CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: Geological Society of America (GSA) Annual Meeting

DATE/PLACE: November 1–5, 2003—Seattle, Washington

AUTHOR: Kevin J. Smart

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CHARGE NUMBER:	AI 20.06002.01.061.461
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AUTHOR:	Kevin J. Smart
PERSONS PRESENT:	K.J. Smart, J. Stamatakos, B. Hill, N. Franklin, K. Murphy, J. Winterle, P. Bertetti, M. Juckett

BACKGROUND AND PURPOSE OF TRIP:

The Geological Society of America (GSA) held its 2003 Annual Meeting in Seattle, Washington from November 2–5, 2003. The GSA is one of the premier professional societies among the geosciences and their annual meeting attracts a broad range of disciplines and interests. This year's meeting was attended by over 6,000 USA and international geoscientists.

Typically, the meeting has several hundred technical sessions given over the four day conference period. Session contents range from theme oriented subjects to general topic sessions that cover virtually every facet of geology and geophysics. NRC staff attendees were Bret Leslie and Jim Rubenstone. CNWRA staff attended this meeting to present research results and observe technical sessions that included a full-day session focused on *The proposed deep geologic repository for high-level radioactive waste at Yucca Mountain, Nevada: attributes of the natural system.*

SUMMARY OF PERTINENT POINTS:

CNWRA staff were authors or coauthors on 6 presentations at the GSA meeting (5 oral presentations and 1 poster):

- Sims, D.W., Morris, A.P. Ferrill, D.A., Stamatakos, J.A., and Waiting, D.J. – *A physical analog model of extensional deformation in the Yucca Mountain region, Nevada.*
- Bertetti, F.P., Prikryl, J.D., and Brown, J.R. – *Mineralogy and geochemistry of the alluvium in the Fortymile Wash region south of Yucca Mountain, Nevada.*
- Franklin, N.M., Ferrill, D.A., Ofoegbu, G.I., Morris, A.P. – *Methodology for analysis of fracture reactivation in response to thermally induced stresses at Yucca Mountain.*
- Murphy, K.R., Stamatakos, J.A., Hill, B.E., and Gray, M.B. – *Geophysical evidence for two distinct Miocene and Quaternary slip rates on the Bare Mountain fault, Nevada.*
- Painter, S. and Winterle, J. – *Using temperature to test models of flow near Yucca Mountain, Nevada.*

- Dinwiddie, C.L. and McGinnis, R.N., Jr. – Heavy oil reservoir outcrop analog near Escalante, Utah: Analysis of agas permeability data set for non-Darcy flow effects.

The first two presentations were both made in the "Yucca Mountain theme session." All research results were well received by the audiences, and generated positive comments and thoughtful questions. In addition, CNWRA staff attended numerous oral and poster presentations on topics directly and indirectly related to the proposed high-level radioactive waste repository.

SUMMARY OF ACTIVITIES:

An all day session on Tuesday, November 4th focused on *The proposed deep geologic repository for high-level radioactive waste at Yucca Mountain, Nevada: attributes of the natural system.* The morning portion of the session was dominated by presenters from the U.S. Geological Survey, the Bureau of Reclamation, the Department of Energy, and other federal labs and covered such topics as:

- the history of site characterization
- overviews of site geology and tectonic setting
- seismic hazard and volcanological studies
- climate, tuff geochemistry
- unsaturated zone flow

The abstract by Sims *et al.* (presented by J. Stamatakos) was somewhat atypical of the session in that it presented new data and interpretations that attempted to address uncertainties in the tectonic evolution of the region. Presentations related to the Yucca Mountain region igneous activity and surficial processes reiterated material presented in recent technical exchanges and gave a preview of in-revision reports. Based on the material in these presentations, previously identified technical concerns on these topics appear only partially addressed. Discussions with the presenters did not increase confidence that staff technical concerns will be wholly resolved in the near future.

Z. Peterman (USGS) provided a review of the geochemistry of the Paintbrush Group Tuff at Yucca Mountain. Many of the geochemical results had been presented previously, but Peterman brought up several points that were relevant to recent geochemical analyses conducted by CNWRA on alluvial sediments. Peterman noted that measurements of loss-on-ignition must be carefully considered in the tuffs because of the variable carbonate and hydrated mineral content. He also noted wide variations in Sr concentrations in some units as well as a general concentration of Sr in layers rich in zeolites. Similar trends have been observed in CNWRA studies and several were presented in a talk by Bertetti *et al.* (summarized below).

