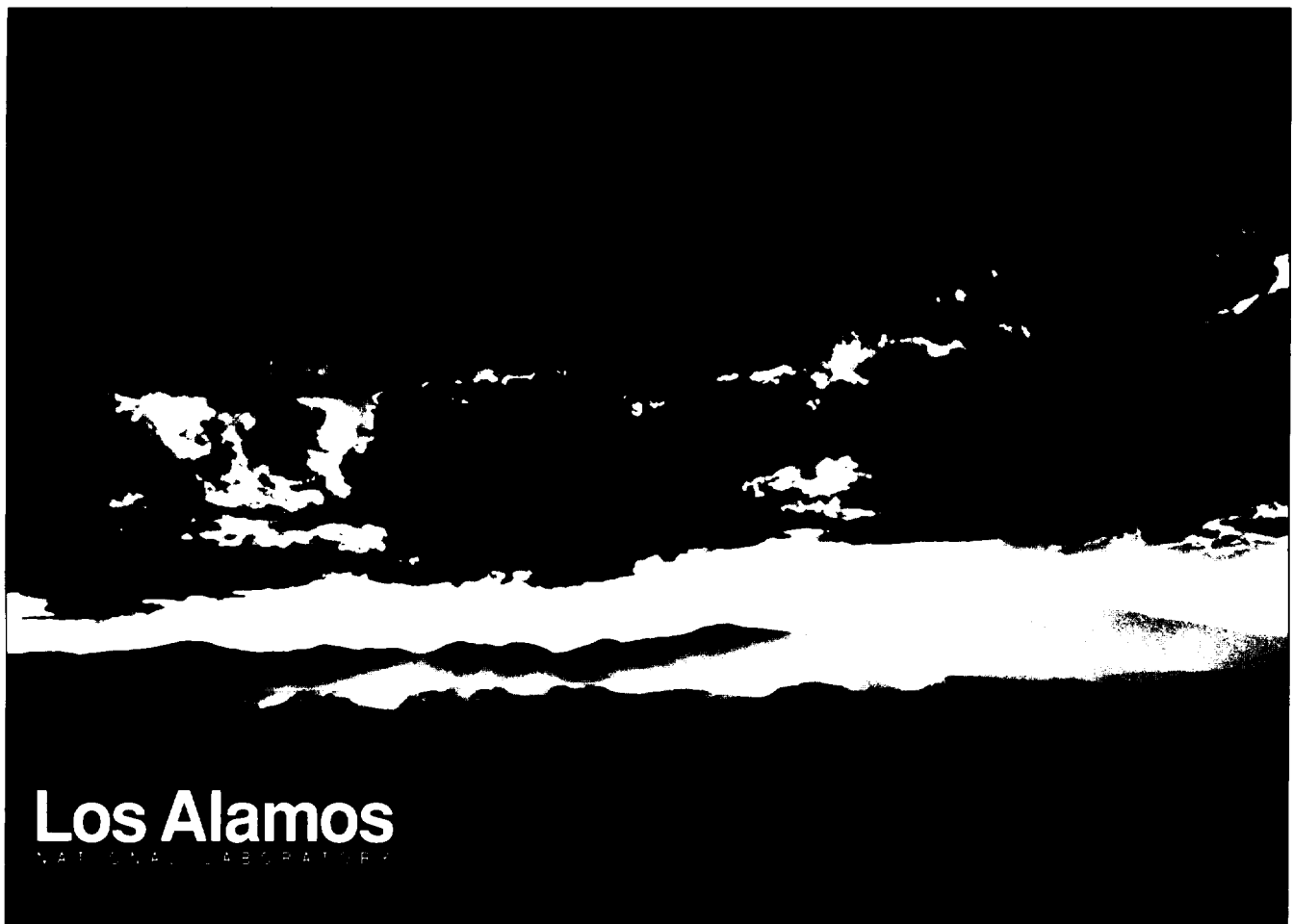


Yucca Mountain Site Characterization Project Monthly Activity Report

December 1991



Attachment to TWS-EES-13-01-92-075

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.

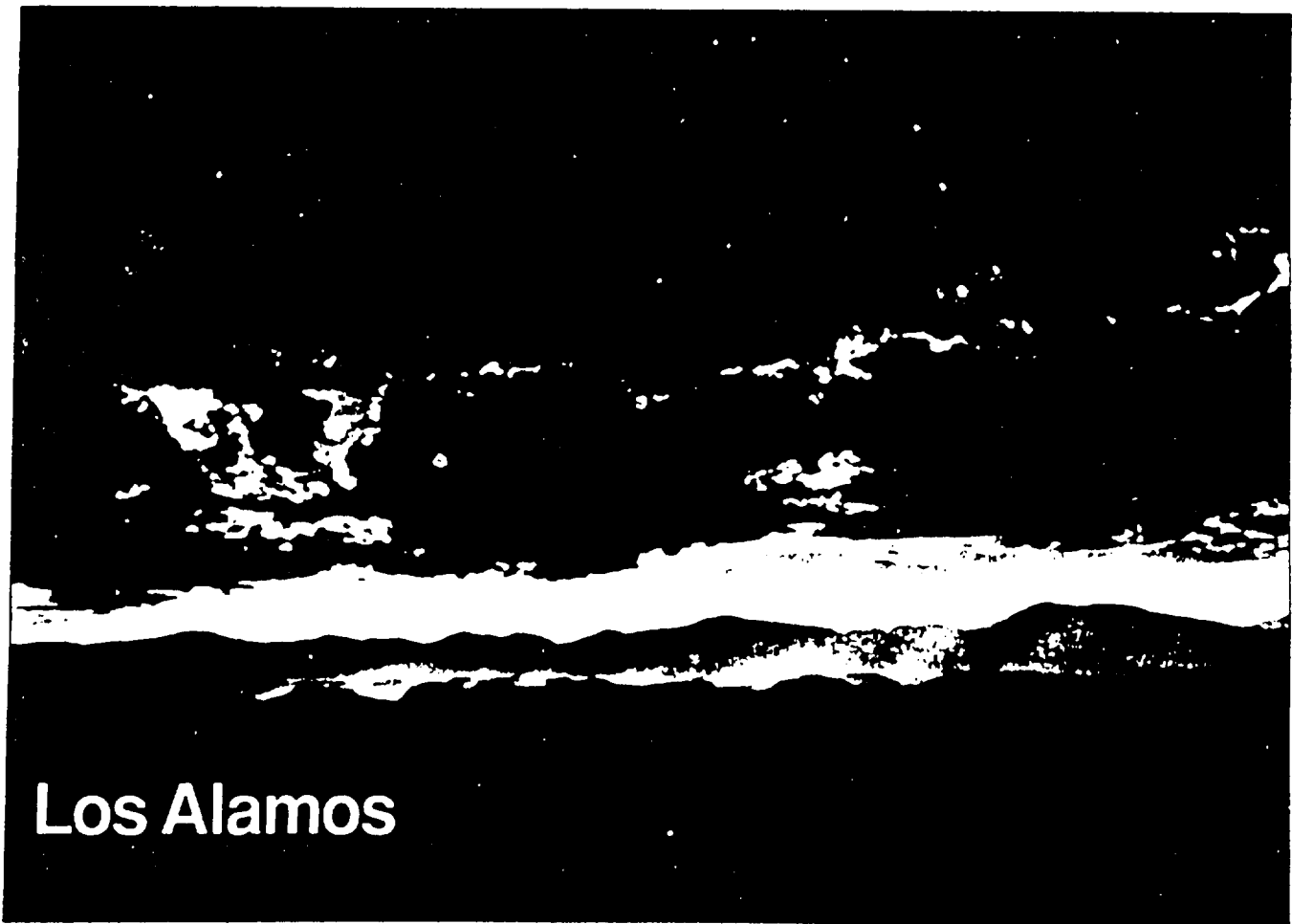
This work was supported by the Yucca Mountain Site Characterization Project Office as part of the Civilian Radioactive Waste Management Program. This Project is managed by the US Department of Energy, Yucca Mountain Site Characterization Project.

