United States Department of the Interior

U. S. GEOLOGICAL SURVEY
Box 25046 M.S. 421
Denver Federal Center
Denver, Colorado 80225

IN REPLY REFER TO

INFORMATION ONLY

November 13, 2002

Victor W. Trebules
Director, Office of Project Control
Yucca Mountain Site Characterization
Project Office
U. S. Department of Energy
P.O. Box 364629
Las Vegas, Nevada 89036-8629

SUBJECT: Yucca Mountain Project Branch - U.S. Geological Survey (YMPB-USGS) Progress Report, October, 2002

Attached is the USGS progress report in the required format for the month of October, 2002.

If you have any questions or need further information, please call Raye Ritchey Arnold at (303)236-5050, ext 296.

Sincerely,

Raye Ritchey Arnold

for Robert W. Craig
Technical Project Officer
Yucca Mountain Project Branch
U.S. Geological Survey

Enclosure:
cc: J. Bresee, DOE/OCRWM-HQ/Forrestal
S. Hanauer, DOE/Las Vegas
R. Dyer, DOE, Las Vegas
D. Barr, DOE, Las Vegas
A. Gil, DOE, Las Vegas
T. Gunter, DOE, Las Vegas
D. Coleman, DOE, Las Vegas

NMSS07

WM11

W. Kozai, DOE, Las Vegas
S. Mellington, DOE, Las Vegas
S. Morris, DOE, Las Vegas
E. Smistad, DOE, Las Vegas
R. Spence, DOE, Las Vegas
T. Sullivan, DOE, Las Vegas
M. Tynan, DOE, Las Vegas
D. Williams, DOE, Las Vegas
R. Latta, NRC, Las Vegas (2 copies)
R. Andrews, M&O/BSC, Las Vegas
G. Bodvarsson, M&O/LBNL, Las Vegas
P. Dixon, M&O/LANL, Las Vegas
A. Eddebbarh, M&O/LANL, Las Vegas
E. Hardin, M&O/BSC, Las Vegas
R. Henning, M&O/BSC, Las Vegas
J. Houseworth, M&O/LBNL, Las Vegas
S. Kuzio, M&O/SNL, Albuquerque
S. Pedersen, M&O/BSC, Las Vegas
M. Peters, M&O/LANL, Las Vegas
J. Wang, M&O/LBNL, Berkeley
W. Alley, USGS, Reston
D. Duncan, USGS, Reston
R. Craig, USGS, Las Vegas
R. Arnold, USGS, Denver
T. Chaney, USGS, Denver
M. Chornack, USGS, Denver
W. Dudley, USGS, Denver
D. Gillies, USGS, Denver
D. Hoxie, USGS, Las Vegas
C. Hunter, USGS, Denver
R. Keefer, USGS, Denver
B. Parks, USGS, Denver
Z. Peterman, USGS, Denver
W. Scott, USGS, Las Vegas
J. Stuckless, USGS, Denver
D. Sinks, BSC, Denver

U.S. GEOLOGICAL SURVEY
YUCCA MOUNTAIN PROJECT, EXECUTIVE SUMMARY

October 2002

Highlights of USGS activity during October include publication of two water-resources investigations reports, which describe results of hydraulic testing at the C-hole complex and progress in modeling the Death Valley regional flow system. In addition, numerous presentations by USGS staff at the 2002 annual meeting of the Geological Society of America (GSA; held in Denver during the last week of October) disseminated results of multiple investigations that support of the Yucca Mountain Project. Discussion of those presentations is placed where appropriate in this summary of YMP-USGS activity. Abstracts of the presentations may be found in the meeting program (2002, Geological Society of America, *Abstracts with Programs*, v. 34, no. 6).

GEOLOGY

Staff responded to technical reviews conducted on lithostratigraphic interpretations from Phase III drilling in the Nye County Early Warning Drilling Program (EWDP). and submitted the related data package for additional review. Work also continued on development of a reference list of data sources used in revisions to hydrostratigraphic Cross Sections Nye-1, Nye-2, and Nye-3. Phase IV drilling is underway, but no samples have yet been examined.

The completed geologic mapping of the southern expansion area of the proposed repository remained in preliminary publication stages, but two presentations at the GSA technical meetings were drawn from those mapping efforts. R. Dickerson and R. Spengler described on-going improvements to understanding the subsurface geology of Yucca Mountain (*Neogene extension of southern Yucca Mountain and northern Amargosa desert, Nevada, based on new subsurface data*) through use of new aeromagnetic and gravity data. R. Drake and others applied new digital field-mapping techniques in mapping the area of potential southern expansion, and that presentation (*Digital geologic mapping in the Yucca Mountain area, Nye County, Nevada*) described use of handheld Global Positioning System (GPS) equipment linked to real-time display, field-mapping software, and digital orthophotographs. The new mapping system allowed location of geologic features (using the GPS unit) directly on digital orthophotographs, avoiding need to digitize field maps in the office and avoiding possible transcription errors. Accuracy of the field locations was improved to much less than the nominal 10-m accuracy of the GPS.

