

12/5/94

MEMORANDUM FOR: Michael J. Bell, Chief  
Engineering and Geosciences Branch, ENGB

FROM: Keith I. McConnell, Section Leader *KIM*  
Geosciences/Geotechnical Engineering Section  
Engineering and Geosciences Branch, ENGB

SUBJECT: INFORMAL MEMORANDUM TO JEANNE NESBIT (DOE)

On or about September 26, 1994, I received the attached informal memorandum from Ms. Jeanne Nesbit of the Department of Energy. Although she requested that I call her to discuss the attachment that consisted of a memorandum from B. Crowe, F. Perry, and G. Valentine of Los Alamos National Laboratory to Ms. Nesbit, no discussions ever occurred.

Attachment: As stated

cc: R. Johnson w/att  
J. Trapp w/att  
S. McDuffie w/att  
PDR w/att

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INFORMAL MEMORANDUM

TO: Keith McConnell

FROM: Jeanne Nesbit *JCN*

DATE: September 16, 1994

RE: Informal response to NRC staff comments on study plan 8.3.1.8.5.1

As you are aware, there are several technical issues within the volcanism program that continue to be points of disagreement between the Los Alamos principal investigators and the NRC and CNWRA staff. For this reason, DOE does not plan to respond formally to the last set of comments on study plan 8.3.1.8.5.1 (letter, Holonich to Shelor, May 21, 1994) or to the rejection of our responses to the NRC detailed technical comments on study plan 8.3.1.8.1.1 (letter, Holonich to Shelor, February 8, 1994) at this time. Speaking as the DOE's Work Breakdown Structure manager for the volcanism program, I'm convinced we have reached a point where it is best to simply agree to disagree. }

However, as we have tried to convey on many occasions, DOE is continuing with our planned volcanism program with the goal of eventually reaching convergence with the NRC. In the meantime, it is important that we continue to try to understand each others' concerns. For this reason, I am providing you with an informal response to the NRC comments on study plan 8.3.1.8.5.1 (attachment). I am hoping that this letter will help you understand how the NRC's comments are received and perceived by the Los Alamos principal investigators. Perhaps this will distinguish among the areas where we have agreement, communication problems, and true technical disagreements.

In order to circulate these informal responses among the staff, I understand that you would need to make them available in the Public Document Room. Until you have a chance to read and think about them, I ask that you keep them as a privileged communication. Please call me to discuss them, after which time they may be put into the PDR.

I can be reached on (702) 794-7930.

Attachment:

Memo, Crowe et al. to Nesbit, July 20, 1994

# Los Alamos

Los Alamos National Laboratory  
101 Convention Center Drive, Suite 820  
Las Vegas, NV 89109

WBS 1.2.3.2.5  
"QA"

## memorandum

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4/16  
Nesbit, J.C.  
Bjorstedt  
Boquer, R.  
Tess  
Lomard  
Sudler-Toms  
Jones, S.  
Chawley

TO: J. Nesbit, DOE/YMSCO

THROUGH: J. Canepa, LANL

FROM: B. Crowe, LANL B. Crowe  
F. Perry, LANL BMC for F. Perry  
G. Valentine, LANL BMC for G. Valentine

SUBJECT: RESPONSE TO NUCLEAR REGULATORY COMMENTS ON STUDY PLAN 8.3.1.8.5.1 CHARACTERIZATION OF VOLCANIC FEATURES (SCPb: 8.3.1.8.5.1) 7/26/94

We received and have evaluated the comments and questions by the US Nuclear Regulatory Commission (NRC) on Study Plan 8.3.1.8.5.1 Characterization of Volcanic Features (Letter 1-357971, Holonich to Shelor). We have tried to respond to comments and questions that can be directly or even indirectly related to information presented in the referenced Study Plan. These include Comments 1, 4, 7, and Questions 1, 5, 8, 9. The other comments and questions cover information from non-reviewed or previously reviewed Study Plans, published papers and the preliminary draft of the *Volcanism Status Report*. We have assumed it is not appropriate to respond formally to NRC comments and questions on non-referenced Study Plans or non-Department of Energy (DOE) documents.