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Yucca Mountain Site Characterization Project

Monthly Activity Report

December 1991



Photograph by Chris J. Lindberg

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WM-11 PDR

Attachment to TWS-EES-13-01-92-075

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

WBS 1.2.9
QA N/A

February 11, 1992

TWS-EES-13-01-92-075

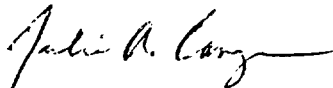
Mr. Carl P. Gertz, Project Manager
Yucca Mountain Site Characterization Project Office
US Department of Energy
P.O. Box 98608
Las Vegas, NV 89193-8608

Dear Mr. Gertz:

SUBJECT: LOS ALAMOS MONTHLY ACTIVITY REPORT—DECEMBER 1991

Attached is the Los Alamos Monthly Activity Report for December 1991. This internal document describes our technical work in detail; however, the report has not received formal technical or policy review by Los Alamos or the Yucca Mountain Site Characterization Project. Data presented in this document represent work progress, are not referenceable, and are not intended for release from the US Department of Energy. If you have changes to our distribution list, please call Susan Klein at FTS 843-0916.

Sincerely,



Julie A. Canepa

JAC/SHK/eyr
Attachment: a/s

Cy w/att.:

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V. J. Cassella, HQ/Washington, DC
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D. E. Kerr, SAIC, Las Vegas, NV
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RPC File (2), MS M321
TWS-EES-13 File, MS J521

Cy w/o att.:

Susan Klein, IS-11, MS J521
CRM-4, MS A150

CONTENTS

| | |
|---|----|
| WBS 1.2.1 – Systems (Canepa) | 1 |
| WBS 1.2.3.2.1.1.1 – Mineralogy, Petrology, and Rock Chemistry of Transport Pathways (Vaniman) | 2 |
| WBS 1.2.3.2.1.1.2 - Mineralogic and Geochemical Alteration (Levy) | 3 |
| WBS 1.2.3.2.1.2 – Stability of Minerals and Glasses | 5 |
| WBS 1.2.3.2.5 – Postclosure Tectonics (Crowe) | 5 |
| WBS 1.2.3.3.1.2.2 – Water Movement Tracer Tests (Fabryka-Martin) | 7 |
| WBS 1.2.3.3.1.2.5 – Diffusion Tests in the ESF (Triay) | 8 |
| WBS 1.2.3.3.1.3.1 – Site Saturated Zone Ground-Water Flow System (Robinson) | 8 |
| WBS 1.2.3.4.1.1 – Ground-Water Chemistry Model (Ebinger) | 11 |
| WBS 1.2.3.4.1.2.1 and 1.2.3.4.1.2.3 – Batch Sorption Studies and Sorption Models (Meijer) | 12 |
| WBS 1.2.3.4.1.2.2 – Biological Sorption and Transport (Hersman) | 13 |
| WBS 1.2.3.4.1.3 – Radionuclide Retardation by Precipitation Processes (Morris) | 14 |
| WBS 1.2.3.4.1.4 – Radionuclide Retardation by Dispersive, Diffusive, and Advective Processes (Triay) | 16 |
| WBS 1.2.3.4.1.5.1 – Retardation Sensitivity Analysis (Eggert) | 17 |
| WBS 1.2.3.4.1.5.2 – Demonstration of Applicability of Laboratory Data (Springer) | 18 |
| WBS 1.2.5 – Regulatory and Institutional (Canepa) | 19 |
| WBS 1.2.6 – Exploratory Studies Facility (Kalia) | 20 |
| WBS 1.2.6.8.4 – Integrated Data System | 21 |
| WBS 1.2.9.1.2.4 – Technical Software Management (Cort) | 21 |
| WBS 1.2.9.1.4 – Records Management (Sanders) | 22 |
| WBS 1.2.9.3 – Quality Assurance (Bolivar) | 23 |
| APPENDIX | 24 |

LOS ALAMOS NATIONAL LABORATORY YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

Monthly Activity Report December 1991

WBS 1.2.1 SYSTEMS

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

Reviewed and revised *Control of Data*, LANL-YMP-QP-8.2.

PLANNED ACTIVITIES

Meet with technical staff to discuss submission of radionuclide solubility data to the Geologic and Engineering Properties: Bibliography of Chemical Species (GEMBOCHS) database.

Will be trained on the Automated Technical Data Tracking (ATDT) System on 22 January by B. Lewis from SAIC.

Meet with staff discuss volcanism data for submittal to the Technical Data Base (TDB) or Reference Information Base (RIB).

CAISSON EXPERIMENT (WBS 1.2.1.4.6)

ACTIVITIES AND ACCOMPLISHMENTS

Efforts concentrated primarily on locating crushing equipment that could meet particle size requirements for the limonite.

Prepared to conduct batch experiments with lithium bromide.

PLANNED ACTIVITIES

Begin writing Standard Operating Procedure for the caisson experiment.

Order silica sand and limonite.

Conduct batch experiments with lithium bromide using silica sand and limonite.

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)

G. Valentine met with staff at Sandia National Laboratory. He assisted them with their report on volcanic scenarios (i.e., event trees), informed them about the year's efforts in the volcanism task, and discussed the results of their total system analysis.

WBS 1.2.3.2.1.1.1

MINERALOGY, PETROLOGY, AND ROCK CHEMISTRY OF TRANSPORT PATHWAYS

The purpose of this activity is to define the important mineralogic and geochemical variables along 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

Specimens from drill core U-25a#1 were examined by transmission Fourier-Transform Infrared (FTIR) microscopy (with the assistance of C. Johnston of the University of Florida, Gainesville) to determine whether FTIR microscopy could be of use in characterizing the alteration minerals associated with biotite and hematite. Preliminary results for samples from the zeolitized tuff of Calico Hills indicate common alteration of biotite rims to kaolinite.

D. Vanniman visited USGS-Denver on 3–5 December. Calcites from both unsaturated and saturated fractures of USW G-4 were sampled for petrographic and chemical analysis. These results of this analysis will expand the range of drill holes studied for calcite chemistry to determine the origins of these commonly late-forming fracture minerals.

