CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

FOREIGN TRIP REPORT

SUBJECT: Site Visit During U.S. Department of Energy (DOE) Contractor Activities at the Nopal I Natural Analog Site (AI 06002.01.222.606)

DATE/PLACE: June 20–23, 2006; Nopal I Uranium Mine, Peña Blanca Mining District, Chihuahua, Mexico

AUTHORS: D. Pickett and K. Smart

DISTRIBUTION:

CNWRA	NRC	SwRI
W. Patrick	J. Dunn-Lee, OIP	Record Copy B, IQS
B. Sagar	W. Reamer	
GED Directors	V. Whipple	
GED Managers	D. DeMarco	
L. Gutierrez	S. Kim	
D. Pickett	T. McCartin	
K. Smart	L. Kokajko	
	E. Collins	
	W. Smith	
	K. Stablein	
	M. Bailey	
	A. Campbell	
	J. Guttmann	
	A. Csontos	
	B. Leslie	
	H. Arlt	
	J. Bradbury	
	D. Brooks	
	P. Justus	
	J. Pohle	
	J. Trapp	
	A. Fetter	
	E. Peters	
	R. Fedors	

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

FOREIGN TRIP REPORT

Subject:

Site visit during U.S. Department of Energy (DOE) contractor activities at the Nopal I natural analog site.

Dates of Travel and Countries/Organizations Visited:

June 20–23, 2006; Nopal I Uranium Mine, Peña Blanca Mining District, Chihuahua, Mexico

Author, Title, and Agency Affiliation:

D. Pickett, Principal Scientist, Center for Nuclear Waste Regulatory Analyses (CNWRA)
K. Smart, Senior Research Scientist, Department of Earth, Material, and Planetary Sciences
Both at Geosciences and Engineering Division, Southwest Research Institute®

Background/Purpose:

The trip was a 2-day site visit to observe DOE contractors conducting field work at the Nopal I natural analog site. The DOE work, conducted under the Office of Science and Technology and International, focuses on studying the site as an analog to radionuclide release and transport and hydrologic flow processes at the potential Yucca Mountain repository. In the future, DOE investigations may support a Yucca Mountain license application. CNWRA conduct of this field work contributes to the U.S. Nuclear Regulatory Commission (NRC) goal of increasing public confidence by providing independent observation and evaluation of processes at the site and DOE activities. The site visit, (first discussed at a DOE and NRC Appendix 7 meeting on February 16, 2006), was especially warranted in light of the long history of NRC and CNWRA investigations at Nopal I. The CNWRA staff last visited the site in 2003.

Abstract—Summary of Pertinent Points/Issues:

Staff were able to observe a variety of DOE contractor activities, including groundwater well sampling and maintenance of a meteorological station and a seepage collection system. The observations and conversations with DOE contractors gave a good sense of the scope and quality of ongoing research activities as they apply to Yucca Mountain technical issues ranging from wasteform degradation to unsaturated zone flow and transport. The CNWRA staff were also able to perform independent field observations to follow up previous CNWRA work, including (i) structural observations of fracture characteristics around the ore body; (ii) global positioning system measurements to better fix sample, well, and observation locations; and (iii) sampling of secondary mineral deposits on fracture surfaces. The trip met its objectives (see Background/Purpose), and NRC-sponsored visits to the site should continue in the future.

Discussion:

Observations of DOE-sponsored activities.

The DOE contractors present were P. Dobson and P. Cook, both of Lawrence Berkeley National Laboratory (LBNL); Dobson has been the main DOE contractor contact for Nopal I work for several years. Staff led the CNWRA staff on a tour of the three wells drilled since 2002, the adit seepage collection system, and the recently installed meteorological station. All participants viewed and discussed many structural and mineralogical characteristics of the ore body and surrounding terrain. The wells, two of which are depicted in Attachment 1, were drilled to the water table and are located 50 m [160 ft] uphill and downhill from the uranium ore body. The LBNL staff sampled these wells by bailer; pumped samples are expected to be collected later in the summer when a team from Los Alamos National Laboratory visits the site. The LBNL staff followed systematic sampling procedures in bailing from these wells. Later in the day, the LBNL staff also sampled an existing well in the limestone west of Nopal I. The CNWRA staff previously sampled this well and reported results in a published article (Pickett and Murphy, 1999); the well has since been fitted with a turbine pump for watering stock. Samples were also taken from a pumped well on Pozos Ranch in the basin further west of Nopal I. Water samples will aid DOE contractors in modeling radionuclide transport from the ore body using a GoldSim (registered trademark of GoldSim Technologies, US) framework analogous to the Yucca Mountain total-system performance assessment model. The CNWRA staff did not obtain splits of water samples on this visit.