Before presenting our responses, we want to raise several important issues brought to focus by the NRC document. These include:

1. Has the NRC established a new precedent of submitting written comments and questions for symposium papers, literature publications and preliminary drafts of technical reports? Is this an official change in NRC policy? Does the NRC keep Study Plans open continuously for review?
2. Some, perhaps many, comments and questions by the NRC result from their misinterpretations of existing information and from errors in logic developed from their reviews of data. Additionally, some comments and questions by the NRC result from their incorrect assumptions of implications of volcanism data and an incomplete understanding of volcanism data provided to them in reports and summarized in oral presentations. Information provided to the NRC in the draft *Volcanism Status Report* and particularly Study Plan 8.3.1.8.1.2 (currently under review by the NRC) covers almost all of the topics contained in the NRC comments and questions. Additionally, much of the question and comment material was discussed at the June, 1993 Technical Exchange and in papers presented at the Focus 93 conference. It appears that our efforts at enhancing communications with the NRC are meeting with limited success. It is not clear how we can attempt to further resolve differences of opinion or communication problems when the NRC continues to exhibit inadequate knowledge of the content of volcanism documents and papers, and an inability to fully absorb the technical information provided on the volcanism program. We are committed heavily to completing ongoing studies described in the

three volcanism study plans. We will fully support any requested future DOE-NRC interactions on volcanism studies. But given the wealth of information already presented to the NRC (*Volcanism Status Report*, publications, and presentations), it is prudent to give near-term priority to completion of the planned work described in the three volcanism Study Plans.

3. Our ongoing and planned work described in the three study plans makes many judicious choices about the relevance of work to the site characterization mission of the DOE. We have attempted to prioritize volcanism studies so they are directly applicable to issues involving assessments of the potential disqualification/suitability of the Yucca Mountain site. Many of the comments and questions contained in the NRC document appear to have at best limited significance to disqualification or suitability issues. In other cases, their comments and questions cover interpretations of data that may not require resolution because the data uncertainty for specific topics are bounded by probabilistic approaches to volcanism studies. We recognize that there are elements of judgmental subjectivity in making decisions on data relevance. However some of the NRC comments and questions cover information that is at best very difficult to relate in any direct way to site characterization issues. We are faced with the dilemma that responding to these comments and questions would have no benefit to the DOE mission and would divert us from ongoing studies.

#### Responses to NRC Comments and Questions

##### Comments That Can be Directly or Indirectly Related to Study Plan 8.3.1.8.5.1

*Comment 1: The aeromagnetic data described in Section 2.11 may not be sufficient to detect and resolve magnetic anomalies associated with small intrusions which are of regulatory concern.*

*Recommendation: Consider conducting more detailed investigations, including ground geophysical surveys, in the area of volcanic centers near Yucca Mountain. In addition, this effort should also involve investigation in appropriate analog areas.*

First, we agree with the NRC that there is a concern with the detection of small intrusive bodies, particularly when the bodies are intruded into volcanic rocks where the contrast in the magnetization properties may be small. As a result, we have had the geophysics program reviewed by Dr. George Thompson, Stanford University. We informed the NRC at two meetings (NWTRB meeting in March, 1994; ACNW meeting in April, 1994) that we would be conducting more detailed geophysical studies, including ground magnetic surveys, to address this concern. Thus we are in fundamental agreement with the NRC on the concern of the detectability of small intrusions. What is incongruous however, is that this comment does not acknowledge or reference our recent discussions with the NRC where we presented plans to address their concern.

Second, the NRC has confused two issues in this comment. Because of *their* confusion, the NRC derived an interpretation, which they attribute to the volcanism program, that *is not* and *has not* been made by the DOE volcanism program.

