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CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: Annual Meeting of the Geological Society of America

DATE/PLACE: Denver, Colorado, 28-31 October 1996.

AUTHOR: Chuck Connor
David Ferrill
Peter Lichtner

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PERSONS PRESENT: Peter Lichtner, Chuck Connor, and David Ferrill

BACKGROUND AND PURPOSE OF TRIP:

The purpose of the trip was to attend the Geological Society of America Annual Meeting, co-chair a symposium and theme session titled: Application of Reactive Transport Modeling to Natural Systems, with C. Steefel and E. Oelkers, and present four papers (Connor et al. 1996, Ferrill et al. 1996, Lichtner 1996, and Stamatakos and Ferrill 1996) summarizing recent work performed at the CNWRA. Additionally, CNWRA staff coauthored a paper summarizing results of the NRC/Caltech GPS survey across Yucca Mountain and the eastern part of the eastern California shear zone (Davis et al. 1996). The weekend before the GSA meeting, P. Lichtner presented a short course along with C. Steefel and E. Oelkers on reactive transport in porous media sponsored by the Mineralogical Society of America.

SUMMARY OF PERTINENT POINTS:

Highlights from the GSA meeting relevant to nuclear waste disposal included the following presentations:

Burns et al. presented "A structural hierarchy of uranyl phases: applications to the disposal of spent nuclear fuel", in which they pointed out the existence of a plethora of phases. The molar volume of these phases is several times that of spent fuel, indicating the possibility of sever expansion and spalling of the spent fuel as it becomes altered under oxidizing conditions.

Glass et al. presented a paper on "Challenging and improving conceptual models for isothermal flow through unsaturated fractured rock." They discussed the inadequacy of current continuum-based models to represent fluid flow in the unsaturated zone.

Wolfsberg and Turin presented "Numerical modeling of vadose-zone chlorine-36 transport in Yucca Mountain, Nevada", in which they discussed results of a dual porosity model to study infiltration in the unsaturated zone and the transport of Cl-36.

Shock and Sassani presented a paper on "Aqueous geochemistry of actinide ions". While breaking new ground, missing was the thermodynamic data for aqueous complexes with actinides.

Two sessions were devoted to scale effects of fluid flow in fractures with several papers demonstrating the scale dependence of fracture permeability.

A total of 22 papers were presented in the session entitled "Neogene and Quaternary Geology of the Yucca Mountain region and its relevance to long-term nuclear waste isolation". The session was chaired by Dennis O'Leary and John Whitney. O'Leary mentioned at the outset of the session that much of the mapping in the area around Yucca Mountain is completed and that many of the papers presented summarize the findings based on this mapping. Overall, the session was marked by very little discussion. Most presenters were not asked any questions. Most of the presentations were data intensive with little or no discussion of the significance of findings in terms of the repository or development of tectonic models. Participants in this session were from the U.S. Geological Survey, the University of Nevada at Reno, and the CNWRA. Some of the papers are summarized in the following.

W.F. Simmonds of the USGS gave a talk summarizing recent work at the Calico Hills. The authors suggested that the pattern of deformation observed in the Calico Hills is largely a result of diapiric uplift of the central core of the dome simultaneous with a period of hydrothermal alteration. This largely occurred 11-13 Ma, during the waning stages of silicic volcanism in the region.

A paper on teleseismic tomography was presented by Glenn Biasi of the University of Nevada at Reno. This is the first crustal scale tomography work done in the Yucca Mountain Region since the work of Evans and Smith, reported at the high-level waste conference in 1992. Biasi and his colleagues concluded that a high velocity region exists beneath the Timber Mountain Caldera complex. This high velocity anomaly extends all the way through the crust. They saw no evidence of the low velocity anomalies reported by Evans and Smith within the crust beneath Crater Flat. At depths of 60-80 km, low velocity anomalies were identified beneath Crater Flat, the Amargosa Valley, and parts of Yucca Mountain. Biasi suggested that the velocity anomalies were due to "some structure in the mantle" during his talk. Connor pointed out that the depths of these anomalies correlate well with the depths of partial melting proposed by Frank Perry, based on the geochemistry of Quaternary basalts in the Yucca Mountain region and asked if the slow velocity anomalies could be caused by the presence of small amounts of partial melt. Biasi agreed that this was possible. However, it was clear that some additional data processing would likely be necessary to investigate this point. Specifically, Biasi was concerned that deeper low velocity structures might be influencing the distribution of low-velocity structures in the 60-80 km tomographic slice.

