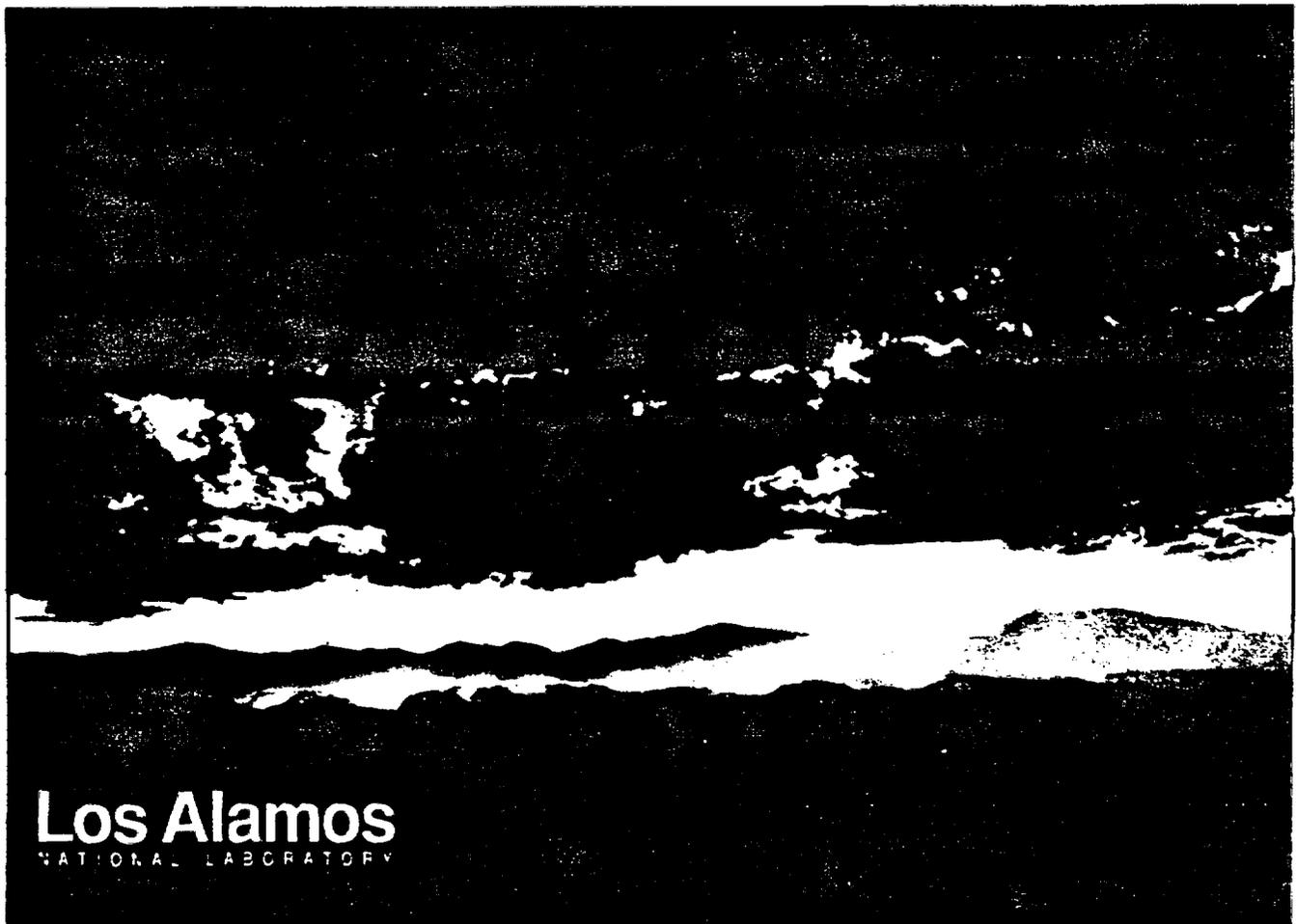


Yucca Mountain Site Characterization Project Monthly Activity Report

September 1991



Los Alamos
NATIONAL LABORATORY

Photograph by Chris J. Lindberg

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Attachment to TWS-EES-13-11-91-050

ENCLOSURE 1

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LOS ALAMOS NATIONAL LABORATORY
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

Monthly Activity Report
September 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

L. Lopez attended a Technical Working Group meeting to discuss parameter normalization. S. Sinnock prepared a proposed normalized parameter list for review and comment.

Finalized DR-0154; verification of this deficiency report is scheduled for 30 September.

PLANNED ACTIVITIES

Revise the quality administrative procedure on data control to reflect YMPO revisions to AP-5.1 and AP-5.2.

Attend Technical Data Advisory Group meeting in Las Vegas. Receive training at SNL for the Automated Technical Data Tracking System. Give a presentation at local high school on careers associated with math and science.

Undergo audit the first week of October on data submitted to TDB and RIB.

CAISSON EXPERIMENT (WBS 1.2.1.4.6)

ACTIVITIES AND ACCOMPLISHMENTS

Efforts continue to obtain equipment and instrumentation for the caisson experiment. The hydraulic and chemical properties of the porous fill material are being characterized by SNL personnel. Once this characterization is completed, the porous material will be ordered and the caisson filled.

E. Springer attended the course *Hydrogeological Decision Analysis* sponsored by YMPO on 9-13 September in Las Vegas.

PLANNED ACTIVITIES

Resolve fill material with SNL personnel. Continue to obtain instrumentation and sampling equipment for the experiment.

PERFORMANCE ASSESSMENT CALCULATIONAL SUPPORT (WBS 1.2.1.4.7)

ACTIVITIES AND ACCOMPLISHMENTS

No progress to report this month.

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

Certified software, acceptable under quality assurance (QA) controls (LANL-YMP-SQAP, R0), became available for scanning electron microscope (SEM) and electron microprobe at the end of September. Software for the regression of x-ray diffraction (XRD) data to determine quantitative mineralogy is not yet certified; however, certifying internally developed software will take several months longer than certifying commercial software. In fracture mineralogy studies, standards for electron microprobe analysis have yet to be certified.

The draft of milestone report 3135, *Mineralogy as a Factor in Radioactive Waste Transport Through Pyroclastic Rocks at Yucca Mountain, Nevada*, has been revised for technical review.

B. Carlos and D. Vaniman completed pre-Title II test planning packages and Exploratory Studies Facility Design Requirements (ESFDR) documents for ESF work in petrologic stratigraphy of the Topopah Spring Member, mineral distributions between the host rock and the accessible environment, and fracture mineralogy. These documents were reviewed, revised, and submitted to the Test Coordination Office.

S. Bolivar and A. Burningham attended the September Sample Overview Committee (SOC) meeting. Sample requests for B. Carlos, D. Broxton, A. Mitchell, and J. Fabryka-Martin were approved. This year, the SOC has addressed about 30 requests; over 1000 samples have been allocated, and 50% of these have been from G-series holes. Drilling schedules and specific sampling needs were also discussed at the meeting.

S. Craven was trained to QA and safety procedures and began examining core from USW VH-1. She will be examining fracture coatings in the Paintbrush Tuff from USW VH-1 and VH-2. B. Carlos began preparing a poster presentation on fracture-lining Mn-oxide minerals at Yucca Mountain; this presentation will be made at the annual Geological Society of America meeting in October.

