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SUBJECT: COMMENTS ON NNWSI GEOLOGIC DATA REVIEW

This letter transmits the comments of the Geology/Geophysics Section concerning the NNWSI geologic data review which occurred between September 17 and September 28, 1984. We recommend that they be forwarded to DOE and their U.S. Geological Survey advisors.

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* Record Note: J Cutler left NRC on 12/21/84 after completing a draft of this document. PJ

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COMMENTS AND OBSERVATIONS: NNWSI DATA REVIEW

Background

From September 17th through 28th, 1984, the WMGT Geology/Geophysics Section, WMRP NNWSI Project Section, and several other NRC staff members participated in a field site investigation and data review of the NNWSI. The field investigation portion of the trip was conducted on September 17th through 21st and included a visit to the U. S. Geological Survey's Core Library, G-Tunnel, and several stops on and around Yucca Mountain. The second portion of the trip involved a visit to the USGS offices in Menlo Park, California (September 24 and 25) and Denver, Colorado (September 26, 27, and 28) where geologic and geophysical data sets and maps were reviewed. The exact data sets reviewed on this trip, along with the data sheets NRC used to review the data, have already been transmitted to DOE (Coplan to Vieth, November 15, 1984). The purpose of this letter is to convey major NRC comments regarding the reviewed data and data collecting procedures. The staff's comments are first presented in summary form and followed by the details of their observations.

Comment Summary

While NRC staff were very impressed with the scientific ability and integrity of the personnel working on the the NNWSI projects, they do have some comments stemming from their recent review of the geologic data. With respect to the drilling program, logging at the well during operation would improve the reliability of the data later interpreted from the obtained core. The geologic mapping effort to date is commendable, and the next step should be to extend this effort to encompass a larger region. Greater attention could also be paid to the timing and implication of NW trending strike slip faults, as well as the nature and distribution of joints and fractures at Yucca Mountain.

In addition, the staff is concerned about the validity and utility of the uranium trend dating technique, and feel that caution is in order when using this method. The staff are also concerned about the hydrologic implications of opal and travertine observed in some trenches. Finally, the staff feel that all of the geologic investigations could benefit from enhanced communications and information sharing between the various projects and a more narrow focus by researchers on the goals and requirements of the NNWSI project.

Core Library

Representative core from USW G-1, G-2, G-3, and Ue25p-1 was examined. This core included most of the important lithologies and some faults. The various lithologies were compared with 3-D velocity logs and a correspondence between low velocity zones and non-welded tuff was observed. The NRC staff noted that the core in the core library is not logged at the well and that there was no evidence that parameters such as drilling speed and fluid pressure were ever recorded. These procedures may lead to core logging errors. The NRC suggests that the DOE consider following a core logging procedure which provides for the recording of this type of data at the well.

The staff also noted that only one borehole at Yucca Mountain was drilled into the carbonate below the tuff. Boreholes can provide important structural and stratigraphic information, and at Yucca Mountain this type of information is lacking for the Paleozoic rocks beneath the tuff. In the future, the DOE may want to consider drilling a few carefully selected holes at least to the depth of the carbonate. The above observations pertain to ISTP issues 5.1.2.2., 5.1.3.1., 5.1.3.2., 5.1.3.4., and 5.1.3.5.

G-Tunnel

In G-Tunnel the staff observed in situ heater block tests and other rock mechanics experiments in rocks which have similar lithologies to those at Yucca Mountain. While observing these tests, we also noted 1) a fault of uncertain origin apparently acting as a conduit for water, and 2) a set of tight, closely spaced fractures with a regular orientation. Since similar fractures exist at Yucca Mountain and since these fractures have the potential to affect waste isolation, as described in sections 5.1.3.1., 5.1.3.2., 5.1.3.4., and 5.1.3.6. of the ISTP, the DOE should consider further study of fractures in G-Tunnel.

Yucca Mountain

The staff reviewed normal faults mapped by Robert Scott (USGS) and observed his approach to developing the "typical" fault pattern at Yucca Mountain. Scott's interpretation appears to be valid for Yucca Mountain proper. Furthermore, the quality of mapping is good. In the future the DOE should consider more investigation into the timing and importance of the NW trending strike slip faults, for reasons described in section 5.1.3. of the ISTP. Scott noted that his work was correlated with aeromagnetic data and well data, but there is a consensus at NRC that the elucidation of the tectonic framework around Yucca

Mountain may benefit from stronger communication between the different USGS projects working at Yucca Mountain.