Review of the Deterministic Seismic Hazard Analysis (DSHA) report continued. The technical reviewers anticipate timely return of the reviews and expect resolution of comments to be straightforward. Final USGS review will be expedited as possible.

Several aspects of geotechnical work continued by USBR staff. Rock-mechanics testing of rock units exposed in the Cross Drift continued. Samples have been tested, others are in preparation, and additional samples were shipped from the SMF. Delays in implementation of new procedures will have no impact on planned completion dates. Investigations to determine the fracture and lithophysal characteristics of the repository host horizon (RHH) also continued. Some 22 data packages have been assembled into a fracture data base. Multi-variant and bi-modal distribution analyses (to determine statistical parameters for development of stochastic input) are expected to begin near the end of October. Planning documents for field analyses have been assembled and await QA acceptance. Aspects of sampling, borehole analysis, mapping, and fracture characterization have begun.

Collection of lithophysal porosity data continued. Planned data activities for FY2002 were completed, but data gathering continued into FY2003 with on-going in situ collection of data in the slot test(s). Slot Test #2 is located approximately halfway through the upper lithophysal zone in the South Ramp of the ESF and is in the small-lithophysal subzone as described by Buesch and others (Buesch, D.C., Spengler, R.W., Moyer, T.C., and Geslin, J.K., 1996, Proposed stratigraphic nomenclature and macroscopic identification of lithostratigraphic units of the Paintbrush Group exposed at Yucca Mountain, Nevada: U.S. Geological Survey Open-File Report 94-469, 47p.). As the subzone name implies, there are many (emphasis on *many*) more small lithophysae in that rock than occur in the rocks described in Slot Test #1 and in the Tptpll Lithophysal Study in the Cross Drift. Some data-collection techniques developed for Slot Test #1 had to be revised for the Slot Test #2 mapping. Low-angle illuminated photographs of the tunnel wall formed the basis for the panel map; the tunnel wall was not thoroughly cleaned, however, so only lithophysal cavities could be identified on the photographs. Video-recording techniques in the slots were revised and resulted in better-quality images. So many small lithophysae (cavities 3 to 60 mm in diameter) are present, however, that the slot maps document of the locations of all lithophysae in a 1-m by 1-m area with the lithophysae depicted by area (that is, by a symbol representing size and not specifically drawn shapes). A summary of the data is being prepared. At the GSA meetings, a presentation (*Methods of documenting variability in lithostratigraphic features, fractures, and properties in the Topopah Spring Tuff at Yucca Mountain, Nevada*) authored by D. Buesch and others described various field and laboratory data-collection methods for acquisition of geotechnical information about the volcanic rocks that would host the proposed repository at Yucca Mountain. Data from surface and tunnel exposures, and from boreholes, document lithologic contacts, faults, fractures, cavities, and indications of zonation in the tuffs and help to describe the environment of the proposed repository.

SATURATED-ZONE STUDIES

Work related to the Alluvial Test Complex (ATC) continued. Material intended for the single-hole tracer-testing report on the analysis of the single-hole injection-pumpback tracer testing in NC-EWDP-19D1 at the Alluvial Testing Complex (ATC) instead has