F. Byers completed the petrographic and SEM/electron microprobe studies required for characterization of surface samples from possible adit locations. These data will be combined with available chemical data and the collected, but yet-to-be-reduced, XRD data to evaluate possible sites for adit-based field experiments at Yucca Mountain. Quantitative XRD data will be required for this comparison; these data will not be available until the software is certified.

Preparation for the Tiger Team visit continued. Work progress will be impacted in October and November while this group is at Los Alamos.

PLANNED ACTIVITIES

Continue analysis of Mn-oxide fracture fillings in the Crater Flat and Paintbrush tuffs to determine their distribution and factors controlling that distribution; finish preparing poster session on Mn-oxide minerals for Geological Society of America Meeting in October; work on image analysis methods for fracture and texture analysis; evaluate glass alteration features in saturated versus unsaturated environments; continue examination of fractures in the Crater Flat Tuff in drill cores other than USW G-4; evaluate possible hazardous minerals at Yucca Mountain; continue examination of fracture-coating minerals in the Topopah Spring Member; and complete paper on Mn-oxides for publication in a refereed journal.

PROBLEM AREAS

With the certification of software for SEM and electron microprobe studies, work on several milestones can now resume. However, many studies still require approval of software for quantitative XRD analysis (e.g., milestone 3137), and electron-microprobe analysis of fracture minerals (milestone 3132) will require certification of standards before work can resume.

MILESTONE PROGRESS

3120

Calcite in Fractures

Will be completed eight months after microprobe software approval.

3123

22 October 1991

Mn Minerals in the Crater Flat Tuff

Undergoing extensive revision.

3132

Tiva Fracture Mineralogy in USW G-4

Will be completed three months after microprobe software and standards are approved.

3135

January 1991

Review of Yucca Mountain Mineralogy

Complete.

3137

26 March 1992

Mineralogy of Calico Hills for Adit Development

Writing 66% complete; will be completed six months after XRD software approval.

PUBLICATIONS

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

Fracture-Lining Manganese Oxide Minerals in a Silicic Tuff

Journal article, *Chemical Geology*

Undergoing extensive revision.

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.

D. Vaniman, D. Bish, D. Broxton, B. Carlos, S. Chipera, and S. Levy

Framework of Altered Pyroclastic Rocks at Yucca Mountain, Nevada

Journal article, *J. Geophys. Res.*

In review.

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

D. Bish participated in two dry runs for the planned presentation on repository thermal effects to the NWTRB in early October. S. Levy also attended the second rehearsal.

G. WoldeGabriel completed a second draft of a report on K/Ar studies of secondary minerals at Yucca Mountain. The draft is being circulated among mineralogy-petrology researchers for comments. An abstract on natural gels at Yucca Mountain, by S. Levy, is being expanded into a full paper.

Calcite-silica studies in Trench 14 and elsewhere are continuing, as are heating and glass-rehydration experiments. INAA and x-ray diffraction analyses (XRD) of opal and calcite from Trench 14 will be completed soon.

PLANNED ACTIVITIES

D. Bish and S. Levy will attend the NWTRB meeting on 8-10 October, where Bish will make a presentation and Levy will be available for discussion.

PROBLEM AREAS

Software quality assurance approval was received for the electron microprobe and scanning electron microscope operating systems. XRD operating and data-reduction software have not been approved.

MILESTONE PROGRESS

3138

26 March 1992

Chemical Transport in Zeolitic Alteration

Research is 55% complete; delayed by quality assurance stop work order.

3141

3 February 1992

Laminated Zone in Trench 14

Research is 46% complete; delayed to FY92.

3142

2 January 1992

K/Ar Dating of Clays and Zeolites

Research continuing; new draft in preparation.

3143

30 September 1991

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.

D. Vaniman, D. Bish, and S. Chipera

Dehydration and Rehydration of a Tuff Vitrophyre

Journal article, *J. Geophys. Res.*

Interim draft complete.

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

We toured the EG&G facilities at Nellis Air Force base and discussed acquiring digital topographic data for the basalt of Crater Flat and the Lathrop Wells center with EG&G personnel. An order was placed to obtain digitized terrain data for the centers using the existing orthophotographic database.

A five-day field trip was completed in the San Francisco Peak volcanic field, the Vulcan's Throne area of the Grand Canyon National Monument, basalt centers of the Uinkaret volcanic center, and basalt centers in Diamond Valley, northwest of St. George, Utah. We examined the morphology and chronology data for basalt scoria cones and flows in the fields. We evaluated possible sites for testing developmental chronology methods. We evaluated possible areas for study of the depth of derivation of lithic fragments in Strombolian and Surtseyan tephra and identified three sites for further studies. These include the SP and Sunset Crater sites in the San Francisco Field (developmental geochronology studies), the scoria cones in Diamond Valley (developmental geochronology studies), and basalt centers exposed in the cliffs below Vulcan's throne and on the south rim of the Grand Canyon (lithic fragment and basalt effects studies).

Multiple tours were taken to the Yucca Mountain site in support of YMPO. Noteworthy tours during September were for Senator Wallop from Wyoming, a special assistant to Admiral Watkins, and a camera crew from CBS National News. Volcanism and geochemistry studies at Los Alamos were summarized for tour participants.

Special public talks on volcanism were presented at the Information Office in Las Vegas and the Community Center in Beatty.

Isotopic data (Sr and Nd) were obtained for a suite of basalt samples from the Lathrop Wells volcanic center. Noteworthy results of the data are that the Q₁ lava is isotopically distinct from the other basalt units of the volcanic center.

A paper published in *Science*, by staff of USGS, was reviewed by program participants. The paper purports to constrain the age of the Lathrop Wells volcanic center using the ³⁹Ar/⁴⁰Ar dating method.

Core-sampling equipment was received for sampling soil sequences prior to trenching with the truck-mounted 4 x 4. Truck repairs and equipment replacement were completed for trenching studies. New tires were ordered to provide better traction in loose sand, the suspension system was upgraded, and transmission repairs were completed.

A video camcorder system with tripod and external battery-operated light source was purchased to record and document trenching studies at Quaternary volcanic centers in Nevada and California.

Work in Progress

Progress continues on the volcanism issue resolution report, and the report was reviewed with DOE participants. The report's organization will be modified in response to review comments.

A letter was sent to YMPO requesting additional environmental surveys of the Lathrop Wells volcanic center to allow further trenching studies.

Modeling studies are in progress for simulating Strombolian and Hawaiian eruptions for consequence studies using the Los Alamos modeling codes. This work will be used for calculations of the effects of basaltic volcanic eruptions.

PLANNED ACTIVITIES

Additional trenching will be conducted at the Lathrop Wells volcanic center as soon as the second phase of environmental surveying has been completed.

Field work will be conducted at the Thirsty basalt shield, located east of the Sleeping Butte volcanic centers, to determine the stratigraphic relations between the shield lavas and the Thirsty Canyon Tuff. If the shield lavas overlie the Thirsty Canyon Tuff, K-Ar dating of the lavas will be undertaken to determine if they could be of Pliocene age.

