

NNA-870622.0025

SAIC/T & MSS  
JUN 22 1987  
C C F RECEIVED

REPORT OF THE PEER REVIEW PANEL  
ON THE  
PROPOSED PROGRAM OF STUDIES OF THE  
CALCITE AND OPALINE-SILICA DEPOSITS  
IN THE YUCCA MOUNTAIN AREA  
NEVADA

- Gilbert N. Hanson, Chairman
- Victor R. Baker
- Philip M. Bethke
- Peter J. Hudleston
- Glenn R. Roquemore

June 18, 1987

8712090275 871110  
PDR WASTE PDR  
WM-11

## Introduction

The members of the peer review panel of the proposed program of studies of the calcite and opaline-silica deposits located along faults in the Yucca Mountain area after reading the "Proposal for Study of Hydrogenic Deposits", observing some of these deposits in the field, listening to oral presentations of the proposed studies, and reading literature appropriate to this study present this unanimous report:

Several models have been suggested for these deposits in the proposal and in the workshop reports. These can be grouped into four main categories:

1. Pedogenic: meteoric waters flowing down through the soil have selectively deposited the calcite and opaline silica along fractures formed by faulting.
2. Cold Spring: cold ground waters ( $T < 30^{\circ}\text{C}$ ) have moved up along the faults depositing the calcite and opaline silica near the surface as spring deposits.
3. Hydrothermal: hot waters ( $T \gg 30^{\circ}\text{C}$ ) of several possible origins have moved up along the faults depositing the calcite and opaline silica near the surface.
4. Seismic Pumping: hot or cold waters moved up along a fault as a direct result of faulting.

The data available for the veins at Trench 14 are not adequate to allow us to evaluate whether any one of these models is the correct one. Four major periods of silica and/or carbonate introduction have been recognized in Trench 14:

1. Chalcedony/opal linings of vugs in the non-welded Ranier Mesa tuff.
2. Drusy quartz and chalcedony lining vugs and fractures in the Tiva Canyon welded tuff.
3. Silica-cemented breccia.
4. Calcite and opaline-silica veins.

The silica-filling vugs and fractures in the Tiva Canyon and Ranier Mesa tuffs predate the breccia and vein fillings and are very likely products of the devitrification of the tuffs or later deposition from ground water. Such silica fillings are common in volcanic rocks the world over (e.g. thunder eggs). Similar occurrences can probably be found in each of the units at locations on the Test Site remote from faulting. Although these silica deposits cannot be ignored in the context of the proposed program, the panel recommends that their characterization be given lower priority than that of the silica-cemented breccia and the calcite and opaline-silica veins.

The silica-cemented breccia cut by the calcite and opaline-silica veins probably represents a different and earlier form of silica and carbonate introduction along the fault zone. On the basis of field inspection it may reasonably be interpreted as a hydrothermal eruption breccia. The peer reviewers feel that, because this is more likely to be of hydrothermal origin, it needs particular attention.

The calcite-opaline veins clearly cut the silica-cemented breccia, and are, therefore, the highest priority for study. There is some indication from the stable isotope data that the calcite and opal samples analyzed so far were deposited from water of less than 30°C, which would favor models 1 or 2. More data, however, are essential. Episodic expulsion of hot or cold water from depth as a consequence of faulting (seismic pumping) would produce effects similar to processes 2 and 3 above, and might not be distinguishable in the nature of the deposits. In the case of seismic pumping the laminae in the deposits will represent discrete fracturing events related to faulting. In the case of normal ground water flow the laminae may also describe faulting events, but they may in part reflect non-fault related changes in the character of ground water flow (e.g. climatic control). The members of the peer review were not able to suggest any model for the origin of the deposits not considered in the material presented to us.

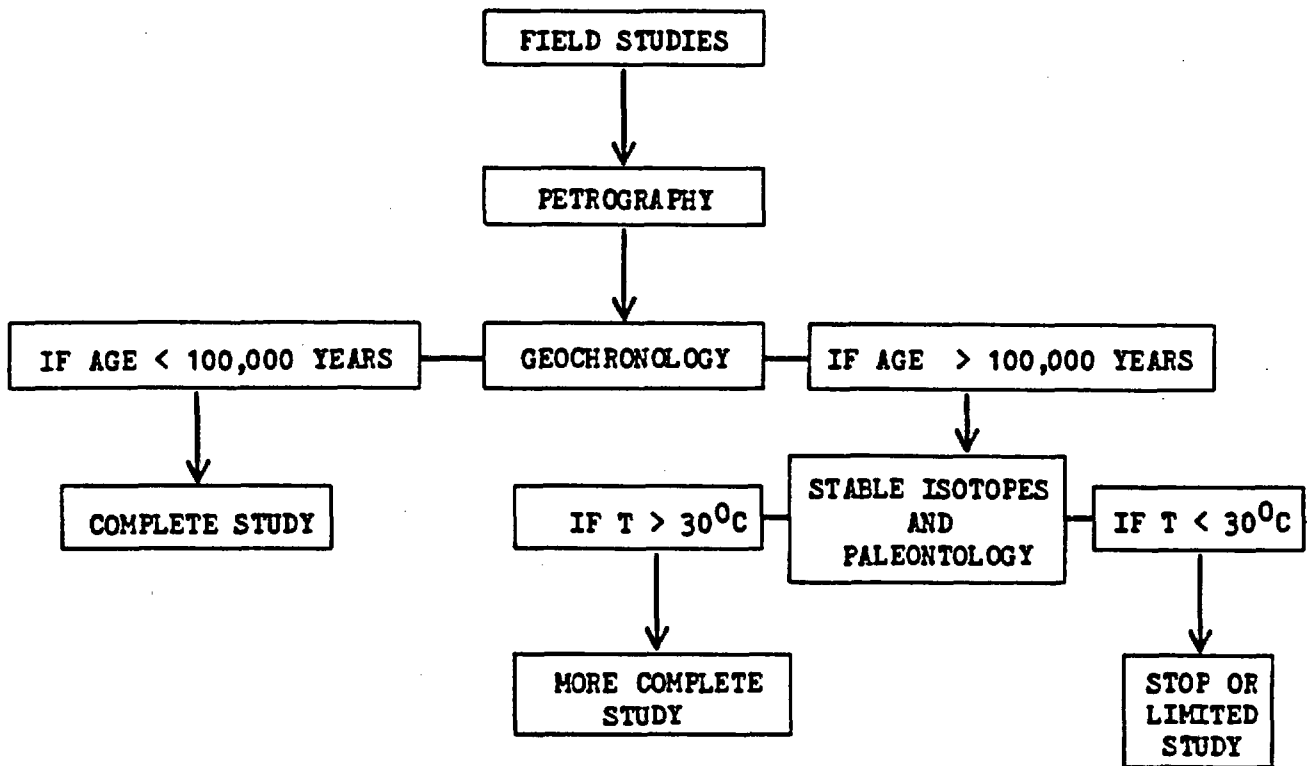
The present data are inadequate for determining the age of the vein formation.

Calcite and opaline-silica veins are common in faults in the Basin and Range. While a pedogenic origin has generally been assumed for these veins, no careful study, of the kind proposed, has really addressed their origin. Considering the ramifications of the effect of large volumes of waters derived from depth on a nuclear repository, it is essential that their origins be clarified. Thus, we strongly recommend that the study begin and recognize that the data collected so far has to be ignored due to inadequacies of quality assurance.