been incorporated into the Saturated Zone In-situ Testing Analysis and Modeling Report (SZ In-situ Testing AMR). An update of USGS analysis of the single-hole injection-pumpback tracer testing in NC-EWDP-19D1 will be provided to the AMR lead, primarily regarding analysis of tracer testing conducted from February 26 to March 14, 2002, in screen #4. Confirmatory hydraulic tests are being analyzed to estimate leakage that would occur from the screen-#5 interval (screen #5) to the screen-#4 interval (screen #4) in the saturated alluvium at the Alluvial Testing Complex (ATC) while pumping screen #4 in NC-EWDP-19D1 during future cross-hole tracer testing. That analysis has been completed; results will be sent to the SZ In-situ Testing AMR lead for incorporation into the AMR. The cross-hole hydraulic tests are being analyzed to calculate transmissivity, hydraulic conductivity, storativity, and specific storage of the alluvium. Preliminary transmissivity values from analyzing the cross-hole tests are up to an order-of-magnitude higher than those obtained previously by analyzing single-hole, pumping-well results, consistent with high head losses in the pumping well, NC-EWDP-19D1. The analysis will be completed for incorporation into the SZ In-situ Testing AMR. A data package containing confirmatory and open-hole hydraulic data was submitted to the TDMS/RPC in completion of **milestone PAGSM42M4 [Confirmatory/Open-hole Hydraulic Data—TDMS/RPC]** on October 2. Analysis of results from the single-hole injection-pumpback tracer test, conducted in the screen-#4 interval of the alluvium at NC-EWDP-19D1 from February 26 to March 14, 2002, continued. Preliminary analysis indicates results similar to those obtained by analyzing injection-pumpback tracer tests conducted earlier in the screen-#1 interval. Results will be incorporated into the SZ In-situ Testing AMR. Monitoring of unstressed open-alluvium hydraulic pressures in boreholes NC-EWDP-19D1 and in –IM2, as well as isolated-interval pressures in borehole –IM1 ended on July 3. Data reduction of the record and preliminary calculations of barometric efficiency and total porosity (upper bound on effective porosity) continued during October. Preliminary calculations indicate total porosity values in the 30% range, which are, as expected, higher than the 10% effective porosity values calculated from the single-hole injection-pumpback tracer tests conducted in NC-EWDP-19D1.

Work on a Software Management Report (SMR) for the Fortran program, RCV2AMOS, written by Allen Moench of the USGS National Research Program, which provides a dimensionless solution of the advection-dispersion equation for radially-convergent tracer tests, was completed in October. That dimensionless solution will be used to analyze future cross-hole tracer tests at the ATC. Modifications of the solution have also been used to obtain preliminary results of single-hole injection-pumpback tracer tests at the ATC. The SMR for RCV2AMOS is expected to be submitted to the Configuration Management (SCM) Group in Las Vegas on October 31. Another SMR was written for MOENCH.vi, a graphical user interface (GUI) that facilitates the use of the Fortran code RCV2AMOS. The SMR for the MOENCH GUI is expected to be submitted on October 31. Also during September, a new SMR was initiated for MOENCH_PEST.vi, a GUI that couples RCV2AMOS with the optimization program PEST (Parameter Estimation) to obtain automatic (rather than manual graphical) fits of the RCV2AMOS solution to actual cross-hole, convergent tracer-testing data. Qualification of MOENCH_PEST will rely in part on qualification of PEST, version 5.5, currently being done by LANL. During October, three SMRs were initiated for THEIS.vi, NEUMAN.vi, and FILTER.vi, user interfaces for

programs to analyze aquifer tests by the Theis (1935) and Neuman (1975) methods, and to filter (that is, remove) earth-tide effects from water-level measurements in order to calculate barometric efficiency.

A new publication by the USGS described hydraulic tests conducted at the C-hole complex from 1995 to 1997 that demonstrated that the Miocene tuffaceous rocks beneath the complex functioned as a single aquifer, even across geologic and lithostratigraphic contacts (Geldon, A.L., Umari, A.M.A., Fahy, M.F., Earle, J.D., Gemmell, J.M., and Darnell, J., 2002, *Results of hydraulic tests in Miocene tuffaceous rocks at the C-hole complex, 1995 to 1997, Yucca Mountain, Nye County, Nevada*: U.S. Geological Survey Water-Resources Investigations Report 02-4141, 58 p.). That behavior likely results from interconnected faults, fracture networks, and intervals with large matrix permeability.

Initial numerical models of the Death Valley regional flow system employed a basic hydrogeologic data set. Some four years ago, DOE requested that the USGS develop a second-generation model which incorporated both new geological interpretations and new modeling approaches. A recently published report (D'Agnese, F.A., O'Brien, G.M., Faunt, C.C., Belcher, W.R., and San Juan, C., 2002, *A three-dimensional numerical model of predevelopment conditions in the Death Valley regional flow system, Nevada and California*: U.S. Geological Survey Water-Resources Investigations Report 02-4102, 114 p.) presented a steady-state model which utilized the initial hydrogeologic data. Calibration of the model allowed evaluation of conceptual models with respect to observed hydraulic heads and flows. The final optimized model improved on previous representations, but analysis identified important uncertainties and sources of model error. A long-term modeling goal will produce a transient model that simulates ground-water conditions in the study area over the period of the historical record.