The adit seepage collection system (Attachment 2) allows sampling of waters that have infiltrated through eight meters of fractured silicic tuff with varying degrees of uranium enrichment and is instrumented to continuously monitor environmental and hydrologic conditions. Only 5 mm [0.2 in] of rain had fallen at the site since March, and low water levels in the collection bottles reflected the resulting low infiltration. Minimal evaporation loss was observed in bottles, on which water levels had been marked in November 2005. Notably, the portion of the adit directly below a 1-m [3.28-ft] deep depression on Level +10 showed no evidence of seepage, suggesting lateral diversion. Also, there is evidence for longer seepage times in the front of the adit in comparison with the rear of the adit. These observations may be relevant to interpretations of unsaturated flow in the fractured tuff at Yucca Mountain.

In March 2006, LBNL had installed a meteorological station just south of the ore body. This station operates continuously and can store up to 6 months of weather data. The precipitation data, in particular, may prove useful in interpreting results of the adit seepage collection experiment.

Independent CNWRA activities.

As part of their independent activities at the site, the CNWRA staff observed and collected new samples of secondary carbonate ± silicate caliche from tuff fractures downslope from the ore body. These samples may be used to supplement our previous work using uranium-enriched fracture deposits to help interpret the history of recent radionuclide mobilization at the site.

The CNWRA staff also made new observations of the geologic setting with emphasis placed on the structural geologic characteristics of the pavement and vertical surface exposures. In particular, staff compared fracture maps of the pavements and vertical surfaces constructed and analyzed by the NRC and CNWRA staff (e.g., Pickett and Leslie, 2005; Leslie, et al., 2005; Pearcy, et al., 1995) with the current state of the exposures. Staff also collected global positioning system locations of selected features with a hand-held Garmin GPSMap 60CSx unit.

The level +00 pavement is heavily degraded, and staff were unable to find any of the survey markers established by earlier CNWRA workers due to the thick cover of detritus. Staff were able, however, to locate three markers with surviving metal tags on the level +10 pavement (i.e., stations +10/-3, +13/-5, +10/+25). These helped in precisely locating new observations. Several low-angle, curviplanar bedding surfaces with strike-parallel (i.e., horizontal) slickenlines (i.e., striations indicating slip) are still exposed on the +10 pavement (Attachment 3, Plot A). The CNWRA staff interpret these to have formed as a result of layer parallel slip during gentle folding of the tuff deposits, rather than "thrust faults" as reported recently by Saucedo, et al. (2005). In light of the current state of the pavements, it would be difficult to collect fracture data to supplement that collected previously from the horizontal pavements unless considerable effort was spent clearing the surfaces.

The vertical surfaces, in contrast, are in generally good condition (Attachment 4). A subvertical surface with gently west plunging slickenlines is well exposed on the +00 vertical surface near the adit entrance (Attachment 5 and Attachment 3, Plot B). Although definitive evidence for the magnitude of slip is not present in the exposure (e.g., offset marker beds), staff interpret this fracture surface to reflect relatively small displacement {≤1 m [3 ft]} based on the absence of fault rock or development of a pervasive damage zone. Structural observations by the CNWRA staff will inform (i) our interpretations of the geologic setting of uranium mineralization and subsequent remobilization and (ii) our evaluations of any DOE use of Nopal I structural data.

Pending Actions/Planned Next Steps for NRC:

No NRC actions needed. The CNWRA staff will process data and samples collected. CNWRA will also continue to monitor DOE activities at the site, with plans to request splits of pumped groundwater samples expected to be obtained by DOE contractors later in the summer.