The studies should emphasize a detailed investigation of the veins and silica-cemented breccia in the fault at Trench 14 (near field studies). The results of the near field studies should be compared to less detailed investigations (far field studies) of the veins and breccia found at the sand ramps exposed on Busted Butte, veins exposed in trenches crossing other faults in the vicinity of Yucca Mountain, veins found in drill cores obtained in the vicinity of Yucca Mountain, and deposits found in hot and cold springs in and near the Nevada Test Site. We do not recommend extensive analytical studies of deposits outside of this area as analogs. The information available in published reports should be adequate for comparing the modes of formation. Comparisons should be made in collaboration with experts on such deposits. If necessary, limited analytical studies of such deposits should be made, again in collaboration with appropriate experts.

We recommend that field, petrographic, geochronological, stable isotope, and paleontological studies be undertaken at each site. Table 1 shows a plan for studies at each site. These studies are most important for: (1) helping to determine the age of the vein and breccia deposits associated with faulting; (2) placing constraints on time intervals between fault movements on a given fault assuming new veins are introduced at, or near, the time of faulting; (3) determining the temperature of waters responsible for the vein deposits; and (4) determining the origin of the veins and breccia. If the veins are young (i.e., less than 100,000 years old), a more complete study, including mineralogy; fluid inclusions; major, minor, and trace element; and tracer isotopes studies will be required. If the veins are old (i.e., greater than 100,000 years) and formed from cold waters, no further studies may be warranted. If the veins or breccias are old (i.e., greater than 100,000 years) and from hot waters, some limited mineralogical and geochemical studies may be warranted.

TABLE 1. FLOW PLAN FOR INVESTIGATIONS OF  
THE CALCITE AND OPALINE-SILICA VEINS



The personnel proposed to be involved in the study are highly qualified scientists, but the panel notes a lack of experience in vein petrology. Because of the fundamental importance of vein petrography (as discussed in a later section of this report) in developing a sampling base for required detailed studies the panel recommends that a geoscientist experienced in the detailed study of epithermal veins be added to the study group and be given the responsibility for vein and breccia petrography. The USGS employs a number of individuals highly qualified to conduct such studies.

## Field Investigations

### Introduction

The field investigation phase of the study provides base-line data for the further analysis of the calcite and opaline-silica deposits. The primary investigations will be near-field, concentrated on the Trench 14 site. The existing trench exposures should be used, as well as expansion of the existing exposures and the excavation of new sites. During the course of the investigation a careful and methodical approach should be taken in sample collection and cataloging.

Far-field investigations need to be conducted that will attempt to compare the features of the calcite and opaline-silica veins in Trench 14 to those of other sites throughout Yucca Mountain, both along faults and at the colluvium-bedrock contact away from faults. The regional comparison should include those deposits in the sand ramps at Busted Butte as well as samples found in the deep cores close to the repository location. Local springs of all types should be investigated for correlatives to the Trench 14 site and a careful review of the open literature should be conducted to locate possible analogs throughout the world. If the literature search proves limited, field studies of analogs outside of the State of Nevada should be permitted.

### Near Field Investigations

#### Systematic Exploratory Trench Logging

Trench 14 contains an extremely complicated mass of calcite and opaline-silica vein infilling. It is evident from field observation, trench logs and photography that cross-cutting relationships exist in the exposed trench walls. These cross-cutting relationships could have a bearing on the origin of the vein filling and possibly on fracture-opening events, presumably faulting events. Through careful small scale mapping procedures\*

---

\*A newly developed procedure of trench logging involves gridding the entire trench wall and numbering the grids in a convenient manner. The wall is then photographed at an equal distance from the wall. A monorail is often used to slide the camera mount on. Overlap is taken in the photographs for stereo viewing. A stereo-zoom transfer scope is used to map the photographs on graph paper. This procedure allows for extremely detailed mapping of the trench wall at various scales and for registration of samples and documentation of sampling procedures.

combined with mapping polished slabs, as discussed in the section on Mineralogy-Petrography, it may also be possible to construct a vein filling history. This history would provide a basis for detailed sampling, and information about the origin of the vein filling by showing growth patterns that could be associated with cold or hot water spring deposition from below, growth patterns that might be associated with the opening of fractures by faulting events followed by the downflow of water, or growth associated with episodic expulsion of water from depth during faulting.

#### Expanded Exploratory Investigation

The existing trench exposures should provide a vast amount of information; however, the 3-dimensionality of the site should be expanded. Trench 14 should be deepened at least to the intersection point of the three prominent veins. The potential for additional cross-cutting relationships exists at this intersection and such relationships may provide information on the recurrence of faulting events and on vein-filling history. A series of shallow trenches that expose the major vein infilling in the tuff should be placed along strike of the fault. The lateral characteristics of the vein infilling, the relationship of the platy calcrete to the fracture filled veins, and the relationship of the overlying soils to the vein filling should be investigated. If it appears that the exploratory trench investigations lack the required information, it might be important to conduct a shallow drilling program. The drill holes should begin up slope of the existing fault trace and continue down slope perpendicular to the fault trace. The holes should be cored and extend through the vein filling or until a depth limit is reached. The panel felt that deep drilling at Trench 14 may not yield useful information. One problem with drilling is that many vein systems are discontinuous leading to uncertainties in interpretation if veins are absent in the drill core.

#### Field Sampling

For the purpose of detailed petrographic and geochemical studies it is suggested that oriented and registered block samples be taken from the calcite and opaline-silica veins and from the silicified breccia. The blocks taken from the vein material should include the entire vein with some tuff as well. This procedure will simplify the record-keeping of sample locations for several experiments that could be conducted on the block. The block(s) and other samples should be filed in a manner similar to the core library procedure. The trench wall should be gridded to closer intervals than 1 meter. Within the grids, sample locations should be carefully marked and transferred to a sample log at a scale equal to the trench log and photographed. A grid numbering system could be established that is based on a standard water well numbering convention.

Another important aspect to the sample collecting procedures is that they should be conducted with input from all disciplines that expect to be conducting experiments on sample material. This will unify the record keeping and library utilization of the samples.

## Far Field Investigations

### Regional Exploratory Trenching

The far field studies will expand the relationships from the Trench 14 site to other areas within Yucca Mountain. Each far field site will not require the detail of Trench 14 but will serve to investigate the potential for a uniform process of vein filling, site specific processes, or a combination of processes throughout the repository area. Obvious targets for the far field investigations should include known, mapped faults and the colluvium-bedrock contact where shallow bedrock is available. The sand ramp area of Busted Butte displayed a vastly different field relationship in vein filling character than the Trench 14 site. The bedrock exposed below the sand ramps at Busted Butte should be trenched to explore for Trench 14-like vein filling.

The problem at hand involves the mobility of water through the repository site and the implications of water-deposited materials discovered in Trench 14. Vein filling has been seen in deep (below the repository level) drill core. The nature of these deep, vein-filling materials must be compared to all surface samples taken in the near field study. The correlation or lack of correlation of these two source areas is very important to conclusions that can be drawn from the surface information alone.

Local analogs of spring activity could be characterized by the investigation of presently operating spring activity on and around the Nevada Test Site. It may be possible to study cold, warm, fault related and non-fault related spring activity that could be used to correlate various modes of vein infilling back to Trench 14 and other sites as well.

It should be possible to locate far field analogs from the available open literature. This procedure should be conducted by experts skilled in spring water deposition, hydrothermal deposition, and seismically-induced water flow. If the literature search does not reveal sufficient information, it may be required to conduct research on these topics using sites not only in Nevada, but in other states as well.

### Mineralogy - Petrography

The Panel recommends that Section 3.2 (Mineralogy) of the Proposal be expanded to include Petrographic Studies. Such studies are implied, but not explicitly identified, in the Proposal.

