and rejected 8, which were returned to the originators for corrections.

The Central Records Facility (CRF) returned 13 records or records packages for corrections. The RPC resubmitted 50 corrected records to the CRF.

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May 1992

### WBS 1.2.9.3 Quality Assurance

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.
Activities and Accomplishments	<p>Software. One software Configuration Control Board (CCB) meeting was held. There were 165 software change requests (SCRs) submitted during May and 106 applications were approved.</p> <p>Grading Reports. Los Alamos has 33 approved grading reports. A revised grading report is in review at the Project Office.</p> <p>Training. The May orientation class was attended by 20 YMP personnel. Over 90% of all YMP personnel have taken the new orientation course.</p> <p>Program Development. Seventeen quality administrative procedures (OPs) are in various stages of revision. We also provided a detailed quality assurance budget for FY93 to the DOE. S. Bolivar attended the American Society for Quality Control meeting in Las Vegas. S. Bolivar also attended the Project quality assurance meeting in Las Vegas.</p> <p>Audits. The audit plan for EES-13 (LANL-AR-92-07) was approved. The EES-13/Las Vegas TCO portion of audit LANL-AR-92-02 was postponed. Subsequently, audit plan LANL-AR-92-16 for EES-13/Las Vegas TCO was approved and the audit conducted. Audit plan LANL-AR-06 for EES-5 was also approved and the audit conducted. All past survey reports have been completed, approved and distributed. The annual management assessment of the Los Alamos QA program was completed.</p> <p>Other staff assisted in the DOE OCRWM and M&amp;O personnel tour of Los Alamos facilities.</p>
Planned Activities	QP revisions will continue. Fifteen members of the quality group are reviewing the QARD. Formal review of the SQAP will be completed.
Problem Areas	Because we must hire a new software configuration manager and support staff, processing of some SCRs may be delayed.
Publications	<p>S. L. Bolivar <i>The Los Alamos National Laboratory Yucca Mountain Site Characterization Project Quality Program, A Progress Report for January 1, 1990 - December 31, 1991.</i> In internal review.</p> <p>S. L. Bolivar and J. L. Day <i>The Role of the Los Alamos National Laboratory Quality Assurance Liaison for the Yucca Mountain Site Characterization Project</i> Conference paper, ASQC Energy Division annual meeting In preparation.</p>

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Preliminary Data—Do Not Reference

May 1992

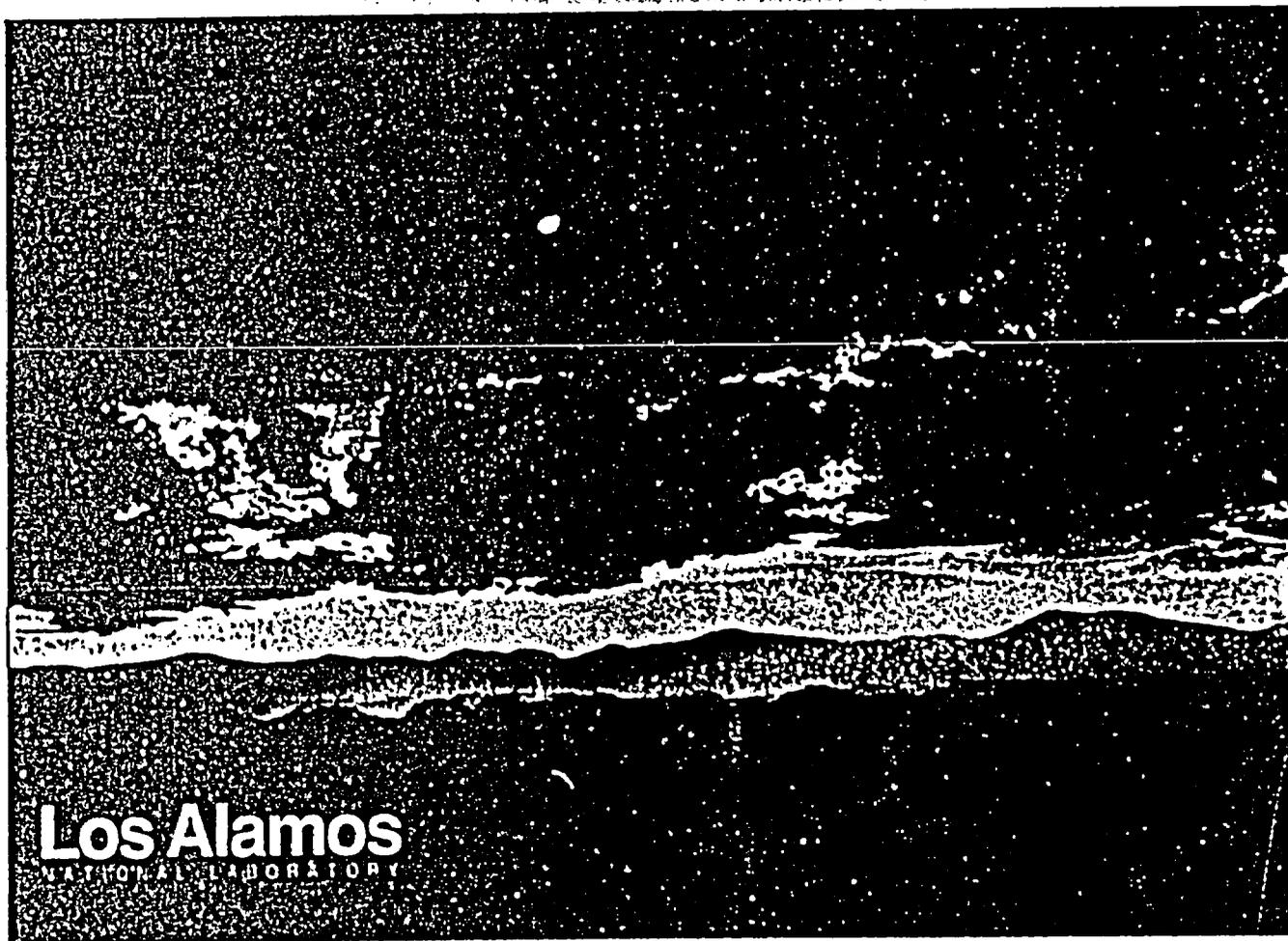
S. L. Bolivar  
*LATA, 1992, Evaluation Report on the March 13, 1992 Orientation to the Los Alamos  
National Laboratory Yucca Mountain Site Characterization Project*  
In preparation.

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# Yucca Mountain Site Characterization Project

## Monthly Activity Report

April 1992



**Los Alamos**  
NATIONAL LABORATORY

Photograph by Chris J. Uraberg

Attachment to TWS-EES-13-06-92-054

~~9208130174 46 pp.~~

This document has not received formal technical or policy review by Los Alamos National Laboratory or by the Yucca Mountain Site Characterization Project. Data presented in this report represent work progress and are not intended for release from the US Department of Energy.

This work was supported by the Yucca Mountain Site Characterization Project Office as part of the Civilian Radioactive Waste Management Program. This Project is managed by the US Department of Energy, Yucca Mountain Site Characterization Project.

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LOS ALAMOS NATIONAL LABORATORY  
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

Monthly Activity Report  
April 1992

WBS 1.2.1 Systems

**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.

Technical Data (WBS 1.2.1.3.5)

**Activities and Accomplishments** Staff received input from principal investigators on the Parameter Normalization List.

**Planned Activities** Submit data from B. Crowe and B. Carlos to the Automated Technical Data Tracking System.

Submit input to SAIC on the Parameter Normalization List.

Work on the parameter screens for the Technical Data Base.

Submit data from I. Triay to the Site and Engineering Property Data Base (SEPDB).

Finalize quality procedure 8.3, "Transfer of Data."

Caisson Experiment (WBS 1.2.1.4.6)

**Activities and Accomplishments** The standard operating procedure (SOP) for the caisson experiment was completed and submitted to the Los Alamos Health and Safety Division for approval.

Arrangements were made with Engineering Division at Los Alamos for the caisson filling on 1 June. A key constraint on this start date is the design and equipment required for the lower-boundary condition.

Work continued on the article for the special issue of *Radioactive Waste Management*.

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*Continued on next page*

April 1992

Planned Activities

Discuss the lower boundary condition with Sandia National Laboratory staff.

Prepare the caisson for filling.

Revise SOP as dictated by review.

Write manuscript for special issue of *Radioactive Waste Management*.

Publications

E. P. Springer and M. D. Siegel  
*An Integrated Intermediate-Scale Caisson Experiment to Validate Models of Fluid Flow and Contaminant Transport in the Unsaturated Zone*  
Journal article, *Radioactive Waste Management and the Nuclear Fuel Cycle*, Special issue on the Yucca Mountain Project  
In preparation.

Performance Assessment Calculational Support (WBS 1.2.1.4.7)

Activities and Accomplishments

G. Valentine and K. Birdsell attended a NRC/DOE technical exchange in Albuquerque on 28-29 April. The discussion focused on calculating complementary cumulative distribution functions (CCDFs).

G. Valentine attended the International High-Level Radioactive Waste Management Conference in Las Vegas on the 15-16 April.

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### WBS 1.2.3.1 Site Management and Integration

#### Site Management (WBS 1.2.3.1.1)

**Objective** The objective of this task is to manage and integrate site characterization activities.

**Activities and Accomplishments** Staff continued to participate in the Integrated Test Evaluation group.  
The RSE and ED division leaders toured the laboratory facilities at Los Alamos and met with key staff to discuss ESF test coordination.

**Publications** J. A. Canepa  
*Strategy for Testing the Applicability and Validity of Radionuclide Transport Models for Yucca Mountain, Nevada*  
Conference Paper, *Migration '91, Jerez de la Frontera, Spain, 14-18 October 1991*  
In revision.

A. M. Simmons and J. A. Canepa  
*Recent Developments in the Integrated Approach Toward Characteristics of Radionuclide Transport, Yucca Mountain, Nevada*  
Conference Paper, *Waste Management '92 Symposium, 2-6 March 1992*  
In preparation.

#### Surface-Based Test Coordination (WBS 1.2.3.1.1)

**Objective** The goal of this investigation is to provide coordination for Los Alamos surface-based test planning package development.

**Activities and Accomplishments** Continued work to develop Tracers, Fluids, and Materials (TFM) Management Program consistent with plan issued by the Project (YM 91-23) prepared by Los Alamos.

Began activities to develop ESF-based sample requirements for laboratory tests.

Completed Appendix B for YMPO 06-04 as part of the Project. Met with participant's point of contact to discuss strategy for gathering tracers, fluids, and material-related information.