Software developed at Los Alamos for quantitative mineral determinations from x-ray diffraction (XRD) data was approved for YMP use this month, and processing began on a large number of analyses that had been collected over the previous year.

S. Bolivar attended the Sample Oversight Committee (SOC) meeting at the Sample Management Facility. The SOC approved a sample request from D. Broxton for cuttings from borehole USW H-5. Drilling methods and schedules were also discussed, and a Drilling Priorities Workshop was set for 22–23 January 1992.

PLANNED ACTIVITIES

Work planned within the next few months includes the following: (1) continue analysis of Mn-oxide fracture fillings in the Crater Flat and Paintbrush tuffs to determine their distribution and factors controlling that distribution; (2) complete paper on Mn-oxides for publication in a refereed journal; (3) continue analysis of calcites to understand transport and precipitation mechanisms; (4) complete sampling of cuttings from USW H-5; and (6) determine quantitative mineralogy from XRD data for milestone 3137.

PROBLEM AREAS

We were able to reinstate several studies using quantitative XRD analysis, which were delayed by the software approval process.

MILESTONE PROGRESS

3120

29 May 1992

Calcite in the Upper Paintbrush Tuff

30% complete.

3123

2 March 1992

Mn Fracture Minerals at Yucca Mountain

Undergoing extensive revision.

3130

17 August 1992

Fracture Mineralogy of the Paintbrush Tuff

3137

30 September 1992

Mineralogy of Calico Hills for Adit Development

Writing 70% complete; will be completed six months after XRD software approval.

PUBLICATIONS

D. Bish and S. Chipera

Detection of Trace Clays and Clay Minerals Amounts of Erionite Using X-ray Powder Diffraction: Erionite in Tuffs of Yucca Mountain, Nevada, and Central Turkey

Journal article, *Clay and Clay Minerals*

In press.

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

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, *J. Geophys. Res.*

Draft complete; may be revised for a different journal.

WBS 1.2.3.2.1.1.2

MINERALOGIC AND GEOCHEMICAL ALTERATION

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

A concerted effort was made this month to obtain QA approval for the software used by G. WoldeGabriel for K/Ar analytical work at Case Western Reserve University. The process involved multiple meetings of the PI, the associate investigator, the Quality Assurance (QA) Liaison, the QA Project Leader, other QA staff, and members of the Software Configuration Management section. The basis for qualification of the software was the use of calibration standards. CCB approval was obtained on 6 December.

D. Vaniman visited the USGS-Denver on 3-5 December to subsample hydrogenic deposits samples. He also prepared 30 samples from the laminated zone in Trench 14 for Instrumental Neutron Activity Analysis.

S. Levy performed a technical review of the *Exploratory Studies Facility Surface-Based Testing North Ramp/Portal Siting Evaluation Report*.

S. Levy's trip report for the November meeting of the European Materials Research Society (EMRS) is included in the Appendix.

PLANNED ACTIVITIES

Produce a LA series report within the next 6 months to provide a unified presentation of work to date on colloids in radionuclide transport. The report would include an expanded version of S. Levy's EMRS paper on natural gels at Yucca Mountain.

Continue zeolite stability and glass rehydration studies.

D. Vaniman will present a talk on calcite-sepiolite associations in waters evaporated from carbonate and tuffaceous aquifers of southern Nevada at the Seventh International Symposium on Water-Rock Interaction in July 1992. Co-authors are M. Ebinger, D. Bish, and S. Chipera.

PROBLEM AREAS

None

MILESTONE PROGRESS

3138

30 October 1992

Chemical Transport in Zeolitic Alteration

3141

31 March 1992

Laminated Zone in Trench 14

3142

3 April 1992

K/Ar Dating of Clays and Zeolites

Research continuing; new draft in preparation.

3143

15 January 1992

Experimental Dehydration of Volcanic Glasses

Interim draft 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.

S. Levy

Natural Gels in the Yucca Mountain Area, Nevada, USA

Conference paper, European Materials Research Society Symposium

In preparation.

D. Vaniman, D. Bish, and S. Chipera
Rehydration of a Tuff Vitrophyre
Journal article, *J. Geophys. Res.*
Interim draft complete.

D. Vaniman, et. al
Waters of Southern Nevada
Conference paper, *Proceedings of the 7th Water-Rock Interactions Symposium*, July 1992

WBS 1.2.3.2.1.2

STABILITY OF MINERALS AND GLASSES

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

ACTIVITIES AND ACCOMPLISHMENTS

This activity has been deferred.

WBS 1.2.3.2.5

POSTCLOSURE TECTONICS

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

Four papers were prepared for the International High-Level Radioactive Waste Conference.

A third phase of trenching was completed at the Lathrop Wells volcanic center. Five soil pits were completed in the scoria-fall sheet of the main scoria cone and on scoria mounds of the QS4 unit. The soils in the pits were described, and these descriptions were incorporated into a paper on the status of field and geochronology studies.

Work in Progress

A rough draft that address comments by the state of Nevada on the Study Plan 8.3.1.8.1.1, *Probability of Magmatic Disruption of the Repository*, has been completed.

A rough draft of the detailed technical procedure (DP) for cosmogenic helium isotopic studies has been reviewed.

The recommendations on volcanism studies in the semiannual report by the NWTRB are being reviewed.

PLANNED ACTIVITIES

Submit final draft to address comments by the state of Nevada on the Study Plan 8.3.1.8.1.1, *Probability of Magmatic Disruption of the Repository*, in January 1992.

December 1991

Conduct additional trenching at the Lathrop Wells volcanic center so that soils studies and collection of samples for thermoluminescence age determinations may be continued in late January or February.

Submit review of recommendations on volcanism studies found in the semiannual report by the NWTRB to DOE in January.

PROBLEM AREAS

None

MILESTONE PROGRESS

A report on the status of geochronology studies at the Lathrop Wells volcanic center was scheduled for Jan 1991. It has been replaced by a paper on the same topic that is being prepared for the April High-Level Radioactive Waste Conference in Las Vegas. The paper has been completed.

3174

8 January 1992

Effects of Magmatic Disruption on the Repository (study plan, R0)

3071

September 1992, expected completion April 1992

Status of Geochronology Studies at the Lathrop Wells Volcanic Center

3129

10 July 1992, expected completion April 1992

Geochemistry of Lathrop Wells Eruptive Sequences

3034

30 September 1992

Report on Magma System Dynamics

3035

30 September 1992, expected completion April 1992

Effects of Strombolian Eruption

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.*

Lathrop Wells Volcanic Center: Status of Field and Geological Studies

Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992

In preparation.

B. M. Crowe *et al.*

Recurrence Models of Volcanic Events: Applications to Volcanic Risk Assessment

Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992

In preparation.

F. V. Perry and B. M. Crowe

Geochemical Evidence for Waning Magnetism and Polycyclic Volcanism at Crater Flat, Nevada

Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992

In preparation.

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

Physical Processes and Effects of Magnetism in the Yucca Mountain Region

Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992

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.

WBS 1.2.3.3.1.2.2

WATER MOVEMENT TRACER TESTS

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 two deficiency reports received by Hydro Geo Chem during its October audit were resolved.