Tom Brocher and Clay Hunter, both of the USGS, gave two talks on recent geophysical work in the Yucca Mountain region. Brocher summarized the interpretation of the seismic line across Yucca Mountain. Brocher's main points were that the Bare Mountain fault appears to have a consistent and steep (60°) dip to a depth of at least 7 km, and that there is good agreement between the depth of the seismogenic crust (about 12 km) and the depth of a reflector on the seismic line interpreted to be the transition from brittle to ductile crust at a depth of about 15 km. However, Brocher emphasized that the seismic data are very difficult to interpret, primarily due to the steep dips of bedding planes in the Paleozoic sequence. Hunter discussed magnetic data and gravity data corresponding to the seismic line across Crater Flat. He noted that there is good agreement between the gravity data and the interpretation of the seismic section. Magnetic data vary from a relatively simple magnetic model because of the presence of a broad positive anomaly in central Crater Flat. Hunter interprets this anomaly to be due to "magnetic Eleana" formation in the Paleozoic section. There was no explanation given for why the Eleana Formation would be out of stratigraphic sequence in this particular location or why its magnetic properties would vary so abruptly in the section beneath central Crater Flat. Hunter's cross section listed "intrusion" as an alternative explanation for the anomaly observed in the magnetic data. An intrusion at

a depth of 3-4 km beneath central Crater Flat would easily explain the magnetic anomaly, as Hunter's model indicates, and avoid the stratigraphic problems with the magnetic Eleana interpretation. Hunter also suggested, based on the magnetic data, that numerous faults in eastern Crater Flat dip east rather than west. This was based on the interpretation of short wavelength variation in the total magnetic field. It did not appear that fault dip would be well constrained by the magnetic models.

Chris Potter gave a talk summarizing detailed geologic mapping on and around Yucca Mountain. His main theme was that, although complex faults are present in the region around Yucca Mountain (within a 20 km wide zone), faulting within the Yucca Mountain block generally consists of short discontinuous fault segments that generally lack major vertical offsets. In other words, the Yucca Mountain block is little deformed compared to the surrounding area.

Robert Dickerson gave a talk on the structural geology of Yucca Wash. Dickerson suggested that the predominate features in Yucca Wash are N-trending normal faults, and that there is little evidence for the NW trending strike-slip fault that appears in numerous tectonic models of the region. His conclusions seem important because the NW trending Yucca Wash has been assumed to be a major structure limiting the northern extent of the repository.

Scott Minor, Chris Fridrich, and Dennis O'Leary presented papers on the general structural setting of Yucca Mountain and a summary of tectonic models for the site region. Much of this involved identification of structural domains and summary of models that have been presented previously.

Kenneth Smith presented a paper on microearthquakes in the Yucca Mountain region, monitored using the dense network of digital seismographs. With this network they recorded numerous (13) earthquakes with magnitudes -0.5 to 1.3 within the Yucca Mountain block. James Brune presented a paper on the positions of precarious rocks in the Yucca Mountain region. He suggested that there are few earthquakes of magnitude close to or greater than the Little Skull Mountain earthquake in the Yucca Mountain region, based on distributions of rocks that might easily topple during seismic shaking.

In a session on "Rates of Geologic Processes in the Holocene", Jim Davis (Center for Astrophysics, Harvard-Smithsonian Astrophysical Observatory) presented a paper on "Strain accumulation along Holocene faults near Yucca Mountain, Nevada, from GPS geodesy." The paper summarized the results to date from the NRC/Caltech GPS network spanning from east of Yucca Mountain west across the Death Valley - Furnace Creek and Hunter Mountain fault systems. The first four campaigns (1991 through 1995) record 6mm/yr right-lateral strike slip across the survey, mostly concentrated in the western part of the survey. From the first four campaigns, within error, there has been no strain accumulation recorded across the Bare Mountain fault or Yucca Mountain. However, preliminary incorporation of data from the 1996 campaign suggests that Bare Mountain may be moving upward with respect to Yucca Mountain at ~0.2 - 0.3 mm/yr (Wernicke, personal communication).

IMPRESSIONS/CONCLUSIONS:

This year' s GSA meeting seemed to have smaller attendance than usual. Sessions attended by CNWRA staff, although small, provided an opportunity to interact with other researchers and to discuss research results and planned research.

PENDING ACTION:

None

RECOMMENDATIONS:

None

PROBLEMS ENCOUNTERED:

None

REFERENCES:

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SIGNATURES.

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