

MEMORANDUM

TO: Martin J. Steindler, Chairman
Advisory Committee on Nuclear Waste
Nuclear Regulatory Commission

DEC 1 1994

FROM: Ken Foland, Consultant

DATE: 4 December, 1994

RE: Comments to the ACNW on Groundwater Dating Working Group

This memo is a brief report to the ACNW to convey some impressions from the Working Group Meeting on "Uses and Limitations of Groundwater Dating Methods" and the associated Site Visit ("Hydrology Field Trip") to Yucca Mountain. I trust that these comments will be useful to Committee considerations and that you will call on me if follow up is desired. I am asking Lynn Deering to distribute this report to all the ACNW members and also to facilitate the clarification of any questions that may arise.

Field Trip -

Although I had previously visited many of the stops on the October 20 trip, it was nevertheless very informative. The work discussed by Alan Flint and June Fabryka-Martin at the NRG-5 site was very interesting and appears to be contributing importantly to the understanding of infiltration. I was surprised to learn that the LM-300 rig sits idle for lack of funding or materials or both. This seems remarkable considering the large number of holes that are described in study plans. In fact, the project leaders who discussed projects seemed to talk in terms of schedules that do not appear to be altered with the changes that will be concomitant with DOE's program approach. There are a number of implications when the program approach is considered.

Working Group -

My general impression of the meeting is that it was very successful along several dimensions, particularly with respect to: fostering interaction among workers; reviewing methods along with their limitations; and, reviewing recently-obtained data on the Yucca Mountain groundwater issues. The success can be attributed to very good organization of the session, as well as to the participation of key scientists

There are a number of issues related to groundwater that result from the complex unsaturated and saturated flow systems at Yucca Mountain, that are relevant to ACNW interests. It seems to me that the most salient are: the amount of work that will need to be performed to understand the system sufficiently and the implications of this on the project schedule; and, the difficulty of using simple (or first-order) parameters (e.g., water age) to evaluate the suitability of a proposed repository. Both of these appear to have regulatory ramifications.

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Some specific impressions and comments follow.

1. Groundwater dating by isotopic methods is invariably complicated because of: variations in the initial states (e.g., variations in initial specific activity); open system reaction of water with matrix (e.g., introduction of dead C); and, mixing of waters. Although the dating work using cosmogenic isotopes can be analytically demanding, it is these complications rather than analytical problems that are the real limitations of the methods. For the Yucca Mountain geologic setting, our general understanding of the methods and ability to model open-system behavior will improve over the next few to 10 years. However, it seems unlikely that there will be a dramatic breakthrough that is going to solve the fundamental complications. It seems prudent to anticipate this situation in the context of regulation.
2. With attendant limitations of each technique, it is very important that the studies be integrated so that different methods are applied to the same samples. Such integration on dating activities appears to have been lacking in previous Yucca Mountain studies. However, the principal investigators recognize the importance and appear to be attempting to effect more meaningful sampling.
3. There is now abundant data that demonstrate complex and heterogeneous water flow systems of the unsaturated zone in the Yucca Mountain area. The isotopic data indicate multiple flow paths and apparent lateral and horizontal fast pathways. The clear implication is a more complete description of the systems including quantitative estimates of migration rates is going to be a demanding task.
4. These complications mean that a groundwater travel time has limited usefulness. The situation does not lend itself to definition in terms of travel times. Residence time is perhaps more meaningful but still is not ideal. It seems much more realistic with such systems to use an alternative concept, such as water flux, as a measure. If the regulations are targeted for travel time, this issue may present a serious difficulty.
5. Studies of the saturated zone also have significant uncertainties. The ^{14}C age estimates and apparent travel times may not be reliable if dead carbon has been introduced by reaction or, as some evidence suggests, by mixing. A consistent story of the paleo water table being about 100 m higher than the current level may be emerging.
6. It seems that the fast pathways are not as yet correlated with bedrock characteristics or features. This seems like an important link in order to be able to use the bedrock site characterization data for overall performance evaluation.
7. At this point, it seems that the specific details of site models that use groundwater dates must be viewed with some degree of circumspection. The use and value of such models inevitably must be judged in the context of the uncertainties in the dates as they exist at present and also likely to exist in the near future.