Results of hydrochemical investigations also were reported at the GSA conference in Denver. A presentation by T. Oliver and G. Patterson (*Hydrochemical facies in ground water near Yucca Mountain, Nevada*) described identification of multiple ground-water flow paths beneath the proposed repository. Chemical and isotopic composition of ground water from sample regions near Yucca Mountain identifies hydrochemical facies and delineates five potential flow paths. Variations in Na and bicarbonate, concentrations of Ca and Mg, total dissolved solids, and sulfate and chloride concentrations define facies, and those distinctions are supported by isotopic data ($\delta^{87}Sr$ and $^{234}U/^{238}U$) related to lithology of potential flow paths.

UNSATURATED-ZONE STUDIES

In on-going USGS support to the Site Description, staff participated in planning regarding types of material for inclusion in the UZ chapter. In other supporting work, studies in caves, a natural analog to the proposed repository, have shown that underground openings can divert UZ water along the walls of openings by capillary action. Those natural analogs (summarized in a GSA presentation by J.S. Stuckless,

entitled *The role of underground openings in the unsaturated zone as a barrier in isolating high-level radioactive waste*) to the proposed repository thereby preserve delicate artifacts and biological remains for thousands of years. In addition to natural barriers to contact of waste packages by seeping water, ventilation planned for the repository could remove much more water than would seep into the repository. Caves typically are ventilated by openings large enough for human entry, but an Arizona cave ventilated by a fracture network could be an example of means for natural ventilation without openings large enough to carry the threat of human intrusion.

The USGS monitored temperature, pressure, and relative humidity (RH) behind the bulkheads in Alcove #7. Those data have provided insight on operation of the ventilation system and impact of bulkheads in the ESF, and the Project has concluded that additional monitoring may bring additional insight. Temperature data continued in the summer pattern (400-Pa diurnal pressure fluctuations and 0.04-degree diurnal temperature fluctuations). The on-going (continued) monitoring should indicate whether the anticipated fall-season temperature decline results in rise of Alcove #7 relative humidity values above 95%. Important baselines for future testing may be illuminated by temperature and RH relations and quantification of any condensation moisture. Measurements across the bulkhead-isolated Ghost Dance fault were made (GSA presentation by M. Kurzmack and others, *Relative humidity, pressure, and temperature values from the Ghost Dance fault, Alcove 7, Yucca Mountain, Nevada*) to evaluate the role of the Ghost Dance fault in flow and transport of fluids through Yucca Mountain. Atmospheric-pressure fluctuations across the bulkheads showed minimum dampening and short time lags. Seasonal temperature variations were transmitted by the ventilation system, but temperature behind bulkheads indicated no annual (seasonal) fluctuation.

Hydrologic data and interpretations were presented at the Denver GSA conference (LeCain, G.D., and others, *In situ water-potential values of the nonwelded units of the Paintbrush Group, Yucca Mountain, Nevada*). Differences in measured values were attributed to depth and to placement of bulkheads. Water potential of nonwelded Paintbrush Group tuffaceous rocks agreed with values measured in the same units in surface-based boreholes. In addition, compilation of the Alcoves #3, #4, and #7 data packages was completed. The Alcoves #3/#4 package has completed review and comment resolution and is being processed for submittal to the RPC. The Alcove #7 package remained in review.

In deferred-work efforts, close-out of the surface-based boreholes continued. Technical and checker review of the UZ borehole data package has been completed, as has the related comment resolution. Final preparation of that UZ borehole data package is underway.

Infiltration studies continued in Alcove #8/Niche #3. The trench experiment is concluded, but the on-going large-plot experiment began in late August. (Heat-dissipation-probe and tensiometer data from the trench are being collected as the trench drains.) An evaporation station was erected to collect data on evaporation rates. Water application to the large plot continued, currently without problems. Water application

has slowed, perhaps due to stabilization of border (boundary) conditions. Data from the box and trench experiments were compiled into data packages and submitted to the TDMS. Several additional data packages were in preparation.

Moisture-monitoring work in the ESF and Cross Drift focused on processing of the monitoring data package and preparations for review. New data-logger programs were drafted to incorporate barometric pressure sensors. Neutron moisture-monitoring holes in the Cross Drift were logged. Staff determined methodology to compute water-vapor density from temperature and relative-humidity data collected in the ESF and in the Cross Drift. The methodology was applied to spreadsheet data to generate time-series water-vapor density. The water-vapor density increased as ventilated air moves through the ESF, indicating on-going dry-out of the surrounding rock.

Moisture monitoring also continued behind the bulkheads. Video data (on video tapes and DVDs) were sent to Denver for review. DAZZLE software was qualified and baselined per AP-SI.1Q. Collection and preparation of temperature, relative humidity (jointly, TRH), barometric pressure, and wind-speed data continued during the reporting period. The three deepest bulkheads have not been opened; data collection continued. Biweekly monitoring by camera continued and showed apparent wind-driven movement (of a streamer hung to show wind movement), but that movement has not been explained.