Signatures are being obtained for the final versions of the seven detailed technical procedures (DPs) listed below:

| | |
|----------------|--|
| LANL-INC-DP-87 | Identification, storage and handling of samples at Hydro Geo Chem |
| LANL-INC-DP-88 | Collection of soil samples for analysis of moisture content, bulk density, halides and chlorine isotopes |
| LANL-INC-DP-89 | Procedure for sieving soil and rock samples |
| LANL-INC-DP-90 | Measurement of moisture content of soil samples |

| | |
|----------------|---|
| LANL-INC-DP-92 | Sample leaching to extract soluble chloride and bromide |
| LANL-INC-DP-95 | Preparation of samples for chlorine-36 analysis |
| LANL-INC-DP-97 | Preparation of carrier solution for chlorine-36 samples |

Drilling was completed on the second of twelve neutron-access boreholes for the USGS study, *Characterization of Unsaturated-Zone Infiltration*, which is providing QA-traceable ream-cutting samples for chlorine-36 analysis. The Sample Management Facility (SMF) was requested to ship all cutting samples collected to the subcontractor to begin processing for chloride, bromide, and chlorine isotope.

The draft-criteria letter for cuttings collection from borehole UZ-16 was revised following technical and QA review and submitted to the YMPO for management review.

PLANNED ACTIVITIES

Complete additional DPs; process cuttings samples from neutron-access boreholes; process USGS water samples; collect surface soil samples from Yucca Mountain area.

MILESTONE PROGRESS

3191

Procedure for Chlorine-36 Analysis of Unsaturated Zone Samples
30 September 1992

WBS 1.2.3.3.1.2.5

DIFFUSION TESTS IN THE ESF

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 level II milestones are planned this fiscal year.

WBS 1.2.3.3.1.3.1

SITE SATURATED ZONE GROUND-WATER FLOW SYSTEM (REACTIVE TRACER TESTING)

Experiments will be conducted at the C-Well complex (holes UE25c#1, UE25c#2, and UE25c#3) and in other wells near Yucca Mountain. Reactive tracers will be used to characterize retardation and transport properties on a scale larger than that currently used in laboratory experiments.

ACTIVITIES AND ACCOMPLISHMENTS

Software Qualification

The implementation phase (coding, verification, etc.) of the SORBEQ application is currently being reviewed, as is the software design document for the FRACNET application, which was submitted as a partial submission of the Detailed Design Baseline. The Software Requirements Specification for the equation solver GZSOLVE has also been submitted. This software is being certified as a reuse component, since it is used in three existing codes within the YMP, FEHMN, TRACRN, and FRACNET. Review comments of the implementation baseline for the interface table tools are currently being addressed.

Z. Dash and B. Robinson are participating in the LANL program's Software Improvement Task Force, a group whose goal it is to develop improvements in the software QA process so that software may be certified in a more timely and efficient manner.

Polystyrene Microsphere Studies

Work on using fluorescent colloids as tracers in the C-well field tests has focused on finding a better analytical method for determining numbers and concentrations of synthetic colloids in a ground water sample and on selecting what kinds of colloids we may want to use. Flow cytometry shows promise as a better method, and we have made arrangements with the LANL flow cytometry resource to test the instrument's capabilities. The flow cytometer has the capability of detecting particles with different fluorescence emissions in the same sample, commonly has good discrimination between background fluorescence and many fluorescent dyes, and has sorting capabilities that may allow separation of synthetic and natural colloids for additional analysis. The combination of hydrodynamic focusing and multiple laser excitation provides excellent counting and concentration capabilities that appear to be very well suited for our needs.

A variety of fluorescent colloids have been obtained from several manufacturers, and we have developed a plan to analyze the accuracy and precision of the flow cytometer with a series of concentration standards made with J-13 water and the various fluorescent colloids. We will be able to determine the best colloids for analysis by flow cytometry by determining the instrument's response to colloids from different manufacturers, with different sizes (0.1-10 μm), with various fluorescent dyes, and with different surface charge characteristics. If the results from these tests are satisfactory, we hope to perform a series of column tests using Bullfrog tuff and the colloids selected from the above analysis. We would like to be able to run at least three sizes of colloids simultaneously and if possible run additional colloids with different surface charge characteristics. The flow cytometer will be used to determine the breakthrough concentrations of the colloids and the results should be useful in making predictions for the field tests. We would ultimately like to have a suite of fluorescent colloids that are well characterized as to their behavior in saturated tuff media for use in the C-well field tests.

LiBr Sorption Studies

No progress this month.

Boron Sorption Studies

No further activities. A letter report, which provides the rationale for discontinuing these experiments, was submitted. See Appendix.

PLANNED ACTIVITIES

Continue the effort to bring the computer codes FRACNET, FEHMN, and SORBEQ and other software into compliance with the SQAP.

Continue activities necessary for the batch sorption experiments with lithium bromide.

December 1991

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

PROBLEM AREAS

None

PUBLICATIONS

B. D. Newman, H. R. Fuentes, and W. L. Polzer

An Evaluation of Lithium Sorption Isotherms and their Application to Groundwater Transport

Journal article, *Groundwater*, V. 29, No. 6, 818-824, 1991

Published.

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.

B. A. Robinson

SORBEQ-A One-Dimensional Model for Simulating Column Transport Experiments

LA-series report

In preparation.

MILESTONE PROGRESS

3193

30 November 1991

Batch Sorption Experiments with Boron Using Single Crystals

Completed.

3188

16 January 1992

Documentation for SORBEQ

3194

1 April 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

GROUND-WATER CHEMISTRY MODEL

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

M. Ebinger attended the Geochemistry Integration Group meeting in Las Vegas on 4-5 December.

Modeling evaporation of different Yucca Mountain waters and waters from the surrounding area continued. We found that water derived from tuffs generally precipitates calcite and sepiolite at relatively low concentration factors (i.e., as low as twice the initial concentration) and water derived from carbonate aquifers, and in some cases shallow soils, shows some calcite precipitation, with dolomite and sepiolite competing for available Mg. We also found that the introduction of silica phases (opal CT, cristobalite) into the simulations resulted in little sepiolite formation, which suggests that opal or other silica phases form after sepiolite forms, a hypothesis consistent with observed sepiolite assemblages.

The pH of waters derived from Yucca Mountain tuffs seems well buffered by $\text{CO}_2(\text{g})$, precipitation of secondary minerals (calcite and smectite), cation exchange with clay minerals and zeolites, and dissolution of tuffs. Simulated addition of acidic waters and waters containing aqueous-U species resulted in little change of pH, increased secondary mineral precipitation, and some additional tuff mineral dissolution.

PLANNED ACTIVITIES

Track Study Plan 8.3.1.3.1.1 during YMPO review.

USGS collaboration will continue. We will arrange to sample and analyze dissolved gases from USGS water samples and sample water in contact with rock in the upper saturated zone. These data will be used to ascertain Eh conditions independently of Pt electrode measurements, "snapshots" of water-rock interactions, and for refined models of groundwater chemistry.

