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Progress Report

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**Research and Development Related to the
NTS Terminal Waste Storage Project**

October 1—December 31, 1978

University of California



LOS ALAMOS SCIENTIFIC LABORATORY

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This is the first report in this series.

This report was prepared by the Los Alamos Scientific Laboratory as part of the NTS Terminal Waste Storage Project managed by the Nevada Operations Office of the US Department of Energy. Based upon their applicability to the NTS Terminal Waste Storage Project, some results from projects supported by the Waste Isolation Safety Assessment Program (Task 4), administered by the Office of Nuclear Waste Isolation and the Radionuclide Migration Project, managed by the Nevada Operations Office of the US Department of Energy, are included in this report.

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Compiled by
Kurt Wolfsberg

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RESEARCH AND DEVELOPMENT RELATED TO
THE NTS TERMINAL WASTE STORAGE PROJECT

October 1 - December 31, 1978

Compiled by
Kurt Wolfsberg

ABSTRACT

Geochemical laboratory and modeling support for Subtask 3.2.2, Tuff Media Investigations, is presented. Mineralogic and petrologic examination and sorption measurements have been started on tuff from Yucca Mountain hole Ue25a1. Investigations with tuff from Jackass Flats hole J-13 is continuing.

I. YUCCA MOUNTAIN TUFF INVESTIGATIONS

Mineralogical and petrological investigations of tuff units from the Yucca Mountain hole (Ue25a1) have begun. Petrographic examination is complete for 22 of approximately 55 samples, and electron microprobe analyses of representative mineral phases are complete for 17 samples. Secondary alteration in these samples appears to be similar to that observed in samples from hole J-13 in Jackass Flats. So far, there is no clear evidence of secondary alteration at temperatures in excess of 100°C.

Five of these Yucca Mountain cores were selected for measurement of sorptive properties by a batch sorption method. They are YM-22 (258 m, purplish gray, densely welded tuff, pumice <3 cm), YM-38 (459 m, pale brown, nonwelded tuff), YM-45 (588 m, light gray, pumice-rich, vitric tuff, 2% lithics <3 mm), YM-48 (644 m, light green-gray, 3-5% lithics <1 mm, fracture 60°/vertical 1 mm thick filled with black material), YM-49 (677 m, brown-gray, pumice-rich, poorly welded tuff, pumice <1 cm, 2-3% lithics <2 mm), YM-54 (759 m, light gray, densely welded, pumice-rich, vitric tuff, trace lithics).

Traced solutions were prepared from J-13 well water which was first pre-equilibrated separately with ground material from the appropriate Yucca Mountain core. Each traced water was made using the radionuclides ^{85}Sr , ^{137}Cs , ^{133}Ba , ^{141}Ce , and ^{152}Eu .

The tagged pre-equilibrated waters are now being used for batch sorption experiments. Samples having particle sizes $<106\text{ }\mu\text{m}$ and in the range 106 to $500\text{ }\mu\text{m}$ are being shaken at room temperature and it is planned to remove them in January, after approximately 20 or 40 days contact time. Concurrently, similar experiments are being run on two types of epoxy, "Barco Bond" and "Eco Bond." Should one of these materials prove to be nonsorptive and stable in the solution used, it could be used as a "container" for whole cores in subsequent experiments.

II. J-13 TUFF INVESTIGATIONS

The sorptive behavior of uranium(VI) was studied with ^{237}U tracer on three tuff samples (JA-18, JA-32, and JA-37) from hole J-13 in Jackass Flats. Water from well J-13 equilibrated with the appropriate tuff was used. Two particle-size distributions (106 - $150\text{ }\mu\text{m}$ and 355 - $500\text{ }\mu\text{m}$) were studied for sorption times of 7, 14, and 21 days and desorption times of 8, 14, and 20 days. Measurements were made at ambient (22°C) temperature. Sorption ratios were very low for all three tuffs. Average values of 8, 3, and 6 ml/g were obtained for samples JA-18, JA-32, and JA-37, respectively.

Data analyses of the experiments with the three J-13 tuff samples and tracers obtained by leaching a tuff sample containing volatile fission products from an underground nuclear explosion with J-13 water have been completed. Sorption ratios are essentially 0 ml/g for I and Sb, 4 ml/g to 10 ml/g for Mo, and 30 to 90 ml/g for Ru for the three tuffs. The ratios for U(VI), I, Sb, and Mo are classified as very low and those for Ru as low. These elements form soluble complexes or are anionic in the ground water.