### Near Field Studies

#### Petrography

Petrographic studies at the hand specimen and microscopic scale of samples from Trench 14 are needed for the following proposes: (1) determination of the history of vein filling, (2) the location of fluid inclusions, and (3) the location of microfossils. Methodology should include polished slab mapping of fracture filling, and petrographic microscopic studies including cathode luminescence (luminoscope) and ultraviolet fluorescence examination.

Mapping of fracture filling on polished slabs is an extension of trench logging to the hand specimen scale, and is required to determine the number of episodes and sequence of fracture filling. The maps prepared in this phase of the study will provide the basis of sampling for geochronology and subsequent geochemical, mineralogical and paleontological tests. They are thus fundamental to the program and need to be prepared as soon, and with as much care, as possible. The techniques of slab mapping are standard and have been used by ore deposit geologists in numerous studies of hydrothermal ore deposits. There is a lack of experienced personnel in this critical area.

Petrographic microscopic study extends fracture mapping to a microscale, and is often needed to clarify relations between minerals or mineral assemblages. It may provide information on replacement of one mineral, or mineral assemblage, by another, and may provide textural information that will allow correlation of depositional stages. Microscopic petrography may serve to locate fluid inclusions and microfossils. It also provides guidance for subsequent electron microprobe or other micro-sampling techniques. Methods of petrographic microscopy are well established, and several of the proposed investigators are expert in them.

Cathode luminescence and ultraviolet fluorescence examination of vein material is recommended. The luminescence and fluorescence characteristics of the various layers of opaline silica or calcite may be sufficiently different to provide a basis of correlation for the relative timing of fracture filling events. They may also elucidate textural features (particularly growth textures) that are not apparent in transmitted or reflected visible light.

### Mineralogy

Mineralogical studies of materials from Trench 14 fall into two categories of the Project Flow Sheet (Table 1); they are needed in support of the petrographic study and are principal elements in the characterization of the vein fillings. Mineralogical studies in support of petrography are principally those of mineral identification (including the different forms of opal). It is possible, but not considered probable, that changes in mineral chemistry will help in the correlation of depositional units. The methodology needed is petrographic microscopy and X-ray diffraction, and possibly electron microprobe and microchemical studies. These techniques are standard and the investigators are expert in their application.

Detailed mineralogical characterization studies are needed to: (1) compare the different types of fracture (or breccia) filling in Trench 14, (2) compare the mineralogy of each type to that reported in the literature for possible analogs of known origin, and (3) provide a basis for selection of samples for geochemical study, and for the interpretation of the results of such study.

Mineralogical characterization should include: (1) the form of silica, (2) the chemical composition (including trace elements) of silica and carbonate minerals, and (3) the identification and, possibly, chemical composition of other minerals found in the vein fillings.

Methodologies needed in the mineralogical characterizations include: (1) X-ray diffraction, (2) electron microprobe and/or analytical scanning electron microscopy, (3) transmitted and, possibly, reflected light



microscopy, and (4) chemical analytical techniques such as INAA on mineral separates. In many cases sampling for chemical analysis may need to be done on a microscale within one depositional interval. The required methodologies are available to the investigators, and they are expert in their use.

#### Materials to be Studied

Materials from Trench 14 requiring mineralogic-petrographic characterization include: (1) banded calcite and opaline-silica fracture fillings, (2) silica-cemented breccia (with some matrix calcite) cut by (1) above, (3) sub-horizontal, platy calcite masses in the platy petrocalcic horizon (Unit 3) overlying bedrock and cut by the apparently latest stages of calcite-opal veining, and (4) drusy quartz in cavities in the Tiva Canyon ash flow tuff. Characterization, comparison, and determination of relative ages of the first three materials is of much higher priority than study of the drusy quartz. This is so because the drusy quartz does not occur as fracture filling, and is probably not related to the veining of interest.

#### Far Field Studies

Mineralogical-petrographic studies similar to those performed on materials from Trench 14, but of much more limited scope, are recommended for calcite-silica deposits at sites removed from Trench 14. These include: (1) vein and breccia filling, uncovered by additional trenching, (2) calcite and/or silica vein fillings in drill core from Yucca Mountain including those close to, and, particularly, below the repository horizon, and (3) precipitations at local springs in and around the NTS. The scope of these studies should be limited by selection of materials and techniques shown to be important by the comprehensive study of material from Trench 14.

In addition to the above, samples of wind-blown dust should be characterized mineralogically. The specifics of methodology will depend on the mineral content. Perhaps X-ray diffraction analysis will be sufficient.

#### Geochronology

Certain of the geochronology studies are absolutely essential to the Project and those involved are highly expert at such studies. These studies should be completed as soon as possible in order to constrain the number and types of other investigations. Critical in this regard is the establishment of a minimum age for the calcite and opaline-silica vein fillings. Four analyses can be used for this purpose, as follows: (1) Uranium-series dating of the youngest calcite vein fillings (as determined by field/petrographic criteria); (2) Uranium-trend dating of the argillic B horizon (Unit 2) of the paleosol developed in the colluvium; (3) Uranium-series dating of the platy petrocalcic horizon (Unit 3) of the paleosol developed on the colluvium; and (4) Potassium-Argon dating of the magnetic black ash filling veins that cut all units older than Unit 2.

Although some of the above dating may not be wholly satisfactory, it is likely that a minimum age will be sufficiently designated to determine if the age of the calcite and opaline-silica vein fillings is either (1) less than 100,000

years or (2) greater than 100,000 years. In case (1) a much more extensive geochronology study will have to be undertaken in relation to the more extensive geochemical characterization. In either case geochronology will have to be used to establish the absolute age relationships for the calcite and opaline-silica vein fillings.

If the age of the deposits is less than 400,000 years, Uranium-series dating will be of major use in establishing the complex history of fracturing and vein filling with calcite and opaline silica. This method will also be critical in the correlation of Trench 14 history to other sites of calcite and opaline-silica accumulation in fault zones.

The proposed fission-track measurements from wall-rock and tuff materials will mainly be useful in checking for annealing of apatite as a paleo temperature tool. This result should resolve the hydrothermal hypothesis. However, ages of the wall rock, including the silica-cemented breccias will be of low priority if sufficient antiquity (greater than 100,000 years) can be demonstrated for the calcite and opaline-silica vein fillings. If the latter prove to be relatively young, then a high priority must be placed on dating the relationship of the calcite and opaline-silica veins to the silica-cemented breccias.

For this particular project the electron spin resonance dating seems of low-priority in comparison with other methods. The panel finds this project scientifically interesting and suggests that it may be of broader applicability to other geochronological concerns in relation to the Nevada Nuclear Waste Storage Investigations Project.

One stated objective of the isotopic dating studies was to determine absolute ages of spring, lake and pedogenic deposits at and near the Yucca mountain area. This objective only becomes important if the calcite/opaline silica veins of fault zones turn out to be relatively young, i.e. less than 100,000 years old.

#### Stable Isotopes

A comprehensive stable isotope study of the materials from Trench 14 (and less comprehensive study of far-field deposits) offers considerable promise in determining the origin of the calcite and opaline-silica veins and associated breccia-fillings. The principal investigator is top-notch, and the analytical and interpretive methodologies are well established. A very large data base exists on the stable isotopic systematics of potential analog environments, and it is supported by a solid body of theory.

The oxygen and carbon isotopic composition of calcite, the oxygen isotopic composition of opal, and the hydrogen isotopic composition of inclusion fluids (if such can be documented as primary) can be used in combination to estimate the source of water, its thermal history, and the temperature of mineral deposition. If primary clay minerals are present and can be analyzed, their hydrogen and oxygen isotopic composition can aid the interpretation.