On-going aspects of hydrochronology and hydrochemistry continued. Compilation of a gas and water-vapor data package continued, with submittal for review expected in early November. Minor delays were caused by prototyping of the data-collection system to be used in FY2003 after the bulkheads in the ECRB Cross Drift are closed (currently scheduled for January 2003). Collection and analysis of water samples from absorbers continued during the period and will continue into FY2003. Development of equipment to extract water from absorber pads also continued. No new samples were obtained because the Cross Drift bulkheads are open. Several efforts in site-scale hydrochemistry continued. A draft USGS open-file report describing the site-scale hydrochemical data base has been completed. Preliminary review is complete, with revisions underway. Boreholes USW WT-1, USW WT-2, and USW H-4 have been selected for discrete-zone sampling. Detailed planning is underway; sampling equipment has been obtained. In isotopic support to the EWDP, samples were collected from Nye County boreholes NC-EWDP-23P [zone 2] and NC-EWDP-75C [zone 3] during the first week of October. A presentation at the GSA meeting in Denver described variations of water composition (dissolved major-ion concentrations) with depth in boreholes and between boreholes (*Chemical composition of pore water from boreholes USW SD-6 and USW WT-24, Yucca Mountain, Nevada*, by I.C. Yang and others). Studies of chemical composition of water samples extracted from borehole samples provide information on possible effects of corrosion on waste canisters.

Preparations for chemical and isotopic analysis of pore water continued. Procurement documents for analytical standards for organic acids in water have been issued, to allow organic acid analysis under the covering QC sample plan. Priorities for water extraction have been determined, with the "aseptic" boreholes to be drilled next month in the ESF.

Core from the Cross Drift in the meantime will be the target of water extraction to expand the spatial characterization of water from the proposed repository horizon. Extraction and analysis of water from borehole ChemSampl continued, and a third analysis was completed during October. Calcite distribution in the Cross Drift was used to estimate past water seepage, in a paper given at the GSA conference (*Estimates of past seepage from calcite distribution in the east-west cross drift, Yucca Mountain, Nevada*, authored by B. Marshall and others). The secondary minerals are a record of millions of years of slow seepage, and scaling of results from the analyzed material allows estimation of overall seepage volume in the UZ underground openings—estimated in that work to be up to 4 liters of water per year per 5-m section of the Cross Drift.

Whole rock $^{234}U/^{238}U$ and $^{230}Th/^{238}U$ data collected in FY2002 were compiled and evaluated by comparing differences in the degrees of U-series radioactive disequilibrium with sample type and location within the Yucca Mountain UZ, as part of on-going delineation of UZ flow zones. In addition, preliminary geochemical modeling was performed using a 1st-order rate model of continuous U loss to evaluate the differences in chemical process causing distinct differences in data for samples from the shallow Bow Ridge fault zone and for samples from the repository horizon in the Cross Drift. Resulting models support the concept that the shallow fault-zone samples have experienced greater bulk U mobility and less $^{234}U/^{238}U$ fractionation, whereas samples away from that near-surface flow zone show minimal bulk U mobility and greater $^{234}U/^{238}U$ fractionation. These results can be interpreted in the sense of greater and lesser degrees of water/rock interaction in different areas and support the concept of using U-series studies to map percolation/flow zones within the UZ. The first draft of a technical report presenting the data and modeling described above was begun. The working title of the report is "U-series disequilibrium as a test for unsaturated-zone hydrologic models at Yucca Mountain, Nevada." The report is intended for publication in the Proceedings of the 10th annual High-Level Radioactive Waste Management conference sponsored by the American Nuclear Society.

A report entitled "Improved spatial resolution for U-series dating of opal at Yucca Mountain, Nevada, USA, using ion-probe and in-situ microdigestion" by J.B. Paces, L.A. Neymark, J.L. Wooden, and H.M. Persing was completed, technically reviewed, revised, and submitted for USGS Director's Approval. The report describes initial efforts to obtain $^{230}Th/U$ and model $^{234}U/^{238}U$ ages from opal hemispheres at higher spatial resolution using new and innovative analytical techniques. The U-series data confirm the extremely slow growth rates previously proposed from general arguments and from U-Pb dating of silica deposited throughout the Tertiary. New ion-probe data demonstrate that 1- to 2-mm-diameter opal hemispheres at the tips of calcite blades require more than 1 million years to form. In addition, the report describes preliminary results that suggest growth rates are related to climate cycles in the last 30 thousand years, and that seepage may have ceased in the middle or late Holocene. The report is intended for submission to the peer-reviewed technical journal *Geochimica et Cosmochimica Acta*.