The annual review and planning meeting for volcanism studies will be held at the University of California, Berkeley, on 8 October.

MILESTONE PROGRESS

3108
30 September 1992
Status of Geochronology Studies at the Lathrop Wells Volcanic Center

3129
10 July 1992
Petrology of Lathrop Wells Eruptive Sequences

PUBLICATIONS

B. Crowe et al.

Multiple Eruptive Events at Small Volume Basaltic Centers: Evidence From the Cima and Crater Flat Volcanic Fields

Journal article

In preparation.

B. Crowe et al.

Methods for Assessing the Risk of Volcanism at the Yucca Mountain Site

Journal article

Revised draft in preparation.

B. Crowe et al.

Status of Geochronology Studies of the Lathrop Wells Volcanic Center

LA-series report

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

Study Plan 8.3.1.2.2.2 completed its Los Alamos reviews and was submitted to YMPO, completing milestone 3192.

Thus far, six detailed technical procedures (DPs) have received technical and quality assurance (QA) reviews, and all comments were resolved. A new draft DP was submitted for technical and QA review, and three other DPs require additional preparation before submission.

Drilling of the first of twelve neutron-access boreholes for the USGS study, *Characterization of Unsaturated-Zone Infiltration*, began 23 September, and the drilling procedure was modified to provide QA-traceable ream-cutting samples for ^{36}Cl analysis. The ream-cutting collection follows guidance provided by J. Fabryka-Martin in a criteria letter submitted to the Sample Management Facility. The sample requests have been approved by the Sample Overview Committee.

PLANNED ACTIVITIES

Submit criteria letter and cutting requests for prototype hole UZF-6; prepare DPs for processing of samples for ^{36}Cl analysis; process cuttings samples from neutron-access boreholes; process USGS water samples.

MILESTONE PROGRESS

3192

1 July 1991

Water Movement Test Study Plan, Revision 1

Complete.

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

Review and submittal of input describing the diffusion tests in the ESF was completed; this input will form part of Test Planning Package 91-5 and the ESF Design Requirements document.

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

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

The tuff material to be used in the lithium batch sorption experiments has been crushed and seived and is now ready for use.

Software Qualification Efforts

The review of the design baseline for SORBEQ was completed, and all review comments were addressed. The development is now in the implementation phase.

The FRACNET application entered the design phase when all review comments of the Software Requirements Specification were addressed. Software baselining was also completed, and the software certified for the following acquired software: IBM DOS, Windows, and data acquisition software for the Dionex ion chromatograph.

PLANNED ACTIVITIES

Continue the effort to bring the computer codes FRACNET, FEHMN, and SORBEQ and other software into compliance with the Software Quality Assurance Plan, which consists of compiling existing documentation and writing new material where necessary.

Continue reviewing software submissions, and continue the batch sorption experiments with lithium bromide.

MILESTONE PROGRESS

3047

November 1991

Evaluation of Preliminary Application of FEHMN to Yucca Mountain
Complete.

3196
27 July 1992
FRACNET Documentation

3193
30 November 1991
Batch Sorption Experiments with Boron Using Single Crystals

T112
22 June 1992
Final Documentation for FEHMN
Delayed.

PUBLICATIONS

W.L. Polzer and H.R. Fuentes
The Use of the Modified Estimate Thermodynamic Equilibrium Properties of Ion Exchange Adsorption of Radionuclides on Volcanic Tuff. Part II. Experimental
Journal article, *Environmental Science and Technology*
Submitted to Project Office 7 August 1990; resubmitted 22 March 1991 under AP-1.3.

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.

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

Conducted preliminary modeling of sepiolite formation to support a presentation at the Clay Minerals Society Meeting in October, and the results are in general agreement with previous work. Sepiolite forms from tuff- or carbonate-derived groundwater when the water is evaporated by factors of 2 to 1000; calcite also forms when tuff-derived water is used, and dolomite forms when carbonate-derived water is used.

Began preparation of abstract entitled *Water-Rock Interactions and the pH of Yucca Mountain Groundwaters* for the 7th International Symposium on Water-Rock Interaction, July 1992.

PLANNED ACTIVITIES

Track Study Plan 8.3.1.3.1.1 during YMPO review.

Continue the USGS collaboration. We will arrange to sample and analyze dissolved gases from USGS water samples. These data will be used to ascertain Eh conditions independently from Pt electrode measurements. Sampling of additional redox couples is under consideration.

MILESTONE PROGRESS

No milestones are scheduled for the next three months.

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 designed to evaluate the effects of crushing on the sorption coefficients obtained by batch techniques were completed. We are awaiting mineralogic analyses from D. Bish before all the data can be properly interpreted. Surface area determinations have been completed on approximately one third of the samples; surface area does not seem to be a major determinant of the variations in sorption coefficients observed for Cs, Sr, and Np in these samples.

A. Meijer attended a meeting with SNL performance assessment (PA) modelers to discuss sorption coefficient distributions to be used in an upcoming PA calculation exercise. Probabilistic sorption coefficient distributions were derived for Np, U, and Cs.

The atomic force microscope has been delivered and installed, and preliminary atomic-scale images were obtained for muscovite. This instrument will be used to image substrates before and after sorption reactions involving the important radionuclides.

The Stanford group completed experiments in which the adsorption of CO₂ onto feldspar and quartz was measured. This component has considerable impact on the adsorption of Np onto these mineral phases, and the experiments will allow quantification of this impact.

A significant effort this month was expended in addressing ES&H (environment, safety, and health) questions. This involved labeling equipment, setting-up waste storage facilities, correcting electrical and plumbing problems, writing standard operating procedures, evaluating the hazards of all operations, attending training sessions and policy videos, finding and reading procedures and administrative regulations, and discarding excess equipment.

PLANNED ACTIVITIES

Continue to study radionuclide sorption on pure mineral phases. Complete paper for sorption workshop proceedings, and revise study plan.

MILESTONE PROGRESS

3216

27 June 1991

Mass Spectrometry as Applied to Americium Sorption

3009

29 January 1992

Variation of Water-Rock Ratio Sorption Coefficients on Zeolitic Tuff
Delayed to 20 February 1992.

PUBLICATIONS

A. Meijer

Sorption Studies Review and Strategy

Conference paper, *Proceedings of the Radionuclide Adsorption Workshop*, Los Alamos, NM, 11-12 Sept. 1990
In preparation.

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

Experiments were completed, in conjunction with M. Ebinger, on the investigation of pH stability of crushed tuff columns under vadose zone conditions. The results of this experiment demonstrated that the effluent pH does not change when the influent pH was varied.

Work continued on the purification of siderophore.

Environment, safety, and health topics were addressed in preparation for the Tiger Team visit.

PLANNED ACTIVITIES

Continue plutonium K_d and colloidal agglomeration experiments.

MILESTONE PROGRESS

3176

22 October 1991

Procedure for Determination of Formation Constants
In progress.

3080

6 December 1991

Report on Chelation

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

Solubility and Speciation Studies

The Berkeley team underwent a quality assurance (QA) audit on 11–13 September conducted by Los Alamos QA staff. No significant problems were identified during the audit; in fact, the auditors were pleased with the QA aspects of the LBL program.

