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Hydrogeology • Mineral Resources Waste Management • Geological Engineering • Mine Hydrology

November 19, 1987
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Fin No. D-1020
Communication No. 160

Mr. Jeff Pohle
Division of Waste Management
Mail Stop 623-SS
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

RE: NTS

Dear Jeff:

A copy of the review of the following document is enclosed.

1. Campbell, Katherine, August 1987, Lateral Continuity of Sorptive Mineral Zones Underlying Yucca Mountain, Nevada. Los Alamos National Laboratory, Los Alamos, NM, LA-11070-MS, 44 p.

Please contact me if you have any questions concerning this review.

Sincerely,

James L. Osiensky
James L. Osiensky

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WMGT DOCUMENT REVIEW SHEET

FILE #:

DOCUMENT #: LA-11070-MS

DOCUMENT: Campbell, Katherine, August 1987, Lateral Continuity of Sorptive Mineral Zones Underlying Yucca Mountain, Nevada. Los Alamos National Laboratory, Los Alamos, NM, LA-11070-MS, 44 p.

REVIEWER: Williams & Associates, Inc.,

James J. Osienky

DATE REVIEW COMPLETED: November 19, 1987

ABSTRACT OF REVIEW:

APPROVED BY:

Roy E. Williams

The report under review describes the results of x-ray diffraction analyses of samples from 14 drill holes in the vicinity of Yucca Mountain. The report describes the compositional data in terms of the existence and location of zeolite minerals. The report concludes that no significant lateral trends in total zeolitization within the units tested are obvious in the vicinity of the exploratory block; however, trends in the abundances of individual zeolite minerals do exist. This report is written strictly from the mineralogist's point of view.

BRIEF SUMMARY OF DOCUMENT:

The report under review describes the mineral composition of samples collected from 14 drill holes in the vicinity of Yucca Mountain. The analyses of the mineral distributions were performed by x-ray diffraction. Figure 1 of the report shows the locations of the drill holes from which samples were collected for analysis.

Ortiz et al. (1985) compiled drilling data from Yucca Mountain and vicinity into a "functional stratigraphy." The report under review investigates the homogeneity of these functional units with respect to mineralogy. The major zeolitized intervals (nonwelded, partially welded, and bedded tuffs) below the Topopah Spring Member are considered in the report.

The tuffs below Yucca Mountain are classified as vitric, zeolitized, and devitrified (Ortiz et al., 1985). The report under review evaluates this classification with respect to the x-ray diffraction data. According to the report, samples from zeolitized units generally are distinguished by the

presence of more than 15% zeolitites (clinoptilolite, mordenite, and/or analcine). Glass was found only in vitric units, except for two samples from test wells USW H-5 and USW H-6, and one sample from J-13. The report notes that about 35% of the nominally vitric samples contain no glass.

Figure 7 of the report shows a projection of x-ray diffraction data onto a plane. This figure shows that the major mineralization types are well separated. However, minor anomalies do occur. According to the report, if the data are reclassified the mineralizations can be divided more cleanly (fig. 8). Figure 9 of the report shows the distribution of total zeolitites in the x-ray diffraction samples from three units defined in the functional stratigraphy used by Ortiz et al. (1985). As suggested by the report, the mineralogy of the units shown on figure 10 may be correlated better with the formal geologic stratigraphy than with the referenced (functional) stratigraphy defined by Ortiz et al. (1985). The referenced stratigraphy defined by Ortiz et al. (1985) defines units with distinct thermal, physical, mechanical, and hydrological properties.

Figure 11 of the report suggests that a trend of decreasing mordenite and increasing clinoptilolite occurs from north to south in the vicinity of the exploratory block. According to the report, total zeolitization in drill hole G-2 is comparable to other drill holes. The report notes that contacts between the unit CHn (basically the tuffaceous beds of Calico Hills) and the overlying Topopah Spring Member and the underlying welded Prow Pass Member cannot be estimated accurately from the sparse and randomly selected x-ray diffraction data. This point is important because depth is a significant factor in accounting for total zeolitization and alkali-feldspar abundance in the x-ray diffraction samples (figs. 12 and 13 of the report).