Final reviews and Los Alamos approvals in support of the Test Planning Package and Job Packages for UZ-16 Water Movement Tracer Tests were provided.

The readiness review for UZ-16 activities was completed with Los Alamos participating as a readiness review team member.

Sample collection instructions were developed by the Water Movement Tracer Test Principle Investigator for UZ-16 drilling and submitted to the Sample Management Facility staff.

Several sample requests were evaluated and approved by the Sample Overview Committee.

April 1992

## 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 mineralogic 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	<p>Results of the internal February audit were distributed; three deficiencies, which were corrected during the audit, were identified. There were also six observations that will impact upcoming operations and require certain procedures to be revised. The entire staff reviewed and revised several quality procedures.</p> <p>A journal article, "Fracture-lining Manganese Oxide Minerals in Silicic Tuff, Yucca Mountain, Nevada," by B. Carlos, S. Chipera, D. Bish, and S. Craven is in internal review (milestone 3123). Scanning electron microscope (SEM) images will be used as figures in the paper.</p> <p>Assembly of the new INEL microdiffractometer was completed this month. It is now being tested.</p> <p>B. Carlos, D. Vaniman, J. Whelan (USGS), and C. Lewis (SMF) visited the Bond Gold Mine near Beatty to sample calcite, opal, and oxide minerals for comparison to the fracture minerals at Yucca Mountain.</p> <p>J. Whelan of the USGS and E. Roedder of Harvard University visited Los Alamos to coordinate the mineralogic/geochemical studies of deep fracture calcites with the studies of stable isotopes (J. Whelan) and fluid inclusions (E. Roedder). Calcites from both the saturated and unsaturated zones are being studied to evaluate their potential role as markers of relatively recent fracture transport and their possible significance in evaluating paleorecharge.</p> <p>S. Bolivar attended the April SOC meeting at the Sample Management Facility. Several potential sample requests were discussed; a request from the State of Nevada for 7 samples was approved.</p>
Planned Activities	Work planned within the next few months includes the following activities: (1) continued analysis of fracture fillings in the Paintbrush Tuff to determine mineral distribution and factors controlling that distribution; (2) completion of internal review of the paper on Mn-oxides; and (3) continued analysis of calcites to understand transport and precipitation mechanisms.
Problem Areas	None
Milestone Progress	3120 29 May 1992 <i>Calcite in the Upper Paintbrush Tuff</i> This milestone will be delayed by about one month because of (1) redirection of a larger part of the author's effort into calcite-silica studies under 1.2.3.2.1.1.2 and (2) expansion of the scope of the milestone to include more data on calcites below the water table.

Continued on next page

3130  
17 August 1992  
*Fracture Mineralogy of the Paintbrush Tuff*

3137  
30 September 1992  
*Mineralogy of Calico Hills for Adul Development*  
90% complete.

Publications

D. E. Broxton  
*Chemical Changes Associated with Zeolitization on the Tuffaceous Beds of Calico Hills at Yucca Mountain, Nevada*  
Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992  
Approved by YMPO.

B. Carlos, D. Bish, S. Chipera, and S. Craven  
*Fracture-Lining Manganese Oxide Minerals in a Silicic Tuff*  
Journal article, *Chemical Geology*  
Undergoing extensive revision.

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

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*  
Draft complete; may be revised for a different journal.

April 1992

## WBS 1.2.3.2.1.1.2 Mineralogic 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** Staff reviewed QP-3.5, R1, "Documenting Scientific Investigations."

We prepared a DOE position paper on the calcite-silica issue. D. Vaniman and S. Levy attended a press conference at which the National Academy of Science/National Research Council Panel on Coupled Processes issued a report evaluating the data related to possible origins of calcite-silica veins, calcretes, breccias, and other alteration features exposed around Yucca Mountain.

Thirty samples of altered rock from Trench 14, Busted Butte, and Yucca Mountain were prepared and submitted for thin-sectioning. D. Vaniman collected samples at Trench 14A in which a different tuff unit (the Rainier Mesa Member of the Timber Mountain Tuff) occurs in the foot wall. This sampling effort will further test how sensitive the calcite-silica veins may be to wall-rock chemistry. Chemical data from previous Trench 14 samples indicate that the detritus mixed in with the calcite silica must have passed through an episode of soil evolution at the land surface, and direct intermixture of calcite silica with the wall rock adjacent to the vertical veins is minimal. These results agree with petrographic and isotopic data that indicate a pedogenic origin for the calcite-silica deposits.

D. Vaniman and S. Levy attended a USGS climate workshop in Denver. One workshop participant suggested that proposed and ongoing Yucca Mountain studies be placed in a regional framework. Vaniman presented results of his mineralogic studies, including preliminary results on the mineralogic contributions of plants.

G. WoldeGabriel is conducting scanning electron microscope (SEM) studies of Yucca Mountain rock samples used for K/Ar studies to determine a paragenetic sequence from textural relations among secondary minerals; this information will be compared to isotopic dating results.

**Planned Activities** Characterization of new materials for hydrothermal experiments will continue, as will ongoing analysis of Trench 14 and other samples. SEM studies of samples from surface exposures of suspected hydrothermal deposits and materials used for K/Ar studies will continue as well.

**Problem Areas** None

**Milestone Progress** 3138  
30 October 1992  
*Chemical Transport in Zeolitic Alteration*  
58% complete.

3141  
31 March 1992 (delayed due to participation in the issue resolution process)  
*Laminated Zone in Trench 14*  
60% complete.

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3142

*Continued on next page*

3142  
3 April 1992  
*K/Ar Dating of Clays and Zeolites*  
Approved by YMPO.

3143  
15 January 1992  
*Experimental Dehydration of Volcanic Glasses*  
In program review.

3150  
15 April 1993  
*Final Report on Bedrock*  
22% complete.

Publications

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.

G. WoldeGabriel, et. al.  
*Preliminary Assessment of Clinoptilolite K/Ar Results from Yucca Mountain, Nevada: a Potential High-Level Radioactive Waste Repository Site*  
Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992  
Approved by YMPO.

D. Vaniman, D. Bish, and S. Chipera  
*Dehydration and Rehydration of a Tuff Varophyre*  
Journal article, *Journal of Geophysical Research*  
Submitted for review.

D. Vaniman, M. Ebinger, D. Bish, and S. Chipera  
*Precipitation of Calcite, Dolomite, Sepiolite, and Silica from Evaporated Carbonate and Tuffaceous Waters of Southern Nevada*  
Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992  
Approved by YMPO.

April 1992

### WBS 1.2.3.2.1.2 Stability of Minerals and Gases

**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.

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## 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	<p>A response to the paper by Turrin, <i>et. al.</i>, "<sup>40</sup>Ar/<sup>39</sup>Ar Age of the Lathrop Wells Volcanic Center, Yucca Mountain, Nevada," has been approved for publication in an upcoming issue of <i>Science</i>.</p> <p>We evaluated paleomagnetic data, including new data for the O<sub>1</sub>, O<sub>1</sub>, and the buried lava flow at Lathrop Wells Volcanic Center and published work by the USGS. We believe the paleomagnetic method provides little useful information for resolving the problems with stratigraphic or geochronology models because the measured field directions overlap the time-averaged quaternary field direction, the quality of outcrops is marginal for sample collection for some flows, and there are problems with lightning. Published data by the USGS are insufficient to document two distinct field directions. Field examination of sample sites used for paleomagnetic studies of the summit of the main cone shows that some bombs are probably redeposited by hydrovolcanic eruptions and are unsuitable for paleomagnetic studies.</p> <p>Four talks were presented at the High-Level Radioactive Waste Management meeting in Las Vegas, and the full papers were published in the proceedings distributed at the meeting.</p> <p>Three talks by members of the volcanism staff were presented at the University of Texas, El Paso, New Mexico State University, and Arizona State University.</p> <p>A field trip was conducted at the Lathrop Wells Volcanic Center with R. Fisher, an expert on emplacement mechanisms of pyroclastic deposits. The group examined the tephra deposits in the quarry at the south end of the main scoria cone, and Fisher agreed that they, with interbedded soil units, are of volcanic origin (hydrovolcanic/strombolian), which implies a complex eruptive history. We traced these deposits to the summit of the cone, using newly cut exposures from the quarrying operation. The uppermost deposits of the cone are mixed hydrovolcanic-strombolian eruptions.</p> <p>A comprehensive two-week audit of the volcanism program was completed. Two DRs were issued for the volcanism program.</p> <p>Thermoluminescence age-determination analysis of soils baked by lava flows from the Snake River Plains was completed.</p> <p>Work continued on the Issue Resolution Report for volcanism, and we met with the DOE and M&amp;O to discuss the report.</p> <p>Sample preparation was completed on sets that will be submitted for INAA and age determinations using the <sup>40</sup>Ar/<sup>39</sup>Ar method.</p> <p>Following several meetings and reviews of OSHA standards for trenching, the EES-13 Field Safety Plan and standard operating procedures (SOPs) for trenching using a truck-mounted backhoe were revised and submitted to Los Alamos management for review and approval.</p>
Planned Activities	Field geochronology studies at Piute Ridge and Crater Flat will continue.

Continued on next page

April 1992

Meet with Los Alamos management to review SOPs for operation of the truck-mounted backhoe.

Final revisions of the Study Plan 8.3.1.8.1.2, "Dynamics of Magmatic Systems and Effects on the Repository," will be completed next month and submitted to DOE.

Milestone Progress

3174

8 January 1992

*Effects of Magmatic Disruption on the Repository (Study Plan 8.3.1.8.1.2, R0)*  
Complete.

3071

September 1992

*Status of Geochronology Studies at the Lathrop Wells Volcanic Center*  
Complete.

3129

10 July 1992, expected completion April 1992

*Geochemistry of Lathrop Wells Eruptive Sequences*  
Complete.

3034

30 September 1992

*Report on Magma System Dynamics*

3035

30 September 1992, expected completion April 1992

*Effects of Strombolian Eruption*  
Complete.

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*

Publications

B. M. Crowe, et al.

*Issue Resolution Report*  
In preparation.

B. M. Crowe, et al.

*Lathrop Wells Volcanic Center: Status of Field and Geological Studies*  
Proceedings paper, *The International High-Level Radioactive Waste Management (IHLRWR) Conference*  
Published.

Continued on next page

B. M. Crowe, et al.  
*Recurrence Models of Volcanic Events: Applications to Volcanic Risk Assessment*  
Proceedings paper, *The International High-Level Radioactive Waste Management (IHLRWR) Conference*  
Published.

