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MEMORANDUM

AUG 9 1991

TO: Charlotte Abrams, Senior Staff Scientist, ACNW

FROM: Kenneth Foland, ACNW Consultant K A Foland

SUBJECT: International High Level Radioactive Waste Management Conference

DATE: 24 June, 1991

As you have requested, this memorandum outlines some of my perceptions of reports presented at the Second Annual Conference on High Level Radioactive Waste Management in Las Vegas which I attended. My comments below address some major points and, in particular, the temporal nature of the volcanic activity and the geochemistry of carbonates, especially the calcite veins of Trench 14, near Yucca Mountain. I emphasize that these comments are based only upon oral conference presentations and the associated short papers from the Proceedings.

- The episodicity of volcanic activity near Yucca Mountain was specifically addressed by D. E. Champion during his presentation in the Seismotectonics and Volcanology session. The main issue addressed is whether the volcanic centers are: "polycyclic" (i.e., with several short-duration eruptive events occurring over intervals on the order of 10^3 to 10^5 years within a restricted area or a single volcanic center); or, "monogenetic" (i.e., with eruptive events at a center confined within an interval on the order of 10^2 years or less). This question is addressed using paleomagnetic pole positions of samples of lava flows. Because of the secular variation of the geomagnetic field, distinct differences in paleomagnetic remanence would be expected for eruptive materials which cooled at different times (separated by more than about 100 years) if the rate of secular variation is sufficiently rapid during the interval. Champion concludes from paleomagnetic measurements and considerations that the various young, mafic volcanic centers are not polygenetic; the various 3.7 to 0.1 Ma centers represent distinct episodes with recurrent activity restricted to less than about 100 years at each center. At the Lathrop Wells center, two very similar but statistically distinct paleomagnetic directions are found. These results are interpreted to indicate two events which were separated by not more than 100 years.

- The age of the Lathrop Wells center which represents the youngest volcanic activity in the Yucca Mountain area was addressed in a paper by B. D. Turrin and D. E. Champion, delivered by Turrin in the Seismotectonics and Volcanology session. The main point of this paper was the age of the Lathrop Wells volcanic activity which has been controversial. The $^{40}Ar/^{39}Ar$ isotopic geochronologic method was the principal one used and emphasized; however, there was discussion of some geomorphic features and some of

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unpublished work by others using alternative dating methods. The main conclusion, again primarily based upon new $^{40}Ar/^{39}Ar$ results, is that the age is 119±11 to 141±10 thousand years and that the previously published 20 thousand year age is incorrect. While the data presented require thorough review because of the difficulty of dating such young rocks by the Ar method, this conclusion appears to be supported by the data. The precise manner in which the above ages and uncertainties were obtained was not immediately obvious; however, the data clearly point to about 100 to 200 thousand years. With the data presented, the possibility of an anomalously old age due to initial ^{40}Ar cannot be ruled out conclusively. Indeed, some laser fusion ages presented were much older and can be attributed to excess ^{40}Ar. To address the potential problems of systematic errors, Turrin showed data for a historic (unrelated) lava flow and indeed indicated a zero age. Unpublished results by others using U-Th and ^{36}Cl were cited to be consistent with the new Ar results for Lathrop Wells. If indeed the results of these methods agree with the Ar results, there will be a convincing case for an age substantially in excess of the much younger one inferred by some on the basis of geomorphic considerations.

- A paper by J. S. Stuckless, J. F. Whelan, and W. C. Steinkampf delivered by Stuckless in the Geochemistry-II session addressed the isotopic characteristics of O, H, and C in ground water beneath Yucca Mountain. The authors demonstrate that the ground waters are isotopically heterogeneous for all three elements; significant variations are seen for the ratios of $^{18}O/^{16}O$, D/H, and $^{13}C/^{12}C$, and in the ^{14}C specific activity. The relationships require contributions (e.g., by mixing) from three or more end-member components. At least two of these must be water to explain the O and H isotope variations while the C variations may reflect another water or reaction with solids.

- R. W. Spengler and Z. E. Peterman, in a paper delivered by Spengler in the Geochemistry-II session, presented data on the concentrations of Rb, K, Sr, and Zr and the $^{87}Sr/^{86}Sr$ ratios in core rocks from Yucca Mountain. The results demonstrate that there are both vertical and lateral heterogeneities in all these parameters. The depth trends of Rb and K abundances are correlated and the concentrations appear to be lower in depth intervals with a high degree of diagenetic alteration. The Sr concentrations and the $^{87}Sr/^{86}Sr$ ratios show significant trends with depth; Sr concentrations increase by an order of magnitude and $^{87}Sr/^{86}Sr$ decreases from about 0.716 to 0.709. These trends are consistent with massive Sr additions from a carbonate aquifer to older tuffs at depth (below the Calico Hills or the Prow Pass Member of the Crater Flat Tuff) but not the younger ones more shallow. The full significance of the Sr isotope relationships is somewhat clouded by the use of composite samples, uncertainties about the degree to which variations may reflect initial, petrogenetic differences, and lack of knowledge about any Sr isotope disequilibrium within individual samples.

- A paper by B. D. Marshall, K. Futa, Z. E. Peterman, and J. S. Stuckless, which was presented by Marshall in the Geochemistry-II session addressed the isotopic compositions of Sr in carbonates in the vicinity of Yucca Mountain. $^{87}Sr/^{86}Sr$ ratios were measured for a variety of materials including, vein and soil carbonates, eolian material, vein and pedogenic carbonates from trenches, and Paleozoic carbonates from Black Marble Hill on the west side of Crater Flat and Spring Mountains 100 km southeast of Yucca Mountain. The results serve to characterize $^{87}Sr/^{86}Sr$ ratios of solutions which precipitate carbonate in the region and, in particular, that in the carbonate-silica veins well known from Trench 14. The $^{87}Sr/^{86}Sr$ ratios for both pedogenic carbonates and near vertical calcite-silica veins as well three eolian samples in the Yucca Mountain area are essentially the same. The range of $^{87}Sr/^{86}Sr$ for these is from approximately 0.7116 to 0.7127 for both the veins and pedogenic carbonate with virtually the same distribution for both types within this interval. The authors stress that these ratios are significantly higher than those of carbonate beneath the water table which is about 0.709. The Sr isotopic relationships support the interpretation that the Sr in both the pedogenic and vein carbonates has a common source. Collectively, the results are consistent with an origin of the vein carbonates from downward-percolating surface waters but not from ascending ground water of the Tertiary aquifer.

- J. S. Stuckless delivered a paper in the Geochemistry-II session which specifically addressed the controversial interpretation of the origin of the calcite vein deposits such as those exposed in Trench 14. A variety of data and relationships, especially C, O, Sr, Pb, and U isotopic, paleontologic, mineralogic, and geologic, were evaluated and used to construct a model for the origin of these veins. All the data were interpreted to be consistent with a pedogenic origin in which meteoric water dissolves surface material, flows downward into fractures and permeable zones, and is removed by transpiration and evaporation leaving calcite and silica deposits. The isotopic constraints imposed by $^{87}Sr/^{86}Sr$ and $^{234}U/^{238}U$ ratios show that the vein fillings did not form from ascending waters like those found in the regional aquifers. Collectively, the evidence for formation by descending surface waters appears to be very compelling.