Two presentations at the GSA conference described isotopic investigations into water-rock interaction and origins of secondary minerals in soils at Solitario Canyon. One

presentation (authored by J. Paces and L. Neymark and entitled *U-series isotopes, water-rock interaction, and evidence of unsaturated-zone flow at Yucca Mountain, Nevada*) described the characteristics and evolution of U isotopes in precipitation, infiltration, percolation, perched water, and SZ water, as well as $^{234}U/^{238}U$ and $^{230}Th/^{238}U$ results for whole rock samples. The increase of U-series isotopes with depth reflects increased interaction with overlying rocks. L. Neymark and others prepared a presentation for the GSA meeting titled *C-O-Sr-U isotope evidence for the meteoric origin of calcrete at Solitario Canyon Wash, Crater Flat, Nevada.* The presentation included a description of the U-series ages and initial $^{234}U/^{238}U$ ratios of colluvial and alluvial deposits in Solitario Canyon and compared the results to those from SZ water samples to help confirm a meteoric source rather than an upwelling SZ water source for authigenic deposits. New C, O, Sr, and U isotopic data show that meteoric water percolated into the soil. Those data do not agree with values obtained in analysis of ground-water samples or the ground-water discharge origin proposed by others.

Additional isotopic and geochemical efforts continued. Work began on a report describing geochemical and physical characterization of ESF dust, largely based on previous dust collection and analysis. A presentation at the GSA meetings noted that while most of the pore water in the rock above the proposed repository is contained in the densely welded tuff, water extractions from the welded tuff are difficult due to the compressive strength of that rock (Z. Peterman and B. Marshall, *Geochemistry of pore water from densely welded Topopah Spring Tuff at Yucca Mountain, Nevada*). Recent ultracentrifugation and analysis of pore-water samples from the densely welded tuff demonstrated compositions much more variable than the composition of the densely welded rock, thereby reflecting water-rock interaction during infiltration and percolation. In addition, the work shows evidence that advective flow and diffusion have not smoothed those compositional differences.

Work to complete the chlorine-36 (^{36}Cl) validation continued. Reviews of an annotated report outline were received from participants, with revisions anticipated to be completed in early November. A comprehensive search of the TDMS was begun for all aspects of the original LANL ^{36}Cl studies. Recent efforts to replicate early observation of ^{36}Cl anomalies in the ESF have been frustrated by variable leaching of Cl from the tuff, depending upon sample preparation procedures, size of leached fragments, duration of leach, and possible contamination during tunnel-construction activities. A paper by M. Gascoyne (GeoProjects, Inc., Canada) at the GSA conference (*Sources of chloride ion in Yucca Mountain tuffs, Nevada*) examined relative importance of leachable Cl components, leach times, and fragment sizes, to understand better Cl-leaching characteristics. Attempts also were made to determine distribution of chemically bound Cl by electron microprobe. In further work presented at the GSA meetings on secondary minerals in the tuffs and their significance, unusual mineral morphologies and rock textures in calcite and silica deposited in openings in the UZ rock were described as results of gas- and liquid-phase dynamics of the calcite and silica deposition (J. Whelan and others, *Gas- and liquid-phase dynamics of low-temperature mineral formation in the unsaturated zone at Yucca Mountain, Nevada*). Preferential deposition at the tips of free-

standing calcite blades reflects mineral formation from water films drawn up crystal faces by surface tension.

WATER-RESOURCES MONITORING

In continuation of routine water-resources monitoring, ground-water levels were measured at 34 sites, and ground-water discharge was measured at springs and at one flowing well. Ground-water and spring-discharge data collected during September were checked and filed. Data on ground-water levels and discharge, collected and compiled for monitoring sites during the period from July to September 2002, were reviewed. A letter report was prepared for DOE describing data from the fourth quarter of FY2002.