F. V. Perry and B. M. Crowe  
*Geochemical Evidence for Waning Magnetism and Polycyclic Volcanism at Crater Flat, Nevada*  
Proceedings paper, *The International High-Level Radioactive Waste Management (IHLRWR) Conference*  
Published.

G. A. Valentine, B. M. Crowe, and F. V. Perry  
*Physical Processes and Effects of Magnetism in the Yucca Mountain Region*  
Proceedings paper, *The International High-Level Radioactive Waste Management (IHLRWR) Conference*  
Published.

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.

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April 1992

## 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 subcontractor, Hydro Geo Chem, processed 12 ream-bit cutting samples from USW UZ-N54 and -N55, plus 5 USGS water samples from the Yucca Mountain area, for  $^{36}\text{Cl}$  analysis. These samples have been submitted to an outside laboratory for analysis.

The collection of ream-bit cuttings was completed for three additional neutron-access boreholes being drilled for the USGS study, "Characterization of Unsaturated-Zone Infiltration." Thus far, 11 holes have been drilled for this study and have provided samples for  $^{36}\text{Cl}$  analysis. Hydro Geo Chem received from the Sample Management Facility (SMF) a shipment containing the soil samples collected by the J. Fabryka-Martin in February and March, plus the alluvial ream-cutting samples from USW UZ-N37.

A draft DP for ion chromatographic analysis (LANL-INC-DP-94) was completed and is ready for technical and QA review. Based on the experience gained from applying various procedures over the past 3 months, we are preparing revisions of several other existing DPs (DP-88, -89, -92, -95, and -97) for review.

### Planned Activities

Complete additional DPs; process soil samples for Cl/Br and  $^{36}\text{Cl}/\text{Cl}$  ratios; process cuttings samples from neutron-access boreholes; collect additional soil samples from Yucca Mountain area as opportunities arise.

### Milestone Progress

3191  
*Procedure for Chlorine-36 Analysis of Unsaturated Zone Samples*  
25 September 1992  
75% complete.

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 nonadsorbing tracers diffuse into the water-filled pores of the Topopah Spring welded unit.

Activities and Accomplishments No significant activity in this study.

Milestone Progress No milestones are planned this fiscal year.

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April 1992

### 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-25 c#1, UE-25 c#2, and UE-25 c#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.** The review comments of the SRS for FEHMN application are currently being addressed. The edtools application (tools for using the netCDF software more easily) has been approved and certified for use. Work continued on the GZSOLVE and genplot (general-purpose plotting routine using DISPLA graphics software) applications, but no new baselines have been completed. Other software required for data acquisition and control of the laboratory experiments has also been certified.

**Lithium Bromide Studies.** Following servicing, performance of the ion chromatograph (IC), which is used to measure the concentration of dissolved ions, has improved, and the measurement precisions are now well below the value stipulated in the IC detailed technical procedure. The standard operating procedure for the IC, was also revised to reflect the optimized analysis procedures developed. The hot room in which the experiments will be carried out (38°C is the temperature for the first set of tests) is now operational, and all samples and equipment have now been prepped for the first set of batch sorption experiments. Methods for suspending the solids in solution have been tested, and low fluid-to-rock ratios (1 ml:1 g) have been achieved.

#### Planned Activities

Continue to bring the computer codes FRACNET, FEHMN, GZSOLVE, and SORBEQ and other software into compliance with the SQAP. This consists of compiling existing documentation on these codes and writing new material required by the SQAP where necessary.

Carry out batch sorption experiments with lithium bromide.

Continue developing techniques to measure the concentration of polystyrene microspheres in solution.

Complete paper on a validation strategy for the matrix diffusion conceptual model.

#### Problem Areas

None

#### Publications

W. L. Polzer, W. L., M. G. Rao, H. R. Fuentes, and R. J. Beckman  
*Thermodynamically Derived Relationships Between the Modified Langmuir Isotherm and Experimental Parameters*  
Journal article, *Environmental Science and Technology*  
Undergoing revision.

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

Continued on next page

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

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

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

Milestone Progress

3188  
30 September 1992  
*Documentation for SORBEQ*

3194  
30 September 1992  
*Batch Sorption Experiments with Lithium*

T112  
22 June 1992  
*Final Documentation for FEHM*

3196  
27 July 1992  
*FRACNET Documentation*

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April 1992

## WBS 1.2.3.4.1.1 Groundwater Chemistry Model

### Objective

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

### Activities and Accomplishments

Final revisions of papers for the 7th Water-Rock Symposium to be held in Park City, Utah, in July were completed.

Test matrix for geochemical model runs supporting most active groundwater determinations was begun. Different compositions of groundwater from Yucca Mountain will be used to simulate radionuclide dissolution and possible changes in water composition.

QA Activities. No additional progress to report on the IMOU between LLNL and Los Alamos. IMOU is in review in Las Vegas.

### Planned Activities

Track Study Plan 8.3.1.3.1.1 during YMPO review.

Continue USGS collaboration. Dissolved gas compositions (e.g., fugacities of CO<sub>2</sub> and O<sub>2</sub>) from existing and new water-table wells will be used to determine Eh conditions independently of Pt electrode measurements. The gas composition data will also be used in further pH buffering capacity modeling and for refined models of the overall groundwater chemistry.

Continue support of QA efforts. Continue tracking IMOU mentioned above.

### Problem Areas

None

### Milestones Progress

3006

31 August 1992

*Eh and pH Buffering Capacity*

3415

30 September 1992

Letter Report: *Most Active Groundwater Chemistry*

### Publications

M. Ebinger

*Water-Rock Interactions and the pH Stability of Groundwaters from Yucca Mountain, Nevada*

Conference paper, *Proceedings of the 7th Water-Rock Interactions Symposium, July 1992*  
Approved by YMPO.

D. Vaniman, D. Bish, M. Ebinger, S. Chipera

*Precipitation of Calcite, Dolomite, Sepiolite, and Silica from Evaporated Carbonate and Tuffaceous Waters of Southern Nevada*

Conference paper, *Proceedings of the 7th Water-Rock Interactions Symposium, July 1992*  
Approved by YMPO.

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LOS ALAMOS NATIONAL LABORATORY  
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

Monthly Activity Report  
April 1992

WBS 1.2.1 Systems

**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.

Technical Data (WBS 1.2.1.3.5)

**Activities and Accomplishments**                    Staff received input from principal investigators on the Parameter Normalization List.

**Planned Activities**                    Submit data from B. Crowe and B. Carlos to the Automated Technical Data Tracking System.

Submit input to SAIC on the Parameter Normalization List.

Work on the parameter screens for the Technical Data Base.

Submit data from I. Triay to the Site and Engineering Property Data Base (SEPDB).

Finalize quality procedure 8.3, "Transfer of Data."

Caisson Experiment (WBS 1.2.1.4.6)

**Activities and Accomplishments**                    The standard operating procedure (SOP) for the caisson experiment was completed and submitted to the Los Alamos Health and Safety Division for approval.

Arrangements were made with Engineering Division at Los Alamos for the caisson filling on 1 June. A key constraint on this start date is the design and equipment required for the lower-boundary condition.

Work continued on the article for the special issue of *Radioactive Waste Management*.

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*Continued on next page*

April 1992

Planned Activities

Discuss the lower boundary condition with Sandia National Laboratory staff.

Prepare the caisson for filling.

Revise SOP as dictated by review.

Write manuscript for special issue of *Radioactive Waste Management*.

Publications

E. P. Springer and M. D. Siegel

*An Integrated Intermediate-Scale Caisson Experiment to Validate Models of Fluid Flow and Contaminant Transport in the Unsaturated Zone*

Journal article, *Radioactive Waste Management and the Nuclear Fuel Cycle*, Special issue on the Yucca Mountain Project

In preparation.

Performance Assessment Calculational Support (WBS 1.2.1.4.7)

Activities and Accomplishments

G. Valentine and K. Birdsell attended a NRC/DOE technical exchange in Albuquerque on 28-29 April. The discussion focused on calculating complementary cumulative distribution functions (CCDFs).

G. Valentine attended the International High-Level Radioactive Waste Management Conference in Las Vegas on the 15-16 April.

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### WBS 1.2.3.1 Site Management and Integration

#### Site Management (WBS 1.2.3.1.1)

Objective	The objective of this task is to manage and integrate site characterization activities.
Activities and Accomplishments	<p>Staff continued to participate in the Integrated Test Evaluation group.</p> <p>The RSE and ED division leaders toured the laboratory facilities at Los Alamos and met with key staff to discuss ESF test coordination.</p>
Publications	<p>J. A. Canepa  <i>Strategy for Testing the Applicability and Validity of Radionuclide Transport Models for Yucca Mountain, Nevada</i>            Conference Paper, <i>Migration '91, Jerez de la Frontera, Spain, 14-18 October 1991</i>            In revision.</p> <p>A. M. Simmons and J. A. Canepa  <i>Recent Developments in the Integrated Approach Toward Characteristics of Radionuclide Transport, Yucca Mountain, Nevada</i>            Conference Paper, <i>Waste Management '92 Symposium, 2-6 March 1992</i>            In preparation.</p>

#### Surface-Based Test Coordination (WBS 1.2.3.1.1)

Objective	The goal of this investigation is to provide coordination for Los Alamos surface-based test planning package development.
Activities and Accomplishments	<p>Continued work to develop Tracers, Fluids, and Materials (TFM) Management Program consistent with plan issued by the Project (YM 91-23) prepared by Los Alamos.</p> <p>Began activities to develop ESF-based sample requirements for laboratory tests.</p> <p>Completed Appendix B for YMPO 06-04 as part of the Project. Met with participant's point of contact to discuss strategy for gathering tracers, fluids, and material-related information.</p> <p>Final reviews and Los Alamos approvals in support of the Test Planning Package and Job Packages for UZ-16 Water Movement Tracer Tests were provided.</p> <p>The readiness review for UZ-16 activities was completed with Los Alamos participating as a readiness review team member.</p> <p>Sample collection instructions were developed by the Water Movement Tracer Test Principle Investigator for UZ-16 drilling and submitted to the Sample Management Facility staff.</p> <p>Several sample requests were evaluated and approved by the Sample Overview Committee.</p>