PROBLEM AREAS

None

MILESTONE PROGRESS

3006

31 March 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

WBS 1.2.3.4.1.2.1 and 1.2.3.4.1.2.3 BATCH SORPTION STUDIES AND SORPTION MODELS

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

The experiments to evaluate the effects of crushing on the sorption coefficients obtained by batch techniques have been completed. We are awaiting mineralogic analyses to properly interpret the data. Surface-area determinations have been completed on approximately 3/4 of the samples.

The construction of a vibration isolation booth for the new atomic-force microscope has been completed, and a testing program has begun to evaluate its capabilities. This instrument will ultimately be used to image substrates before and after sorption reactions involving the important radionuclides. It will also be used to characterize the detailed textures of Yucca Mountain tuffs at the nanometer scale.

A preliminary set of sorption coefficients was transmitted to Golder Associates in Redmond, Washington, to be used in performance assessment calculations as part of the early site suitability analysis. The data transmitted included minimum Kds and Kd probability distributions for several of the poorly sorbing elements.

P. Rogers has finalized the new contract with J. O. Leckie at Stanford University, and experimental work has been restarted. This work will focus on the dependence of solution composition (i.e., ground waters) on sorption coefficients for U and Np on several pure mineral phases, including sanidine.

A new staff member has been identified and will be hired in the next several months. However, this person is not Q-cleared, which will prevent him or her from being involved in the experimental program for at least 6 months.

P. Rogers and A. Meijer attended the Geochemistry Integration Meeting in Henderson, Nevada, on 4-5 December. A. Meijer presented the "minimum Kd approach" to the use of sorption coefficients in performance assessment calculations.

PLANNED ACTIVITIES

Continue to study of radionuclide sorption on pure mineral phases. Revise paper for sorption workshop proceedings after policy review. Complete study plan revisions.

MILESTONE PROGRESS

3009

20 February 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 a Workshop on Sorption*, Los Alamos, New Mexico, 11-12 September 1990. In preparation.

I. R. Triay, A. Meijer, M. R. Cisneros, and G. G. Miller, A. J. Mitchell, M. A. Ott, D. E. Hobart, P. D. Palmer, R. E. Perrin, and R. D. Aguilar,

Sorption of Americium in Tuff and Pure Minerals Using Synthetic and Natural Groundwaters

Radiochimica Acta, V. 52/53, 141-145, 1991

Published.

WBS 1.2.3.4.1.2.2

BIOLOGICAL SORPTION AND TRANSPORT

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 microorganisms capable of utilizing drilling fluids as growth substrates are of special interest.

ACTIVITIES AND ACCOMPLISHMENTS

A literature review on siderophores was completed, and it was found that some siderophores are unstable in mild alkaline conditions (Meyer and Abdallah, 1978). Following 86 hours of incubation, the pH of the growth medium of *Pseudomonas* sc. was determined to be 8.36 (initial pH - 6.8). This increase could explain the 5 HPLC siderophore peaks that have identical amino acid composition.

PLANNED ACTIVITIES

Continue plutonium K_d and colloidal agglomeration experiments.

PROBLEM AREAS

None

MILESTONE PROGRESS

3080

30 September 1992

Report on Chelation

3092

30 September 1992

Report on Colloidal Agglomeration

3176

30 September 1992

Procedure for Determination of Formation Constants

In progress.

3177

30 September 1992

Procedure for Determination of Effects on Colloidal Agglomeration

PUBLICATIONS

L. R. Hersman, D. E. Hobart, and T. W. Newton

Preliminary Evidence of Siderophore/Plutonium Complexation

Journal article, *Journal of Applied and Environmental Microbiology*

Undergoing revision.

WBS 1.2.3.4.1.3

RADIONUCLIDE RETARDATION BY PRECIPITATION PROCESSES

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

ACTIVITIES AND ACCOMPLISHMENTS

Speciation Studies

We continued to develop the qualified version of the photoacoustic-spectrometer (PAS) software, and we hope to have a paper describing the development phase of the photoacoustic work completed by February. This paper will be submitted to a refereed journal (either *Analytical Chemistry* or *Reviews of Scientific Instrumentation*).

Experimental work on the PAS system continued, with the focus on the Pu(IV) carbonate system. The "colloid" experiment described in our previous report is now underway. We have also begun to examine Pu(IV) in solution at 0.1 M carbonate concentration.

Synthesis on model complexes continued, and final ¹³C NMR integrations were completed on the 242-Pu(IV) carbonate system. The results will be published as a milestone report and submitted to the *Journal of the American Chemical Society*.

We have decided to prepare an unsolicited letter report concerning the hydrolysis studies of UCl₄ completed in FY 91. This and related information on actinide model complexes is contributing to understanding the influence of carbonate and hydroxide complexation on the electronic spectra of the actinides. This information can already be integrated into our interpretive efforts. For example, H. Nitsche recently reported the possibility of a Np(V) hydroxide species in his solubility experiments. However, he sees only two species in the electronic spectrum of these solutions: one presumed to be the aquo complex and the other the carbonate complex. Our experience with model complexes suggests that the complexation by hydroxide should provide a sufficient electronic perturbation to see this species spectroscopically.

A new 242-Pu(IV) stock solution was made from 242-PuO₂ for use in Pu(IV)-EDTA complexation experiments. Work was started using the new stock solution to produce single crystals of the several Pu(IV)-EDTA complexes that have been shown to exist in the system. We plan to characterize these species by single crystal X-ray diffraction. We continued efforts to produce a stable Np(V) stock solution (10⁻⁵ M in Np at pH=8.5) in J-13 water for I. Triay. D. Hobart initiated and completed extension of the YMP Contract with H. Nitsche (LBL) through March 31, 1992.

D. Hobart represented Los Alamos at the Tenth YMP Open House Tour on 7 December and entertained questions at the LANL-YMP poster from a VIP Soviet delegation of nuclear waste engineers and health physicists from Moscow (the Joint Coordination Committee of Civilian Nuclear Reactor Safety).

H. Nitsche visited Los Alamos on 3-5 December and presented a seminar on his research.

Solubility Studies

No progress this month.

PLANNED ACTIVITIES

Efforts in all above mentioned areas will continue.

PROBLEM AREAS

None

MILESTONE PROGRESS

3120

30 September 1991

Progress Report on PAS

In preparation.

3031

30 September 1992

Speciation Measurements

3329

30 September 1992

Report on Neptunium, Plutonium, and Americium Solubility Experiments from Oversaturation

PUBLICATIONS

J. M. Combes, C. J. Chisholm-Brause, G. E. Brown, Jr., G. A. Parks, S. D. Conradson, P. G. Eller, I. R. Triay, D. E. Hobart, and A. Meijer,

EXAFS Spectroscopic Study of Neptunium(V) Sorption at the α -FeOOH/Water Interface

Journal article, *Environmental Science and Technology*.

In press.

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.

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 preparation.

C. D. Tait, D. E. Morris, J. M. Berg and W. H. Woodruff

Evaluation of Alternative Detection Schemes in Photoacoustic Spectroscopy

In preparation.