The discussion of stable isotope studies in the proposal leaves a few worries, but the panel feels that all can be addressed:

1. The oxygen isotopic composition of fluid inclusions in oxygen-bearing minerals (particularly calcite) cannot be used to define the oxygen isotopic composition of the depositing water unless it can be independently demonstrated that the fluid was trapped at near-ambient temperatures. This is because of the potential for continued exchange with the host during the cooling history. This is well recognized by the principal investigator and should be no concern. If the proposal is written into a work plan, this aspect should be omitted or qualified.

2. In low temperature environments (specifically travertines) the carbon and oxygen isotopic composition of calcite is controlled by kinetic fractionation factors, i.e., their composition is a function of rate of precipitation. This has been well documented in the literature. These fractionations are regular, however, and the composition of carbonates falls along linear trends on C-13 - O-18 diagrams, the slope of the trend being a function of the rate of precipitation. At sufficiently slow rates the values fall along an equilibrium fractionation trend. Therefore, the degree of approach to equilibrium can be estimated in such systems if a sufficient range of C-13 and O-18 values is found. This, too is well recognized by the principal investigator, and needs only acknowledgement.

3. There is not yet sufficient knowledge of the thickness or isotopic homogeneity of individual bands in the banded calcite and opaline silica or in the breccia filling to warrant purchase of a laser sampling system. The principal investigator is a master at obtaining and running small samples. Preliminary analysis based on the detailed vein mapping may well provide such justification in the future, and if so such a system could prove very important to the study.

The general opinion of the Panel is that stable isotopes hold real promise for the resolution of the problem of origin of the calcite-opal veins, that the principal investigator is the right person to get the most out of the study, and that the sampling must be very closely tied to the history of the vein-filling.

#### Fluid Inclusions

The possible utility of fluid inclusions in evaluating the origin of the Trench 14 calcite opaline silica veins is discussed in the proposal, but few specifics are supplied as to either the methods to be employed or the materials to be studied. This is no doubt due to the fact that two-phase fluid inclusions have been found only in drusy quartz, and only a few of them were large enough to allow measurement of homogenization temperature on a heating-freezing stage. None were large enough to allow determination of freezing point depression. In the opinion of the panel it is unlikely that fluid inclusion studies of any type will prove of value, but some feasibility studies are probably warranted.

Fluid inclusions trapped at temperatures below about 70°C usually do not nucleate a vapor bubble on cooling. Lack of the optical contrast between the vapor bubble and surrounding liquid makes such inclusions hard to see in

minerals of low refractive index, and particularly in those of high birefringence. The problem is seriously compounded by fine grain size. The vein calcites very likely contain many such "cryptic" inclusions. This can be determined by opening the inclusions by thermal decrepitation or by crushing, both in vacuo, and by collecting the water in a cold trap. If many cryptic inclusions are present, it suggests that the temperature of trapping was below 70°C, and suggests that it may be possible to analyze the contents of the inclusions. Another method of recognizing the presence of "cryptic" fluid inclusions (and estimating their size) is by examination of polished surfaces of calcite. Pits due to the opening of fluid inclusions can usually be distinguished from those resulting from sample preparation, particularly if the nature of their walls is examined by scanning electron microscopy.

Both the gas chemistry and aqueous solutes can be analyzed for bulk samples of fluid inclusions by techniques briefly described in the proposal. However, no really satisfactory method of analyzing aqueous solutes has yet been developed. Those methods employing the opening of the inclusions by thermal decrepitation or crushing in vacuo followed by leaching of the residue have been particularly disappointing. Charge balances typically disagree by more than 20%! The problem appears to be in the leaching process. The panel sees no value in attempting such analyses on material from the calcite-opal veins.

Determination of gas chemistry of fluid inclusions is, in general, a very promising technique, but is still in the developmental stage. It is being developed, principally, in three laboratories in the United States: Dave Norman's lab at New Mexico Tech, Colin Barker's lab at the University of Oklahoma, and Gary Landis' lab at the USGS in Denver. It is far from a standard technique, but many labs are rushing to acquire the instrumentation because of its promise. The data base on the gas chemistry of fluid inclusions from various environments is very small, so that even general interpretation of results is difficult. The panel is of the opinion that the potential value of the gas chemistry of fluid inclusions is sufficiently small that only a reconnaissance study of calcite should be attempted, and only if such analyses can be accomplished in one of the three principal laboratories, or if other facilities are being developed for other purposes within one of the participating groups. In the latter event, advice and continuing guidance should be sought from at least two of the operators of the principal laboratories because each of the three has custom-developed his methodology and each methodology differs from the others in significant ways. This is a tough game, and there is a real danger of substantial misinterpretation. A further concern has to do with the analysis of inclusions whose integrity cannot be checked optically. This is recognized in the proposal, but no strategy of verification is presented.

In general, the fluid inclusion section of the proposal suggests a lack of experience in fluid inclusion studies, although the principals presumably involved are first class scientists.

#### Geochemistry

The geochemistry program presented in the proposal emphasizes analytical techniques rather than addressing the more important problem of how the geochemical data will be used to place constraints on the origin of the

hydrogenic deposits. The investigators should present well thought-out arguments as to which elements may be the most useful, including a description of the approach necessary to evaluate the data. It would seem more appropriate to analyze a limited number of well characterized samples for those elements that most low-temperature geochemists would agree could help in such a discrimination rather than analyze a large number of elements on a large number of samples. Using strictly a fingerprinting approach for evaluating the data may not be useful because it may not allow the investigators to account for variations in water chemistry due to factors such as, for example, the extents to which the various waters have reacted with a variety of host rocks before precipitating the calcite and opaline silica. It is not clear from the proposal whether the investigators have sufficient experience with trace elements in low-temperature, vein deposits to make adequate evaluations.

#### Tracer Isotopes

The tracer isotope studies as presented are well thought out and worthwhile. The analysts will produce first-rate isotopic data. It is essential that these studies be integrated at a very early stage with the major, minor, and trace element studies on the same material.

#### Paleontology

Although some very generalized age information is provided, the main purpose of the paleontological studies is in providing paleoenvironmental information. This information is complementary to information provided by geochemical techniques, notably the stable isotope studies. Thus, the paleontological studies should proceed regardless of the initial geochronology results, that is whether or not the age of the calcite and opaline-silica vein fillings exceeds 100,000 years.

The paleontological studies must be tied closely to the sampling strategy that is keyed to critical field relationships and petrography. It is essential that the paleoenvironmental interpretations be tied to key, dated horizons. Moreover, the strategy of collecting from modern analog environments is a sound one, quite necessary to establishing the paleoenvironmental connections. The investigator is a recognized expert in such paleontological studies.

#### Hydrologic Studies

The hydrologic studies proposed as part of this Project are all in a sense derivative. Models of past groundwater flow in the vicinity of the Bow Ridge Fault and Trench 14 will depend on parameters and information that are provided by the other parts of the Project. There are no studies proposed which have a direct bearing on the age or origin of the calcite and opaline-silica deposits, nor do we believe there are any such appropriate studies.

Studies of the chemistry of water from active springs in the Test Site area are proposed, and these will provide data to help assess the relative merits of the various models being considered for the origin of the calcite-opaline

silica deposits. They should proceed as planned.

The hydrological studies are thus peripheral to the main concerns of the Project. They are, however, obviously central to other aspects of site characterization.