In the future, the DOE should consider extending Scott's work to include a larger region without sacrificing the commendable detail of the current work. The NRC's review of the data indicates that some of the problems which need to be addressed in the Crater Flat area include 1) the relationship of the Lathrop Wells cone to the other cones in the vicinity, and 2) the implications that a collapsed caldera complex under Crater Flat would have for the tectonic development of Yucca Mountain. The reasons for the staff's concerns about volcansim are described in sections 5.1.3.1.2. and 5.2.3.3. Finally, more attention needs to be paid to the surface mapping of joint and fracture sets so that their significance with regard to both tectonics and groundwater flow can be formally appreciated (or dismissed, if appropriate). This last comment is particularly germain to ISTP section 5.1.3.2.

The staff reviewed Chris Barton's (USGS) pavement study, and we think that if the "worm tubes" he describes are typical of fracture and joint surfaces at Yucca Mountain, then the implication of this feature for groundwater flow may be important. If most of the joints and fractures at Yucca Mountain are due to cooling and have a vertical orientation, then this may also have an impact on groundwater flow. Even if these joints are due to cooling, they may impart a preferred orientation on the faults formed during later extension. The NRC staff sees the spatial distribution of these fractures in the vicinity of Yucca Mountain as being important enough to merit further investigation, again for reasons described in the ISTP under section 5.1.3.2.

Trenches The making and logging of trenches provides critical information regarding the existence and activity of faults, both of may affect waste isolation as described in sections 5.1.3.5 to 5.1.3.7. and 5.1.4 of the ISTP. The Rock Valley trenches are being mapped in detail, and the results appear to justify the obvious effort that went into these trenches. The use of photographs is a good idea and is encouraged. Until comparable efforts are undertaken at the other trenches, the trench logging program can only be described as "in progress."

In trenches 8, 10b, and 14 both the bedrock and overburden are observed to be faulted. The presence of travertine and opal in these faults may have far reaching implications as possible indicators of hydrothermal activity associated with fracture flow at the site. Examination of trenches RV1, RV2, 14, 10b, and 8 shows small offsets in the K-horizon, and faulted alluvium was observed in all three Crater Flat trenches. Fault activity revealed in the trenches suggests that the site may be within the East-West zone of long term

seismic activity. These relations indicate that the DOE should further consider the extent of Quaternary faulting at Yucca Mountain, along with the implications that the timing of faulting may have for waste isolation.

Menlo Park

The staff also reviewed regional geologic data with Mike Carr (USGS), including the 1:100,000 compilation map and fault data. A good regional study is underway, however, the NRC suggests that the DOE document the objectives of this study and focus clearly on how these objectives serve the goals of waste isolation at NNWSI.

The importance of establishing and understanding the stratigraphy at Yucca Mountain is detailed in section 5.1.2. of the ISTP. For this reason, thin sections taken from core samples were reviewed along with supporting descriptions. While these descriptions were determined to be accurate, the staff thinks that descriptions should contain more detail and follow a consistent and standardized format.

Denver

The staff reviewed uranium trend dating techniques and studies for the NTS with John Rosholt (USGS). The range for this dating technique is about 10,000 to 700,000 years with great uncertainty at the extremes. The staff has some concern regarding the validity and utility of this dating technique as there is no assurance that the uranium "clock" has been reset during the reworking of alluvial material. In addition, certain isotopes can be selectively reworked into various clays and zeolites and the potential for these processes to bias the results needs to be considered. The DOE should carefully evaluate the validity of uranium trend dating before drawing any significant conclusions from this technique. The importance of geochronology to waste management is described indirectly in ISTP sections 5.1.1.3, 5.1.1.4., 5.1.2.1., and 5.1.4.6.

The staff reviewed Al Rogers' (USGS) southern Nevada earthquake catalog in Golden, CO, as well as the equipment and procedures used in collecting and processing earthquake data from the Yucca Mountain seismic network. The network was impressive and the quality of the work was high. The importance of seismicity is discussed in the geologic section of the ISTP (section 5.1.4.).

The NRC staff attempted to review lineament analysis data in the absence of John Whitney (USGS), the principle investigator on that project, but the location of the data was unknown. A lineament map was reviewed but no

explanation was given. This remains an open item. The importance of lineament analysis to the program is discussed in ISTP section 5.1.3.1.

The staff reviewed Will Carr's faulting and tectonics studies. Carr's knowledge in the tectonics of the Yucca Mountain area and the southern Great Basin appears to be a plus to the program and especially to the continued studies in Crater Flat. The importance of these type of studies is the subject of all of section 5.1.3. of the ISTP.