There are two issues concerned with magmatic intrusions. These are the effect of *undetected* intrusions on the estimates of the probability of magmatic disruption of a specified area (E2 given E1), and the effect of intrusions on estimates of the effects of magmatic processes (E3). We have presented preliminary data that studies of eroded basaltic intrusions in the Yucca Mountain region (YMR) have not revealed an example where an intrusion formed *without an accompanying surface eruption* (the term *surface* and *eruption* are redundant but we use both terms to emphasize the point). This observation, which we are continuing to test as part of site characterization activities, applies mostly to the estimates of E1. If there are undetected intrusions in the YMR, estimates of E1 could be too low (a point of agreement). However, if intrusions do not form without "surface" eruptions, the detectability issue is not significant because surface volcanic rocks ranging in age from Late Quaternary to Pliocene are readily visible to even cursory field studies. Therefore it is unlikely that the recurrence rate would be underestimated. A second point of confusion relates to models used to develop probabilistic estimates of E2. The probability estimates for intersection of a specified area presented in the *Volcanism Status Report* includes both the surface centers and the geometry of subsurface feeder dikes. The latter factor is precisely why the spatial and structural models were expanded to include the exploration block and to *accommodate the dimensions of subsurface intrusions*. Models of the subsurface geometry of basalt dikes are examined explicitly in the papers by Sheridan (1992) and Wallman et al. (1993). These models are included in the probabilistic estimates of E2 in the *Volcanism Status Report* and in the paper by Crowe et al. (1993). Simple inspection of multiple tables and figures in both documents should have revealed this to the NRC -- it is not a subtle or difficult point to grasp.

The NRC appears equally confused with our studies of the effects of volcanism (E3) *despite the fact that they are currently reviewing* Study Plan 8.3.1.8.1.2. This document presents plans to assess the geometry of intrusions including intrusion with or without eruptions. Our intention to carefully consider the geometry of subsurface intrusions is illustrated in numerous figures in sections I and VII in the *Volcanism Status Report*. It is a point of considerable discussion in the papers by Valentine et al. (1992; 1993). Again, it is difficult to assess how the NRC could have read carefully the cited reports and papers without understanding this point.

Finally the NRC assertion that Crowe et al. (1993; referring to the *Volcanism Status Report*) assumed the intrusive to extrusive ratio of basalt in the YMR to be one-to-one *is completely erroneous*. This conclusion was not made in the *Volcanism Status Report*. It is an inference made by the NRC. We agree that the ratio is probably not 1:1 and can only ask why the NRC thinks we have made this conclusion?

#### Other Errors in Comment 1

**NRC text:** *Probability models developed to date have dealt almost exclusively with the probability of a volcanic event in the Yucca Mountain region during the containment period (10,000 years). These models, with the notable exception of Sheridan (1992), do not deal with the likelihood of intrusion to repository depths without accompanying volcanic activity.*

The model of Sheridan (1992) was included in the probability calculations used in the *Volcanism Status Report* and in Crowe et al. (1993). Further, studies by Wallman et al. (1993) also included subsurface dike geometry in probability calculations and the Wallman et al. (1993) results were also included in the cited reports. Neither the work by Sheridan (1992) nor Wallman et al. (1993) emphasized uniquely the likelihood of intrusion without accompanying volcanic activity. They did however, assess the subsurface geometry of intrusions *accompanying* volcanic eruptions. Moreover the geometry of subsurface intrusions is used in the spatial and structural models described in the *Volcanism Status Report* and in Crowe et al. (1993). It is the primary basis on which the models are expanded beyond the boundaries of the surface distribution of volcanic rocks.

**NRC text:** *The 1980 activity at Long Valley caldera may provide another example of a dike reaching shallow depths in a continental setting without erupting.*

The 1980 Long Valley event is an inferred intrusive event (and there is some debate whether this was an intrusive event or a deformation event) at a silicic caldera complex with a probable shallow magma chamber. It is very difficult to understand how Long Valley setting provides any analogy to the YMR where volcanic activity consists of small volume pulses of basalt with mineralogical assemblages that preclude residence time in a shallow magma chamber. We remain open about the issue of intrusion without eruption. But certainly it is logical to look for analog sites in more appropriate areas than Long Valley and the Snake River plains.