The contract for the Solubility Determination effort at Berkeley was recently extended until 30 November 1991.

New stock solutions of plutonium, neptunium, and americium/neodymium were prepared and characterized for the UE25p#1 solubility determinations at 60°C. The plutonium solution was purified by a new procedure involving an intermediate Pu(IV) polymer preparation and separation. This process gave a stable Pu⁴⁺ solution, in contrast to solutions obtained in previously reported work.

Work continued on preparing and revising three detailed technical procedures.

D. Hobart represented Los Alamos at the September Open House Tour of the Yucca Mountain site. D. Hobart and L. Clark attended the *Environmental Remediation '91* meeting in Paseo, Washington, on 8–11 September.

Photoacoustic Spectroscopy (PAS) and Speciation

Data acquisition for the thermodynamic studies of Pu(VI) (as PuO₂²⁺) speciation in complexing carbonate media, using high-field Fourier-Transform NMR, is now complete. The analysis of this data was slowed due to the Tiger Team visit. The emphasis in these experiments has been on determining line-broadening parameters (hence, equilibrium and rate constants) for characterization of the ligand exchange process between bound and free carbonate.

Model complex studies are also continuing. This effort has focused on the development of preparative routes that impart control of both the stoichiometry and molecular structure of actinide complexes. The solution UV-Vis-NIR spectroscopy of these well-characterized model complexes has helped us to identify unique spectroscopic signatures of several structural motifs and should aid our interpretation of the near future.

Our new glovebox facility is nearly operational.

PLANNED ACTIVITIES

Efforts in all above mentioned areas will continue.

PROBLEM AREAS

Preparation for the Tiger Team has required significant effort from all Solubility personnel at Los Alamos; this impact is expected to continue for several more weeks.

MILESTONE PROGRESS

3010

30 June 1991

Report on Measured Solubilities of Pu, Am, and Np in J-13 Groundwater from Oversaturation Conditions
Complete.

3030

26 August 1991

Carbonate Complexation of Pu(IV)
Complete.

31 August 1991

Progress Report on PAS
In preparation.

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

Staff continued the study of the transport behavior of radionuclides as a function of mineralogy. The most likely reasons 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. This month, the staff continued performing stability experiments with Np and Pu solutions of the type used for the column transport experiments.

Solutions from well-characterized acidic Pu(IV) and Pu(VI) were prepared in J-13 water, USW H-3 water, and UE25 P#1. These solutions were filtered through a 0.05-nuclepore filter. After filtration, the solutions were allowed to settle, and aliquots from the solutions were obtained (without stirring) as a function of time elapsed. The results are given in the following table.

Stability of Solutions Prepared with Pu(IV)

Water	Initial Concentration	% Left in Solution		
		Immediately After Filtration	After 17 Days	After 48 Days
J-13	$2.5 \times 10^{-7}M$	55	55	54
H-3	$2.5 \times 10^{-7}M$	64	64	60
P-1	$2.5 \times 10^{-7}M$	51	51	49

Stability of Solutions Prepared with Pu(VI)

Water	Initial Concentration	% Left in Solution		
		Immediately After Filtration	After 17 Days	After 48 Days
J-13	$2.5 \times 10^{-7}M$	93	88	87
H-3	$2.5 \times 10^{-7}M$	91	91	83
P-1	$2.5 \times 10^{-7}M$	66	66	62

These results indicate that once the Pu solutions are filtered, they remain stable for a long period of time (longer than the time required to perform some of the planned column experiments).

PROBLEM AREAS

Environment, safety, and health efforts to prepare for the Tiger Team visit have significantly impacted our technical output.

MILESTONE PROGRESS

3025
 9 September 1991
Letter Report on Speciation and Transport in Pure Mineral Columns
 Delayed.

3061
 9 December 1991
Letter Report on Techniques to Study Kinetics of Sorption

3234
 9 December 1991
Letter Report on Techniques of Studying Diffusion of Nuclides Through Saturated Tuff

3236

9 December 1991

Letter Report on Techniques of Studying Diffusion of Nuclides Through Unsaturated Tuff

PUBLICATIONS

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 Sept. 1990

In internal review.

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/Chemical Processes

Work continued on modifying FEHMN to include a dual porosity/dual permeability (DPDP) model. This work is being done as rapid prototyping. The code modifications will be made permanent if the DPDP model seems to satisfactorily describe fracture/matrix interaction in the unsaturated zone.

Work continued on milestone report 3049, *Update Report on Coupled Phenomena*.

Three-dimensional calculations of colloid transport were run, based on the 3D flow field used for several dissolved species transport calculations run by our team. Colloids were transported using 2D laminar flow down parallel plates (ideal fractures) with irreversible attachment at the walls. The calculation clearly showed the separation of large and small colloids. The small colloids, because of their much higher diffusivity, were rapidly absorbed on the wall while the larger colloids moved rapidly through the fracture. R. Jain is working to plot the data in 3D for better visualization.

QA and Programmatic

The Software Requirements Specification document for TRACRN is being modified, and additional detail is being added to make code verification more straightforward. This document, the Models and Methods Summary, and the Software Design Document are nearly complete. The Verification and Validation Plan has been outlined to help guide the choice of verification examples. Several analytic solutions and some numerical solutions have been chosen to start verification work. The user's manual is also being written.

Corrective actions to clear deficiency reports from Audit No. LANL-AR-91-05 continued.

PROBLEM AREAS

Environment, safety, and health activities to prepare for the Tiger Team visit have significantly impacted our work.

September 1991

MILESTONE PROGRESS

3049

27 June 1991

Update Report on Coupled Phenomena

Draft in preparation.

3229

30 May 1991

Report on FEHMNS Calculations

Delayed.

3121

22 October 1991

Baseline Documentation of CTCN Code

Delayed.

3052

2 January 1992

Baseline Documentation for TRACRN

Delayed.

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

The 91-5 Test Planning Package and ESF Design Requirements for this study were prepared, reviewed, and submitted to the Test Coordination Office.

PLANNED ACTIVITIES

Continue to support the change request and to develop the study plan.

PUBLICATIONS

C. Woloshun

A Summary and Discussion of Hydrologic Data from the Calico Hills Nonwelded Hydrogeologic Unit at Yucca Mountain, Nevada

LA-series report

Submitted to YMPO on 20 August 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). Issued by DOE/HQ as a controlled document; sent to NRC and State of Nevada; revision is in progress.

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 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

Performed independent review of the consolidated Test Planning Package (TPP) 91-5. Completed and submitted to the RSED consolidated, participant QA-verified TPP 91-5.

Presented information on YMPO plans to manage and control foreign materials introduced during the site characterization-related activities at Yucca Mountain.

Participated in developing logic charts and activity networks to reorganize ESF testing-related tasks for FY92.

Review comments on Tracer, Fluids, and Materials Management Plan were received and resolved. This plan has been revised and will be transmitted to YMPO. The Wednesday planning meetings for RSED design has been postponed and will be initiated at the discretion of M&O; the Friday planning meetings may be reconstituted with a much broader focus.