D. Vaniman (LANL) presented a detailed look at several geochemical signatures of clay and zeolite mineral phases in tuffs of the Paintbrush Group. Vaniman noted that the distinct chemistry of the clay mineral fraction in the unsaturated zone provided evidence of its *in situ* formation and noted that Mn-rich clays were often present above the repository horizon. Other alteration evidence was presented to indicate that the chemical composition of recharge waters is affected by glass dissolution above the repository horizon and waters are then modified by cation exchange in zeolites below the repository horizon.

The afternoon portion of the Yucca Mountain theme session was also dominated by researchers from the USGS, Bureau of Reclamation, and DOE-sponsored labs, and addressed a variety of issues related to geochemistry and flow in the saturated and unsaturated zones.

R. Roback (LANL) presented results from sorption and radionuclide transport studies of the saturated alluvium of Fortymile Wash and vicinity. He spent some time discussing results of Np-237 sorption studies and then spoke about studies of Pu and colloid facilitate transport. Colloids collected from pumped water at well 19D1 were composed primarily of smectite but did contain some minor fraction (<5%) of zeolite. The colloid sample was collected near the end of the initial tracer/pump testing at the Alluvium Testing Complex, and the investigators felt that potential drilling fluid contamination was minimized. P. Reimus noted that the investigators were aware of the potential for some drilling fluid contamination and indicated that the analysis of the colloids showed a chemical signature that was different from drilling fluids used at 19D1. Initial batch testing was performed to study sorption onto the colloids and evaluate kinetics. Pu(V) was used in the experiments. Of the initial Pu in solution, at least 44% sorbed onto the colloids (mass to solution ratios and/or Kds were not provided). The forward sorption took about 100 days to come to equilibrium. When a desorption experiment was conducted (by introducing water with no Pu), only about 20% of the sorbed Pu was released over a similarly slow time frame (~100 days). Column studies were then performed using alluvium-filled columns and the same water as used in the batch work. Solutions of Pu-bearing colloids and dissolved Pu were passed through the column(s). Dissolved Pu was retained, while the Pu-bearing colloids passed through with no retention (same breakthrough as tritiated water). Filtration did not seem to be significant. The column experiments were conducted on the order of a few days. After the dissolved Pu was sorbed onto column materials, Pu-free colloids were passed through the column to test for detachment from the alluvial material onto colloids. No detectable detachment from the column onto the colloids was observed. R. Roback indicated in further discussions that some of the data presented may be included in upcoming AMRs.

Bertetti *et al.* presented a summary of recent results from petrographic and geochemical studies of drilling cuttings from selected Early Warning Drilling Program wells. The presentation provided a discussion of the mineralogy of wells NC-EWDP-2D and NC-Washburn-1X and included a comparison of mineralogic trends to stratigraphic designations made by USGS/DOE, Nye County, and CNWRA. Geochemical results were used to provide confirmation of differences in sediments within well NC-EWDP-2D and to examine geochemical trends in heavily zeolitized horizons. Thin section and scanning electron microscopy images were used to demonstrate the occurrence of zeolite and smectite minerals as grain coatings. A primary conclusion of this presentation was that the occurrence of zeolite and clays indicates they will be important phases in determining the radionuclide sorption properties of the saturated alluvium. A detailed review of the results of the studies presented in this talk can be found in a CNWRA report entitled "Mineralogy and Geochemistry of Well Cuttings from Selected Early Warning Drilling Project Wells in Fortymile Wash," submitted to NRC in July, 2003.

A Sunday morning theme session on *Mathematical modeling of earth surface processes: the good, the bad, and the ugly* emphasized the need for clear distinctions between model predictions and model forecasts. The prevailing view of this session was that geological processes eventually could be predicted based on careful measurement of key parameters. However, the models presented were generally unsuccessful in predicting such processes. There was little discussion of modeling approaches using stochastic methods, or the utility of using numerical models to forecast a range of potential outcomes. In his presentation on performance assessments of geologic repositories, R. Ewing concluded that if he were the state of Nevada, he would drive DOE and NRC to quantitative performance assessment because it is such an easy target [for licensing contention]. Dr. Ewing stated that he "wasn't against modeling" but argued that necessary abstractions and uncertainties in current performance assessment models limit their use as quantitative tools. He listed a number of potential conceptual and parameter errors that could be included in performance assessment models and concluded that performance assessments alone were not sufficient for safety analyses.