April 1992

### 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 mineralogic 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	<p>Results of the internal February audit were distributed; three deficiencies, which were corrected during the audit, were identified. There were also six observations that will impact upcoming operations and require certain procedures to be revised. The entire staff reviewed and revised several quality procedures.</p> <p>A journal article, "Fracture-lining Manganese Oxide Minerals in Silicic Tuff, Yucca Mountain, Nevada," by B. Carlos, S. Chipera, D. Bish, and S. Craven is in internal review (milestone 3123). Scanning electron microscope (SEM) images will be used as figures in the paper.</p> <p>Assembly of the new INEL microdiffractometer was completed this month. It is now being tested.</p> <p>B. Carlos, D. Vaniman, J. Whelan (USGS), and C. Lewis (SMF) visited the Bond Gold Mine near Beatty to sample calcite, opal, and oxide minerals for comparison to the fracture minerals at Yucca Mountain.</p> <p>J. Whelan of the USGS and E. Roedder of Harvard University visited Los Alamos to coordinate the mineralogic/geochemical studies of deep fracture calcites with the studies of stable isotopes (J. Whelan) and fluid inclusions (E. Roedder). Calcites from both the saturated and unsaturated zones are being studied to evaluate their potential role as markers of relatively recent fracture transport and their possible significance in evaluating paleorecharge.</p> <p>S. Bolivar attended the April SOC meeting at the Sample Management Facility. Several potential sample requests were discussed; a request from the State of Nevada for 7 samples was approved.</p>
Planned Activities	Work planned within the next few months includes the following activities: (1) continued analysis of fracture fillings in the Paintbrush Tuff to determine mineral distribution and factors controlling that distribution; (2) completion of internal review of the paper on Mn-oxides; and (3) continued analysis of calcites to understand transport and precipitation mechanisms.
Problem Areas	None
Milestone Progress	<p>3120 29 May 1992 <i>Calcite in the Upper Paintbrush Tuff</i></p> <p>This milestone will be delayed by about one month because of (1) redirection of a larger part of the author's effort into calcite-silica studies under 1.2.3.2.1.1.2 and (2) expansion of the scope of the milestone to include more data on calcites below the water table.</p>

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Continued on next page

3130  
17 August 1992  
*Fracture Mineralogy of the Paintbrush Tuff*

3137  
30 September 1992  
*Mineralogy of Calico Hills for ADA Development*  
90% complete.

Publications

D. E. Broxton  
*Chemical Changes Associated with Zeolitization on the Tuffaceous Beds of Calico Hills at Yucca Mountain, Nevada*  
Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992  
Approved by YMPO.

B. Carlos, D. Bish, S. Chipera, and S. Craven  
*Fracture-Lining Manganese Oxide Minerals in a Silicic Tuff*  
Journal article, *Chemical Geology*  
Undergoing extensive revision.

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

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*  
Draft complete; may be revised for a different journal.

April 1992

## WBS 1.2.3.2.1.1.2 Mineralogic 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** Staff reviewed OP-3.5, R1, "Documenting Scientific Investigations."

We prepared a DOE position paper on the calcite-silica issue. D. Vaniman and S. Levy attended a press conference at which the National Academy of Science/National Research Council Panel on Coupled Processes issued a report evaluating the data related to possible origins of calcite-silica veins, calcretes, breccias, and other alteration features exposed around Yucca Mountain.

Thirty samples of altered rock from Trench 14, Busted Butte, and Yucca Mountain were prepared and submitted for thin-sectioning. D. Vaniman collected samples at Trench 14A in which a different tuff unit (the Rainier Mesa Member of the Timber Mountain Tuff) occurs in the foot wall. This sampling effort will further test how sensitive the calcite-silica veins may be to wall-rock chemistry. Chemical data from previous Trench 14 samples indicate that the detritus mixed in with the calcite silica must have passed through an episode of soil evolution at the land surface, and direct intermixture of calcite silica with the wall rock adjacent to the vertical veins is minimal. These results agree with petrographic and isotopic data that indicate a pedogenic origin for the calcite-silica deposits.

D. Vaniman and S. Levy attended a USGS climate workshop in Denver. One workshop participant suggested that proposed and ongoing Yucca Mountain studies be placed in a regional framework. Vaniman presented results of his mineralogic studies, including preliminary results on the mineralogic contributions of plants.

G. WoldeGabriel is conducting scanning electron microscope (SEM) studies of Yucca Mountain rock samples used for K/Ar studies to determine a paragenetic sequence from textural relations among secondary minerals; this information will be compared to isotopic dating results.

**Planned Activities** Characterization of new materials for hydrothermal experiments will continue, as will ongoing analysis of Trench 14 and other samples. SEM studies of samples from surface exposures of suspected hydrothermal deposits and materials used for K/Ar studies will continue as well.

**Problem Areas** None

**Milestone Progress** 3138  
30 October 1992  
*Chemical Transport in Zeolitic Alteration*  
58% complete.

3141  
31 March 1992 (delayed due to participation in the issue resolution process)  
*Laminated Zone in Trench 14*  
60% complete.

3142

Continued on next page

3142  
3 April 1992  
*K/Ar Dating of Clays and Zeolites*  
Approved by YMPC.

3143  
15 January 1992  
*Experimental Dehydration of Volcanic Glasses*  
In program review.

3150  
15 April 1993  
*Final Report on Bedrock*  
22% complete.

Publications

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.

G. WoldeGabriel, et. al.  
*Preliminary Assessment of Clinoptilolite K/Ar Results from Yucca Mountain, Nevada: a Potential High-Level Radioactive Waste Repository Site*  
Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992  
Approved by YMPO.

D. Vaniman, D. Bish, and S. Chipera  
*Dehydration and Rehydration of a Tuff Varophyre*  
Journal article, *Journal of Geophysical Research*  
Submitted for review.

D. Vaniman, M. Ebinger, D. Bish, and S. Chipera  
*Precipitation of Calcite, Dolomite, Sepiolite, and Silica from Evaporated Carbonate and Tuffaceous Waters of Southern Nevada*  
Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992  
Approved by YMPO.

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April 1992

### WBS 1.2.3.2.1.2 Stability of Minerals and Gases

**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.

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## 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	<p>A response to the paper by Turnn, et. al., "<sup>40</sup>Ar/<sup>39</sup>Ar Age of the Lathrop Wells Volcanic Center, Yucca Mountain, Nevada," has been approved for publication in an upcoming issue of <i>Science</i>.</p> <p>We evaluated paleomagnetic data, including new data for the Q<sub>1</sub>, Q<sub>2</sub>, and the buried lava flow at Lathrop Wells Volcanic Center and published work by the USGS. We believe the paleomagnetic method provides little useful information for resolving the problems with stratigraphic or geochronology models because the measured field directions overlap the time-averaged quaternary field direction, the quality of outcrops is marginal for sample collection for some flows, and there are problems with lightning. Published data by the USGS are insufficient to document two distinct field directions. Field examination of sample sites used for paleomagnetic studies of the summit of the main cone shows that some bombs are probably redeposited by hydrovolcanic eruptions and are unsuitable for paleomagnetic studies.</p> <p>Four talks were presented at the High-Level Radioactive Waste Management meeting in Las Vegas, and the full papers were published in the proceedings distributed at the meeting.</p> <p>Three talks by members of the volcanism staff were presented at the University of Texas, El Paso, New Mexico State University, and Arizona State University.</p> <p>A field trip was conducted at the Lathrop Wells Volcanic Center with R. Fisher, an expert on emplacement mechanisms of pyroclastic deposits. The group examined the tephra deposits in the quarry at the south end of the main scoria cone, and Fisher agreed that they, with interbedded soil units, are of volcanic origin (hydrovolcanic/strombolian), which implies a complex eruptive history. We traced these deposits to the summit of the cone, using newly cut exposures from the quarrying operation. The uppermost deposits of the cone are mixed hydrovolcanic-strombolian eruptions.</p> <p>A comprehensive two-week audit of the volcanism program was completed. Two DRs were issued for the volcanism program.</p> <p>Thermoluminescence age-determination analysis of soils baked by lava flows from the Snake River Plains was completed.</p> <p>Work continued on the Issue Resolution Report for volcanism, and we met with the DOE and M&amp;O to discuss the report.</p> <p>Sample preparation was completed on sets that will be submitted for INAA and age determinations using the <sup>40</sup>Ar/<sup>39</sup>Ar method.</p> <p>Following several meetings and reviews of OSHA standards for trenching, the EES-13 Field Safety Plan and standard operating procedures (SOPs) for trenching using a truck-mounted backhoe were revised and submitted to Los Alamos management for review and approval.</p>
Planned Activities	Field geochronology studies at Piute Ridge and Crater Flat will continue.

Continued on next page

April 1992

Meet with Los Alamos management to review SOPs for operation of the truck-mounted backhoe.

Final revisions of the Study Plan 8.3.1.8.1.2, "Dynamics of Magmatic Systems and Effects on the Repository," will be completed next month and submitted to DOE.

Milestone Progress

3174

8 January 1992

*Effects of Magmatic Disruption on the Repository* (Study Plan 8.3.1.8.1.2, R0)  
Complete.

3071

September 1992

*Status of Geochronology Studies at the Lathrop Wells Volcanic Center*  
Complete.

3129

10 July 1992, expected completion April 1992

*Geochemistry of Lathrop Wells Eruptive Sequences*  
Complete.

3034

30 September 1992

*Report on Magma System Dynamics*

3035

30 September 1992, expected completion April 1992

*Effects of Strombolian Eruption*  
Complete.

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*

Publications

B. M. Crowe, et al.

*Issue Resolution Report*  
In preparation.

B. M. Crowe, et al.

*Lathrop Wells Volcanic Center: Status of Field and Geological Studies*  
Proceedings paper, *The International High-Level Radioactive Waste Management (IHLRWR) Conference*  
Published.

Continued on next page

B. M. Crowe, et al.

*Recurrence Models of Volcanic Events: Applications to Volcanic Risk Assessment*  
Proceedings paper, *The International High-Level Radioactive Waste Management (IHLRWR) Conference*  
Published.

F. V. Perry and B. M. Crowe

*Geochronological Evidence for Waning Magnetism and Polycyclic Volcanism at Crater Flat, Nevada*  
Proceedings paper, *The International High-Level Radioactive Waste Management (IHLRWR) Conference*  
Published.

G. A. Valentine, B. M. Crowe, and F. V. Perry

*Physical Processes and Effects of Magnetism in the Yucca Mountain Region*  
Proceedings paper, *The International High-Level Radioactive Waste Management (IHLRWR) Conference*  
Published.

S. G. Wells, et al.

*Multipic Eruptive Events at Small Volume Basaltic Centers: Evidence From the Cima and Crater Flat Volcanic Fields*  
Journal article  
In preparation

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April 1992

## 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 subcontractor, Hydro Geo Chem, processed 12 ream-bit cutting samples from USW UZ-N54 and -N55, plus 5 USGS water samples from the Yucca Mountain area, for  $^{36}\text{Cl}$  analysis. These samples have been submitted to an outside laboratory for analysis.