PLANNED ACTIVITIES

Issue a revised Fluids, Materials, and Tracer Management Plan, and update the ESF Test Support Requirements Document. Prepare SCPB changes (Sections 8.3 and 8.4) to incorporate new ESF configuration and test descriptions developed through TPP 91-5. Prepare Title II Test Planning Packages. Develop new networks for ESF testing. Participate in the October NWTRB meeting.

Continue to finalize the CIP with the M&O and develop plans for FY92 and FY93.

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

Completed the Preliminary Operations Plan, which included staffing recommendations, maintenance strategy, and operations strategy.

The draft Integration Plan was also completed this month. As part of the Integration Plan, a detailed schedule was developed for three classes of IDS-supported tests: new tests, replicated tests, and tests that will reuse existing IDS equipment.

A list of required tasks for FY92 was created, and a presentation was given to the ESF Task Force to justify the need to continue IDS activities during FY92. The presentation did not change the planned zero funding for IDS.

Assisted RSN with the informal review of the Draft Design Summary Report.

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 Engineering

The `INTERFACE_TABLES` application was submitted for implementation review. This application is of primary importance because interface tables are the data input and output interface for Los Alamos YMP software that generates or reads quality-affecting data. Interface tables provide several advantages over data access methods based upon traditional files, i.e., a standard interface; data reusability, portability, and tracking; self-describing data, run-time input/output configuration, and elimination of `FORMAT` statements.

Four programming language standards were developed and submitted for review: Ada standards, DCL standards, C shell script standards, and a general structured language standard. Most software developed by this task will be written in Ada, and we anticipate that DCL and shell scripts will be used widely to support and install software.

Software was developed to automate schedule updates for the Project Control section. This administrative application automatically generates detailed schedule information and transmits it to each PI by electronic mail. The PI then updates the information and returns the schedule to Project Control by electronic mail.

Work continued on `DOCGEN`, a support tool for developers that will be used on source code modules to maintain in-line documentation (maintain the data dictionary and narrative documentation, format and check the syntax of pseudocode, and format source code). Preliminary analysis performed to identify data structures for the `DOCGEN` objects, and several walkthroughs have been performed on proposed prototype designs for various `DOCGEN` facilities. Work also continued on developing a command-line parser, which will be used to obtain and validate a `Unix` command for applications written in Ada.

Because software reuse enhances productivity, staff continued to evaluate Booch Components, a set of over 500 software reuse components developed for Ada. To date, these components have been incorporated into numerous prototypes and promise to be a valuable addition to our software-engineering tool set.

Our program of weekly software engineering seminars programs concluded with the presentation of *Putting It All Together: Building Program Units in Ada*. Throughout the summer, student interns presented weekly seminars on software engineering topics.

Software Configuration Management (SCM)

Staff continued efforts to qualify and certify software. Software supporting the scanning electron microscope and microprobe systems has been qualified and is in use. Comment resolution was completed on the detailed designs of the CDF_TOOLS and SORBEQ applications. The INTERFACE_TABLES application implementation baseline was submitted and distributed for review, and programming standards for the Ada language were approved.

During September, we processed 15 baseline submissions, which included storing the submitted material in the Certification Environment, generating the attendant SCM documentation, performing Physical and Functional Configuration Audits on each, and generating software review packets to support Configuration Control Board (CCB) review of each. The SCM effort also sanctioned nine software applications and updated the Computer Program Library for each.

Two CCB meetings were held at which six reviews were approved, six change initiations were accepted, two software change requests were withdrawn, one software implementation notice was discussed, and one SCM variance was authorized.

The Configuration Manager began work on the Software Requirements Specification for the Configuration Status Accounting Database upgrade. This upgrade will allow Los Alamos Project members to interact directly with the database to generate, sign, and submit SCM forms. Concurrently with this task, an upgrade of the Computer Program Library architecture is in progress.

PLANNED ACTIVITIES

In configuration management, continue management of submitted baselines and change orders; develop a Software Requirements Specification for the CSA Database upgrade; and develop a Software Requirements Specification for the Computer Program Library upgrade. In software engineering, continue work on specification, design, and implementation of DOCGEN; continue work on the specification and design of the command line parser; identify issues to be resolved for the INTERFACE_TABLES implementation baseline; and continue to support 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 8 records and accepted 47 records in September; however, records will not be transmitted to the Central Records Facility until the stop work order is lifted.

L. Sanders and K. West attended a Records Coordinator's meeting in Las Vegas.

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, 28 are approved, 3 have been withdrawn, and 1 is in YMPO review.

Training

Training classes were held for QP-8.2 (data) and QP-8.1 (samples). Efforts continue to redesign the training program; a pilot orientation class with the new training concepts was held and critiqued by 25 YMP personnel. All respondents considered the new course to be an improvement over previous courses. Final changes are being completed, and the new orientation class will be available in early November.

K. West, J. Day, and C. Chavez attended a Training Coordinator's meeting in Denver.

Program Development

Reviews of quality administrative procedures QP-4.5 (procurement), QP-6.2 (preparing QPs), QP-2.5 (personnel selection), and QP-6.1 (controlled documents) were completed. Six other procedures are in draft stage.

S. Bolivar attended a grading workshop in Las Vegas. He also gave presentations on *The Status of QA* and *How to Survive an Audit* to Stanford University and LBL subcontractors.

Deficiencies

The amended response for CAR-91-041 was approved by YMPO.

Audits

Audit report LANL-AR-91-07 was approved and distributed. Internal audits of the Stanford University and LBL were completed, and both organizations were found to have strong QA cognisance.

A DOE surveillance of criterion 6 was completed with no findings. Three internal surveys were conducted on the Test Coordination Office and volcanism activities.

PLANNED ACTIVITIES

Grading package revisions will continue. An internal audit of the University of New Mexico will be conducted. QP-16.2 (trending) will be rewritten, and revisions to several other QPs will continue.

PROBLEM AREAS

The proposed QA Regulations Document will affect our schedule for revising some of QPs.

APPENDIX

ATTACHMENTS AND LEVEL III MILESTONE REPORTS

FY91 PROGRESS REPORT FOR CAISSON EXPERIMENT AND
DEMONSTRATION OF THE APPLICABILITY OF LABORATORY
DATA TO REPOSITORY TRANSPORT CALCULATIONS

E. P. Springer
Los Alamos National Laboratory

INTRODUCTION

This report describes FY91 activities related to flow and transport model validation for in two WBS areas, 1.2.1.4.6 and 1.2.3.4.1.5.2. The scope of these tasks is limited to validation of flow and transport models along with parameter and data validation. It is recognized that validation may be required of other activities, such as design, but that is not the function of these tasks. The term validation will refer to flow and transport models and any other meaning of validation will be described. The first WBS area is concerned with model validation supported by performance assessment activities; the second WBS area supports validation in the Radionuclide Transport Program at Los Alamos.

The task being conducted in WBS 1.2.1.4.6 is the caisson experiment. The approach being taken here is to use an intermediate-scale experimental design for flow and transport to determine a quantitative approach to model validation. The underlying conceptual model governing flow and transport will be known because of the experimental design that uses a fill material for the caisson. Heterogeneities will still be present due to packing of the caisson, and characterization will attempt to describe parameter variations in order to supply models with sufficient data to predict the response of the caisson to a tracer pulse.