Other investigators relayed the general impression that minimal value is placed on numerical models in legal proceedings, due to the relative ease in selecting a model that can be manipulated to give conclusions supporting an advocated position.

Franklin *et al.* described a methodology for analyzing fracture reactivation in a session on *Structural geology: advances in rock mechanics* on Monday afternoon. He presented an example of synthetic fractures surrounding a emplacement drift and analyzed the location and orientation of fractures likely to reactivate and slip in the perturbed stress field. In this same session, Heiny *et al.* (presentation made by W. Dunne, a CNWRA consultant) demonstrated a methodology for estimating fracture size and fracture aspect ratio from borehole data. Dunne noted that this work can be applied to other surveying of fracture size on cylindrical walls like tunnels.

Murphy *et al.* presented a poster based on a gravity survey across Black Marble at the southern tip of Bare Mountain. The recognition of a gravity low directly above Black Marble led the authors to interpret the feature as a megabreccia deposit. Stratigraphic relationships of the megabreccias and Crater Flat volcanic units constrain most of the slip on the Bare Mountain fault to between 11-12 Ma. Murphy *et al.* concluded that Miocene slip rates were 1-2 mm/yr, but then slowed dramatically after 11 Ma to current slip rates of about 0.01 to 0.02 mm/yr.

Painter and Winterle discussed their recent efforts that using temperature data to constrain flow models near Yucca Mountain. They observed that elevated groundwater temperature patterns aligned with large-offset north-trending fault zones near Yucca Mountain can be explained simply by the geometry of the flow system and the varied overlying topography. Further, they concluded that there is no need to invoke conceptual models of upward fault-zone recharge or local geothermal anomalies to explain the observed groundwater temperature patterns.

Albright and Rimstidt (Virginia Polytechnic Institute with funding by the State of Nevada) presented a poster entitled *A canister corrosion-rate drip test for the Yucca Mountain, Nevada high-level radioactive waste repository.* The poster described several laboratory experiments in which simulated groundwaters from the Yucca Mountain area were dripped onto a heated sample of Alloy 22. The experiments revealed no corrosion of the sample, but rather the precipitation of several of the salts formed a protective layer over the metal. Rimstidt was familiar with Catholic University studies (where exceptionally corrosive solutions were formed by evaporation), and stated that given the results of his study, he feels that conditions necessary for formation of such a solution would be extremely unlikely in the natural environment.

Gascoyne and Miller presented a poster entitled *Polonium-210 in dusts from the ESF tunnel, Yucca Mountain,* which described the composition of potentially hazardous dusts in the Yucca Mountain tunnels. Polonium-210, a component of cigarette smoke proven to be carcinogenic and a daughter product of Radon decay, is adhered to the surface of dusts in the tunnel. Breathing these dusts could present a health hazard to workers in and around the tunnels. Dr. Gascoyne concluded that further studies and appropriate protective measures are necessary to ensure safety of workers.

CONCLUSIONS:

The 2003 GSA Annual meeting proved to be a successful and productive event. CNWRA staff participated actively as speakers and poster presenters, as well as observers for numerous technical sessions that bear directly and indirectly on the work related to proposed Yucca Mountain repository.

PROBLEMS ENCOUNTERED: None

PENDING ACTIONS: None

RECOMMENDATIONS:

Attendance at professional society meetings is an integral component of staff professional development. In addition to maintaining an up-to-date understanding of our technical disciplines, this activity ensures that CNWRA staff remain visible participants in the scientific and engineering community.

SIGNATURES:

Kevin J. Smart — 12/5/03
Kevin J. Smart, Date
Research Scientist

CONCURRENCE:

H. Lawrence McKague — 12/05/03
H. Lawrence McKague, Manager, Date
Geology and Geophysics

Budhi Sagar — 12/8/03
Budhi Sagar, Date
Technical Director