#### Data Integration

It is very clear that close cooperation among all researchers is essential at all stages of this Project, both because there is interdependence among the various approaches to be used and because the later parts of the research will depend on the results of the earliest and most important studies (see Table 1). Most obviously, if the calcite and opaline-silica veins turn out to be young (less than 100,000 years) a great deal more effort will be needed to determine their origin and the path of movement of the water that deposited them than would be the case if they are old.

Data integration in one sense should be a continuous process that occurs simultaneously with data collection. This is recognized in the proposal by the plan that the group of experts who will be responsible for the analytical work will also be responsible for the sampling, and that this will be done in a coordinated way. We feel this is very important. The proposal to hold formal workshops on the results six months and one year after the project is initiated is a good way of facilitating data integration.

A prime example of the importance of continuous data integration is the close tie-in needed between field investigations to determine the vein-filling history in Trench 14, the petrography which helps determine that history, and the geochronology that needs to be done selectively on parts of the veins to find the ages of vein filling. An essential element in the analytical program is that all studies be carefully tied in to the temporal and spatial frame established by field and petrographic work.

# Los Alamos

Los Alamos National Laboratory  
Los Alamos, New Mexico 87545

July 22, 1987  
ESS-1, Geology/Geochemistry  
MS D462  
(805) 667-9504/1863

TWS #ESS-1-7/87-200 ACTION Blanchard

CC Livingston

CC \_\_\_\_\_

CC: \_\_\_\_\_

CC: \_\_\_\_\_

CC: \_\_\_\_\_

REC'D IN WMPO

7/24/87

SAIC/T&MSS

JUL 27 1987

CCF RECEIVED

Maxwell B. Blanchard  
Waste Management Project Office  
U.S. Department of Energy  
P.O. Box 14100  
Las Vegas, NV 89114

Dear Max:

Listed below are our responses, as representatives of LANL, to the recommendations of the peer review panel for proposed calcite and opaline silica research. In general we agree with their recommendations, but we have several reservations regarding their report. We would like to have our comments included as a part of the record of this peer review.

Introduction, Page 1, Paragraph 5: "On the basis of field inspection [the silica-cemented breccia] may reasonably be interpreted as a hydrothermal eruption breccia."

See comment on Introduction, page 4.

Page 2, Paragraph 3: "Thus, we strongly recommend that the study begin and recognize that the data collected so far has to be ignored due to the inadequacies of quality assurance."

The data collected so far have been obtained following appropriate LANL and USGS quality assurance procedures. These data must not be ignored. In particular, we are concerned that the peer reviewers would, by this statement, reject the LANL report "A Preliminary Comparison of Mineral Deposits in Faults near Yucca Mountain, Nevada, with Possible Analogs," which is now in press. This statement is therefore unacceptable to LANL.

Page 2, Paragraph 4: "We do not recommend extensive studies of deposits outside this area as analogs."

Such studies may be unavoidable. Considering the four main categories of possible origin listed on page 1, it will be extremely difficult to find examples of all within the area around Yucca Mountain. There are some data within the literature, but with the exception of economically significant deposits the data on mineralogy and chemistry are very sparse.

TO: Max Blanchard

-2-

July 22, 1987

Introduction, Page 2-3, Paragraph 5 (Page 2) and Table 1:

The flow plan for calcite-silica investigations proposed by the peer review committee agrees reasonably well with existing investigator plans and priorities. One significant point of departure is the reviewers' choice of a 30°C temperature as a cutoff for further study of deposits older than 100,000 years. A key question in this study is whether the calcite-silica deposits formed by discharge of ground water, particularly deep groundwater, because ground water discharge could carry radionuclides from a nuclear waste repository to the accessible environment. The importance of understanding water movement is acknowledged elsewhere in the peer review, but not in the flow plan. A 30°C temperature criterion, with or without other evidence, may be insufficient to distinguish between a ground water and surface water source. Some ground water in the vicinity of Yucca Mountain is only slightly warmer than 30°C, but the surface discharge of this water would be of just as much concern as the discharge of warmer water from depth. For these reasons, the 30°C criterion should not be given preeminence in the determination of study priorities.

Introduction, Page 4, Paragraph 1: "...the panel recommends that a geoscientist experienced in the detailed study of epithermal veins be added to the study group and be given the responsibility for vein and breccia petrography."

The personnel now responsible for vein and breccia petrology have many years of experience in the study of fracture fillings and alteration products in the pyroclastic rocks of Yucca Mountain and vicinity. On the basis of our preliminary investigations of the silica-cemented breccias, interpreting these features as definite hydrothermal eruption breccias would not be justified at present. This interpretation will certainly be considered, but the mineralogic similarities between the breccia matrix and the soils require consideration of non-hydrothermal origins as well. For the investigation of both hydrothermal and non-hydrothermal origins, our expertise is more appropriate than that of an ore petrologist. We will consult with a geoscientist experienced in study of epithermal veins as we deem necessary.

Page 5, Paragraph 2: "The panel felt that drilling at Trench 14 may not yield useful information."

This is probably not true. One of the most important criteria for evaluating the hydrologic regime at depth (regardless of origin) will be the presence or absence of transmissive versus aquitard mineralogy. If the fault is plugged with smectite, for instance, then it could hardly be a conduit for flow either up or down. (One might argue that in such a case the clay might be hydrothermal in origin, but the smectite/illite interstratifications would be definitive.) Drilling to moderate depth could be very important if excavation and shallow holes prove inconclusive.



TO: Max Blanchard

-3-

July 22, 1987

Petrography, Page 6-7, Paragraphs 1 (Page 6) and 3 (Page 7): "Cathode luminescence and ultraviolet fluorescence examination of vein material is recommended."

A few samples of carbonate material from Trench 14 have already been examined for cathodoluminescence, with predominantly negative results. We may examine more samples, but this technique did not seem very promising. The walls of Trench 14 have been examined under ultraviolet light. Silica in veins and in petrocalcic horizons fluoresces strongly. This may be a useful tool for vein mapping.

Page 6, Paragraph 2: "The problem at hand .... from the surface information above."

Deep veins have already been compared to the deposits in Trench 14, and they are very different. A report summarizing these data was available to the peer review committee (Vaniman et al., "A Preliminary Comparison ...").

Page 6, Paragraph 3: "Local analogs .... to Trench 14 and other sites as well."

The local analogs are limited, as shown by Figure 1 in Vaniman et al. There are a few cold springs and seeps, many highly varied pedogenic sequences, but no warm-spring or thermal-spring sinters and no unequivocal "seismic-pumping" localities near Yucca Mountain.

Materials to be Studied, Page 8, Paragraph 2: "Characterization, comparison, and determination of relative ages of the first three materials is of much higher priority than study of the drusy quartz. This is so because the drusy quartz does not occur as fracture filling, and is probably not related to the veining of interest."

Among the silica deposits in the trench, including drusy quartz, chalcedony, silica-cemented breccia, and botryoidal silica, the silica-cemented breccia has been given highest study priority by the peer review because "...drusy quartz does not occur as fracture filling, and is probably not related to the [calcite-silica] veining of interest." The peer review understandably emphasizes the particular importance of the calcite-silica veins and silica-cemented breccia in Trench 14 because this is also the emphasis in the study plan. However, this study was formulated to address concerns about any deposits of suspected hydrothermal origin and is not restricted to consideration of calcite-silica veins and silica-cemented breccia. The drusy quartz, which does in fact fill fractures, is a material widely perceived by members of the geologic community and of the community at large as a product of hydrothermal activity. This perception cannot be dismissed or qualified without solid documentation to show why the drusy quartz should not be a concern. We have field evidence to indicate that the quartz is among the older secondary mineral deposits in Trench 14 and we infer that quartz deposition was related to cooling and devitrification

TO: Max Blanchard

-4-

July 22, 1987

of the enclosing pyroclastic unit about 10 m.y. ago, but we need to support this interpretation with the best possible documentation.