Within the Yucca Mountain Site Characterization Project (YMP), the Radionuclide Transport Program is charged with providing the models, data, and the scientific foundation for these models and data to support design and performance assessment activities at Yucca Mountain. The SCP study is titled "Demonstration of the Applicability of Laboratory Data to Repository Transport Calculations" (Study 8.3.1.3.7.2). Because this study is site characterization, a study plan is required. There are different approaches to the issue of model and data validation, so a change request was submitted to divide the study into four activities for a more logical division of the effort. Also, a presentation to the Nuclear Waste Technical Review Board on anthropogenic analogues was made at the April meeting. Preliminary material describing a potential field tests was prepared for Exploratory Studies Facility (ESF) design and test planning during FY91. Efforts to collaborate with Lawrence Berkeley Laboratory (LBL) on design and implementation of the field-testing phase of this study were initiated.

VALIDATION WITHIN YMP

There is considerable uncertainty about model validation and the approaches that will satisfy regulatory scrutiny and public perceptions for long-term disposal of waste. Regulations require model validation, but the definition is (at least in a regulatory arena) missing. This gap leads one to work on an effort without any definition of a final goal or product. Qualitative definitions for model validation have been proposed, but until one ascertains what is required by the regulator, the question of issue closure remains in doubt.

Even within the Project, validation efforts are spread over participants and program components (site characterization and performance assessment). This feature is not unique to YMP as noted by the National Research Council (1990) model validation for groundwater models is a term that means many things to many people because it is rarely defined with any precision. To begin the process of a more precise definition, the structure of the program to identify where validation is required must be defined.

Model Hierarchy

One of the first issues to determine structure is the classification of the different levels of modeling activity within the YMP. Figure 1 presents a hierarchy of categories within the Project that was taken from the Performance Assessment Strategy Plan (DOE, 1990). The use of a triangle recognizes that the base is provided by site models, i.e., the function of the site characterization program is to establish the scientific basis for the higher-level models. It has generally been recognized that subsystem and total systems models will be simpler in terms of processes represented than the process level or site models due to the total number of calculations required and that the subsystem and total systems models will be the tools on which repository performance is assessed.

Site models contain detail on processes and mechanisms that affect radionuclide transport, and through techniques such as sensitivity and uncertainty analyses, site models can be simplified from a position of knowledge, not expediency, so that important processes are retained in the performance assessment models. This functional relationship between site and performance models leads to the requirement of validating site models. Otherwise, no technical basis for supporting model simplification can be defended -- especially for scenarios, where different processes may operate because of changes in boundary conditions or forcing functions. With the detailed model validated, requirements for validating the higher-level models are obscure. This is an issue that will require some investigation to be resolved.

As with any process, exceptions can be taken. Calculations and assessments can be made without following the approach of proceeding from a detailed model to a simplified one as long as there is confidence in the results. Confidence is translated to mean that the technical basis is available to support the conclusions.

Validation Criteria

The definition for model validation that was given in the draft report from the Validation Oversight Group (VOG) is the IAEA definition:

A conceptual model and the computer code derived from it are "validated" when it is confirmed that the conceptual model and the computer code provide a good representation of the actual processes occurring in the real system. Validation is thus carried out by comparisons of calculations with field observations and experimental measurements.

If one dissects this definition into two parts, it can be seen that one component is the conceptual model and representation of the system and the other is the ability to predict the results of experiments or field observations. For the Project, the validation effort must concentrate on the second component or demonstrating the predictive capability. Conceptual models will be developed and tested through the site characterization program and supporting observations. One reason for this is the timing of many validation experiments will be very late relative to License Application so, if a problem is found in the conceptual model, then efforts will have to be restarted to obtain data for the new model. Validation experiments will use the techniques developed by site characterization to predict and measure the response for different experimental conditions. If multiple conceptual models exist, then each of these will have to be tested. It may be possible in this case to distinguish for the scale of the validation experiment between various conceptual models, but this is appropriate only for that scale and may not be applicable at the larger site scale.

The draft report by the VOG gives the first Project-wide perspective on model validation. The VOG report lists three key components for model validation: document model development, conduct field and laboratory experiments, and perform peer reviews. Each of these steps is important for model acceptance.

The experimental effort for validation will concentrate on testing the predictive capability of models. This immediately raises issues such as accuracy requirements and quantitative measures. The difficulty in defining any numerical basis stems partially from lack of a definition for validation from either a regulatory or scientific perspective. It is recommended at this time to begin the building of quantitative validation criteria for the YMP in

order to design experiments and to ensure that all facets of the validation issue, i.e., both the conceptual models and computer codes derived from these models, are addressed within the YMP.

A final issue is that of peer review. The development of quantitative criteria and conducting experiments will be possible only for a limited number of the total possible conditions that will exist at Yucca Mountain. Also, the scale of experiments in space and time will be finite compared with the total system. Therefore, peer review will be important, particularly for applying models over long time frames. This needs to be recognized early and incorporated into the validation process as soon as possible.

In summary, the scientific basis for performance assessment models within the YMP comes from the site characterization program and associated site models. These site models will be simplified where possible to produce the subsystem and total systems models. Validation will be required of the site models in order to provide the basis for the higher-level performance assessment models if confidence in the results is required. The experimental effort for model validation will concentrate primarily on evaluating predictive accuracy of the models while it is assumed that site characterization will address the conceptual models. There are currently no quantitative criteria in place for model validation within the YMP. Efforts need to be initiated to provide validation criteria so that required data are collected for conceptual models and experimental design can proceed.

CAISSON EXPERIMENT

As initially envisioned, the caisson was intended to be a test bed for development of validation approach. A relatively simple system is created where the underlying conceptual model is known to be a porous media continuum, but heterogeneities in the parameters are still present. Therefore success was dependent on identifying parameter values and distributions for transport calculations. Model predictions would be made using an a priori set of parameters, and these predictions would be compared with observed results. In this case, a baseline for predictive capabilities was to be provided because the system at Yucca Mountain would surely be more complex, particularly in terms of the underlying conceptual model.

Initial efforts for this task attempted to involve other participants in the experiment. A meeting was organized by Sandia National Laboratories (SNL) on December 19, 1990, to discuss the caisson experiment and potential SNL involvement. On February 7, 1991, a meeting was held with the Geologic Repository Program at LBL to present the caisson effort along with other validation tasks associated with WBS 1.2.3.4.1.5.2. A presentation was made on March 7, 1991, at LBL to the Project INTRAVAL group about including

the caisson as a YMP contribution to INTRAVAL Phase II. The caisson was rejected by this group because it was felt to be more laboratory-oriented than field-oriented. A presentation on the caisson was made at the PA review held in Las Vegas during the April 2-3. A meeting was held with SNL on May 21, in which SNL solidified its participation in this experiment. In the interim, the issues of environment, safety, and health (ES&H) have been paramount at DOE facilities, and these issues were investigated for the caisson. At present, there does not appear any major ES&H issues beyond the preparation of an Standard Operating Procedure for the caisson.

