CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: 15th Annual V.M. Goldschmidt Conference (Goldschmidt 2005) (AI 06002.01.212.501)

DATE/PLACE: May 19–23, 2005; Moscow, Idaho

AUTHORS: Miriam R. Juckett

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SUBJECT: 15th Annual V.M. Goldschmidt Conference (Goldschmidt 2005) (AI 06002.01.212.501)

DATE/PLACE: May 20–25, 2005; Moscow, Idaho

AUTHOR: Miriam R. Juckett

PERSONS PRESENT: Miriam R. Juckett

BACKGROUND AND PURPOSE OF TRIP:

The purpose of the trip was to participate in the 15th Annual V.M. Goldschmidt Conference (Goldschmidt 2005) that was held May 20–25, 2003, in Moscow, Idaho. The conference is an international forum held every year to discuss issues of interest to the geochemical community. The trip was undertaken to present a paper discussing the results of an U.S. Nuclear Regulatory Commission (NRC)-sponsored experimental and modeling study designed to determine the deliquescence relative humidity (DRH) of dust samples similar to those that may be deposited on the surfaces of drip shields and waste packages at the potential Yucca Mountain repository. In addition, the conference provided an opportunity to obtain information from international scientists on geochemical issues relevant to nuclear waste management that may be useful in NRC reviews and analyses of U.S. Department of Energy (DOE) work.

SUMMARY OF PERTINENT POINTS AND ACTIVITIES:

The 2005 meeting had 19 general symposia and 56 special symposia designed to promote discussion on specific topics within geochemistry. Participants from various countries presented nearly 1,000 papers in oral and poster sessions.

The conference had a special symposium, Lifetime Predictions of Toxic and Radioactive Waste Disposal and Remediation Schemes: Thermochemical Data, Theoretical Models, and Reaction Transport Codes, in which papers were presented on recent developments in modeling, characterizing, and experimenting to determine geochemical properties relevant to the disposal of long-lived radioactive waste materials and contaminants. A keynote paper entitled Episodic Release and Transport at the Peña Blanca Repository Analog Site was presented by W. Murphy (California State University) and coauthored by D. Pickett, Center for Nuclear Waste Regulatory Analyses (CNWRA). The Peña Blanca, Mexico, site is a natural analog to the potential repository at Yucca Mountain, Nevada. Long-term and episodic release rates estimated from the secondary uranyl minerals and uraniferous caliche at the site give perspective to potential releases at Yucca Mountain.

The following papers were presented on topics relevant to dust deliquescence:

S. Carroll (Lawrence Livermore National Laboratory) presented a paper titled Chemical Environment at Waste Package Surfaces in a High-Level Radioactive Waste Repository. A

series of experiments, including deliquescence, boiling point, chemical transformation, and evaporation experiments, were conducted to determine the composition of waters likely to evolve and contact the waste packages in a potential nuclear waste repository. High nitrate to chloride ratios are expected in brines during the above-boiling period and appear to be stable beyond the high temperatures previously predicted. Deliquescence was observed using free salt assemblage resistance experiments where a sudden change in resistivity indicated deliquescence. Three types of brines were determined to be possible from evaporation experiments using synthetic dilute waters based on U.S. Geological Survey porewater data. The dilute waters are expected to evolve to either Na/K/Cl/NO_3 or Ca/Mg/Cl/NO_3.

D. Palmer (Oak Ridge National Laboratory) presented Experimental Approaches to Predict the Behavior of Liquid Films. These experimental techniques have been developed to better understand the interaction of liquid films with corrosion-susceptible metal oxide surfaces. Measurements can be made of the compositions of liquid films on metal alloy coupons with and without a coating of dust, and a volatility apparatus has been developed to measure equilibrium compositions of liquid and vapor phases, even for highly corrosive solutions. These experiments were designed to allow accurate pH measurements of solution chemistry up to high temperatures. Experiments to measure metal releases from metal coupons inside a pressure vessel are still under development. In collaboration with OLI Systems, methods have been developed to model both localized and crevice corrosion. The experimental techniques may prove useful for repository related geochemistry studies.

T. Wolery (Lawrence Livermore National Laboratory) presented Dust Salts and Deliquescence on Waste Packages in an Unsaturated-Zone Repository. The rock dust samples were collected by Z. Peterman of the U.S. Geological Survey (Note: splits of these samples are currently being used for CNWRA experimentation). The primary salts in the solution of soluble salts from the dust are NaCl-KNO_3. Some phase changes occur, including the formation of KCl at moderately elevated temperatures, along with other salts. Changes in the calcium nitrate phase structure produces a fast drop in the deliquescence curve in some cases. Nitrate-rich solutions still persist, with enough nitrate to protect the Alloy 22, the proposed construction material for waste packages. Atmospheric dusts contained much higher salt content (13 percent) than rock dusts (less than 1 percent). Dust storms in Asia and California may affect the Yucca Mountain area, as atmospheric dust from these sources reaches the potential repository site. However, the soluble ionic ratios are similar for all dusts. Although ammonium was not originally considered in test plans, ammonium ions were found. Since ammonium salts tend to sublimate quickly, subtracting them off essentially brings the salt composition back to the expected values.

M. Juckett presented a poster paper titled Deliquescence Relative Humidity and Characterization of Dusts from the Vicinity of Yucca Mountain, Nevada, co-authored with L. Yang and R. Pabalan. The paper discussed the results of experiments designed to characterize dust samples and determine the deliquescence relative humidity (DRH) of the soluble fraction of atmospheric dust samples from Death Valley, California. Dust was characterized using X-ray Diffraction (XRD), scanning electron microscopy (SEM), and using elemental analysis by Inductively Coupled Plasma (ICP). The soluble fraction was removed from the whole dust sample, and DRHs of the soluble fraction were measured at a constant temperature of 50 °C using a conductivity cell inside a controlled temperature/humidity chamber. No deliquescence behavior was observed for the soluble fraction of the dust samples. These experiments are being extended to include rock dust samples and whole dust studies to determine the effects of the insoluble fraction of dusts or deliquescence behavior. The results

of the study will be used to evaluate the chemistry of water contacting the drip shields, waste packages, and ground support materials in the potential Yucca Mountain repository and the time and temperature during which corrosion of the metallic materials initiates.

PROBLEMS ENCOUNTERED:

None.

PENDING ACTIONS:

None.

RECOMMENDATIONS:

Continued participation in future Goldschmidt conferences is highly recommended. The conference facilitates interaction and collaboration between international experts on various aspects of geochemistry, including nuclear waste management.

SIGNATURE:

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Date 6/10/05

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Date 6/10/2005

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