December 1991

C. D. Tait, D. E. Morris, S. A. Ekberg, P. D. Palmer, and J. M. Berg
Plutonium Carbonate Speciation Changes with pH
Abstract, American Chemical Society National Meeting, San Francisco, California, April 1992
Submitted to YMPO on 25 November 1991.

Carbonate Complexation of Pu(IV)
LA-series report
In preparation.

Report
Molecular Models for Actinide Speciation
Submitted 5/30/91.
Internal technical review completed.

WBS 1.2.3.4.1.4

RADIONUCLIDE RETARDATION BY DISPERSIVE, DIFFUSIVE, AND ADVECTIVE PROCESSES

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

We continued to study the transport behavior of radionuclides as a function of mineralogy. (The most probable explanations for the discrepancies between batch sorption coefficients and sorption coefficients obtained via column experiments [reported in May 1991] are pseudocolloid formation, precipitation, slow speciation kinetics, or slow mass transfer kinetics).

We continued performing stability experiments with Np solutions of the type used for the column transport experiments. An explanation of the process follows:

A solution from a well-characterized Np(V) acidic stock was prepared by adding an aliquot of NaOH added to J-13 water. Then an aliquot of the acidic Np stock was added to the J-13 water containing NaOH. Following addition of the Np, the pH of the solution was adjusted to 8.1 via addition of HCl. The initial concentration was $1 \times 10^{-5}M$. After 5 days, a sample of this solution was taken (with stirring) and 96.3% of the Np appeared to be still in solution. This solution was filtered through a 0.05 nuclepore filter, and 72% of the Np remained in the filtered solution. The filtered solution was allowed to settle and aliquots from the solution were obtained (without stirring) as a function of time elapsed. The results are given in the following table.

Stability of Filtered Np solution in J-13 water:

| Time Elapsed in days (After filtration) | %Np Left in Solution |
|--|----------------------|
| 3 | 70 |
| 6 | 69 |
| 8 | 69 |
| 9 | 69 |

Preliminary Data—Do Not Reference

These results indicate that once the Np solutions are filtered, they appear to remain stable. We are investigating the source of Np loss during filtration. Aliquots of the Np solution in J-13 were taken to determine the amount of Si before and after filtration. It is suspected that Np loss is caused by scavenging of Np and the formation of a silica precipitate.

We have completed the fabrication of 6 diffusion cells, 6 rock beakers, and 6 solid rock columns from newly acquired tuff cores from the Sample Management Facility. We plan to study transport under advective and diffusive conditions using the fabricated equipment.

We attended the YMP open house 7 December. After interacting with public from Las Vegas, a special briefing was given to a VIP soviet delegation of nuclear waste engineers and health physicists from Moscow.

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, 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 Radionuclide Adsorption Workshop*, Los Alamos, NM, 11–12 September 1990

Submitted.

WBS 1.2.3.4.1.5.1

RETARDATION SENSITIVITY ANALYSIS

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 accessible environment.

ACTIVITIES AND ACCOMPLISHMENTS

Analysis of Physical and Chemical Properties

No progress in December.

QA and Programmatic

Certification of TRACRN continues. Code modifications to incorporate dynamic memory allocation are almost complete, and modifications necessary to incorporate interface table input/output have been completed.

RIDs have been generated.

The TRACRN subcommittee reviewed the Software Requirements Specification, the Models and Methods summary, and the Software Design document.

Work on the Verification and Validation Plan was begun, and we found that the calculated results for several verification examples compared favorably to the analytic solutions. Work on the user's manual continues.

N. Rosenberg and G. Valentine attended a Geochemistry Integration meeting in Henderson, NV. The meeting focused on getting individuals involved in performance assessment and site characterization familiar with each other's approaches and needs.

PLANNED ACTIVITIES

The RIDs that have been generated will be handled in early January.

The Models and Methods summary and the Software Design document will be submitted for formal review in January.

MILESTONE PROGRESS

3052

30 March 1992

Baseline Documentation for TRACRN

WBS 1.2.3.4.1.5.2

DEMONSTRATION OF APPLICABILITY OF LABORATORY DATA

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

ACTIVITIES AND ACCOMPLISHMENTS

Six north-portal locations were evaluated for their potential influence on underground and surface-based testing at a meeting at the Los Alamos Test Coordination Office in Las Vegas on 2 December. A qualitative approach was used to rate each of the six locations for their positive and negative impacts on testing.

E. Springer attended the quarterly Geochemistry Integration meeting held in Las Vegas on 4-5 December.

PLANNED ACTIVITIES

Submit proposed revision to the Site Characterization Plan Baseline to WBS manager for YMPO review.

Continue to develop study plan.

Travel to Lawrence Berkeley Laboratory to discuss field test design and study plan preparation.

PROBLEM AREAS

None

MILESTONE PROGRESS

No FY91 milestones.

PUBLICATIONS

E. P. Springer

The Use of Anthropogenic Analogues in Site Characterization of Low-Level Radioactive Waste Sites
Conference Paper, Proceedings of the 13th Annual DOE Low-Level Waste Management Conference, Atlanta, Georgia,
19–21 November 1991
In preparation.

C. Woloshun

A Summary and Discussion of Hydrologic Data from the Calico Hills Nonwelded Hydrogeologic Unit at Yucca Mountain, Nevada
La-series report
Received YMPO approval on 29 October 1991.

WBS 1.2.5

REGULATORY AND INSTITUTIONAL

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.

Study Plans

Water Movement Test, R3 (8.3.1.2.2.2). A revision incorporating NRC and State of Nevada comments was submitted on 16 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 on 11 June 1991.

Testing of the C-Hole Sites With Reactive Tracers, R1 (8.3.1.2.3.1.7). Issued by DOE/HQ as a controlled document, and sent to the NRC on 10 April 1990.

Mineralogy, Petrology, and Chemistry of Transport Pathways, R3 (8.3.1.3.2.1). Accepted by the NRC on 4 September 1990. Responses to NRC comments were submitted on 19 August 1991.

History of Mineralogy and Geochemical Alteration at Yucca Mountain, R0 (8.3.1.3.2.2). A revision incorporating SAIC comments was submitted on 13 June 1991.

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). Comment resolution meeting for DOE/HQ and Project Office comments was held on 14–15 March 1990; revision activity has been deferred.

Sorption Studies and Sorption Modeling, R0 (8.3.1.3.4.1; 8.3.1.3.4.3). Comment resolution meeting for DOE/HQ and Project Office comments was held in February 1990; revision is in progress.

Biological Sorption and Transport, R1 (8.3.1.3.4.2). Revision, incorporating DOE/HQ and Project Office comments, was submitted to Project Office on 20 May 1991. Additional revised text was submitted to the Project Office on 28 August 1991.

Dissolved Species Concentration Limits, and Colloid Formation and Stability, R0 (8.3.1.3.5.1; 8.3.1.3.5.2). Submitted to Project Office on 17 August 1990.

Dynamic Transport Column Experiments, R0 (8.3.1.3.6.1). Comment resolution meeting for DOE/HQ and Project Office comments was held on 28–30 August 1990; revision is in progress.

Diffusion, R0 (8.3.1.6.2). Comment resolution meeting for DOE/HQ and Project Office comments was held on 28–30 August 1990.