**NRC text:** *In addition, this effort should also involve investigation in appropriate analog areas.*

Study Plan 8.3.1.8.1.2 presents plans to conduct field geological studies at analog sites where intrusive bodies of basaltic composition are exposed in the shallow crust. Results of these studies were presented at the High Level Radioactive Waste Conference in 1992, at Focus 93, and at the volcanism presentation to the ACNW in April, 1994. The NRC was present at all of these presentations. Valentine et al. (1992; 1993) has published papers describing the results of studies of analog sites. These papers were referenced in the *Volcanism Status Report*. The NRC is currently reviewing Study Plan 8.3.1.8.1.2. We are forced to raise the question of why the NRC would recommend undertaking investigations of analog sites *when analog studies are described in the Study Plan and in published work?*

**Comment 4:** *It is unclear how the volume of eruptive basalts is being calculated.*

**Recommendation:** *Provide a more complete description of parameters used to calculate eruption volumes and the assumptions used to convert volumes to dense rock equivalents. Describe the method used for compensating for the dispersed ash associated with eruptions.*

Perhaps the best method to respond to this comment is with a quotation from the *Volcanism Status Report*:

Section VII, Part IV B, Item 1: *"We are in the process of completing revised volume calculations for the Pliocene and Quaternary basalt centers of the YMR. Descriptions of the methods of volume calculations, the uncertainty of the calculations, and the resulting data should be completed in late calendar year 1994."*

The development of volume data for basaltic volcanic rocks of the YMR is an evolving topic and has been considerably aided by several developments. First, we have obtained digital terrain data for the Pliocene and Quaternary volcanic rocks of the Crater Flat basin through aerial surveys supported by the DOE. Second, the volcanism project has funded aerial topographic surveys and processed digital terrain data for the Lathrop Wells and Sleeping Butte volcanic centers. Third, EG&G, a YMP contractor, provides support to the DOE for the development of GIS capabilities. They have substantial expertise through the use of Silicon Graphics workstations and Dynamic Graphics software and are planning currently 3-D computer calculations of the volume of volcanic centers and associated deposits in the YMR. Revised volume calculations for the Pliocene and Quaternary volcanic rocks of the Crater Flat area and the Sleeping Butte centers will be obtained through the computer-based 3-D calculations using geologic maps compiled on orthophotographic bases and incorporating geophysical data on the distribution of subsurface volcanic rocks. We are now developing the methods for revised volume calculations and have delayed completion of a Detailed Procedure on the methods until acquisition of the digital terrain data, the orthophotographic bases, and QA approval of the software packages.

We are puzzled why the NRC continues to question whether we have considered "compensating for the dispersed ash associated with eruptions." In our 1983 calculations (Crowe et al. 1983), we noted that the volume of eroded scoria-fall deposits associated with the scoria cones of the YMR was estimated by comparison to published studies of scoria cones and their associated fall sheets. This is discussed on page 272 of the cited text. We also discussed ranges in scoria sheet-to-cone ratios and cited examples from the volcanological literature. A ratio of 5.1 was assumed for the calculations used in the 1983 paper and the method applied was illustrated by figure 7 (in this paper), a log plot of area of coverage vs. thickness of deposits of Strombolian scoria-sheet deposits (again page 272). We discussed the sensitivity of different assumptions of the sheet-to-cone ratios in magma volume calculations in Crowe and Perry (1989, page 332) and also discussed plans for revised volume calculations (also on page 332). Our future calculations will of course be updated using newly published methods described in the volcanological literature and will take advantage of the more than 100 trench exposures constructed in the Lathrop Wells deposits.

