CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: Observation of U.S. Department of Energy Natural Analogue Field Work (20.06002.01.141.005)

DATE/PLACE: May 6–8, 2003
Chihuahua, Mexico
Nopal I Uranium Mine, Peña Blanca, Chihuahua, Mexico

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BACKGROUND/PURPOSE:

The relevance of the Peña Blanca natural analogue site to the proposed repository at Yucca Mountain is widely recognized. Peña Blanca studies conducted by the U.S. Nuclear Regulatory Commission (NRC) and the Center for Nuclear Waste Regulatory Analyses (CNWRA) beginning in 1991 have focused on better understanding spent fuel analogue degradation and radionuclide release and transport from the Nopal I uranium deposit. U.S. Department of Energy (DOE) representatives attended an Appendix 7 meeting on Peña Blanca hosted by the CNWRA in March 1999; subsequently, DOE staff, DOE contractors, and the Nuclear Waste Technical Review Board have visited the site and DOE has initiated research. Under contract with DOE, the Universidad Autónoma de Chihuahua has in recent months been drilling through and sampling the Nopal I deposit to characterize the extent of uranium mineralization in the subsurface and vertical radionuclide transport and redistribution resulting from leaching from the ore body. This work is planned by DOE specifically to support the potential Yucca Mountain license application and increase public confidence in the proposed repository by comparing it to the natural system at Peña Blanca.

The week of May 5, 2003, DOE staff member Eric Smistad and DOE contractor Steven Goldstein (Los Alamos National Laboratory) traveled to Chihuahua to meet with Universidad Autónoma de Chihuahua staff and sample waters at Nopal I. CNWRA staff traveled at the same time in order to observe DOE activities and obtain confirmatory water samples and analyses. Our activities were conducted as independently as possible; we traveled in separate vehicles and provided all our own logistical support, supplies, and equipment (with the exception of bailers). However, in recognition that Nopal I is now a DOE study site, we did not visit the site in the absence of the DOE group. CNWRA staff conduct of this field work is an appropriate extension of our past technical studies and provides for independent evaluation of processes at the site and of the DOE activities and interpretations.

SUMMARY OF PERTINENT POINTS/ISSUES:

CNWRA staff traveled to the Mexican state of Chihuahua to observe DOE activities and obtain and analyze water samples at the Nopal I natural analogue site, Peña Blanca district. Under contract with DOE, the Universidad Autónoma de Chihuahua had drilled two water wells near the uranium ore body and had nearly completed one core hole through the ore body. The project is intended to provide DOE with important information on the nature and timing of

radionuclide mobilization at a key natural analogue in order to support their license application for a potential repository at Yucca Mountain. We observed the final stages of coring operations and sampled water from one of the new wells and two existing wells. DOE sampling of the wells was slowed by difficulties in handling bailers. In coming weeks, DOE plans to install a pump, allowing sampling that should be more efficient and representative of groundwater undisturbed by drilling and drilling fluids. In addition to conducting field work, we were able to learn about preliminary project results from researchers at the Universidad Autónoma de Chihuahua campus. CNWRA staff conduct of this field work is an appropriate extension of our past Peña Blanca studies and should continue. These efforts will contribute to the NRC strategic goal of increasing public confidence by providing independent evaluation of processes at the site and of the DOE activities. The importance of natural analogue studies is underlined by the May 19, 2003 site visit by the Nuclear Waste Technical Review Board—their second visit to the site.

DISCUSSION:

DOE Project Status

At the time of the Nopal I visit, three new wells were either completed or in progress. The well called PB1 is a core hole, located on mine Level +10, through the uranium ore body itself. Twice during drilling, the coring bit had been lost down the hole, necessitating drilling of a new adjacent hole to continue the core. During the trip, work continued on the third hole, using a hammer drill, to reach the level at which the second core had been abandoned. We observed that drilling resulted in the discharge of a large amount of drilling mud onto Level +00, though not in the vicinity of the down-gradient well (PB3) located on Level +00. The drilling mud was observed to flow over a portion of the exposed ore body on Level +00 before continuing to lower levels down the hillside. The core itself was being stored in wooden boxes at the El Nopal mining camp, where workers from Universidad Autónoma de Chihuahua and the drilling subcontractor were housed. Visual description of the core was being carried out by a member of the staff of the Universidad Autónoma de Chihuahua Facultad de Ingenieria (Engineering Department). Coring of PB1 was expected to be finished during the week of May 12, 2003 at which point all drilling would be complete.