As part of the May 21 meeting at SNL, a modified design of the experiment was proposed. Initial efforts were to use crushed Bandelier Tuff from the Los Alamos area for fill material in the caisson. The objective was to look more at describing the transport of nonreactive solutes and to look at characterizing hydraulic parameters governing transport. Investigators from SNL were interested in characterizing hydraulic and chemical behaviors in the laboratory and translating the laboratory-scale behavior to larger scales. It was considered that a model porous medium such as a silica sand would be a better fill material than the Bandelier Tuff because more background information was available. A second issue was the testing of predicting geochemical retardation by sorption using various approaches. This was accommodated by adding a sorptive layer at the center of the caisson. The layer would be composed of either an oxide, a zeolite, or both. Again, the silica sand was a better fill material because of its relatively low adsorption. These changes were accepted, and a schedule was devised for filling the caisson, conducting the experiment, and dividing responsibilities and resources between SNL and LANL participants. The cost to the overall task was lost time and the caisson not being filled during FY91. It must be rated by the Project as to whether this cost is acceptable.

Instrumentation of the caisson is a major issue. SNL proposed using time-domain reflectometry (TDR) to measure soil moisture in the caisson. In past experiments conducted by LANL, neutron probe tubes were installed horizontally to measure moisture. It has been decided that TDR will be used to measure moisture in the annulus near the caisson wall (approximately 15 cm) because the neutron probe is not effective in this zone and the neutron probe will be used as in the past. Geophysical monitoring of soil moisture using electromagnetic techniques was proposed by SNL and evaluated. The potential of these techniques particularly for the field-scale tests is tremendous. The issue for application to the caisson was the amount of metal present at the caisson and the instrumentation, such as TDR leads that will conduct electricity and confound the signal. In September, it was decided by the LANL principal investigator to discontinue the effort on using electromagnetic techniques for soil moisture monitoring because of costs and uncertainty in performance due to so many confounding influences.

Particle size distribution of the fill material has been the primary hurdle to filling the caisson. It is desirable to create the sorbing layer so that the hydraulics are not affected. The approach is to remove one particle size and replace it with a zeolite. The oxide component of the layer will be formed by coating another particle size with the oxide material. Once these issues have been resolved the material for filling will be ordered. It is anticipated to fill the caisson in the November 1991 time period to meet the schedule of conducting the experiment next June.

Modeling efforts for the caisson experiment will be conducted by SNL and LANL. SNL will use NORIA and HYDRGEOCHEM, and LANL will use TRACRN. A stochastic modeling effort was initiated by Los Alamos during FY91 with Dr. Yoarim Rubin of the Univ. of California at Berkeley and Dr. Gedeon Dagan of Tel Aviv Univ. in Israel. This effort will analyze previous caisson experiments. The modeling efforts have the responsibility of identifying parameter needs and assisting in experimental design for sampling.

DEMONSTRATION OF THE APPLICABILITY OF LABORATORY DATA TO REPOSITORY TRANSPORT CALCULATIONS

Primary effort for this task in FY91 was to prepare a study plan. Early, it was recognized that this study would encompass many different facets so a change request was submitted to break the study into four activities to more focus the work. These activities were titled: Intermediate-Scale Experiments, Field-Scale Experiments to Study Radionuclide Transport at Yucca Mountain, Natural Analogue Studies of Radionuclide Transport, and Data on Radionuclide Transport From Other DOE Sites (Anthropogenic Analogues). Prior to processing the change request, activity descriptions were required for the Site Characterization Program Baseline (SCPB). These descriptions are being reviewed at LANL.

The Project Office requested that LANL assist in providing direction to the Geologic Repository Program (GRP) group at LBL. The composition of this group and their backgrounds make them logical choices in assisting in the design of field-scale experiments for this study. A preliminary meeting was held with LBL, DOE, and LANL personnel in February 1991. A tour of N and P Tunnels was taken by the same group in March 1991. A meeting of LANL and LBL personnel was held in July 1991 to discuss design of the proposed field-scale experiment for the ESF. Several ideas were proposed at the July meeting and efforts in FY92 will concentrate on developing the study plan with LBL support.

A presentation on the overview of this study was made at an NRC Technical Exchange on March 21, 1991. A presentation to the NWTRB on using data from DOE sites to support Yucca Mountain was made at the April meeting in Reno.

In preparation for Title II design of the ESF, the Test Coordination Office (TCO) was assigned responsibility to prepare test planning packages (TPP) and modify the ESF Design Requirements (ESFDR) documents to reflect changes in the ESF brought about by using the Option 30 alternative. The development of drifts in the Calico Hills unit meant that this study would become part of the ESF. Therefore, input was prepared for the 91-5 TPP and ESFDR and submitted.

REFERENCES

DOE (U.S. Department of Energy). 1990. Performance assessment strategy plan for the Geologic Repository Program. DOE/RW-0266P, Office of Civilian Radioactive Waste Management, Washington, D.C.

National Research Council (Committee on Ground Water Modeling Assessment). 1990. Ground water models scientific and regulatory applications. National Academy Press, Washington, D.C., 303 p.