The collection of ream-bit cuttings was completed for three additional neutron-access boreholes being drilled for the USGS study, "Characterization of Unsaturated-Zone Infiltration." Thus far, 11 holes have been drilled for this study and have provided samples for  $^{36}\text{Cl}$  analysis. Hydro Geo Chem received from the Sample Management Facility (SMF) a shipment containing the soil samples collected by the J. Fabryka-Martin in February and March, plus the alluvial ream-cutting samples from USW UZ-N37.

A draft DP for ion chromatographic analysis (LANL-INC-DP-94) was completed and is ready for technical and QA review. Based on the experience gained from applying various procedures over the past 3 months, we are preparing revisions of several other existing DPs (DP-88, -89, -92, -95, and -97) for review.

### Planned Activities

Complete additional DPs; process soil samples for Cl/Br and  $^{36}\text{Cl}/\text{Cl}$  ratios; process cuttings samples from neutron-access boreholes; collect additional soil samples from Yucca Mountain area as opportunities arise.

### Milestone Progress

3191

*Procedure for Chlorine-36 Analysis of Unsaturated Zone Samples*

25 September 1992

75% complete.

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 No significant activity in this study.

Milestone Progress No milestones are planned this fiscal year.

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April 1992

### 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-25 c#1, UE-25 c#2, and UE-25 c#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.** The review comments of the SRS for FEHMN application are currently being addressed. The cdstools application (tools for using the netCDF software more easily) has been approved and certified for use. Work continued on the GZSOLVE and genplot (general-purpose plotting routine using DISSPLA graphics software) applications, but no new baselines have been completed. Other software required for data acquisition and control of the laboratory experiments has also been certified.

**Lithium Bromide Studies.** Following servicing, performance of the ion chromatograph (IC), which is used to measure the concentration of dissolved ions, has improved, and the measurement precisions are now well below the value stipulated in the IC detailed technical procedure. The standard operating procedure for the IC was also revised to reflect the optimized analysis procedures developed. The hot room in which the experiments will be carried out (38°C is the temperature for the first set of tests) is now operational, and all samples and equipment have now been prepped for the first set of batch sorption experiments. Methods for suspending the solids in solution have been tested, and low fluid-to-rock ratios (1 ml:1 g) have been achieved.

**Planned Activities**

Continue to bring the computer codes FRACNET, FEHMN, GZSOLVE, and SORBEQ and other software into compliance with the SQAP. This consists of compiling existing documentation on these codes and writing new material required by the SQAP where necessary.

Carry out batch sorption experiments with lithium bromide.

Continue developing techniques to measure the concentration of polystyrene microspheres in solution.

Complete paper on a validation strategy for the matrix diffusion conceptual model.

**Problem Areas**

None

**Publications**

W. L. Polzer, W. L. M. G. Rao, H. R. Fuentes, and R. J. Beckman  
*Thermodynamically Derived Relationships Between the Modified Langmuir Isotherm and Experimental Parameters*  
Journal article, *Environmental Science and Technology*  
Undergoing revision.

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

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April 1992

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

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

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

Milestone Progress

3188  
30 September 1992  
*Documentation for SORBEQ*

3194  
30 September 1992  
*Batch Sorption Experiments with Lithium*

T112  
22 June 1992  
*Final Documentation for FEHM*

3196  
27 July 1992  
*FRACNET Documentation*

April 1992

## WBS 1.2.3.4.1.1 Groundwater Chemistry Model

### Objective

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

### Activities and Accomplishments

Final revisions of papers for the 7th Water-Rock Symposium to be held in Park City, Utah, in July were completed.

Test matrix for geochemical model runs supporting most active groundwater determinations was begun. Different compositions of groundwater from Yucca Mountain will be used to simulate radionuclide dissolution and possible changes in water composition.

QA Activities. No additional progress to report on the IMOU between LLNL and Los Alamos. IMOU is in review in Las Vegas.

### Planned Activities

Track Study Plan 8.3.1.3.1.1 during YMPO review.

Continue USGS collaboration. Dissolved gas compositions (e.g., fugacities of CO<sub>2</sub> and O<sub>2</sub>) from existing and new water-table wells will be used to determine Eh conditions independently of Pt electrode measurements. The gas composition data will also be used in further pH buffering capacity modeling and for refined models of the overall groundwater chemistry.

Continue support of QA efforts. Continue tracking IMOU mentioned above.

### Problem Areas

None

### Milestones Progress

3006

31 August 1992

*Eh and pH Buffering Capacity*

3415

30 September 1992

Letter Report: *Most Active Groundwater Chemistry*

### Publications

M. Ebinger

*Water-Rock Interactions and the pH Stability of Ground waters from Yucca Mountain, Nevada*

Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992  
Approved by YMPO.

D. Vaniman, D. Bish, M. Ebinger, S. Chipera

*Precipitation of Calcite, Dolomite, Sepiolite, and Silica from Evaporated Carbonate and Tuffaceous Waters of Southern Nevada*

Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992  
Approved by YMPO.

April 1992

## WBS 1.2.3.4.1.2.1 and 1.2.3.4.1.2.3 Batch Sorption Studies and Sorption Models

### 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

P. Rogers attended two sorption-related symposia at the annual spring meeting of the American Chemical Society. Of particular interest were talks presenting high-resolution scanning-transmission (STM) images of chromium adsorbed on hematite and low-resolution atomic-force microscope (AFM) images of hematite dissolution in the presence of citrate. Keynote addresses by W. Stumm (EAWAG, Switzerland) and G. Sposito (UC Berkeley) stressed the importance of spectroscopic studies (especially using XPS and EXAFS) to understanding sorption mechanisms and developing predictive sorption models. Conversations with several participants yielded suggestions on experimental techniques to improve resolution of AFM images, particularly of hematite.

M. Hawley attended the Materials Research Society Meeting, which also emphasized AFM and STM techniques and advances.

New AFM tips that reduce the force applied to a sample during a scan were received. Reducing the scanning force is critical to obtaining images of sorbed compounds, the scanning force must be reduced; the force now used pushes most sorbed compounds out of the imaging field.

### Planned Activities

Prepare for two new staff who will be joining this task. Prepare for visit by representatives of the Office of Civilian Nuclear Waste Management.

### Problem Areas

Work in conjunction with the Stanford contract has been temporarily suspended because of a lack of funds.

### 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

A. Meijer

*A Strategy for the Derivation and Use of Sorption Coefficients in Performance Assessment Calculations for the Yucca Mountain Site*

Conference proceedings, *Proceedings of the DOE/Yucca Mountain Site Characterization Project Radionuclide Adsorption Workshop at Los Alamos National Laboratory September 11-12, 1990.*

Approved by YMPO.

April 1992

## 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	<p>Work continued on characterizing of the siderophore(s) produced by microorganism 11c. Specifically, a bioassay of the siderophore, using ethylenediamine di (o-hydroxyphenyl) acetic acid (EDDA) was performed.</p> <p>A review of the literature on chelation chemistry of mineral dissolution was completed.</p> <p>Work continued on milestone 3080, "Report on Chelation," and 3092, "Report on Colloidal Agglomeration."</p> <p>L. Hersman attended the annual meeting of the American Chemical Society.</p>
Planned Activities	<p>Continue plutonium <math>K_d</math> experiments.</p> <p>Continue colloidal agglomeration experiments.</p>
Problem Areas	None
Milestone Progress	<p>3080 30 September 1992 <i>Report on Chelation</i> In preparation.</p> <p>3092 30 September 1992 <i>Report on Colloidal Agglomeration</i> In preparation.</p> <p>3176 30 September 1992 <i>Procedure for Determination of Formation Constants</i> In progress.</p> <p>3177 30 September 1992 <i>Procedure for Determination of Effects on Colloidal Agglomeration</i> In preparation.</p>
Publications	<p>L. R. Hersman, D. E. Hobart, and T. W. Newton <i>Preliminary Evidence of Siderophore/Plutonium Complexation</i> Journal article, <i>Journal of Applied and Environmental Microbiology</i> Resubmitted.</p>

## 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

A new staff member to assume D. Hobart's responsibilities is in the process of being hired. (Hobart has accepted a two-year appointment in Washington, D.C.)

The revised study plan should be complete by the 15 August target date.

D. Morris met with representatives of the DOE and proposed continuing solubility and speciation studies for FY93 and postponing solubility and speciation modeling until FY94.

Task participants Clark, Hobart, Nitsche, Palmer, and Tait attended the national meeting of the American Chemical Society. Many excellent technical sessions, particularly in nuclear chemistry, geochemistry, and environmental chemistry, were of interest to those associated with Yucca Mountain Project research.

Speciation Studies. Pu(IV) EDTA complexation experiments to observe speciation changes for pH 7 to 10 continued and preliminary analysis of the data suggests three species in this pH region. Single crystals of two of species were grown using slow evaporation from aqueous solution, and they will be examined by XRD studies as soon as appropriate standard operating procedures are completed. Line-width measurements made on Pu(VI) and Am(VI) carbonate complexes indicated that ligand substitution follows an associative pathway for uranium through americium. Data reduction on <sup>13</sup>C NMR on the 242-Pu(VI) carbonate system suggests that some additional experiments are warranted to deduce the intimate exchange mechanism. The results of these studies will be written up for publication as a milestone report and submitted to the *Journal of the American Chemical Society*.

Synthesis on model complexes continued, and the letter report on model complex studies is presently being converted to LAMS format.

Experimental work on the photoacoustic spectroscopy (PAS) system has focused on determining the absorption spectrum and cross section of bona fide Pu(IV) colloids. This data is necessary to check if any of the peaks observed in the Pu(IV)-carbonate system correspond to that of a colloid. Contrary to our expectations, we observed significant scattering and low signal strength for large sized colloidal particles. Unless we find that the smaller sized particles have significantly larger PAS signals, we believe that the Pu(IV) in bicarbonate media peaks we previously observed did not reflect colloid formation, and we will try to obtain PAS spectra from smaller sized colloidal particles. We will also use T-dependent PAS to measure the temperature effects on dilute Pu(IV)-carbonate systems.

The FrameMaker-formatted version of the coding standards for QuickBASIC were submitted to the CCB for approval.

Solubility Studies. Three neptunium oversaturation experiments in UE-25 pH1 water at 60°C have been completed, and three neptunium undersaturation experiments under the same conditions have been started. Solids from the oversaturation experiments at the same pH were used, except for a small portion set aside for XRD analysis. The undersaturation

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experiments will be assayed frequently at first; assays will be decreased to every two to three weeks after the experiments are underway. All assays to date have been analyzed.