The most recent set of batch measurements of the sorption of ^{241}Am on the J-13 tuff samples have been completed and data have been analyzed. Many of these samples also contained ^{239}Pu ; however, the need to determine the Pu radiochemically has delayed most of the results. A few experiments with ^{237}Pu (much lower Pu concentration) are in progress.

The same three tuff samples from hole J-13 in Jackass Flats were used with ground water from well J-13. The water had been pre-equilibrated with the

appropriate tuff. Contact times of 7, 14, 28, and 56 days, both ambient (22°C) and 70°C temperatures, and two particle sizes (106-150 and 355-500 μm) were studied. Traced feed solutions were prepared by drying acid solutions of the Am and Pu tracers in polypropylene tubes and then dissolving in the appropriate ground water.

Average Am sorption ratios of 200, 110, and 750 mL/g were obtained for samples JA-18, JA-32, and JA-37, respectively. In general, a decrease in particle size is accompanied by a small increase in sorption ratio, while an increase in temperature results in a slight increase in sorption.

III. PROPOSALS

A proposal, "Field Tests of Nuclide Migration Proposed Jointly By Los Alamos Scientific Laboratory, Sandia Laboratories, and Argonne National Laboratory," has been prepared and is being sent as a letter of interest to NV for forwarding to the Office of Nuclear Waste Isolation. The objectives of the proposal are to perform experiments in G Tunnel to (1) develop the experimental, instrumentation, and safety techniques necessary to conduct controlled small-scale radionuclide migration experiments in the field, (2) use these techniques to define radionuclide migration through rock by performing field experiments under closely controlled conditions, and (3) determine whether available material properties and modeling are sufficient and appropriate to describe real field conditions (i.e., to scale from laboratory to bench to field).

A series of experiments to outline and quantify the effects of increased temperature under conditions of controlled pore and lithostatic pressures on various tuff units has been designed. The experimental plan will be sent to NV in the form of a letter of intent to be forwarded to the Office of Nuclear Waste Isolation.

IV. PUBLICATIONS AND PRESENTATIONS

Mineralogical and petrological investigations of 37 representative samples of various tuff units from western Jackass Flats (Drill Hole J-13) were assembled into a report entitled "Petrology of Tuff Units from the J-13 Drill Site, Jackass Flats, Nevada," by G. H. Heiken and M. L. Bevier. Technical reviews of the manuscript were received from USGS. Distribution of the final draft as

Los Alamos Scientific Laboratory Informal Report LA-7563-MS is expected in January 1979. The report presents evidence for several successive cycles of zeolitic alteration. No evidence of secondary alteration at temperatures in excess of 100°C was observed.

Reviews of a manuscript entitled "An Evaluation of the Storage of Radioactive Waste with Silicic Pyroclastic Rocks," have been received from the editors of Environmental Geology. The manuscript has been revised according to the suggestions of the reviewers and returned to the editors. The paper presents a general preliminary evaluation of tuff as a waste isolation medium in the light of existing data on physical and chemical properties. A review of the conclusions of this paper was presented at the Materials Research Society annual meeting in Boston on November 28, 1978.

The report "Applicability of Microautoradiography to Sorption Studies," LA-7609-MS, by J. L. Thompson and K. Wolfsberg has been published.

The report "Sorption-Desorption Studies on Tuff," LA-7480-MS, by K. Wolfsberg et al. is in preparation.

A paper, "Sorption and Migration of Radionuclides in Geologic Media," by B. R. Erdal et al. was presented at the Symposium on Science Underlying Radioactive Waste Management, Materials Research Society, Boston, Nov. 28, with the proceedings to be published.

V. QUALITY ASSURANCE

The following quality assurance procedures, work plans, etc., were developed, issued, and implemented: "Tuff Experiments - Sorption Coefficients and Migration Measurements, Group CNC-11," "Document Control, NTS Terminal Waste Storage," "Quality Control in Counting Radioactive Nuclides," "Quality Control Index for NTS Terminal Waste Storage," "Quality Assurance Program Plan for NTS Terminal Waste Storage," "Data on Past Nuclear Events," and "Isotopic Dating of Young Volcanic Activity." Implementation of the quality assurance program has continued and surveillance activities are being conducted in the geology group and radiochemistry group where sorption and column studies are being done.

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