QADB Filename: TSBuqo051700

MEMORANDUM

DATE: 17 May 2000

TO: Nick Stellavato

FROM: Tom Buqo

SUBJECT: Review of AMR - Characterize Eruptive Processes at Yucca Mountain, Nevada (ANL-MGR-GS-000002, Rev 00)

I have reviewed the subject document and have a number of comments:

Comment 1.

Section 5, page 21-24, Assumptions

Data from analog sites is used as the basis for estimating key parameters in the eruptive processes analysis. Analog sites used include volcanoes in Hawaii, New Mexico, Mexico, Italy, Russia and elsewhere, but little reliance is based upon volcanoes and volcanic features in the Yucca Mountain Region, most notably the cinder cones and basalt flows and the subsurface volcanic features in the Amargosa Desert, Crater Flat, Oasis Valley, Sarcobatus Flat, and Clayton Valley. Figure 3/9-6 of the Yucca Mountain Site Description (B00000000-01717-5700-00019, REV 0, page F3.9-6) depicts no less than twenty younger post-caldera basalts of post-Miocene age in the immediate vicinity of Yucca Mountain. Additional information on these features within the immediate vicinity of Yucca Mountain and within the Yucca Mountain region would likely provide a much better basis for analysis than a few scattered locations from around the world.

For example, in Langenheim (1995 p. 3) total magmatic volumes are given for two volcanic centers in Crater Flat and two aeromagnetic anomalies in Amargosa Desert, yet the discussion on page 39-40 of the AMR includes only the volume of the Lathrop Wells Cone. The recent aeromagnetic survey work sponsored by Nye County has provided additional information about the buried volcanic features in Amargosa Desert and Crater Flat, especially with regard to the interrelationship between the locations of these features and regional-scale geologic structures. These features were reported on by Langenheim (1995) who concluded that:

> “Modeling of the aeromagnetic anomalies over alluvial areas near the potential Yucca Mountain high-level waste site can contribute to a better understanding of the history of volcanism in the area as well as supplement volume estimates necessary for calculating the probability of future volcanism at Yucca Mountain (as cited, p. 13).”

The AMR concludes on pages 47 that “Duration and volume of individual explosive phase during formation of a new volcano should be a probability distribution function derived from Table 5...”, but no information concerning volume can be derived from Table 5. The failure of the AMR to include volume estimates specific to the Yucca Mountain region such as those by Langenheim (1995) is considered a significant deficiency in the approach employed in analyzing eruptive processes. The failure of the AMR to include such work also contradicts statements that the verification of assumptions is not required because the AMR is based on the best available information.

Comment 2

There is some question as to the validity of Assumption 2 (the most likely future eruptive event will have a magmatic chemistry similar to the mean composition of the Lathrop Wells volcano). Heizler et al (1999, p. 768) states “The type of geochemical variations observed at Lathrop Wells has not been reported from other small-volume basalt centers...” citing the work of Bradshaw and Smith (1994) on polygenetic Quaternary volcanism in Crater Flat. Neither the work of Heizler et al (1999) nor the work of Bradshaw and Smith (1994) are cited in the AMR. The failure of the AMR to include such work contradicts statements that verification of assumptions is not required because the AMR is based on the best available information.

Comment 3

With regard to conduit diameters and depths, the statements are made on page 25 that “the best potential data for these parameters would come from a study of basaltic volcanic necks exposed by erosion in the southwestern United States where direct measurements of conduit diameter and its variation with depth could be made. However, such data are lacking; although many volcanic necks have been mapped as part of regional studies, they were not measured in detail, at least for the range of compositions of interest to the YMP. Without access to direct measurements of conduit diameter, estimates of the parameter are based on analog studies.”

Such measurements should have been made both within the Yucca Mountain region and in the southwestern United States. Further, the calculation of conduit diameter for one of the analogs that was used (Tolbachik volcanic vents) was based on “estimates of eruption volume, xenolith content of the pyroclastic deposits, and source depths of the xenoliths. By assuming an initial conduit diameter and calculating the volume of county rock removed along part of the length of the conduit, one can calculate the progressive enlargement of the conduit as the eruption proceeds (AMR, p 25)”. Thus the value used to provide an upper bound conduit diameter is not a measurement but rather a calculated value based upon estimates and assumptions. The AMR should be revised to make it clear that the value is not a measurement.