Far Field Studies, Page 8, Paragraph 3: "...studies...of much more limited scope, are recommended for calcite-silica deposits at sites removed from Trench 14."

The terms "near field" and "far field" have been given very specific meanings within the NNWSI project and we do not expect the peer reviewers to use these terms in their restricted project meanings. However, it should be emphasized that all of the proposed study sites, including Trench 14, are considered "far-field" by project definitions. The peer review recommendations are based on the assumption that Trench 14 is near-field and other sites, such as Busted Butte, are far-field. Both of these sites may be similar distances from the boundaries of a potential repository and therefore deserve more nearly equal priority than the peer review suggests. The same rationale holds true for other sites surrounding Yucca Mountain.

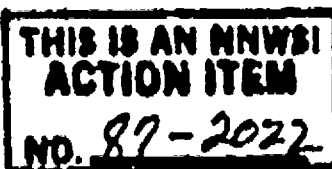
Geochronology, Page 9, Paragraph 4: "For this particular project the electron spin resonance dating seems of low-priority in comparison with other methods."

The documentation need that electron spin resonance dating would fill is covered in the comment on Materials to be Studied, page 8, paragraph 2. This technique will extend the upper age limit of dateability for silica deposits beyond the limits of the other dating methods in the Geochronology section.

Fluid Inclusions, Page 10, Paragraph 6: "In the opinion of the panel it is unlikely that fluid inclusion studies of any type will prove of value, but some feasibility studies are probably warranted."

The peer review correctly notes that some of our fluid inclusion capabilities are still in the developmental stage and that the nature of the materials to be studied makes it difficult to obtain complete or reliable data. The facilities for fluid inclusion study have been set up or are in the process of being set up; these activities will continue regardless of their utilization for calcite-silica studies. We intend to take advantage of these facilities at least to the extent of assessing the possible value of fluid inclusion data for the calcite-silica studies. The investigators involved in this activity have had formal training and experience in the study of fluid inclusions. In regard to the recommendation that fluid inclusion gas extraction be performed under the guidance of personnel in existing gas extraction laboratories, it was clearly stated in the formal presentation that this is already being done at Dave Norman's Laboratory in New Mexico.

Page 12, Paragraph 1: "Using strictly a fingerprinting approach for evaluating the data may not be useful ..."



TO: Max Blanchard

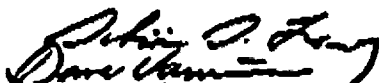
-5-

July 22, 1987

Comment:

This may be true; empirical approaches are always suspect because they do not address the underlying processes. Unfortunately, almost all of the candidate origins are beset by either kinetic or disequilibrium problems. Consider warm-spring sinters which appear to be almost universally Opal-A (although data in the literature are not too helpful); how long does it take this Opal-A to transform to a more stable silica mineral, and would that silica mineral be chemically as well as mineralogically comparable to the Opal-A/Opal-CI in Trench 14? Then consider the pedogenic hypothesis, where disequilibrium is complicated by "microsite" evolution of isolated water-rock pockets at low temperature; the great variety of neoformed soil chemistries in the region is evidence that the input materials are extremely varied and must be cataloged empirically before they can be understood (see Jones, 1983, C.N.R.S. Colloquium on Petrology and Weathering of Soils). Equilibrium trace-element partitioning has eluded researchers in these areas for many years, and it is beyond the scope of this study to tackle such a problem. An expert in "low-temperature, vein deposits" should be added to the study as the peer reviewers suggest, but that person will probably be no better equipped to evaluate the other hypothesized origins than the people already involved.

Yours truly,

  
S. Levy/D. Ventman

SAIC/T&amp;MSS

Cy: D. Oakley, N-5, MS J521  
CRM-4, MS A150  
TWS Resident File, MS D462  
RPC Files (G. Ortiz), MS J521  
ESS-1, MS D462  
File

JUL 27 1987

CCF RECEIVED



## United States Department of the Interior

GEOLOGICAL SURVEY  
BOX 25046 M.S. 421  
DENVER FEDERAL CENTER  
DENVER, COLORADO 80225

IN REPLY REFER TO

July 22, 1987

Max B. Blanchard  
Waste Management Project Office  
U.S. Department of Energy  
P.O. Box 98518  
Las Vegas, NV 89193-8518

SUBJECT: Response to Comments by the Hydrogenic Deposits Peer Review  
Committee

Dear Max:

The USGS has no serious disagreement with comments the subject committee has made concerning the USGS/LANL Hydrogenic Deposit proposal. Minor comments and proposed recommendations are described in this attached letter of July 20, 1987 prepared by John Stuckless.

Sincerely,

Larry R. Hayes  
NNWSI/USGS

Attachment

LRH/mt  
0189M

cc: David Vaniman, LANL  
Don Livingston, WMPO  
Bob Raup, USGS  
John Stuckless, USGS



## United States Department of the Interior

GEOLOGICAL SURVEY  
BOX 25016 M.S. 963  
DENVER FEDERAL CENTER  
DENVER, COLORADO 80225  
Branch of Isotope Geology

July 20, 1987

IN REPLY REFER TO

To : L. R. Hayes *JRH*

From : J. S. Stuckless *JS*

Subject: Response to Comments by the Peer Review Committee on the Hydrogenic Deposits Research Proposal, Nevada Test Site

The review of the USGS/LANL proposal is generally very positive and contains some valuable suggestions. There are, however, a few points for which we wish to express an opinion in order to avoid ambiguities at a later date.

On page 1, seventh paragraph, the committee refers to 4 periods of depositions. These were presented as 4 types because types 1 and 2 may represent 1 or 2 periods of depositions. In the next paragraph we disagree with calling all of the breccias younger than the vugs because current data are not yet complete enough to draw such a firm conclusions.

The third paragraph on page 2 ends with that statement that "the data collected so far has to be ignored due to inadequacies of quality assurance." This statement probably refers to the geochronology done to date in Trench 14 and as such the statement is correct. The committee did not have access to records needed for judging quality assurance of all of the data collected as part of the work on hydrogenic deposits, therefore, the statement must not be construed as applying to all data collected to date.

The designation on page 2, fourth paragraph, of near-field and far-field studies and consequent recommendations for more and less detailed study does not seem to be in the best interest of the overall project. For purposes of site characterization, the veins intersected by drill core and those exposed in the sand ramps must be studied in more detail than proposed analogues located some distance from the Nevada Test Site. To assume on the basis of appearance or limited study that all calcite and opaline silica veins near Yucca Mountain are of the same origin and of similar age would be detrimental to the program.

The flow chart on page 3 uses 30°C as a dividing point between hot and cold waters. We assume that this is only meant to symbolize the difference between cold (which usually means less than mean annual temperature; -15°C at NTS) and hot (which usually means greater than body temperature, 37°C). Furthermore the diagram seems to imply that deep seated cold springs with an age in excess of 100,000 years are not important, and we disagree with this position.

Also on page 3 and in the text, the report suggests that the geochronologic studies be completed before some of the other research is done. Although there is some logic and potential economy in such an approach, strict adherence to such a plan will tend to prolong the study inordinately. We recommend, as the original proposal stated, that many elements of the

Investigation proceed in parallel rather than in series as recommended by the panel.

