CNWRA **A center of excellence in earth sciences and engineering**

A Division of Southwest Research Institute™
6220 Culebra Road • San Antonio, Texas, U.S.A. 78228-5166
(210) 522-5160 • Fax (210) 522-5155

July 27, 2001
Contract No. NRC–02–97–009
Account No. 20.01402.861

U.S. Nuclear Regulatory Commission
ATTN: Mrs. Deborah A. DeMarco
Two White Flint North
11545 Rockville Pike
Mail Stop T8A23
Washington, DC 20555

Subject: Programmatic Review of Abstracts

Dear Mrs. DeMarco:

The enclosed abstracts are being submitted for programmatic review. These abstracts will be submitted for presentation at the Geological Society of America annual meeting to be held November 1–10, 2001, in Boston, Massachusetts. The title of these abstracts are:

> "Recharge at Yucca Mountain, Southern Nevada and Black Mesa, Arizona: Estimates from the Chloride Mass Balance Method and Chlorine-36 Data" by J. Winterle et al.

> "Using Temperature Data to Constrain Models of Groundwater Flow Near Yucca Mountain, Nevada" by S. Painter and J. Winterle

Please advise me of the results of your programmatic review. Your cooperation in this matter is appreciated.

Sincerely,

Budhi Sagar for
Technical Director

/ph
Enclosures

cc:			
	J. Linehan	T. Essig	W. Patrick
	B. Meehan	K. Stablein	CNWRA Directors
	E. Whitt	D. Brooks	CNWRA Element Mgrs
	J. Greeves	B. Leslie	T. Nagy (SwRI Contracts)
	J. Piccone	N. Coleman	P. Maldonado
	W. Reamer		

Washington Office • Twinbrook Metro Plaza #210
12300 Twinbrook Parkway • Rockville, Maryland 20852-1606

RECHARGE AT YUCCA MOUNTAIN, SOUTHERN NEVADA AND BLACK MESA, ARIZONA: ESTIMATES FROM THE CHLORIDE MASS BALANCE METHOD AND CHLORINE-36 DATA

LOVE, Erica, ZHU, Chen, University of Pittsburgh, czhu@pitt.edu; Jim Winterle, Center for Nuclear Waste Regulatory Analyses, Southwest Research Institute, 6220 Culebra Road, San Antonio, TX 78238, Phone #: (210)522-5249; Fax #: (210)522-5155, jwinterle@swri.edu

Average Holocene and late Pleistocene recharge rates at Yucca Mountain, southern Nevada, and at Black Mesa, Arizona, are estimated from the chloride mass balance method. Yucca Mountain is being evaluated as a potential site for a geologic repository for high-level nuclear waste. The amount of local recharge is important to the proposed repository because it is water that may pass through the repository. At Black Mesa, Arizona, coal mining raises concerns for depleting the only source of drinking water in the region. For water resource evaluation, the availability of groundwater resources is in part determined by the recharge into aquifers. Accurate estimates of recharge to aquifers in arid and semiarid areas is a challenge because recharge fluxes are low and spatially and temporally variable.

In this study, we first derived Holocene and late Pleistocene Cl^- deposition rates from ^{36}Cl deposition rates and $^{36}Cl/Cl$ ratios in groundwater and packrat middens. Calculated Cl^- deposition rates were lower in late Pleistocene than Holocene at Yucca Mountain but higher in late Pleistocene than Holocene at Black Mesa. Recharge rates were then calculated from Holocene and late Pleistocene Cl^- deposition rates, respectively. The calculated average Holocene recharge at Black Mesa is 9 mm/yr, and the average recharge in late Pleistocene is 35 mm/yr. The temporal variation patterns of recharge compare well with those estimated independently from numerical models calibrated to the distribution of radiocarbon dates and with known climate changes in the area. Local recharge rates at Yucca Mountain were estimated from the $^{36}Cl/Cl$ ratios and Cl^- concentrations in perched waters. Estimated recharge for late Pleistocene is about 15 mm/yr and for Holocene is 5 mm/yr. Although there is uncertainty in these estimates, greater confidence can be placed in the relative rates of recharge estimated for the late Pleistocene and the Holocene. These estimates agree well with spatially and time-averaged net infiltration estimates for present-day and glacial-transition climates (4.6 mm/yr and 15.6 mm/yr, respectively) obtained from a watershed-scale infiltration model of Yucca Mountain. [This work, performed in part under U.S. Nuclear Regulatory Commission (NRC) contract NRC-02-97-009, does not necessarily reflect views or position of the NRC.]

Using temperature data to constrain models of groundwater flow near Yucca Mountain, Nevada

Scott Painter and James Winterle
CNWRA, Southwest Research Institute, 6220 Culebra Road, San Antonio TX 78238
Phone: (210) 522-3348 Email: spainter@swri.edu

Previous studies [1] of the groundwater system near Yucca Mountain, Nevada identified significant spatial lateral variability in the groundwater temperature measured at or near the water table. In particular, the groundwater temperatures in the vicinity of the Paintbrush Fault were found to be elevated by several degrees compared to those in the surrounding region. Upward movement of water from a warmer underlying carbonate aquifer has been suggested as one explanation for this temperature variability. A non-isothermal groundwater flow model was constructed to test the hypothesis of upwelling along the Paintbrush Canyon fault zone. The MULTIFLO code [2] was used to model heat transport and density dependent flow in the fractured tuff aquifers near Yucca Mountain, Nevada. The non-uniform logically rectangular grid of size 30x25x20 conforms to a coarse (four layer) hydrostratigraphic framework for the region. A zone of enhanced permeability along the Paintbrush Canyon fault zone was required to match measured hydraulic heads. However, calculated groundwater temperatures match measured temperatures without including the postulated upward movement of water from the underlying carbonate aquifer. The calculated elevated temperatures above the Paintbrush Fault in this model were caused by buoyancy driven upward flow above a structural high in the underlying carbonate aquifer. These results suggest that groundwater temperature variations in the Yucca Mountain region may be due simply to buoyancy driven flow initiated by the variable thickness of the tuff aquifers.

This abstract documents work performed in part by the Center for Nuclear Waste Regulatory Analyses under contract No. NRC–02–97–009. The report is an independent product and does not necessarily reflect the regulatory position of the NRC.

References:

1. J. H. Sass, A. H. Lachenbruch, W. W. Dudley Jr., S. S. Priest and R. J. Munroe, 1988, Temperature, thermal conductivity, and heat flow near Yucca Mountain, Nevada: Some tectonic and hydrologic implications, US Geol. Surv. Open-File Rep., 87-649, 118 pp.

2. P. Lichtner, M. S. Seth, and S. Painter, 2000, MULTIFLO User's Manual, Multiflo Version 1.2: Two-Phase Non-isothermal Coupled Thermal-Hydrologic-Chemical Flow Simulator. San Antonio, Texas: Center for Nuclear Waste Regulatory Analyses.