PB2 is a water well located 50 meters southwest of PB1. Water from PB2 is expected to lie hydraulically up-gradient of the ore body, and thus may represent groundwater unaffected by radionuclides that may be mobilized from the ore. Drilling of PB2 was completed in early April. The water table was reached at a depth of about 230 meters.

PB3, drilled 50 meters northeast of PB1 on Level +00, is presumed by DOE to be down-gradient of the ore body. Drilling, which had been hampered by inadvertent interception by an unidentified mining tunnel, had been completed less than a week before our arrival. Both PB2 and PB3 had been cased with PVC pipe and cuttings were stored at the El Nopal camp. Universidad Autónoma de Chihuahua researchers said that PB3 gamma log results show a spike in radioactivity just below the water table, within the conglomerate of the Pozos Formation, with activity returning to background levels in the underlying limestone. These preliminary observations suggest that radionuclides may have been mobilized from the ore body and accumulated at the water table.

The main DOE research objectives for the drilling project are to characterize the PB1 core and cuttings from PB2 and PB3 (Universidad Autónoma de Chihuahua), interpret down-hole log data (Universidad Autónoma de Chihuahua), and perform geochemical and isotopic analyses on samples of core, cuttings, and groundwater (Los Alamos National Laboratory). For the May 6-8, 2003 trip, Goldstein and Smistad planned to sample waters from available wells (i.e., PB2, PB3, and two agricultural wells located east of Nopal I and drilled more than 10 years ago). Because the water table was deeper than expected, the environmental pump on site could not reach the water table. For purposes of well sampling, Universidad Autónoma de Chihuahua workers constructed bailers (with capacities of about one and four liters) from PVC pipe and metal valves, and the bailers were lowered by hand with the use of a wooden spool.

CNWRA Staff Activities

CNWRA staff spent two days at Nopal I and one day at the Universidad Autónoma de Chihuahua campus. In all water sampling activities, Universidad Autónoma de Chihuahua workers performed the bailing and we obtained samples only after DOE staff had finished their sampling. Day One was concerned with sampling well PB2, performing geochemical analyses on the water, and filtering samples. On the first sampling attempt, the large (~ 4 liter) bailer was lost when its line broke and it sank to the bottom of the well. A smaller (~ 1 liter) bailer was then used with success to retrieve water. The PB2 water had a relatively large amount of particulates and lesser amounts of a white foamy material that may have been a drilling by-product. We obtained 4 liters, splitting it into samples variously filtered and unfiltered, acidified and unacidified (the same sample split scheme was used at PB3, PB4, and Pocos Ranch). We also immediately performed analyses of water temperature, pH, conductivity, alkalinity, oxidation-reduction potential, and dissolved oxygen. An unusually high pH of more than 11 was obtained by both the DOE and CNWRA groups.

On Day Two, three wells were visited. At PB3, the DOE group obtained about a liter of water with the small bailer; it was cleaner than the PB2 water and had a pH of 8.4. A new 4-liter bailer was then inadvertently lowered to the bottom of the well, resulting in a heavy dispersal of mud throughout the water column. Because of the potential geochemical effects of the mud, and the likelihood that it would settle very slowly, we decided not to sample PB3. Discussions the next day with Universidad Autónoma de Chihuahua researchers suggested that this was drilling mud, which flowed into the bottom of the well after having accumulated in the tunnel intercepted during drilling.

An existing agricultural well, now called PB4 and located about 1.3 kilometers southeast of Nopal I, was then bailed, sampled, and analyzed. This same well was sampled by CNWRA staff in 1995 and geochemical and isotopic data from the well were published. The water in this well is contained within Cretaceous limestones and is generally, though not precisely, down-gradient from Nopal I. The PB4 water was considerably clearer than the PB2 and PB3 samples, but had a surprisingly high pH of 9.9, exceeding our 1995 measurement of 7.7.