The first paragraph on page 4 seems to recommend that the USGS should assign a petrographer to the study. Although we agree that an expert on epithermal vein petrography should be added to the research team, this phase of the work is being conducted by Los Alamos National Laboratory. Therefore, that institution should be responsible for choosing any petrographers.

The first paragraph on page 6 recommends trenching to bedrock at the sand ramps. Although this has merit, the down thrown block may be too deep to reach without unreasonable excavation costs.

On Page 6 in the second paragraph and again on page 8 in the third paragraph the reviewers refer to veins below repository level. We believe that these statements should refer to all calcite and opaline silica veins intersected by drilling. The veins were mentioned only briefly and on the last day of review. As such the peer panel probably did not realize that these veins are not restricted to deep occurrences.

The fourth paragraph on page 6 omits pedogenic expertise from the skills required in literature searches of analogues. We presume that this represents an oversight.

The peer reviewers seemed to view geochemistry as only a tool to determine origin and as such question the use of an empirical "finger printing approach". However, the broad spectrum analyses currently proposed are of great value in screening for possible economic materials and may be of very great value in correlation between similar deposits in like host rocks. The empirical approach may be the only one that will discover critical trace element differences between the vein and cemented breccia deposits.

Throughout the report, there is too great an emphasis on the age of 100,000 years. Firstly, the fact that part of a vein system is older than 100,000 years is not proof that the entire system is old. Secondly, 10CFR960 sections 4-2-2 (Geochemistry), 4-2-4 (Climatic changes), 4-2-6 (Dissolution including breccias), and 4-2-7 (tectonics) all require that predictions about the future be based upon knowledge of Quaternary events, roughly the last 2 millions years. This information is specifically required under post-closure guidelines, and therefore will have to be obtained during site characterizations.

If the investigators from LANL agree, we can adopt all other suggestions provided by the peer review committee. These suggestions can be incorporated in a revised proposal, SIP, and/or study plan. Alternatively, perhaps the review and comment can be appended to such documents as deemed necessary by the project, such that work can be resumed in a more timely fashion.

*John S. Stuckler*

**Department of Energy**

Nevada Operations Office

P. O. Box 98518

Las Vegas NV 89193-8518

SAIC/T&amp;MSS

SEP 04 1987

SEP 0 1987

CCF RECEIVED

Larry R. Hayes, USGS, Denver, CO  
Donald T. Oakley, LANL, Los Alamos, NM

**PARTICIPANT REVIEW OF PEER PANEL RECOMMENDATIONS ON RESEARCH PROPOSED ON CALCITE AND OPALINE SILICA DEPOSITS LOCATED ALONG FAULTS**

The Waste Management Project Office (WMPO) has received comments from the United States Geological Survey (USGS) and Los Alamos National Laboratory (LANL) on the report issued by the peer review panel concerning the proposed work on the calcite and opaline silica deposits located along faults near Yucca Mountain. The participants recognized the value and credibility of the recommendations made by the peer review panel and generally accepted their conclusions. However, on several important issues, the participants have expressed reservations regarding the approaches and courses of action suggested by the peer review report.

The purpose of this letter is to emphasize that the WMPO will consider seriously the recommendations of the peer review panel during the review of the study plans which will authorize future work on these deposits. As a consequence, investigators should be certain that any work they propose which differs from the guidance or recommendations of the peer review panel must be clearly defined and well justified.

Although the peer review panel report contained numerous specific suggestions and recommendations, the WMPO believes that the most significant aspects of the report can be summarized in two general statements:

1. An understanding of the geologic relationships in trench 14 and similar deposits, derived from continued detailed mapping and petrography, is fundamental to evaluation of their nature. It is important to conduct the investigations with an open approach which recognizes that multiple origins are possible, and that different generations of the veins may have different origins.
2. It is important to prioritize investigations so that excessive time and effort are not expended on problems which are not relevant to the issue of repository safety. Thus, the level of effort devoted to studies of the nature of the deposits is, in part, a function of their age.

The WMPO is generally satisfied that the participating research organizations have recognized the significance and relevance of the work being proposed. Investigators should bear in mind that study plan reviewers will focus not only on how the proposed work compares with the peer review recommendations, but also on its applicability to performance assessment and demonstrability of repository safety.

SEP 03 1987

Multiple Addressees

-2-

Each of the investigators is to be congratulated for their contribution to the peer review. The presentations were well designed and organized, and the interaction with the panel yielded a number of significant observations and well-founded recommendations, while confirming the overall technical merit of the studies. If you have additional questions, please contact D. E. Livingston (FTS 575-8944, or 702-295-8944) at WMPO.

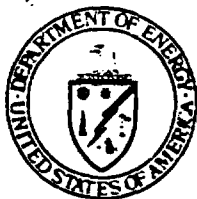
  
Maxwell B. Blanchard, Chief  
Regulatory & Site Evaluation Branch  
Waste Management Project Office

WMPO:DEL-2660

cc:

V. J. Cassella HQ, (RW-222) FORS  
M. E. Spaeth, SAIC, Las Vegas, NV  
S. R. Mattson, SAIC, Las Vegas, NV  
A. C. Matthusen, SAIC, Las Vegas, NV  
Stephen Metta, SAIC, Las Vegas, NV  
M. D. Voegele, SAIC, Las Vegas, NV  
L. R. Hayes, USGS, Denver, CO  
J. S. Stuckless, USGS, Denver, CO  
W. H. Langer, USGS, Denver, CO  
D. L. Schleicher, USGS, Denver, CO  
D. T. Oakley, LANL, Los Alamos, NM  
D. T. Vaniman, LANL, Los Alamos, NM  
J. A. Canepa, LANL, Los Alamos, NM  
T. O. Hunter, SNL, 6310, Albuquerque, NM  
F. W. Bingham, SNL, 6312, Albuquerque, NM  
D. E. Livingston, WMPO, NV  
D. C. Dobson, WMPO, NV





## Department of Energy

Nevada Operations Office  
 P. O. Box 98518  
 Las Vegas, NV 89193-8518

SAIC/T&MSS

SEP 04 1987

SEP 02 1987

CCF RECEIVED

NWA 8709040025

Gilbert N. Hanson, SUNY at Stony Brook, Stony Brook, NY  
 Philip M. Bethke, USGS, Reston, VA  
 Victor R. Baker, University of Arizona, Tucson, AZ  
 Glenn R. Roquemore, Naval Weapons Center, China Lake, CA  
 Peter J. Huddleston, University of Minnesota, Minneapolis, MN

### CLARIFICATION OF THE FINAL PEER REVIEW REPORT ON THE CALCITE/OPALINE SILICA DEPOSITS LOCATED ALONG FAULTS NEAR YUCCA MOUNTAIN

The Waste Management Project Office (WMPO) would like to thank the members of the peer review panel for the time and effort invested in their review of the Nevada Nuclear Waste Storage Investigations (NNWSI) Project studies on the significance of calcite/opaline silica deposits located along faults. The report of the peer review panel will greatly assist the NNWSI Project in its planning for the characterization of Yucca Mountain as a potential high-level nuclear waste repository.