Table 2 of the report lists models for the abundance of minerals in reference unit CHn. Appendix D of the report discusses the construction of the probabilistic models. The report notes that the models are preliminary, univariate models, the primary use of which is to indicate the extent that observed variability in the data is unaccounted for by detectable trends. Table 3 of the report presents models for the clinoptilolite/mordenite distribution in reference unit CHn at a relative depth of $D=0.5$.

Samples from reference unit CFUn (lower Prow Pass Member) have been collected from nine drill holes. According to the report, well J-13 stands out because the zeolitization in the three J-13 samples consists entirely of analcine; in addition, the J-13 samples contain higher than average concentrations of quartz. The zeolite composition ranges from 100% clinoptilolite in the vicinity of USW G-3 and H-3 to an average of 40% clinoptilolite in the vicinity of USW G-2. According to the report, depth is a factor that explains much of the variability in total zeolitization (fig. 18) and in alkali-feldspar abundance; however, no lateral trends have been observed. Table 4 of the report lists models for the abundance of minerals in reference unit CFUn.

Samples from reference unit CFMn in the middle of the Crater Flat tuff (lower Bullfrog Member and upper Tram Member) were collected from seven

drill holes. According to the report, drill holes J-13, UE-25b#1H and USW G-2 located to the north and east of the exploratory block contain little clinoptilolite, display lower overall zeolitization, display the absence of cristobalite, and contain more quartz than drill holes USW G-1, GU-3, and H-3 that are located within the exploratory block. Samples from well USW G-4 exhibit higher overall zeolitization than samples from the north and east of the exploratory block. Table 6 of the report lists models for the abundance of minerals in reference unit CFMn.

In summary, the report suggests that the variability in mineral distribution among drill holes does not appear to be significantly greater than the variability within holes. Two exceptions to this statement are noted. These are:

1. Samples from holes in the lowest CFMn reference unit are split geographically by hole location with high clinoptilolite and low quartz to the southwest, and low clinoptilolite and high quartz to the northeast.
2. The mineralogy in wells J-12, J-13, and USW G-2 (well outside the exploratory block) appears to be different from the mineralogy in the remaining holes.

SIGNIFICANCE TO NRC WASTE MANAGEMENT PROGRAM:

The report under review presents a description of x-ray diffraction data from 14 drill holes in the vicinity of Yucca Mountain. This document is significant with respect to evaluating the potential for retardation of radionuclide movement beneath the proposed repository in Yucca Mountain. It should be of primary interest to mineralogists and geochemists involved in the evaluation of radionuclide migration from the proposed repository.

PROBLEMS, DEFICIENCIES OR LIMITATIONS OF REPORT:

The report under review describes the results of x-ray diffraction analyses of samples from 14 drill holes in the vicinity of Yucca Mountain. The primary emphasis of the report is to describe the continuity of zeolite minerals along potential pathways for radionuclide migration beneath the proposed repository location. An understanding of the mineralogy beneath the proposed repository is important to geochemists involved in evaluating the potential for retardation of radionuclide migration. The discussions presented in the report are limited strictly to the mineralogy of units of interest below the proposed repository. The geochemistry of the individual minerals (zeolites) is not evaluated in the report.

SUGGESTED FOLLOW-UP ACTIVITIES

We suggest that the report under review be reviewed by a geochemist and/or a mineralogist who is a recognized expert on the ion exchange capacity of the various zeolite minerals.

REFERENCES CITED:

Ortiz, T.F., Williams, R.L., Nimick, F.B., Whittet, B.C., and South, D.L., 1985, A Three-Dimensional Model of Reference Thermal/Mechanical and Hydrological Stratigraphy at Yucca Mountain, Southern Nevada. Sandia National Laboratories, Albuquerque, NM and Livermore, CA, SAND84-1076.