Points for Commission Consideration/Items of Interest:

None.

Attachments:

Figures discussed in text.

References:

Leslie, B., K. Smart, and E. Pearcy. "Characterization of Fractures at the Nopal I Site and Comparison to Fracture Characteristics of Yucca Mountain, Nevada." *Geological Society of America Abstracts With Programs*. Vol. 37, No. 7. p. 196. 2005.

Pearcy, E.C., J.D. Prikryl, and B.W. Leslie. "Uranium Transport Through Fractured Silicic Tuff and Relative Retention in Areas With Distinct Fracture Characteristics." *Applied Geochemistry*. Vol. 10. pp. 685–704. 1995.

Pickett, D.A. and B.W. Leslie. "Mobilization of Uranium From the Nopal I Analog and Implications for Nuclear Waste Repository Performance." *Geological Society of America Abstracts With Programs*. Vol. 37, No. 7. p. 268. 2005.

Pickett, D.A. and W.M. Murphy. "Unsaturated Zone Waters From the Nopal I Natural Analog, Chihuahua, Mexico — Implications for Radionuclide Mobility at Yucca Mountain." Scientific Basis for Nuclear Waste Management XXII. Symposium Proceedings. D.J. Wronkiewicz and J.H. Lee, eds. Warrendale, Pennsylvania: Materials Research Society. Vol. 556. pp. 809–816. 1999.

Saucedo, A., M. Fayek, I.A. Reyes, P.F. Dobson, and P.C. Goodell. "Structural Analysis of the Nopal I Uranium Deposit, Peña Blanca, Mexico." *Geological Society of America Abstracts With Programs*. Vol. 37, No. 7. p. 196. 2005.

SIGNATURES:

David Pickett
Principal Scientist

Date 7/21/2006

Kevin Smart
Senior Research Scientist

Date 7/21/06

CONCURRENCE:

English C. Pearcy
Manager

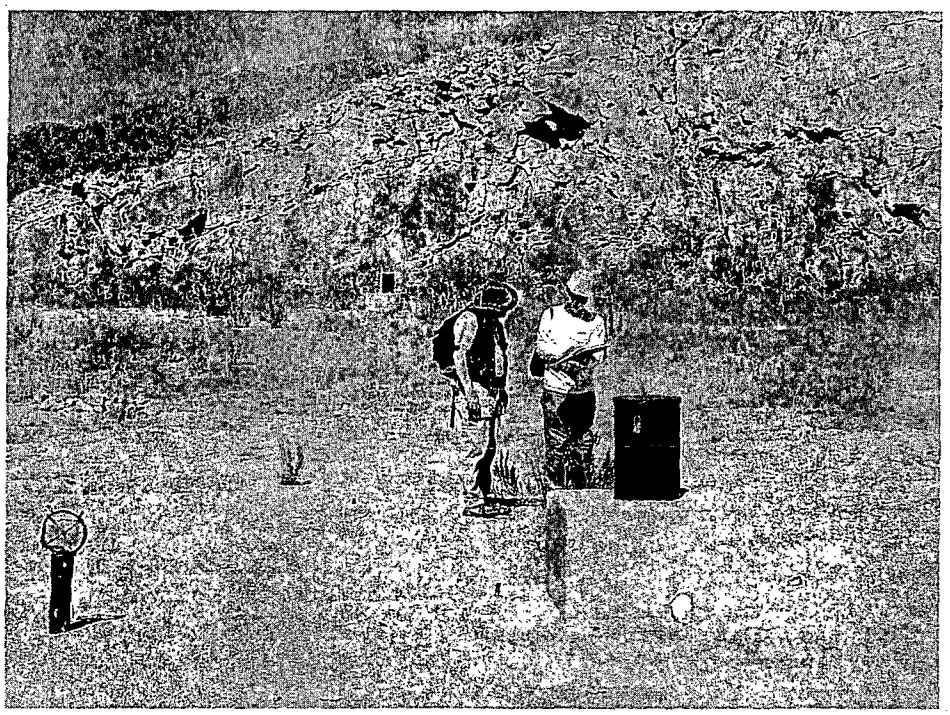
Date 7/21/2006

Gordon Wittmeyer
Assistant Director

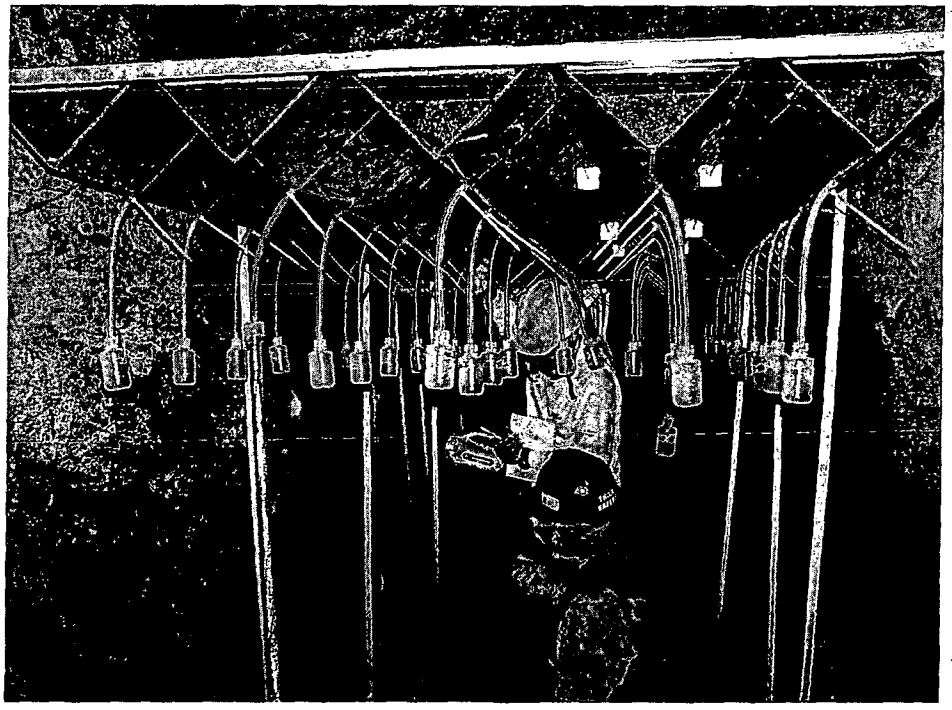
Date 7/21/2006

Budhi Sagar
President

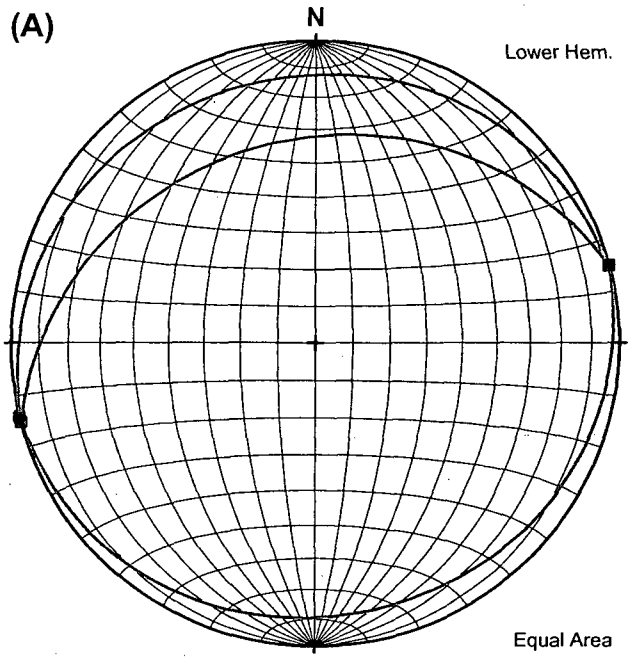
Date 7/21/2006

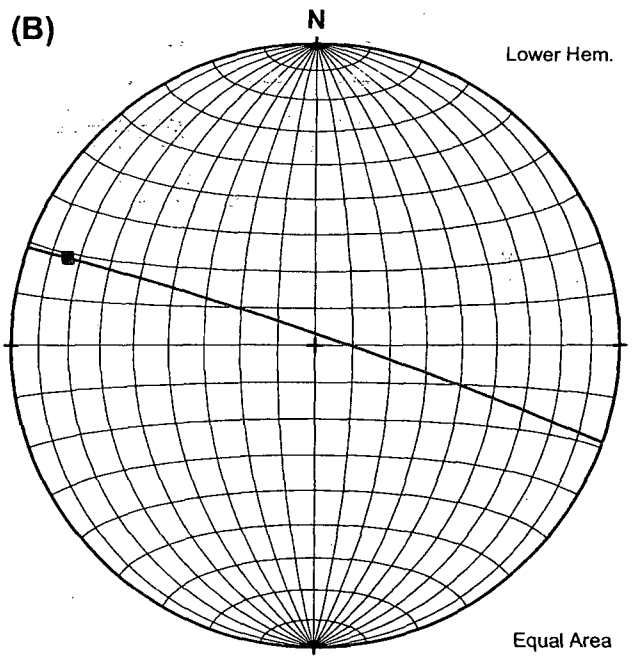


Attachment 1. DOE-installed Groundwater Wells on Level +10, Nopal I

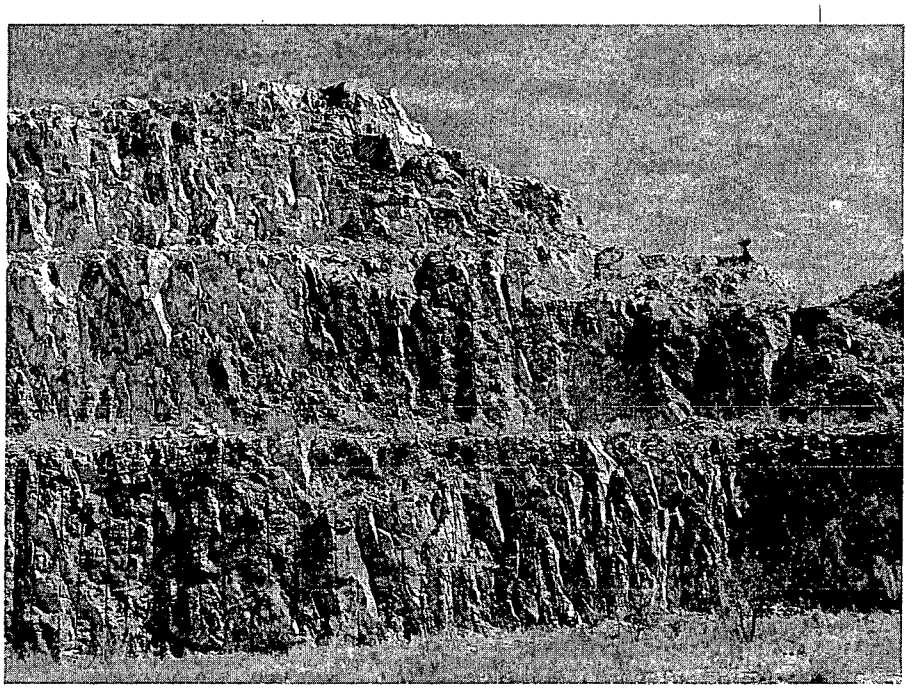


Attachment 2. LBNL-Installed Seepage Collection System in Level +00 adit, Nopal I





Attachment 3. Lower-Hemisphere Equal-Area Stereonet Plots of Fracture Data From Nopal I Site. (A) Low-angle Fracture Surfaces (Blue Lines) with Strike-parallel (i.e., Horizontal) Slickenlines (Red Squares) from Level +10 Pavement. (B) Steeply Dipping Fracture Surface (Blue Line) with Gently West Plunging Slickenlines (Red Square) from +00 Vertical Surface near Adit Entrance.



Attachment 4. View of +10, +20, and +30 Vertical Surfaces. Photograph was Taken Standing on the +10 Pavement.

Attachment 5. Photograph of Steeply Dipping Fracture Surface with Well-Developed, Gently West Plunging Slickenlines.