Probability of Magmatic Disruption of the Repository, R0 (8.3.1.8.1.1). Revision incorporating DOE/HQ and Project Office comments was submitted on 19 June 1990.

Effects of Magmatic Disruption of the Repository, R0 (8.3.1.8.1.2). In preparation.

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

Retardation Sensitivity Analysis, R0 (8.3.1.3.7.1). A revision incorporating DOE/HQ and Project Office comments was submitted on 18 June 1991.

Ground Water Chemistry Modeling, R0 (8.3.1.3.1.1). Submitted to Project Office on 15 March 1991.

WBS 1.2.6.A EXPLORATORY STUDIES FACILITY

These exploratory studies (ES) will address the issues and information needs associated with the feasibility of storing high-level nuclear waste in a geologic repository at Yucca Mountain.

ACTIVITIES AND ACCOMPLISHMENTS

Prepared responses to the Construction Implementation Plan (CIP) for M&O.

Briefed YMPO on current status of the Exploratory Studies Facility (ESF) testing program, including future work.

Met with EG&G staff to ascertain if the GIS system may be applied to the management of fluids, materials, and tracers at the YMP.

Supported meeting with YMPO to prioritize ESF access construction.

Evaluated proposed north-portal locations and submitted a ranking to DOE/YMP of various north-portal locations with respect to ESF testing.

Performed informal review of the ESF Design Report.

PLANNED ACTIVITIES

Update ESF Test Support Requirements document.

Prepare Title II Test Planning Packages.

Continue to support M&O on resolving comments on Construction Implementation Plan (CIP) developed by M&O by supporting meetings on management of water used during site characterization and meetings on topics such as ESF Design, TIG, Sample Management Facility surface-based testing and its interface with ESF Testing.

We will also carry out the following initiatives: develop an inventory of fluids, materials, and tracers to be used at YMP; replan the Los Alamos effort and assist others in developing plans to be implemented during FY 1992 and FY 1993; and prepare requests for changes in testing needs to update the ESF-RD (Project-level document).

PROBLEM AREAS

None

MILESTONES

None

WBS 1.2.6.8.4 INTEGRATED DATA SYSTEM

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.

WBS 1.2.9.1.2.4 TECHNICAL SOFTWARE MANAGEMENT

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.

ACTIVITIES AND ACCOMPLISHMENTS

Software Configuration Management (SCM)

The first meeting of the Software Process Improvement Task Force was held; its goal is to increase worker productivity with regard to software use, development, and management throughout the LANL program. Two meetings were held to discuss ways to improve various processes, and members are currently preparing proposals to be presented before the task force.

During December, the SCM section processed 13 baseline submissions and stored the submitted material in the Certification Environment, generated the attendant SCM documentation, performed physical and functional configuration audits on each submission, and generated software review packets to support Configuration Control Board (CCB) review of each packet. The SCM section sanctioned 8 software applications and updated the Computer Program Library to include each application.

Two CCB meetings were held during December at which 24 reviews were approved, 2 change initiations were accepted, and 2 SCM variance authorizations were issued.

The Configuration Manager participated in database management training to upgrade the Configuration Status Accounting Database.

Software Engineering

The RIDs for the INTERFACE_TABLES application were closed out, and the final implementation baseline was received by SCM. The developer awaits issuance of the BCN and ECN for this application.

The software section continued software reviews, both formal CCB-initiated and informal internal reviews, of baseline components of the applications under development.

Work proceeded on the following applications:

COMMAND-LINE PARSER - A mini-prototype employing object-oriented techniques was successfully built and tested. Work continues on the detailed object-oriented decomposition of the entire application.

DOCGEN - The top-level Software Requirements Specification was completed and circulated among section members for their comments.

PSEUDOCODE FORMATTER - An advanced operational prototype of this application was completed, and extensive testing files were compiled.

CONDITION NOTIFICATION FACILITY - Detailed-design baseline RID issues were successfully resolved, and the final detailed-design baseline has been returned to SCM for certification.

PLANNED ACTIVITIES

Configuration Management

- Continue management of submitted baselines and change orders.
- Develop a Software Requirements Specification for the CSA Database upgrade.
- Develop a Software Requirements Specification for the Computer Program Library upgrade.

Software Engineering

- Continue work on specification, design, and implementation of DOCGEN, specifically submission of the pseudocode formatter detailed design and completion of the requirements specification for the data dictionary component.
- Continue work on the object-oriented design of the command line parser.
- Submit the implementation baseline for the condition notification facility, and continue work on the design and implementation of the extended string utilities and the design and implementation of the extended copy utilities.
- Continue support of the schedule update effort for the Project Control section.

WBS 1.2.9.1.4 RECORDS MANAGEMENT

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 rejected 21 records and accepted 70 records in December; however, records will not be transmitted to the Central Records Facility until the stop work order is lifted.

WBS 1.2.9.3 QUALITY ASSURANCE

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

Grading

Of the 32 Los Alamos grading packages being prepared, 27 have been approved, 3 have been withdrawn, and 3 are in review at the Project Office (one report has been resubmitted as R1).

Document Control

Procurement of Noncommercial-Grade Items and Services, LANL-YMP-QP-04.5, R2; *Trending*, LANL-YMP-QP-16.2, R1; and *Deficiency Reporting*, LANL-YMP-QP-16.3, R0 were issued and distributed.

Training

S. Bolivar and J. Day attended the DOE-sponsored Software Quality Assurance course in Las Vegas.

Program Development

Twelve procedures are in various stages of the review cycle. The YMP semiannual meeting was held with presentations by C. Harrington, S. Bolivar, R. J. Herbst, and R. Patterson (Laboratory Officer QA).

Deficiencies

The responses to corrective action requests (CARs) YMP-92-001 and -003 have been accepted.

Audits

Audit reports LANL-AR-91-10 (Ohio State University), and LANL-AR-91-11 (Stanford University) were approved and distributed.

PLANNED ACTIVITIES

Grading package revisions will continue. Uncompleted audit and survey reports will be completed, and an audit of criterion 18 will be conducted. Revisions to several quality procedures will continue, and there will be a concerted effort to close-out any open CARs. S. Bolivar is compiling an annual progress report of all quality-associated activities.

PROBLEM AREAS

The audit of criterion 18 had to be postponed until January because the lead auditor was involved in an automobile accident.

APPENDIX

ATTACHMENTS AND LEVEL III MILESTONE REPORTS

S. Levy - Trip Report

Destinations

11/4/91-11/7/91: Attended meeting of the European Materials Research Society (Fifteenth International Symposium on the Scientific Basis for Nuclear Waste Management) in Strasbourg, France.

11/8/91: Visited Kernforschungszentrum Institut für Nukleare Entsorgungstechnik, Karlsruhe, Germany.

Purpose of Trip

The purpose was to attend the Fifteenth International Symposium on the Scientific Basis for Nuclear Waste Management, to present a paper, "Natural Gels in the Yucca Mountain area, Nevada, USA," and to visit nuclear waste treatment facilities at Kernforschungszentrum in Karlsruhe, Germany.