Hanford

Federal bill could take heat off Washington as possible dump site

Associated Press

LACEY, Wash. — Federal legislation may be taking some of the heat off of Washington state as a potential host for the nation's nuclear waste repository, but state officials said Friday they're continuing their vigil.

The Senate approved legislation this week that focuses attention on Yucca Mountain, Nev., as the dump site and authorizes an above-ground interim storage facility. The other two sites proposed for the repository are the Hanford nuclear reservation in eastern Washington and Deaf Smith County, Texas.

Key House chairmen prefer a moratorium on government testing of the three finalist sites, pending an independent review of how they were chosen and whether they are the safest sites.

Washington officials take comfort in that approach, too, since they insist Hanford was chosen for political, not scientific, reasons.

But that doesn't mean the state can relax, officials said Friday at a meeting of the state Nuclear Waste Board.

"We're vigilant for two reasons: The final decision has not been made by Congress, and secondly, even if the Johnston approach passes, it doesn't mean Hanford is off the

hook," said Curt Eschels, nuclear advisor to Gov. Booth Gardner.

Sen. Bennett Johnston, D-La., is prime architect of the Senate plan that abandons simultaneous site studies in the three states, in favor of a single site chosen by the government, presumably Yucca Mountain.

"Nevada is designated as the premier choice, but if a fatal flaw is discovered, the attention comes right back to Washington and Texas," Eschels said in an interview.

Washington needs to amass a compelling body of data to show that Hanford isn't suitable, he said.

"The heat is off Hanford for the moment, but for the wrong reason. It's for political reasons. If you're off the list for technical (scientific) reasons, you're off for good. That's what we're trying to show. If we're off for political reasons, that can change."

Washington House Energy Chairman Dick Nelson, D-Seattle, a board member, said he likes Washington's vigorous approach.

"I don't see Hanford as off the hook," he said. "The intent is to focus on Nevada, but this process still is highly susceptible to (discovery of) fatal flaws. All three sites, including presumably Nevada, were picked for political reasons, not technical reasons.

"The Johnston approach assumes Nevada is technically acceptable, but we don't know that. I don't take comfort in the Johnston approach. They may luck out and find Nevada qualifies.

"But we will be No. 2, most probably, right behind Nevada."

Terry Husseman, head of the state Office of Nuclear Waste Management, told the board that congressional observers predict passage of a version closer to the House moratorium idea than to the Johnston plan.

U.S. House leaders, including Rep. Morris Udall, D-Ariz., aren't ready to scrap the whole site-selection law, but want a moratorium while a special commission and Congress study the problem.

Two Texas congressmen want to add a rider that would ban any site that is beneath an aquifer. That would eliminate Washington and Texas, Husseman said.

The board's agenda Friday reflected the continuing state push to study the Hanford site closely. The panel was briefed by federal Department of Energy officials, and received an update on state lawsuits challenging the selection process, Iodine 129 studies, and the impact of Hanford projects on Indian religious sites on the reservation.

Nuclear waste dump compromise rethought

Associated Press

WASHINGTON — Influential House committee chairmen are alarmed by a move in the Senate to scuttle a plan establishing two dump sites for the accumulating tons of high-level nuclear waste.

The Senate proposal, approved by the chamber on Wednesday, would scrap a hard-won, delicately balanced compromise that called for the creation of two underground waste dumps, the first one in the West, the second in the East or upper Midwest.

Voicing immediate opposition were Interior Committee Chairman Morris Udall, D-Ariz., Energy and Commerce Committee Chairman John Dingell, D-Mich., and Philip Sharp, D-Ind., of the Energy and Commerce subcommittee on energy and power. All three panels have responsibility for nuclear issues.

The three have written House Appropriations Chairman Jamie Whitten, D-Miss., and House Speaker Jim Wright, D-Texas, complaining about the Senate's inclusion of the nuclear waste plan in an energy and water de-

velopment appropriations bill for fiscal 1988, which began Oct. 1.

After two weeks of debate, the Senate voted 89-6 for the \$15.9 billion spending package, which also contains \$4.26 billion for Corps of Engineers and Bureau of Reclamation water projects.