In general, the panel report was clear, concise, and reflected considerable thought and attention to the concerns which have been raised regarding our investigation into these deposits. However, the WMPO would like to request clarification of one statement which appears in the report. The statement, which appears on page 2, second full paragraph, is: "Thus, we strongly recommend that the study begin and recognize that the data collected so far has to be ignored due to inadequacies of quality assurance." The term quality assurance (QA) has a very specific definition in the NNWSI Project and QA was not a topic of consideration by the peer review panel. It is the position of the WMPO that some of the data collected in the past may be inadmissible because of insufficient QA documentation; but the project does not believe that all past data must be ignored. We assume that the WMPO, in our presentation, must have conveyed an incorrect impression to the panel that there were more problems with QA than actually exist. In contrast, technical adequacy (e.g., adequacy of data or sample collection, analytical methodology, or interpretation of data) was an important topic of review and consideration by the panel. We therefore request that the peer review panel clarify whether the above statement refers to the panel's interpretation of the specific quality assurance problems described by the WMPO (in connection with some geochronologic data), or whether the panel believes, on technical grounds, that existing data must be disregarded. If there are technical reasons for the recommendation to disregard data, please specify them.

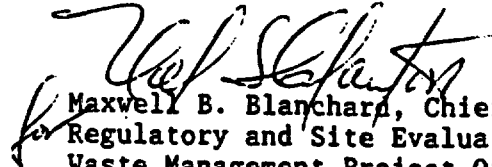
In the interest of efficiency, the WMPO suggests that the response be prepared by the panel chairman, Gilbert N. Hanson, through consultation with the other panel members. However, we are open to alternative methods of response the panel members may choose. As in the past, members should charge their time and expenses through Science Applications International Corporation (SAIC), or through the appropriate government channels.

SEP 03 1987

Multiple Addressees

-2-

Again, the time and effort of the peer review panel is greatly appreciated. Please refer any concerns or questions to Steve Mattson (702-295-8615 or FTS 575-8615) at SAIC, Don Livingston (702-295-8944 or FTS 575-8944), or Dave Dobson (702-295-8945 or FTS 575-8945) at the WMPO.

  
Maxwell B. Blanchard, Chief  
Regulatory and Site Evaluation Branch  
Waste Management Project Office

WMPO:DEL-2642

cc:

V. J. Cassella, HQ (RW-222) FORS  
M. E. Spaeth, SAIC, Las Vegas, NV  
S. R. Mattson, SAIC, Las Vegas, NV  
A. C. Matthusen, SAIC, Las Vegas, NV  
Stephen Metta, SAIC, Las Vegas, NV  
M. D. Voegele, SAIC, Las Vegas, NV  
L. R. Hayes, USGS, Denver, CO  
J. S. Stuckless, USGS, Denver, CO  
D. T. Oakley, LANL, Los Alamos, NM  
D. T. Vaniman, LANL, Los Alamos, NM  
T. O. Hunter, SNL, 6310, Albuquerque, NM  
F. W. Bingham, SNL, 6310, Albuquerque, NM  
L. D. Ramspott, LLNL, Livermore, CA  
D. E. Livingston, WMPO, NV  
D. C. Dobson, WMPO, NV

Geosciences Program  
Department of Earth and Space Sciences  
State University of New York at Stony Brook  
Stony Brook, New York 11794-2100  
telephone: (516) 632-8200

# Stony Brook

September 30, 1987

NNA.871014.0049

Maxwell B. Blanchard  
Chief, Regulatory and Site Evaluation Branch  
Waste Management Project Office  
Department of Energy  
P.O. Box 98518  
Las Vegas, NV 89193-8518

Dear Mr. Blanchard:

Regarding your request of September 3, 1987 for a clarification of the the third paragraph on the second page of the "REPORT OF THE REVIEW PANEL ON THE PROPOSED PROGRAM OF STUDIES OF THE CALCITE AND OPALINE-SILICA DEPOSITS IN THE YUCCA MOUNTAIN AREA NEVADA" by Gilbert N. Hanson, Victor R. Baker, Philip M. Bethke, Peter Hudleston and Glenn R. Roquemore dated June 18, 1987 which read as follows except for the underlining of the last sentence.

Calcite and opaline-silica veins are common in faults in the Basin and Range. While a pedogenic origin has generally been assumed for these veins, no careful study, of the kind proposed, has really addressed their origin. Considering the ramifications of the effect of large volumes of waters derived from depth on a nuclear repository, it is essential that their origins be clarified. Thus, we strongly recommend that the study begin and recognize that the data collected so far has to be ignored due to inadequacies of quality assurance.

I have consulted with all of the members of the Review Panel and they agree that the underlined sentence in this paragraph is too terse and does not clearly express the intent of the authors of this report. The underlined sentence should be expanded to read:

"Thus, we strongly recommend that the study begin. As the panel understood from discussions at the review meeting in Las Vegas, May 27 to 29, 1987, some of the data collected so far may have to be ignored because they were collected under a quality assurance program that may no longer be considered adequate. In the Review Panel's opinion the data collected thus far are of adequate quality for technical or scientific purposes."

Sincerely

*Gilbert N. Hanson*

Gilbert N. Hanson

cc:  
P.M. Bethke  
V.R. Baker  
G.R. Roquemore  
P.J. Hudleston

ACTION WMPD  
INFO \_\_\_\_\_

AMA \_\_\_\_\_

AMESH \_\_\_\_\_

AMOE \_\_\_\_\_

SAICIT & MSS

SEP 14 1987

CONF RECEIVED

ACTION \_\_\_\_\_

cc *Blanchard*

cc *WMPD*

cc *Robson*

cc \_\_\_\_\_

cc \_\_\_\_\_

cc \_\_\_\_\_

10/9/87

NOV 10 1987

Distribution--Memorandum dated

D. H. Alexander, HQ (RW-232), FORS  
Ralph Stein, HQ (RW-23), FORS  
C. O. Abrams, NRC, Washington, D.C.  
P. T. Prestholt, NRC, Las Vegas, NV  
R. R. Loux, NWPO, Carson City, NV  
Carl Johnson, NWPO, Carson City, NV  
L. R. Hayes, USGS, Denver, CO  
J. S. Stuckless, USGS, Denver, CO  
P. M. Bethke, USGS, Reston, VA  
D. T. Oakley, LANL, Los Alamos, NM  
D. T. Vaniman, LANL, Los Alamos, NM  
T. O. Hunter, SNL, 6310, Albuquerque, NM  
F. W. Bingham, SNL, 6310, Albuquerque, NM  
L. D. Ramspott, LLNL, Livermore, CA  
Vincent Gong, REECO, Las Vegas, NV  
J. P. Pedalino, H&N, Las Vegas, NV  
R. L. Bullock, F&S, Las Vegas, NV  
M. E. Spaeth, SAIC, Las Vegas, NV  
S. R. Mattson, SAIC, Las Vegas, NV  
A. C. Matthusen, SAIC, Las Vegas, NV  
Stephen Metta, SAIC, Las Vegas, NV  
M. D. Voegele, SAIC, Las Vegas, NV  
J. L. Younker, SAIC, Las Vegas, NV  
Martha Pendleton, SAIC, Las Vegas, NV  
G. N. Hanson, Stony Brook, NY  
V. R. Baker, University of Arizona, Tucson, AZ  
G. R. Roquemore, Naval Weapons Center, China Lake, CA  
P. J. Hudleston, University of Minnesota, Minneapolis, MN  
C. P. Gertz, WMPO, NV  
M. P. Kunich, WMPO, NV  
W. R. Dixon, WMPO, NV  
L. P. Skousen, WMPO, NV  
James Blaylock, WMPO, NV  
D. E. Livingston, WMPO, NV  
D. C. Dobson, WMPO, NV  
J. S. Szymanski, WMPO, NV

PDR-1.  
LPDR WM-11(2)

WM DOCKET CONTROL  
CENTER

'87 NOV 16 P2:05

WM Record File  
102.2

WM Project 11

Docket No. \_\_\_\_\_

PDR

X LPDR  (11)

Distribution:

Abrams

Stablein

(Return to WM. 623-SS)

4