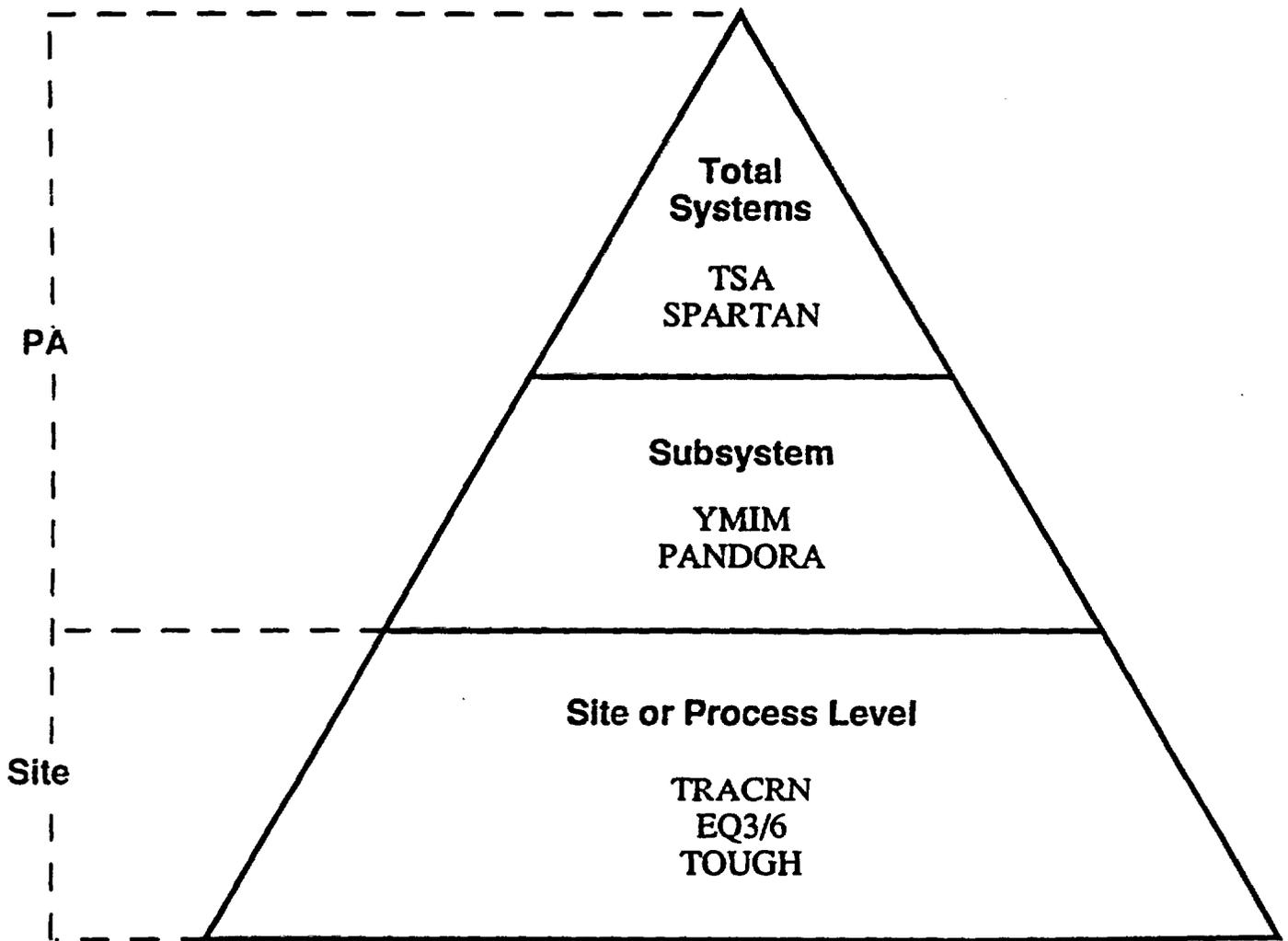


Figure 1. Triangle relating various levels of models within the Yucca Mountain Site Characterization Project

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

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT (YMP)

NOVEMBER 1991 - STATUS REPORT

SITE (1.2.3)

WBS 1.2.3.5

Task: LM-300 Drill Rig

The LM-300 drill rig with pipe handling system remains in the Lang Exploratory Drilling (Lang) yard in Salt Lake City, Utah, undergoing modifications and repairs. Acceptance testing of the modifications and repairs is scheduled for December 5, 1991, in Utah. Expected delivery of the LM-300 to the Nevada Test Site is mid-December.

A partial payment of \$27,000 was made to Lang for performance testing of the LM-300 drill rig and pipe handling system. To date, Lang has been paid a total amount of \$121,835.37, leaving a balance of \$1000.00. Upon receipt of a Subcontract Release Statement signed by Lang, the balance will be paid and the subcontract closed.

Task: Capital Equipment to support Drilling Programs

Purchase Order 0887-YCA-01-1 was awarded to Perry Equipment Corporation for the air processing and metering system. Delivery is expected in March 1992.

Task: USGS Hydrological Research Facility (HRF) Holes (Job Pkg 91-6)

All work in support of HRF holes has been completed with the exception of instrumenting and stemming of UZP-3a, to be scheduled at a later date.

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

Continued operations on Neutron Access Holes during November. Fishing for the bottom 6 inches of the shoe joint left at 103.73 feet was successfully completed. The hole was conditioned, and new Odex casing was run to the bottom; a depth of 193 feet. The hole was continuously cored, and the Odex casing was driven to a total of 255.79 feet. The Joy 1 drill rig was rigged up on UZ-N54 and is presently coring at 120 feet.

Task: JF-3 Water Monitoring Well (Job Package 92-1)

Initiated and completed site preparation; moved the Auger rig in on November 25, 1991. A 36-inch hole was augered to 14.79 feet. Seventeen feet of 26-inch conductor pipe was set on the bottom, and the hole was cemented to the surface. Rigging up of the BIR 800 rig will begin on December 3, 1991.

EXPLORATORY STUDIES (1.2.6)

WBS 1.2.6.1

Task: Exploratory Studies Facility (ESF)

Continued to provide constructability support to activities to begin Tunnel Boring Machine operations and ESF Title II design. Draft 2 of the Request for Proposal for Underground Mining Subcontractor is in Quality Work Group review. Continued to provide review and comment on Project management plans, and provided input to ESF and SBT documents as requested.

FIELD OPERATIONS (1.2.7.4)

Task: Administrative & Maintenance Support

Continued support to W. A. Wilson, Yucca Mountain Site Manager to include: process purchase requisitions for Field Operations Center Site Office requirements, provide support services to participants and maintenance to YMP utilized facilities and roads in Area 25, and provide logistical and support services to management contractor.

Provided support for the Yucca Mountain Site Office open house and public tours. Support included but was not limited to: arrangements for buses, coordination of lunches/beverages, medical service, furniture, mechanical service, and grading of access road. Continued preparations for upcoming tours.

Task: Building 4015 Fire Protection

Modification of the water system for Building 4015 fire protection is on hold, pending resolution of permit requirements and funding availability.

Task: Reactivate Well VH-1

Continued work to reactivate and maintain Well VH-1. Made final settings on pump and generator shut down controls; extended casing and began hauling water to water tanks at H-Road and Forty Mile Wash.

Task: Class III Sanitary Landfill

Budget estimates and Title I review was completed and transmitted to DOE/YMP in October. No action on this task during this period.

PROJECT MANAGEMENT (1.2.9)

WBS 1.2.9.1

Task: Site Characterization Plan (SCP) Distribution

Four SCP sets were distributed during November. Address verification cards were sent to addressees who did not respond to the first verification conducted earlier this year.

Task: Long Range Planning (LRP)

Continued support of LRP, Planning and Control System (PACS), and Performance Measurement Baseline activities to include: completion and submittal of November PACS input for actual expenditures, submittal of Fiscal Year 1992 PACS input and header information, development and update of activity estimates and schedules, and completion of cost estimates as requested.

WBS 1.2.9.3

Task: Quality Assurance (QA)

Continued review, comment, and approval of various REECo implementing procedures, standard operating procedures, quality procedures, and purchase requisitions.

Completed resolution of Corrective Action Requests (CARs) resulting from the February DOE/YMP Audit and Surveillance, YMP-91-02.

Continued work revising existing quality procedures and replacing documents with management control (MC) procedures. Distributed weekly matrix report to REECo/YMP departments for input on status of new procedures. Continued ongoing development of training sessions to be conducted as MC procedures are completed.

Provided a draft Quality Assurance Requirements and Description Document to the YMP Division/Departments for information purposes.

Evaluated and accepted Quality Services Section response to Internal Audits REECo-010-91 (Audit Finding Report [AFR] #1) and REECo-001-90 (AFR #3). These audits are now closed.

Supported DOE/YMP QA Department personnel during audit YMP-92-04 of REECo. The audit resulted in no findings.

Issued CAR-91-001 with a January 1992 completion date for Surveillance SR-REECo-022 of Division records management activities at the REECo Local Records Center.

General

REECo has no reportable Level I or Level II milestone activities at this time.