CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

- **SUBJECT**: 7th International Conference on the Occurrence, Properties, and Utilization of Natural Zeolites (AI 06002.01.242.607)
- DATE/PLACE: July 16–21, 2006; Socorro, New Mexico
- AUTHOR: Roberto T. Pabalan

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PERSONS PRESENT:

About 150 participants from 30 countries attended the conference.

BACKGROUND AND PURPOSE OF MEETING/TRIP:

The purpose of the trip was to participate in the 7th International Conference on the Occurrence, Properties, and Utilization of Natural Zeolites (Zeolite'06). The Natural Zeolite meetings, which are held every 4 years, are an international forum for discussing current developments and future perspectives of the science and technology of natural zeolites, including their applications in the treatment of waters contaminated with radionuclides and heavy metals. The author of this trip report is a member of the Zeolite'06 scientific board and helped review and edit the abstracts that were submitted to the conference. At the conference, the author chaired a session on Thermodynamics, Ion Exchange, and Characterization and presented two papers. One was an NRC-funded poster paper on Experimental and Thermodynamic Modeling Study of Multicomponent Ion Exchange of Alkali and Alkaline-Earth Metals, coauthored with F.P. Bertetti. The second was an invited oral presentation on Discovering the Properties of Natural Zeolites: Ion Exchange.

SUMMARY OF PERTINENT POINTS:

The conference comprised 4 days of technical sessions, with about 130 papers presented in oral and poster sessions on various aspects of natural zeolites. The conference session topics were

- Symposium on 250 Years of Natural Zeolite Science
- Zeolite Formation and Occurrence
- New and Innovative Zeolite Applications
- Zeolites in Radioactive Waste Control
- Modeling of Zeolite Surfaces and Processes
- Mineralogy of Natural Zeolites
- Thermodynamics, Ion Exchange, and Characterization
- Symposium on the Legacy of Fred Mumpton
- Environmental Applications of Zeolites
- Zeolites in Agriculture and Animal Nutrition

The conference program and a book of abstracts can be downloaded from the website http://www.ees.nmt.edu/Zeolite06/orders.php. A brief summary of some of the more pertinent papers follows.

L. Wang (University of Michigan) presented the results of a study on the thermal and radiation effects on the microstructures of the zeolites analcime, natrolite, and zeolite-NaY. X-ray diffraction and transmission electron microscopy were used to evaluate these effects. The study demonstrated that zeolites of various types are extremely susceptible to irradiation-induced solid-state amorphization, which can be induced either by ionization processes (e.g., with beta- or gamma-irradiation) or by direct displacement damage processes (as by alpha-recoil).

S. Chipera (Los Alamos National Laboratory) described a study that evaluated the effectiveness of a coating made by incorporating the zeolite mineral clinoptilolite into a strippable polymeric oligopeptide film to decontaminate radionuclide contamination in urban settings (e.g., surfaces of buildings). The results of the study showed that the polymeric coating with clinoptilolite is extremely effective in removing radioactive contamination (cobalt and cesium) when the contaminant was applied as a dry powder. When the contaminant was applied as liquid media, the technology was still effective in reducing the residual contamination, but less so than when applied as dry powder. Imbibition of the contaminant into the materials lessened the effectiveness of the polymeric coating strips.

L. Neymark (U.S. Geological Survey) presented a study that assessed the potential of zeolitized tuff underneath the potential repository at Yucca Mountain, Nevada, to retard the migration of uranium. Samples of zeolitized tuff from the Calico Hills Formation and the Prow Pass Tuff, as well as pore water samples obtained by ultracentrifugation or leaching of rock samples with deionized water, were analyzed for uranium concentration and isotopic composition. Uranium sorbed on mineral surfaces was desorbed using sodium acetate solution and also analyzed for concentration and isotopic composition. The results yielded an estimated *in-situ*²³⁸U K_d of 7 mL/g. This value is larger than the value of 0.5 mL/g obtained for crushed tuffs from laboratory batch sorption experiments. Although current models ascribe groundwater flow in zeolitized units at Yucca Mountain to fracture flow, the chemical and isotopic data indicate that matrix flow is also viable. The uranium isotope data indicate that uranium removed from overlying units is transported in percolating water and retained in underlying zeolitized units. The author stated retardation of radionuclides by these units may be greater than currently credited in Yucca Mountain performance assessments.

The poster paper presented by the author of this trip report described an experimental and modeling study of ion-exchange processes involving the zeolite mineral clinoptilolite. Zeolites, including clinoptilolite, heulandite, and mordenite, are important mineral phases present in fractures and matrices of rocks in the unsaturated and saturated zones of Yucca Mountain, Nevada, and could affect the transport of radionuclides from the potential high-level waste repository at Yucca Mountain. A thermodynamic model based on the Wilson equation was used to model the ion-exchange data. A correlation method that has been applied to predictions of formation constants of aqueous hydroxo-metal complexes was used to help constrain the equilibrium constants derived from binary isotherm data. The Wilson model, with parameters derived only from binary ion-exchange data, was used to predict ternary and quaternary ion-exchange equilibria. A comparison of experimental data for ternary and quaternary systems and thermodynamic model predictions indicates that the Wilson model adequately reproduces

multicomponent ion-exchange equilibria. The results suggest that it is possible to use the Wilson model to evaluate multicomponent ion-exchange involving alkali and alkaline-earth metals in natural systems.

IMPRESSIONS/CONCLUSIONS:

The symposium was very well organized and well attended. The meeting provided an opportunity to interact with international scientists conducting studies relevant to the occurrence, properties, and utilization of natural zeolites and solicit feedback on work funded by the NRC.

PROBLEMS ENCOUNTERED:

None.

PENDING ACTIONS:

None.

RECOMMENDATIONS:

Continued participation in future Zeolite conferences is recommended.

SIGNATURE:

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Date

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2006

8/18/2006 Date