The Senate's nuclear waste dump plan would put the second repository on hold, a move popular among lawmakers in threatened states, and authorize a so-called monitored retrievable storage facility to process and hold waste until it is shipped to a permanent dump.

Operating under the 1982 law, the Energy Department has tabbed Yucca Mountain, Nev., the Hanford nuclear reservation in south-central Washington state, and Deaf Smith County, Texas, for detailed studies to determine the best geologic site for the first waste dump.

The Senate proposal requires the department to perform the detailed tests at one site at a time, a move the plan's chief architect, Bennett Johnston, D-La., says could save \$3.9 billion if the first site is suitable.

Above-ground nuclear waste storage considered

Associated Press

OLYMPIA — When America's energy officials talk about MRS, it has nothing to do with marital status.

Each letter is pronounced separately, and it stands for "monitored retrievable storage" of the nation's highly radioactive nuclear wastes.

Washington's Nuclear Waste Board and its advisory council took sometimes conflicting testimony Thursday on the idea of storing nuclear wastes above ground at least until a safe underground site can be opened.

The U.S. Department of Energy's MRS proposal could have a direct bearing on Washington, since it could either inadvertently or purposely become a substitute for deep geologic storage, state officials were told.

The Hanford nuclear reservation in south-central Washington is one of three western sites nominated for further study as the nation's first, and possibly only, nuclear waste repository.

The U.S. Senate has just approved a bill that focuses the siting process on Nevada and authorizes construction of an MRS

facility. If the energy agency gets its way, a national MRS facility will go to Clinch River at Oak Ridge, Tenn.

Expansion of on-site storage at reactors and development of regional MRS centers, possibly one at Hanford, also are suggested approaches. Sen. Dan Evans, R-Wash., has been a big fan of monitored retrievable storage, and Rep. Sid Morrison, R-Wash., has proposed regional storage sites.

The government's MRS expert, Jim Carlson, told the Washington officials there is no hidden agenda to make a central MRS site a

de facto repository. The agency is willing to bar use of the facility until construction of a permanent underground repository is authorized, he said.

Under questioning, however, he said the MRS facility could be a permanent solution to the storage problem.

In a memo to the state officials, staff analyst Linda Steinmann said monitored retrievable storage could rekindle debate over geologic disposal. Despite DOE's assurances, "the political temptation to abandon siting a repository once an MRS is developed would be great," she said.

Senate approves overhaul of nuclear dump program

Associated Press

WASHINGTON — A major overhaul of the nation's long-term program for dumping the highly radioactive wastes produced by nuclear power plants was approved Wednesday by the Senate.

The measure, part of a \$15.9 billion energy and water development bill which the Senate approved 86-9, would scrap a hard-won 1982 compromise that called for building two permanent nuclear waste repositories, one in the West and one in the East.

Instead, it would restructure the waste disposal system around a single repository, probably in Nevada, to be completed shortly after the turn of the century.

The appropriations measure, sent to a House-Senate conference, includes \$7.5 billion for the Energy Department's nuclear weapons production system, but calls for the continued shutdown of the controversial N reactor at the Hanford nuclear reservation in Washington.

The N reactor, similar in design to the ill-fated Chernobyl plant in the Soviet Union, is one of three aging U.S. plants used to manufacture plutonium, a component of hydrogen warheads.

The Energy Department wanted to restart the facility, which was closed for retrofitting and \$55 million worth of safety improvements early this year, but the Senate, by cutting off future funds, effectively agreed with critics who said the plant remained unsafe.

Serious safety concerns also have been raised about the other two production reactors, at Savannah River, Ga., which produce both plutonium and tritium, another key warhead component.

Some defense experts worry that shifting the N reactor's production burden to those plants could endanger the nation's ability to meet its nuclear stockpile requirements, even in light of pending arms control agreements.

Senate overhauls nuclear waste

Associated Press

WASHINGTON — The Senate passed legislation to overhaul the program that just five years ago was billed as the final solution to disposing of the nation's growing accumulation of high-level nuclear waste.