Alpha-pulse height analysis was used to shorten analyses time of assays from the Am/Nd experiments.

Work continued on a detailed technical procedure (DP), "Concentration Determination of Soluble Radionuclides from Data Provided by a Low-Energy Gamma Counting System." It will be submitted next month for review. Another DP, "Calibration of Low Energy Gamma Counters for the Yucca Mountain Waste Element Solubility Study," is being revised and will be resubmitted in June 1992.

Planned Activities

Certification of commercial NMR software will begin, and efforts in all above mentioned areas will continue.

D. Tait will attend the Rocky Mountain Regional Meeting of the American Chemical Society and present a talk at the session on chemistry and environmental issues.

Problem Areas

We are concerned about the loss of Software Quality Assurance Program staff as it may significantly impact our efforts in this task.

Milestone Progress

3031

30 September 1992

*Plutonium(IV) and Plutonium(VI) Carbonate Speciation Studies by NMR and PAS Spectroscopies*  
On schedule.

3329

30 September 1992

*Report on Neptunium, Plutonium, and Americium Solubility Experiments in UE-25p#1 Water from Oversaturation.*  
On schedule.

3330

1 January 1993

*Evaluation of Alternative Detection Schemes in Photoacoustic Spectroscopy*  
Early completion anticipated.

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  
*Plutonium(IV) and Plutonium(VI) Carbonate Speciation Studies by NMR and PAS Spectroscopies*  
LA-series report  
In preparation.

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D. L. Clark, J. G. Watkins, 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*  
Undergoing revision.

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  $UCl_6$ : Spectral Effects of Ligand Exchange*  
LA-series report.  
In preparation.

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 Groundwater (J-13) from the Yucca Mountain Region*  
LA-series report  
Submitted for 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, D. E. Morris, S. A. Ekberg, P. D. Palmer, and J. M. Berg  
*Plutonium Carbonate Speciation Changes with pH*  
Conference abstract, *American Chemical Society National Meeting Program*, April 1992  
Approved by YMPO.

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## 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 performance assessment.

### Activities and Accomplishments

This month we continued Np transport work using crushed-tuff columns made from tuffs G4-1530.3 and G4-275. As stated last month, in order to study Np transport, we must obtain sharp breakthroughs for tritium elutions. (Neptunium is expected to sorb to trace minerals [such as hematite] in the tuff, which will tend to broaden the elution curves; consequently, we must ensure that physical dispersion is not responsible for the broadening.) We also completed optimizing all possible parameters (including packing techniques) to minimize elution broadening.

Table I shows the parameters used in columns tritium elutions for Columns G-J made with tuff G4-1530. We do not have a dry weight for Columns I and J because a wet-packing technique was used.

Table I

Fig. No.	Column #	Flow Rate (ml/hr)	Length (mm)	Diameter (mm)	Dry/Wet Weight (g)
1	G4-1530.3G	3.0	1000	4.72	19.4/29.4
2	G4-1530.3H	0.15	1000	4.72	19.4/29.4
3	G4-1530.3I	0.3	1816.1	4.72	*NA/52.25
4	G4-1530.3J	1.0	1816.1	4.72	*NA/52.25

\*NA= not available

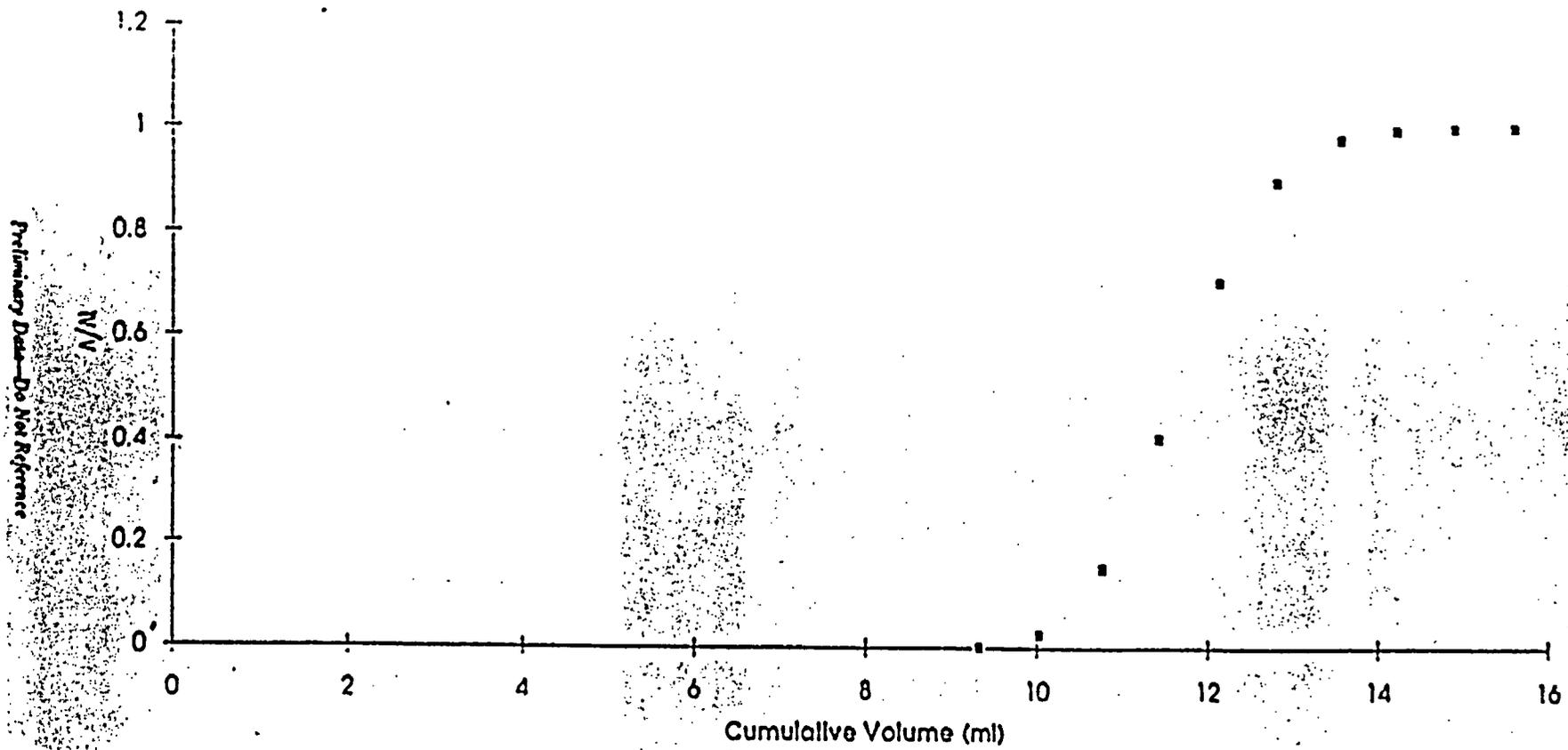
Figures 1-4 show the cumulative activity of tritiated water eluted through the columns (A/AI) versus the cumulative volume eluted. Each column was injected with 0.5 ml of tritiated water. Column I showed the optimal breakthrough curve; however, the flow rate was too slow for timely completion of these experiments. Column J showed adequate dispersion, and we began the Np elution through this column. The results of these studies will be reported next month.

We observed a distinct amount of black material at the bottom of Column J, and using a magnetic separator, we separated the two fractions of crushed tuff G4-1530 and sent them for chemical and XRD analysis.

We tested all waters in storage (J-13, H-3 and P-1) for microbial activity; most of the J-13 water showed considerable microbial contamination and was discarded; one container that will be monitored long-term was retained. We found no microbial contamination in the USWH-3 and UE-25 p#1 waters.

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Fig. 1 HTO elution through G4-1530.3G



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Fig. 2 HTO elution through G-4-1530.3H