*Comment 7: It is unclear how the research discussed in this study plan will resolve alternative petrogenetic [sic] models*

*Recommendation: The study plan should describe the methodology which will be used to differentiate between the various alternative petrogenetic models.*

It is beyond the scope of a study plan to provide detailed information on the precise methodology of testing or resolving alternative petrogenetic models. The methods are specific to the data set. However, the suite of major trace element and isotopic studies proposed in the study plan should be sufficient to

allow full consideration of alternative petrogenetic models. One possible source of confusion could be from a discussion emphasis in the study plan on petrologic studies of polycyclic models. We will rewrite that section in future revisions to make it more clear that we will test multiple alternative petrogenetic models.

We also do not understand the NRC emphasis on lithospheric to asthenospheric source transitions in relation to petrogenetic trends in the Yucca Mountain region (e.g., "*The Crater Flat system has not reached an asthenospheric stage of magmatism, and therefore, cannot be considered a waning magma system on the basis of regional petrogenetic trends*"). We have no knowledge of studies in the western U.S. that relate waning of volcanism specifically to a change to an asthenospheric source. Instead, the timing of the lithosphere/asthenosphere source transition appears to be controlled by the tectonic history of particular regions (i.e., the extent and timing of lithospheric thinning due to lithospheric extension). Given the unique tectono-magmatic history of the southern Great Basin, it is very possible that magmatism will *never* reach an asthenospheric stage but it will surely wane at some point. To conclude that the Crater Flat system will continue to be active for several million years simply because it presently has a lithospheric source is erroneous. As petrogenetic studies progress, our conclusions regarding the evolution of the Crater Flat system will be guided primarily by data obtained from the Crater Flat system itself, tempered by insight obtained from consideration of appropriate analog systems.

Furthermore, NRC continues to express concern over waning volcanic models. While we feel the current data are suggestive of a waning volcanic system, we use a steady state model in probability estimates. Thus because of this assumption, *proof of a waning system may not be required in volcanism studies*. The "waning versus steady-state" explanation was made repeatedly to the NRC at the Technical Exchange in 1993. We will continue to test alternative geochemical models to ensure probability models do not underestimate risk. However we can only ask why the NRC continues to question a waning model when we assume steady state models in probability estimates?

Question 1: *What methods for the determination of all important rock magnetic properties have been considered?*

*Recommendations: Consider analyzing the samples in a rock magnetism laboratory so that the VRM component can be removed prior to estimation of polarity.*

The application of rock magnetic properties in Study Plan 8.3.1.8.5.1 is primarily for cross-checking the results of geochronology studies. Detailed paleomagnetic studies are undertaken when the studies could prove critical to discrimination of alternative models. For example, detailed paleomagnetic studies have been undertaken for the Lathrop Wells center to attempt to discriminate monogenetic versus polycyclic eruption models (see Section 3.2.2.8 Paleomagnetic Studies [p. 64]) for descriptions of paleomagnetic studies and procedures used to test or discriminate field volcanic units. Results of these studies have been described in Champion (1991) and in the *Volcanism Status Report*.

The fluxgate magnetometer is used routinely in field studies to establish the polarity of basaltic volcanic rocks. Uncertainty in Vertical Remnant Magnetization (spurious results) is commonly observed and accounted for by making multiple polarity measurements at multiple sites and comparing the results of



the polarity measurements with aeromagnetic surveys. Discrimination of polarity data will be considered only if polarity results conflict with geochronology studies. The essential point is that polarity measurements are used primarily as a cross-checking tool for geochronology studies. They should not be confused with paleomagnetic studies for discrimination of alternative eruption models. Measuring the polarity of basaltic volcanic rocks is simple and routine. We cannot see the merit of development of a specific detailed procedure for this work and include it under volcanism field studies (Los Alamos Detailed Procedure 606).