The revamped search for an underground radioactive waste site is the most contentious feature in a \$15.9 billion appropriations bill providing money for energy and water development programs in the fiscal year that began Oct. 1.

Approved by an 86-9 vote, the

legislation would scrap the delicate, hard-won compromise reached by Congress in 1982 to create two waste repositories, one in the West and the other in the East or upper Midwest.

The new Senate plan, advocated by Sen. Bennett Johnston, D-La., and the Reagan administration, would all but scrap the eastern site and tilt the selection process toward placing the western repository at Yucca Mountain, Nev.

The plan also would authorize an above-ground facility to serve as an interim cooling and packaging area for waste headed for

the permanent facility. The Energy Department has proposed Oak Ridge, Tenn., for the so-called monitored retrievable storage facility.

In an effort to sweeten the pot for states getting nuclear waste, the bill would provide \$100 million a year for hosting a permanent repository and \$50 million a year for temporarily storing the waste.

The Senate proposal faces an uncertain future. The House version of the spending bill proposes no changes in the 1982 program and members of the House influential on nuclear issues have criticized the Senate plan.

Dear Abby	6C
Horoscopes	7C
Local/area news	1-5B
Movies	5D
Obituaries	6B

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LEWISTON MORNING TRIBUNE

Four Sections

Lewiston, Idaho/Clarkston, Washington

Friday, November 13, 1987

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Nevada likely N-waste site

By Lee Byrd
 of the Associated Press

WASHINGTON — The Senate approved 63-30 on Thursday a major overhaul of the nation's high-level nuclear-waste program, virtually tabbing Nevada as the most likely host for a permanent repository while scuttling plans to build an identical facility in the upper Midwest or the East.

The new plan, drafted by Sens. Bennett Johnston, D-La., and James McClure, R-Idaho, includes a \$100 million annual federal payment to the repository state, and \$50 million per year to the state in which an interim cooling and packaging facility, known as an MRS, is built.

Though the legislation, an amendment to a \$16 billion energy and water development bill, does not specify Nevada's Yucca Mountain as the first choice for a permanent burial site for spent nuclear fuels and other high-

level wastes, it clearly points that way.

Under current law, Yucca Mountain, as well as sites at the Hanford nuclear reservation in Washington state and Deaf Smith County, Texas, are candidates for exploratory work — including the drilling of deep shafts — costing nearly \$6 billion.

Johnston's measure calls for that exploration to be done in sequential, rather than simultaneous, order, in hopes that the first site to undergo major testing will prove suitable for the repository — and that work at the other two can be canceled at a savings of \$3.9 billion.

Technically, it would be left to the Energy Department to decide by Jan. 1, 1989, which site should be explored first, but the legislation is shaped in a manner that clearly tilts toward the Yucca Mountain site. "This bill will save the (utility) ratepayers \$3.9 billion," said Johnston. "It's that simple."

Most of the high-level nuclear waste pro-

gram, estimated to cost upwards of \$40 billion when the repository and the MRS — for monitored retrievable storage — are completed around the turn of the century, is financed through assessments against the 108 commercial nuclear plants.

Meanwhile, current requirements that a second nuclear repository be built east of the Mississippi would virtually be scrapped under Johnston's plan, a feature that angered Western lawmakers but delighted those from Maine and other candidate states in the East and upper Midwest.

Several western senators, including Brock Adams, D-Wash., and Harry Reid, D-Nev., had attempted to filibuster the package to death, but the Senate voted Tuesday to cut off the bitter debate.

Sen. Daniel Evans, R-Wash., noted that 43,000 metric tons of spent reactor fuel and other high-level waste already awaits burial, and "this is a national problem which needs to be resolved as soon as possible." He said Johnston's approach was proper.

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By David Johnson
 of the Tribune

Employees of the down Kamiah planer building back on the job next negotiations to lease a boring mill's planer a tied, August Klau Spokane's Empire L Co. said Thursday.

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Klaue, owner of K Mills (a subsidiary of E



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