The final well sampled was the Pocos Ranch well located a few kilometers east of Nopal I on the upper alluvial slopes of the Aldama Valley. Samples here were obtained via the well's powered pump; pH was 7.2.

The DOE group decided not to visit the site on Day Three, as they felt that further sampling of PB3 was unwarranted. Instead, we visited the Universidad Autónoma de Chihuahua campus.

Goldstein's main objective that day was to train Universidad Autónoma de Chihuahua researchers in water sampling methodology. We took the opportunity to discuss the drilling and logging results with Universidad Autónoma de Chihuahua researchers.

General Observations

This trip was useful for allowing CNWRA staff to directly observe DOE-sponsored drilling and sampling activities, to discuss the project with DOE, Los Alamos National Laboratory, and Universidad Autónoma de Chihuahua staff, and to obtain independent samples and analyses. Our interactions with these other groups, while conducted in a way that we could maintain our independence and not interfere with DOE activities, were positive and cooperative. We have a keen interest in this site owing to our long-term involvements there and to its unique utility as a natural analogue for the proposed Yucca Mountain repository. DOE intends to use the project results to increase public confidence in their safety case. Specifically, they hope to show that radionuclide mobility from and around Nopal I has been limited within the recent geologic past. Therefore, continued CNWRA attention to the DOE project, as well as independent studies, will contribute to the NRC strategic goal of increasing public confidence in its regulatory role at Yucca Mountain.

We plan to obtain geochemical analyses on the water samples, but we recognize that the results will need to be interpreted with caution. The PB2 well had been completed only a few weeks previously and showed indications of residual drilling materials. PB3 was not sampled, as discussed above, and was apparently completely contaminated by drilling mud. PB4 water had a puzzlingly high pH. The unavailability of an appropriate pump, necessitating bailing, meant that DOE was unable to purge the wells. The wells must be cleared as much as possible of any residual drilling materials before meaningful geochemical data may be obtained from them with confidence. DOE was in the process of obtaining a new pump that would reach the water table, but it is not clear when it will be available to them. The other effect of the absence of a pump was that DOE was unable to efficiently sample large amounts of water from their wells.

Unsurprisingly, drilling is an activity that significantly perturbs a natural system, potentially contaminating, for example, groundwater and surface materials with drilling mud. The Nopal I activities are not yet at the stage where these perturbations can be neglected. Nevertheless, it is encouraging that after many delays, the DOE drilling program has begun. Direct observation of potential groundwater transport pathways, past and present, in the vertical dimension will lead to much better constraints on the analogue implications of Nopal I.

PENDING ACTIONS:

DOE is awaiting a pump that will improve groundwater sampling. Should DOE travel again to the site to sample waters with the pump, under conditions more conducive to effective sampling, we propose that NRC consider sending CNWRA staff to again make observations and to obtain independent samples and analyses.

DOE has indicated their willingness to provide additional information and sample splits. Within the next few weeks, we will provide a draft letter so that NRC may request from DOE the following items:

- A map accurately locating all wells
- Down-hole log data (including gamma) from PB1, PB2, and PB3
- Available preliminary PB1 core descriptions

As they become available later, we will request splits of water and rock samples from the wells.

POINTS FOR COMMISSION CONSIDERATION/ITEMS OF INTEREST:

DOE intends to use natural analogue information, including results from Nopal I, to support its safety case, and the Nuclear Waste Technical Review Board(see below) continues to emphasize the importance of analogues. Therefore, continued independent studies are warranted.

ATTACHMENTS:

None.

ON THE MARGINS:

On May 19, 2003, members of the Nuclear Waste Technical Review Board and their staff visited Nopal I with DOE staff and contractors. This activity is indicative of the board's continuing interest in the usefulness of natural analogue information in supporting DOE process model and performance assessment results. We will follow with interest any related Nuclear Waste Technical Review Board activities or commentary.

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