USGS Milestone Report

October 1, 2002 - October 31, 2002

Sorted by Baseline Date

Level: 4

Deliverable		Due Date	Expected Date	Completed Date
PAGSW932M4	Supplemental Fracture Data to TDB/RPC	10/25/2002	11/1/2002	
PAGSW258M4	Letter Report: 4th Qtr FY02	10/31/2002	10/31/2002	10/31/2002

USGS Milestone Report

October 1, 2002 - October 31, 2002

Sorted by Baseline Date

Level: 5

Deliverable		Due Date	Expected Date	Completed Date
PAGSM37EM5	Mtg Summary to TPO	10/31/2002	10/25/2002	10/25/2002

YMP PLANNING AND CONTROL SYSTEM (PACS)

MONTHLY COST/FTE REPORT

Participant U S Geological Survey
Date Prepared 11/13/2002 12 37 PM

Fiscal Month/Year October 31, 2002

	CURRENT MONTH END						FISCAL YEAR		
WBS ELEMENT	ACTUAL COSTS	PARTICIPANT HOURS	SUBCONTRACT HOURS	PURCHASE COMMITMENTS	SUBCONTRACT COMMITMENTS	ACCRUED COSTS	APPROVED BUDGET	APPROVED FUNDS	CUMMULATIVE COSTS
1 5 02 2 3	7	44	158	0	29	0	140	0	7
1 5 02 2 3 2	67	1184	230	0	139	0	935	0	67
1 5 02 2 3 3	264	3526	1717	0	795	0	4277	0	264
1 5 02 2 4 3	145	1888	74	0	78	0	1430	0	145
1 5 04 6 3	347	4490	3233	0	1139	0	6465	0	347
	830	11132	5412	0	2180	0	13247	0	830

U.S. GEOLOGICAL SURVEY
ESTIMATED COSTS FOR October 1, 2002 - October 31, 2002
11/13/2002 8 21 35 AM

		OCT EST	NOV EST	DEC EST	JAN EST	FEB EST	MAR EST	APR EST	MAY EST	JUN EST	JUL EST	AUG EST	SEP EST	TOTAL
4568-9U004	USGS Support to Site Description	7 3	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	7 28
ANSG01	USGS Support to Site Description	7 3	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	7.28
1.5 02.2.3	Natural Systems	7 3	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	7 28
4568-9U048	Cross-hole Hydraulic & Tracer Testing AT	27 4	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	27.44
4568-9U049	Nye County EWDP Borehole Lithostratigr	12 3	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	12.33
ASZG01	USGS SZ Investigations	39 8	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	39.78
4568-9U082	Isotopic/Hydrochemical Support to the AT	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 00
4568-9U083	Hydrochronology of the Yucca Mountain F	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 00
4568-9U084	Site-Scale Hydrochemistry	19 4	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	19 42
4568-9U092	Isotope/Hydrochemical Support to Nye Co	7 7	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	7 73
ASZG02	USGS SZ Isotope Hydrology	27 1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	27 14
1.5.02.2.3.2	Saturated Zone	66 9	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	66 92
4568-9U001	Science Advisors	41 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	41 00
4568-9U010	Publications	19 2	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	19.16
4568-9U040	Tectonics	21 5	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	21 55
4568-9U041	Water Levels	3 4	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	3 41
4568-9U042	Geophysics	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 00
4568-9U060	Mapping Expertise (USBR)	14.6	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	14.57
4568-9U081	Geochemistry	11.7	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	11 68
819Y01	USGS Technical Advisory Capability	111 4	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	111 37
4568-9U050	Alcove 7/X-Dnft Instrument Strains	7 8	0.0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	7.77
4568-9U063	Alcove 8/Niche 3 Infiltration	25 9	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	25 92
4568-9U064	Moisture Monitoring ESF & X-Dnft	19 2	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	19 23
4568-9U065	Bulkhead Moisture Monitoring	8 2	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	8 19
4568-9U066	Support to UZ In-Situ Processes AMR	7 3	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	7 27
AUZG01	USGS UZ Moisture Studies	68 4	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	68 38
4568-9U085	U-Series Delineation of UZ Flow Zones	26 8	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	26 76
4568-9U086	Complete Chlorine 36 Validation	5 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	4 96
4568-9U087	Chemical & Isotopic Composition of Pore	30 4	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	30 35

U S GEOLOGICAL SURVEY
ESTIMATED COSTS FOR October 1, 2002 - October 31, 2002
11/13/2002 8 21 35 AM