Comment 4

On page 26, the AMR states that the major element variation for Lathrop Wells is based upon 45 chemical analyses from Perry and Straub (1996, Appendix A). However, a review of the cited reference indicates that there were analyses of 118 samples and that none of the analyses listed in the note to Table 2 of the AMR included the vent scoria deposits. The rationale for only using the analyses for flows while ignoring the analyses for the scoria should be clearly presented in the AMR along with a discussion of the consequences of censoring the data from the scoria and tephra deposits.

Along these same lines, the AMR presents in Table 3 the mole percent concentration of volcanic gases with “lumped means” of sample results for hawaiite, tholeiitic basalt, nephelenite, and alkali basalt with no indication of the numbers of samples or analyses of each type of volcanic rock. Perry and Straub (1996, Figure 4, p. 5) clearly demonstrate however, that all of the basalts of Lathrop Wells are classified as alkaline basalt. The rationale for using analyses for basalts with contrasting Na2O + K2O:SiO2 ratios and the consequences of using such an approach should be clearly presented in the AMR.

Comment 5.

On page 31, the AMR states "YMR basaltic lavas are generally aphyric to sparsely prophyritic, citing Perry and Straub 1996, p. 6). The cited reference states that "Basalts of Lathrop Wells are sparsely porphyritic with phenocrysts of olivine and plagioclase in a fine-grained groundmass of plagioclase, olivine, titanomagnetite and clinopyroxene." The cited reference also states on the same page that "The Sr and Nd isotopic compositions of Lathrop Wells basalts are highly unusual for continental alkali basalts of the western U.S. and indicate derivation from a trace-element enriched lithospheric mantle source, citing Farmer et al (1989). The AMR misstates the description by Perry and Straub who *did not* characterize the YMP basalts as generally aphyric, and the AMR does not cite the work of Farmer et al (1989) which suggests that the use of analogs from far distant sites is not only inappropriate, but could cause misleading results. The AMR does however use the mischaracterization of Perry and Straub's work to infer that the lavas were erupted at near-liquidus or superliquidus temperatures without any reference to work that would lead to that conclusion or inference.

Comment 6

The methodology used to calculate the densities listed in Table 4 (page 32) is not clear from the discussion on page 32 and insufficient data are presented in the AMR to reproduce the calculated values. The AMR should provide both adequate data and descriptions of the methodology to allow independent reviewers to verify all calculations that were performed as part of the analyses.

Comment 7

The AMR (p. 48) does not provide adequate justification for concluding that the mean particle size erupted during a violent strombolian phase will be a log triangular distribution with a minimum of 0.01 mm, a mode of 0.1 mm, and a maximum of 1.0 mm. This conclusion is not supported by the discussion on p. 44-45, nor is it consistent with the fact that volcanic bombs in the range of 10 cm to 1 m are common in many areas of the southwestern United States. The particle size distribution should be revisited as the stated size distribution would result in the "sandblasting" of the containerized wastes while in reality, the waste containers could be bombarded by much larger (and hence much more destructive) clasts.

Comment 8

The conclusions section (p. 47-48) should include statements on the high degree of uncertainty relative to the various volcanic styles and processes, and the even higher uncertainty relative to interactions between eruptive events and the waste stored in a repository.

Comment 9

The AMR makes no attempt to address two of the most important issues related to volcanic eruptions in the Yucca Mountain Region... .where are such eruptions likely to occur, and what is the probability of an eruption occurring within the pre-closure and post-closure time frames. These issues may be addressed in another AMR (or AMRs) and if so, then the AMR should clearly state where these issues are addressed. If these issues are not addressed by other AMRs, then this AMR should provide a complete analysis addressing the probabilities of the where and when of volcanic eruptions.