*Question 5: If the theory of polycyclic volcanism is correct for the volcanoes in the region of Yucca Mountain, how will it be assured that age determinations accurately represent the age of the various cones?*

*Recommendation: Present a sampling scheme that will be used to resolve the concerns with age determinations of potential polycyclic features.*

We agree fundamentally with the thrust of this comment. However the requested data for this question is covered already in Study Plan 8.3.1.8.5.1. Basically, the sensitivity of chronology methods is dependent on application to probabilistic studies, which in turn is somewhat dependent on the age of the volcanic unit. We probably do not have to discriminate polycyclic models at Pliocene volcanic centers and it may not be possible given the loss of the volcanic record with time. Our current results of geochronology studies suggest that the duration or time interval between polycyclic events is < 100 ka. Sub-100 ka chronologic resolution for the Pliocene or older Quaternary volcanic rocks is probably beyond analytical capabilities. We carefully described the application of multiple geochronology methods for resolution of chronology studies in section 3.2 of Study Plan 8.3.1.8.5.1. We can only urge the NRC to carefully reread this section. It is simplistic however, to think that we can specify in a Study Plan a set number of analyses or methods to resolve the chronology of an individual volcanic center. The discovery process is an intricate part of scientific studies.

*Question 8: How will the volumetric relationships from the different volcanic systems in western North America be used to develop specific time-dependent, volume-predictable models for the Crater Flat system.*

*Recommendation: Provide more information regarding the basis for selection of volcanic fields thought to be analogous to those near the Yucca Mountain site.*

The answer to the recommendation part of this question is provided already in Study Plan 8.3.1.8.5.1. Page 49 lists criteria for the selection of volcanic fields for study. The goal of activity 8.3.1.8.5.1.5 Evolutionary Cycles of Basaltic Volcanic Fields is "... to determine if the volcanism of the Yucca Mountain region (YMR) is in a recognizable stage of evolution" (page 21 of the Study Plan). Given the sparse data set for the YMR, we strongly doubt whether "specific time-dependent, volume-predictable models" can be demonstrated with certainty for the YMR. Our goal however is to test alternative ranges of models for the YMR to ensure assumptions used in probability estimates are reasonable and do not underestimate volcanic risk. We cannot provide specifics details on how data will be used until we are more advanced in our studies. Page 50 of the Study Plan is a preliminary list of volcanic fields to be

studied and includes many of the fields mentioned in the text material of the NRC comment. We agree with the concerns expressed for the Springerville volcanic field and the Colorado Plateau transition area. While we are gathering readily available literature data for these fields, the data may or not prove appropriate to the YMR volcanism studies. We are well aware of the pros and cons of selection or elimination of volcanic fields and the application of the data to the YMR (see discussions p. 48-50 of Study Plan 8.3.1.8.5.1). The important point is that we develop a ". . . range of models for the evolutionary patterns of volcanic fields." Perhaps the NRC should defer this comment until they have seen actual results of these investigations

Question 9: *How will phenocryst mineralogy be characterized in sparsely phytic rocks?*

*Recommendation: Describe how the phenocryst assemblage will be characterized.*

The characterization of phenocryst mineralogy is described in the study plan. We did not consider heavy mineral separations for scoria deposits in our development of plans for the mineralogical characterization studies. We will reevaluate our planned studies taking this question into consideration.

**Explanation for "No Response Required" for Other Comments and Questions:**

Comment 2: Study Plan 8.3.1.8.5.1 describes the methods that will be used for establishing the chronology of Pliocene and Quaternary volcanic centers in the YMR. Comment 2 raises a question about the results of one method (thermoluminescence, [TL]). While we agree with the general text of the comment, it is not concerned with the Study Plan. Furthermore as a minor comment, the NRC appears to be unaware that sunlight exposure removes existing TL signals and is the basis for applying the TL method to soil samples. This particular application has been used many times, and in fact, more times than "baked" samples. The sunlight exposure assumption has been described in almost all references to TL age determinations including the references cited by the NRC in Comment 2.