	OCT EST	NOV EST	DEC EST	JAN EST	FEB EST	MAR EST	APR EST	MAY EST	JUN EST	JUL EST	AUG EST	SEP EST	TOTAL
4568-9U088 ECRB H2O, H2O Vapor & Gas Chemistry	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 00
4568-9U089 Microclimate Records in Fracture Minerals	13 9	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	13 86
AUZG02 USGS UZ Isotope Hydrology	75 9	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	75 93
4568-9U090 Isotope Support for Thermal Testing	7 9	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	7.87
AUZG03 USGS Drift-Scale Test ESF	7.9	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	7.87
1.5.02.2.3.3 Unsaturated Zone	263 6	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	263 56
4568-9U091 Geochem/Physical Characterization of ES	2 1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	2.13
AEBG01 USGS Effects of Water-Rock Interaction	2 1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	2.13
4568-9U067 Quantify Lithophysal Porosity - In Situ Tes	8 1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	8 08
AEBG02 USGS Nevada Operations Support to E	8 1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	8 08
4568-9U068 Rock Mechanics Testing in the ECRB (US	91 5	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	91 51
4568-9U069 Fracture & Lithophysal Characteristics of	43 7	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	43 68
AEBG03 USBR Testing Activities in Support of D	135 2	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	135 20
1.5 02.2.4.3 Engineered Barrier System	145 4	0 0	0 0	0 0	0 0	0.0	0 0	0.0	0 0	0 0	0 0	0 0	145 41
1 5 02 2	483 2	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	483 17
1 5 02	483 2	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	483 17
4568-9U002 Br Chief, Asst Br Chief, Deputy TPO, Tea	38.5	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	38 46
819Y11 USGS Branch Management	38 5	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	38 46
4568-9U011 Reports Specialists	18 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	17.95
4568-9U012 Data Management	49 3	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	49 30
4568-9U013 Records Support	22 2	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	22 23
4568-9U014 QAS Support	7 0	0 0	0 0	0 0	0.0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	7 04
819Y12 USGS Data, Records & Reports	96 5	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	96 53
4568-9U021 Administrative Support & Personnel Servi	33 2	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	33 17
4568-9U022 Facilities Management	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 00
819Y13 USGS Administration & Facilities	33 2	0 0	0 0	0 0	0 0	0 0	0.0	0.0	0 0	0 0	0 0	0 0	33 17
4568-9U023 Training	15 8	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0.0	0 0	0 0	15 77

U S GEOLOGICAL SURVEY
ESTIMATED COSTS FOR October 1, 2002 - October 31, 2002
11/13/2002 8 21 35 AM

		OCT EST	NOV EST	DEC EST	JAN EST	FEB EST	MAR EST	APR EST	MAY EST	JUN EST	JUL EST	AUG EST	SEP EST	TOTAL
819Y14	USGS Training	15 8	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	15.77
4568-9U024	Computer/Network Support	26 4	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	26.44
819Y15	USGS Commputer/Network Support	26 4	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	26 44
4568-9U025	Property Management	24.1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	24.14
819Y16	USGS Property Management	24 1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	24 14
4568-9U003	Planning & Project Control	27 4	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	27 40
819Y21	USGS Planning & Project Control	27 4	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	27 40
4568-9U030	Regulatory Compliance Support	40 8	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	40 84
819Y31	USGS Regulatory Compliance Support	40 8	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	40 84
4568-9U061	Water Resources Monitoring	16 8	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	16 83
819Y41	USGS Water Resources Monitoring	16 8	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	16 83
4568-9U062	Safety	9 1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0.0	9 09
819Y51	USGS Safety	9.1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0.0	9 09
4568-9U043	Hydrogeologic Data Integration	13 4	0 0	0 0	0 0	0 0	0 0	0.0	0.0	0 0	0 0	0 0	0 0	13 37
4568-9U044	3D Hydrogeologic Model Development	1.2	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1 20
4568-9U045	Flow Model Calibration and Evaluation	3 9	0 0	0 0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	3 88
4568-9U046	DVRFS Knowledge Exchange Protocol	0 0	0.0	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 00
4568-9U047	DVRFS Predictive Capability	0.0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.00
819Y61	USGS Death Valley Regional Flow Mod	18 5	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	18 45
1.5.04.6.3	DOE Technical Support Services	347.1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	347.13
1.5 04.6		347.1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	347.13
1.5 04		347.1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	347.13
1.5		**830.3**	**0.0**	**0.0**	**0 0**	**0 0**	**0.0**	**0.0**	**0 0**	**0 0**	**0.0**	**0.0**	**0.0**	**830.30**

U S. GEOLOGICAL SURVEY
ESTIMATED COSTS FOR October 1, 2002 - October 31, 2002
11/13/2002 8 21 35 AM

	OCT EST	NOV EST	DEC EST	JAN EST	FEB EST	MAR EST	APR EST	MAY EST	JUN EST	JUL EST	AUG EST	SEP EST	TOTAL
1.5 OPERATING	830 3	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	830 30
CAPITAL EQUIPMENT	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0
GRAND TOTAL	830 3	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	830 30
FTEs													
FEDERAL	61 0	0 0	0 0	0 0	0 0	0 0	0 0	0.0	0 0	0 0	0 0	0.0	
CONTRACT	34 7	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	
TOTAL	95 6	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	