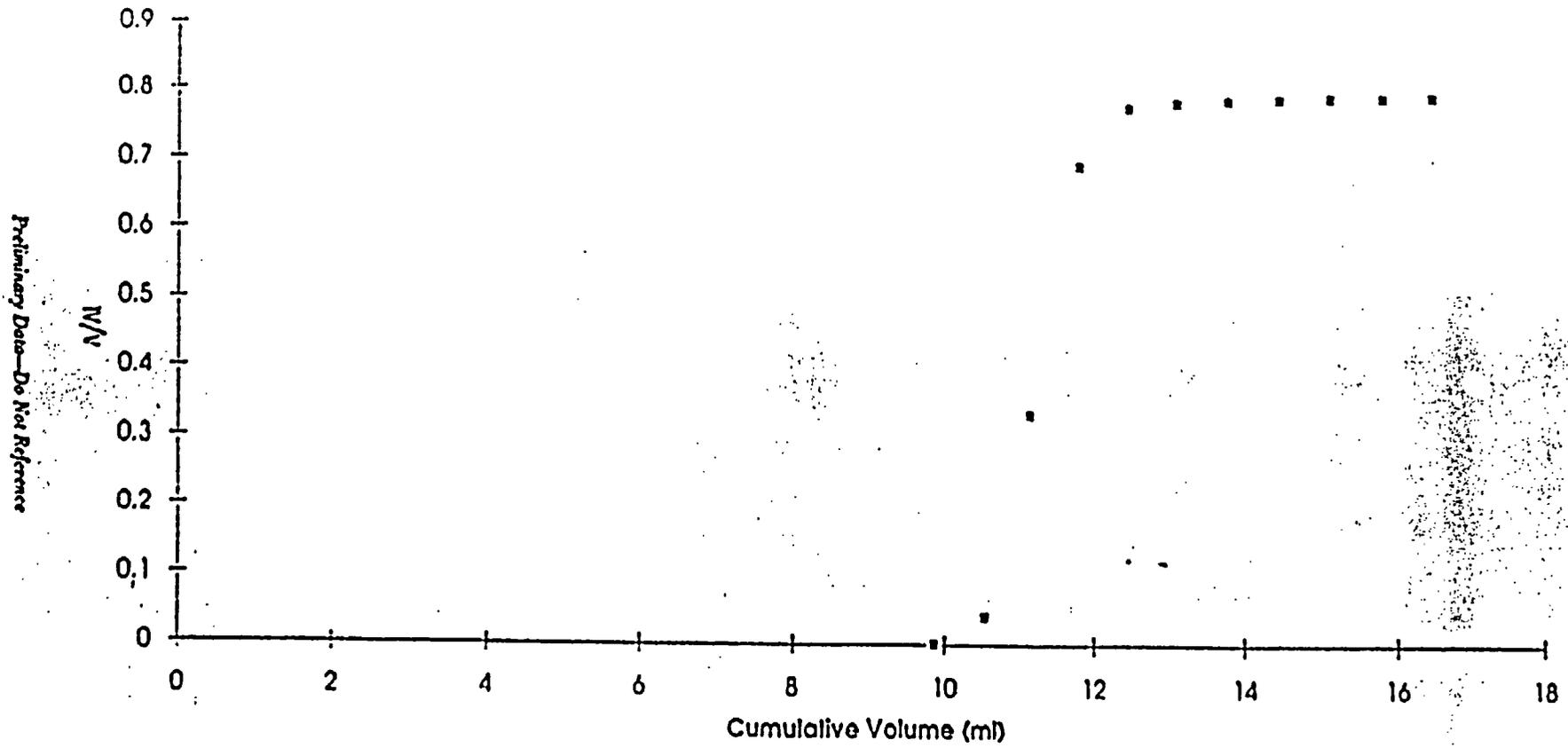
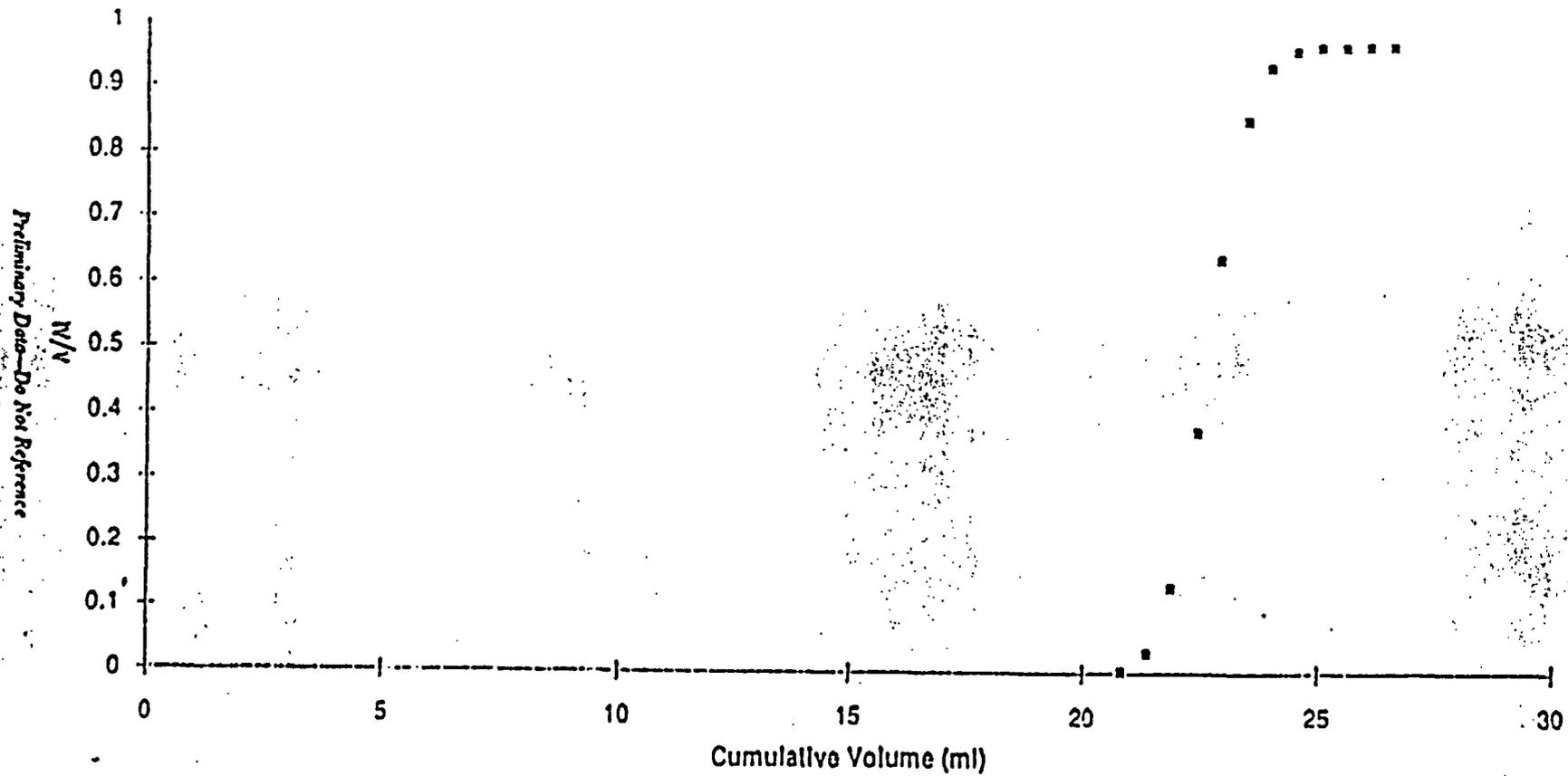
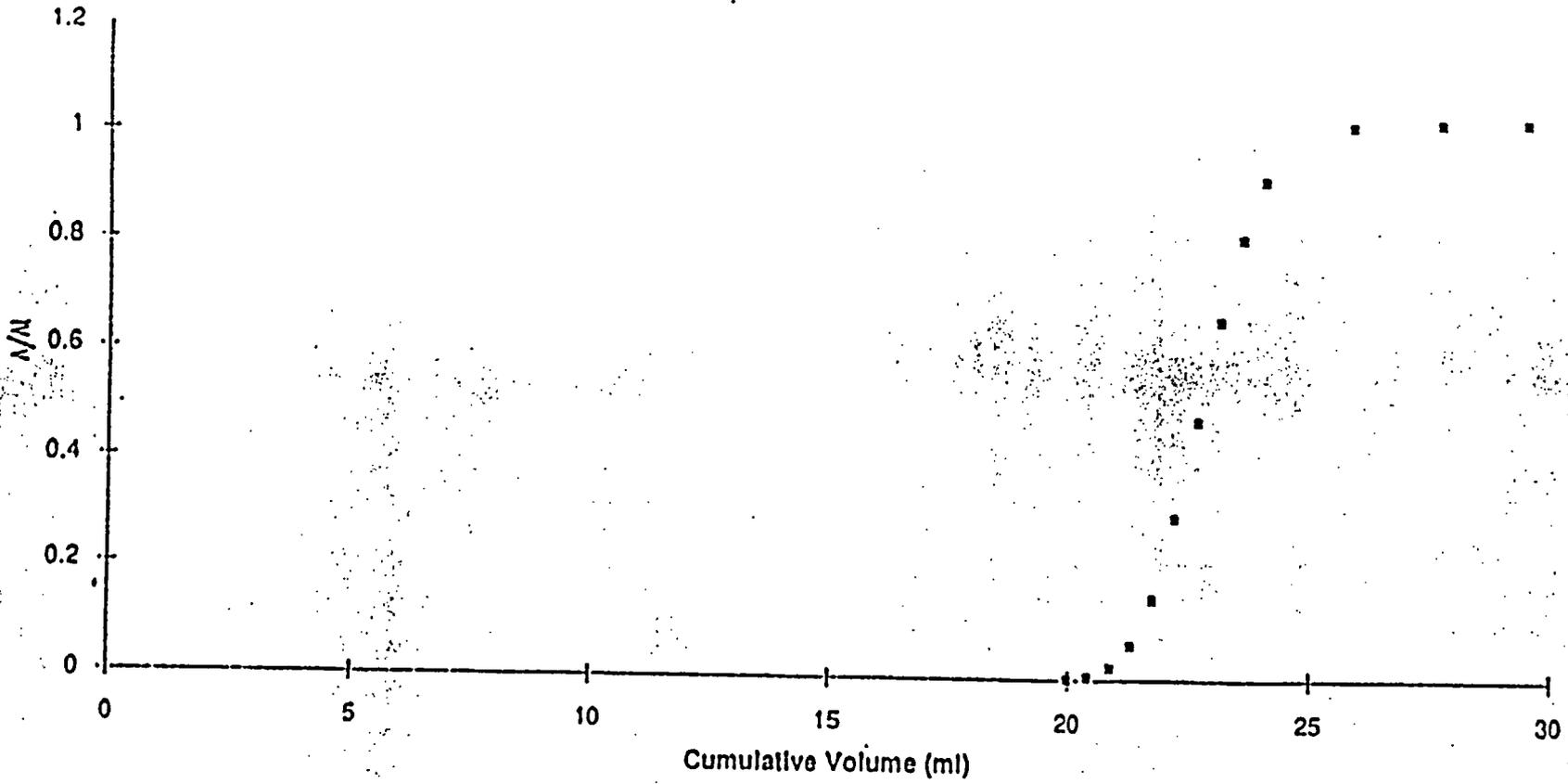


Fig. 3 HTO elution through G4-2530.3I



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Fig. 4 HTO elution through G4-1530.3J



Preliminary Data—Do Not Reference

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Using sterile containers, A. Mitchell and M. Ott collected water from the J-13 well (L. Hersman advised the staff about a study regarding the optimal procedure to use to avoid microbial contamination.) The new J-13 water will be received at Los Alamos next month.

To support our transport experiments, we began Np batch-sorption experiments with tuffs G4-1530 and G4-275 with waters from USWH-3 and UE-25 p#1.

A. Mitchell served as a briefer at the Los Alamos exhibit for the April 1992 YMP open house, and A. Mitchell and M. Ott briefed a high-school tour at the FOC.

Planned Activities

Continue work described above.

Milestone Progress

3040  
30 September 1992  
*Kinetics of Sorption on Columns of Pure Minerals*

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

3027  
31 March 1992  
*Report on Sorption by Batch and Column Techniques*

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*  
In preparation.

I. R. Triay, A. J. Mitchell, and M. A. Ott  
*Radionuclide Migration Studies for Validating Sorption Data—Past, Present, and Future*  
Conference paper, *Proceedings of the DOE/Yucca Mountain Site Characterization Project Radionuclide Adsorption Workshop at Los Alamos National Laboratory September 11-12, 1990.*  
Responding to YMPO comments.

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### 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** K. Birdsell met with P. Rogers, the new principal investigator for the sorption task, to discuss our approach to modeling the minimum  $K_d$  sorption strategy. Rogers suggested specific radionuclides to focus on.