Comment 3: Comment three questions the results of chronology methods, not the material presented in Study Plan 8.3.1.8.5.1. However the NRC should be aware that their comment is based on incorrect interpretations of the stratigraphy of the Lathrop Wells center. The "young tephra" (chronostratigraphic unit 4) was never compared with the Black Tank cone in the Cima volcanic field. They have confused discussions of chronostratigraphic unit 4 with earlier discussion of the Lathrop Wells cone (Wells et al. 1980). In fact an extremely critical and key inference for the stratigraphic position of the deposits of the youngest event was that the geochemistry of chronostratigraphic unit 4 is distinctly different from the deposits of chronostratigraphic unit 3 (the main cone). It is difficult to understand how the NRC could have read carefully the *Volcanism Status Report* and confused the cited correlation with the Black Tank cone. This correlation was never proposed and has no application to chronostratigraphic unit 4.

- Comment 5: Comment 5 is concerned with studies described in Study Plan 8.3.1.8.1.1 *not* Study Plan 8.3.1.8.5.1. This comment continues to reflect confusion on the part of the NRC concerning a key point made repeatedly in the *Volcanism Status Report*, in many published papers, and in numerous presentations made directly to the NRC and at meetings where the NRC was present. *A probabilistic approach does not necessarily require testing or discrimination of all alternative tectonic models.* The more important issue is whether alternative tectonic models produce different results in probabilistic risk assessment. Given the limited number of volcanic events in the YMR, it may not be necessary to discriminate alternative tectonic models if they produce similar results in probabilistic risk assessment. This comment also illustrates a recurring problem that we attempted to correct many times. The NRC somehow developed the mistaken conclusion that the volcanism studies are using only one tectonic model. Multiple alternative spatial and structural models were presented in assessments of E2 in the *Volcanism Status Report* (see particularly Section VII) and in Crowe et al. (1993).
- Comment 6: Xenolith studies are described in Study Plan 8.3.1.8.1.2 and not in Study Plan 8.3.1.8.5.1. We can only express surprise at this NRC confusion. They are currently reviewing Study Plan 8.3.1.8.1.2 that describes planned xenolith studies. The results of xenolith studies from analog sites were presented at Focus 93 (Valentine et al. 1993) at a session that was *co-chaired by a NRC staff member.*
- Question 2: This question is concerned with the results of paleomagnetic studies, some of which have been conducted by researchers outside the YMP. It is not relevant to the discussion of the methods of paleomagnetic studies described in Study Plan 8.3.1.8.5.1.
- Question 3: The topic of exploration methods related to question 3 are described in Study Plan 8.3.1.8.1.1 *not* Study Plan 8.3.1.8.5.1.
- Question 4: The topic of teleseismic "seismic" tomographic data referred to in question 4 applies to Study Plan 8.3.1.8.1.1 *not* Study Plan 8.3.1.8.5.1. We presented information orally that answers this question at the NWTRB meeting in March and the ACNW meeting in April. The NRC staff was present at both meetings.
- Question 6: The topic of tectonic models and application to volcanism studies is discussed in Study Plan 8.3.1.8.1.1 *not* in Study Plan 8.3.1.8.5.1. Again we must remind the NRC of a point made repeatedly in our Study Plans, publications, and presentations: we may not be required to prove or discriminate alternative tectonic models. Given the limited data base of volcanic events, this is probably impossible. What is more important is an evaluation of the effects on probabilistic risk assessment of multiple *alternative tectonic models.*

J. Nesbit, DOE/YMSCO  
NRC COMMENTS ON  
STUDY PLAN 8.3.1.8.5.1  
July 20, 1994

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Question 7: The topic of degassing and hydrothermal alteration is discussed in Study Plan 8.3.1.8.1.2 not in Study Plan 8.3.1.8.5.1. This topic is also described extensively in the papers by Valentine et al. (1992; 1993).

BMC:jp01

Cy: EES-13/LV, LANL, MS 527  
RPC/LV, MS 527