Summary

I presented a paper, "Natural Gels in the Yucca Mountain Area, Nevada, USA," at a session on clays and hydrosilicate gels in the nuclear field (Fifteenth International Symposium on the Scientific Basis for Nuclear Waste Management, Strasbourg, France). The paper reports research on the genesis, transport, and deposition of abundant colloidal material during natural alteration processes that have taken place at Yucca Mountain. This research is part of an assessment of the potential role of colloids in radionuclide transport and sorption. Yucca Mountain may be unique among potential or existing nuclear waste sites worldwide in the abundance of natural glass as a possible source of colloids. For other projects, the concern over colloids and gels centers around degradation products of waste-form glass. Other presentations (predominantly French) discussed the results of experimental studies of synthetic glass alteration in simulated repository conditions and characterization of the reaction products, particularly the gel layers developed on the glass surface by reaction with water at elevated temperatures.

Audience reaction to my talk was a mixture of interest and puzzlement. People were intrigued by the evidence that rock textures have preserved indications of gel formation and transport, and there were more questions than I could answer in the time available. It was clear that one 20-minute talk wasn't enough for the audience to grasp the implications and possibilities. For the study of what ultimately happens to gels and colloids generated by glass alteration and natural alteration processes at Yucca Mountain are probably among the best natural analogs available. There is some potential for projects in other countries to benefit from a variety of natural glass alteration studies at Yucca Mountain, but it would probably require a lot of promotion on our part to stimulate interest in these studies.

The technical visit to the Kernforschungszentrum Institut für Nukleare Entsorgungstechnik in Karlsruhe, Germany, concentrated on technical developments and practice of high- and low-level nuclear waste treatment. Training models and prototypes of hull-compaction apparatus, remote welding (computer-driven robot with fiber-optic televised inspection capability), and master-slave manipulators were demonstrated.

Persons Contacted

Thierry Allard, student, Laboratoire de Mineralogie-Cristallographie, Universités Paris VI et VII, Paris, France: Use of helium ion beam implantation to simulate the effects of alpha irradiation on production of paramagnetic defects in minerals.

Dr. Karl-Heinz Hellmuth, Finnish Centre for Radiation and Nuclear Safety, Helsinki, Finland: Applications of the carbon-14-polymethylmethacrylate impregnation method in studies on porosity and matrix diffusion.

Dr. Tim W. Payne, Australian Nuclear Science and Technology Organization, Menai, New South Wales, Australia: Radionuclide transport by groundwater colloids at the Koongarra uranium deposit.

Dr. Rolf Sjoblom, National Board for Spent Nuclear Fuel, Stockholm, Sweden: Discussion of independent oversight role in high-level waste storage projects.

Literature Acquired

European Materials Research Society 1991 Fall Meeting Programme (with abstracts), Strasbourg, France, November 4-8, 1991.

K-H Hellmuth and M. Siitari-Kauppi, "Investigation of the porosity of rocks. Impregnation with ¹⁴C-polymethylmethacrylate (PMMA), a new technique," Finnish Centre for Radiation and Nuclear Safety report STUK-B-VALO 63 (June 1990).

K-H Hellmuth, M. Siitari-Kauppi, and A. Lindberg, "Applications of the Carbon-14-polymethylmethacrylate (PMMA) impregnation method in studies on porosity and matrix diffusion," preprint. Lins, W., and W. Stegmaier, "The Karlsruhe Nuclear Research Center," Kernforschungszentrum Karlsruhe pamphlet (1986).

Sjoblom, R., "Developments and Plans for the Management of Spent Nuclear Fuel in Sweden," contribution to the IAEA Advisory Group Meeting "Strategies, Options, and Trends in Spent Fuel Management with Emphasis on Safety, Economics and Environmental Impact," Vienna, 15-18 April 1991.

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Julie Canepa, EES-13, MS J521
DATE: December 12, 1991
THRU: Bruce Robinson, EES-4, MS D443 *BR*
MAIL STOP/TELEPHONE: J495/7-3073
FROM: Will Polzer *WP*
SYMBOL: EES15-91-433
SUBJECT: **JUSTIFICATION FOR DROPPING BORON FROM CONSIDERATION AS A TRACER FOR C-WELL TESTS**

The report "Boron Adsorption on Hematite and Clinoptilolite," by Gabriela Maria Gainer, LA-UR-90-4051, describes experiments performed to determine the suitability of boron as a potential reactive tracer for use in saturated-zone C-well reactive tracer studies for the Yucca Mountain Project (YMP). Experiments were performed to identify the prevalent sorption mechanism of boron and to determine adsorption of boron on hematite and clinoptilolite as a function of pH. The sorption mechanism was evaluated by determining the equilibration time of boron-mineral suspensions, by measuring changes in equilibrium concentrations as a function of pH, and by measuring electrophoretic mobility. Experiments were performed with the minerals suspended in NaCl electrolyte concentrations ranging from 0.001 N to 0.1 N NaCl. In these experiments the pH ranged between 3 and 12 and the temperature was maintained at about 38°C.

Electrophoretic mobility and potentiometric titrations of hematite and clinoptilolite indicated a shift in the pH of zero point of charge (ZPC) to a lower pH after boron additions. This shift suggests a pH-dependent sorption interaction of boron with the studied materials. This pH-dependent interaction indicates chemisorption of boron. Both electrophoresis and potentiometric titration data show the pH of ZPC for clinoptilolite to be 3 and that for hematite to be 6.4.

The adsorption of boron on clinoptilolite and hematite is a function of both pH and electrolyte concentration. Comparison of data in Tables 19 and 20 of the above report indicates that boron is adsorbed by hematite to a greater degree than it is adsorbed by clinoptilolite. Both minerals show a greater degree of adsorption at higher electrolyte concentrations. In these experiments the amount of adsorption is based on the difference in the initial concentration of boron in solution and that in solution at adsorption equilibrium. The variability in boron concentration after adsorption in the 0.001 N NaCl system suggests that no real difference exist between the initial and final concentration with the exception of that at a pH of 6.2. In the 0.1 N NaCl system the variability in boron concentration for replicate experiments was much less than the observed decrease in boron concentration after adsorption when the pH is greater than 6.

The pH of J-13 and C-well waters is approximately 7.7 and the electrolyte concentration of these waters is approximately 0.0025 N (Table 4 of report). Under these conditions the adsorption data for the 0.001 N NaCl system should be more appropriate for predicting boron adsorption in J-13 and C-well systems than the data for the 0.1 NaCl system. Thus the evidence obtained in this study suggests that clinoptilolite will not adsorb boron under C-well conditions. On the other hand, hematite should adsorb boron under those same conditions. However, the average percent of hematite expected to be present in the Bullfrog Member of the Crater Flat Tuff formation, the formation where the C-well field study will be conducted, only ranges between 0 and 1%.

Although limited, the evidence obtained in the study suggests that boron is not expected to adsorb significantly in the Bullfrog Member of the Crater Flat Tuff formation. We therefore recommend that the evaluation of boron as a tracer for the C-well tests be discontinued.

WLP:lm

Enc. a/s

Cy w/o enc.:

E. Springer, EES-13, MS J521

B. Robinson, EES-4, MS D443