QA and Programmatic. Certification of TRACRN is continuing, and the design phase will be submitted to the CCB in a few weeks. As part of the design phase, variable descriptions were written for 500 variables, and pseudocode was written for the new memory management subroutines and the restart subroutines. The Verification and Validation Plan is nearly complete; several additional verification problems were run, and the results were added to the Verification Report. We have almost completed work on a program that automatically reruns and verifies the verification problems and on the user's manual.

G. Valentine chaired a review committee for the Software Requirements Specification Documents for the software CONAPS and MIEEQA, which are used for the dynamic transport task. He also performed a formal technical review of the FEHMN SRS.

Pseudocode and variables descriptions were written for the matrix solver GZSOLVE, which will be a re-use component of several Los Alamos YMP codes.

**Planned Activities** We will continue certification of TRACRN.

**Milestone Progress** 3052  
31 July 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  
Responding to comments from YMPO.

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**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 analogues will be assessed for their potential to provide the required data.

**Activities and Accomplishments** On 1 April a schedule and budget for the LBL component of this task was developed and loaded on software at Los Alamos for eventual PACS input to the Project. On 22 April, A. Simmons of the DOE was briefed on the techniques, plans, and status of field-test activity. A revised FY92 budget for LBL will allow more effort in planning. A change request to PACS will be prepared for LBL.

A Hydrology Integration Task Force (HITF) meeting was held on April 16 in Las Vegas.

**Planned Activities** Continue to develop study plan.

Review LBL N and P Tunnels report.

**Problem Areas** None

**Milestone Progress** No FY91 milestones.

**Publications** C. Loeven  
*A Summary and Discussion of Hydrologic Data from the Calico Hills Nonwelded Hydrogeologic Unit at Yucca Mountain, Nevada*  
 LA-series report  
 Approved by YMPO.  
 Accession numbers for references are being obtained.

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## WBS 1.2.5 Regulatory and Institutional

Objective	The purpose of this task is to coordinate the regulatory and institutional 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 and institutional framework.
Management and Integration	Significant effort was made to put forth changes to the SCP Baseline. In particular, the rock-varnish work to support volcanism, erosion, and neotectonic studies was identified discretely. PACs changes were initiated. Work began to evaluate rock-varnish data in support of the erosion issue resolution.
Study Plans	<p>Water Movement Test, R1 (8.3.1.2.2.2). R1 has been approved by DOE but not by NRC. A revision incorporating NRC and State of Nevada comments was submitted to the YMPO on 17 October 1991.</p> <p>Diffusion Test In the Exploratory Studies Facility, R0 (8.3.1.2.2.5). A revision incorporating DOE/HQ and Project Office comments was submitted to Dr. Dobson in June 1991.</p> <p>Testing of the C-Hole Sites With Reactive Tracers, R1 (8.3.1.2.3.1.7). In February 1990 DOE/HQ issued this study plan as a controlled document; it was then sent to the NRC for comments. In January 1992 we were requested by DOE to revise NRC comments. The revision is in progress.</p> <p>Ground Water Chemistry Modeling, R0 (8.3.1.3.1.1). In March 1991 this study plan was submitted to the project office for review.</p> <p>Mineralogy, Petrology, and Chemistry of Transport Pathways, R3 (8.3.1.3.2.1). In August 1990 the NRC approved the study plan. In October 1991 we were asked to revise the study plan; in January 1992 we submitted revised comments to T. Bjerstedt.</p> <p>History of Mineralogy and Geochemical Alteration at Yucca Mountain, R0 (8.3.1.3.2.2). The Project Office approved the study plan in December 1991 and submitted it to the NRC in January 1992 for comments.</p> <p>Natural Analogue Hydrothermal System in Tuff (8.3.1.3.3.1). This is an out-year activity.</p> <p>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). A comment resolution meeting for DOE/HQ and Project Office comments was held in March 1990; revision on this activity has been deferred because funds have not been allocated.</p> <p>Sorption Studies and Sorption Modeling, R0 (8.3.1.3.4.1; 8.3.1.3.4.3). A revision is in progress.</p> <p>Biological Sorption and Transport, R1 (8.3.1.3.4.2). Revisions incorporating DOE/HQ and Project Office comments were submitted in May 1991. Additional revised text were submitted in August 1991.</p>

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Dissolved Species Concentration Limits, and Colloid Formation and Stability, R0 (8.3.1.3.5.1; 8.3.1.3.5.2). In November 1990 the project office submitted comments to Los Alamos to revise; that revision is in progress.

Dynamic Transport Column Experiments, R0 (8.3.1.3.6.1). A comment resolution meeting for DOE/HQ and Project Office comments was held in August 1990; revisions are in progress and are expected to be completed by April 1992.

Diffusion, R0 (8.3.1.3.6.2). A comment resolution meeting for DOE/HQ and Project Office comments was held in August 1990; revisions are in progress and are expected to be completed by April 1992.

Retardation Sensitivity Analysis, R0 (8.3.1.3.7.1). A revision incorporating DOE/HQ and Project Office comments was submitted in June 1991. In October additional comments were received from SAIC, P. Cloke. The comments have been addressed and were submitted to the P. Cloke in March 1992.

Demonstration of the Applicability of Laboratory Data to Repository Transport Calculations, R0 (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). This study plan was approved by the Project Office in September 1990 and by the NRC in October 1991.

Effects of a Volcanic Eruption Penetrating the Repository, R0 (8.3.1.8.1.2). In preparation, expected target date is May 1992.

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

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## 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	<p>Supported ED&amp;D in developing briefing material for Prototype Test Facility and started work to prepare draft Prototype Test Facility rationale and justification.</p> <p>Developed a draft summary-level document to assess sample needs from ESF.</p> <p>Continued to participate in Test Integration (TIG) meetings and SMF meetings.</p> <p>Prepared briefings for bi-weekly ESF management meeting.</p> <p>We have started developing test information for tests to be performed in north-portal area and started preparation of test planning packages for launch chamber tests.</p>
Planned Activities	<p>Prepare test planning packages for launch chamber tests.</p> <p>Continue gathering TFM information from participants.</p> <p>Continue to develop definitive design-related information for tests to be performed in the launch chamber.</p> <p>Continue to support integration meetings such as ESF design, TIG, SMF, surface-based testing and its interface with ESF testing.</p> <p>Support ED&amp;D effort in developing rationale and justification for the need to have a prototype test facility for Yucca Mountain.</p> <p>Continue to support Los Alamos surface-based test planning process.</p> <p>Develop interfaces for testing and the ESF design.</p> <p>Revise and update PSAR as required.</p> <p>Work will be initiated to prepare Title II Test Planning Packages.</p> <p>Initiate work to develop new networks for ESF testing.</p> <p>Complete YMP prototype concept paper with recommendations.</p> <p>Schedule Exploratory Studies Facility Test Coordination meeting for 12 May.</p>
Problem Areas	None
Milestones	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**

This activity has been deferred.

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## WBS 1.2.9.1.2.4 Technical Software Management

### Objective

The purpose of this activity is to manage the development, implementation, and use of all software employed on activities that will support a license application; to manage the configurations of all software and computational data; and to provide tools and procedures that support these activities. Technical software management continued to perform the quality assurance, configuration management, and engineering tasks that are required by the Los Alamos Software Quality Assurance Plan for the Yucca Mountain Project.

### Activities and Accomplishments

This activity has been deferred because of lack of funds.

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#### WBS 1.2.9.1.4 Records Management

**Objective** The objective of this task is to manage records and documents related to the licensing of a geologic repository for the disposal of high-level radioactive waste by developing, implementing, and maintaining a comprehensive, automated, and integrated information management system.

**Activities and Accomplishments** An eight-month record backlog was processed, following lifting of the stop work order. Approximately 800 records were shipped to the Central Records Facility, and only 52 records were returns for corrections.

Fifty-nine new records were received during April.

Staff worked with the training coordinator to develop and implement formal records training. The course will be available as soon as revisions to the records procedures are finalized.

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### WBS 1.2.9.3 Quality Assurance

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.
Activities and Accomplishments	<p>Software. A software Configuration Control Board (CCB) meeting was held; 158 software change requests were submitted, and 95 were approved.</p> <p>Grading Reports. Los Alamos has 33 approved grading reports. A revised grading report is in review at the Project Office.</p> <p>Records/Document Control. Five detailed technical procedures (DP-07, -112, -125, -129, and -605) and one quality administrative procedure (QP 6.1, R4, Controlled Documents) were issued. Detailed technical procedures DP-06, -50, -122, and -123 were deleted.</p> <p>Training. The April orientation class was attended by 24 YMP staff. At this time approximately 75% of all YMP personnel have completed the new orientation course.</p> <p>Program Development. Eighteen quality administrative procedures (OPs) are in various stages of revision. The QAPL presented a semi-annual update of the QA program to EES-13/Las Vegas personnel. Work began on the FY93 budget. The QAL attended a Los Alamos root-cause training class.</p> <p>Deficiencies. The Project Office closed CAR-92-003. A trend evaluation for the first quarter of 1992 was submitted to the TPO; no new adverse trends were recognized, and two existing trends were closed.</p> <p>Audits. Audit reports for EES-13/Volcanism (LANL-AR-92-02), and subcontractors University of New Mexico (LANL-AR-92-03), Ohio State University (LANL-AR-92-04) and University of California at Riverside (LANL-AR-92-05) were approved and issued. The EES-13/Las Vegas TCO portion of audit LANL-AR-92-02 was postponed. Subsequently, audit plan LANL-AR-16 for EES-13/Las Vegas TCO was approved. Audit plan LANL-AR-06 for EES-5 was also approved. The annual management assessment of the Los Alamos QA program was completed.</p> <p>A quality assurance management assessment was conducted as required by the QA Plan.</p>
Planned Activities	QP revisions will continue and three 1991 survey reports will be completed. The annual quality assurance status report of 1991 will be published. An orientation class will be offered in May. Audits of EES-13/Las Vegas and EES-5 will be conducted.
Problem Areas	The current software quality assurance plan is under internal review and may be modified to accommodate current budget constraints.
Publications	S. L. Bolivar <i>The Los Alamos National Laboratory Yucca Mountain Site Characterization Project Quality Program,</i> A Progress Report for January 1, 1990 - December 31, 1991. In internal review.

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S. L. Bolivar and J. L. Day  
*The Role of the Los Alamos National Laboratory Quality Assurance Liaison for the Yucca Mountain Site Characterization Project*  
Conference paper, ASOC Energy Division annual meeting  
In preparation.

S. L. Bolivar  
*LATA, 1992, Evaluation Report on the March 13, 1992 Orientation to the Los Alamos National Laboratory Yucca Mountain Site Characterization Project*  
In preparation.

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