

SUMMARY OF NRC-DOE TECHNICAL EXCHANGE
ON HYDROGENIC DEPOSITS
Las Vegas, Nevada (February 6, 1990)
Field Trip Localities in the Vicinity of
Yucca Mountain, Nevada (February 7, 1990)

Agenda: See Attachment 1.

List of Attendees: See Attachment 2.

Summary:

On February 6-7, 1990, the U.S Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) conducted a technical exchange on hydrogenic deposits in the vicinity of Yucca Mountain, Nevada. The objective of the technical exchange was to discuss preliminary results of activities directed toward the identification and characterization of the hydrogenic deposits at Trench 14, Busted Butte, and other localities near Yucca Mountain. On February 6, various DOE investigators led discussions on the results of various lines of evidence that are being factored into an understanding of the origin and significance of the hydrogenic deposits. Preliminary conclusions based upon the ongoing Trench 14 studies were presented by DOE at the end of the day (Attachment 3). On February 7, the group visited a number of sites in the vicinity of Yucca Mountain in order to examine various kinds of hydrogenic deposits in the area and to see the field evidence relating to these deposits. The State of Nevada participated in the exchange and introduced information based upon its field and laboratory studies relating to the hydrogenic deposits (Attachment 4).

Both NRC and DOE considered that the exchange promoted a better understanding of the range of models that could account for the Yucca Mountain hydrogenic deposits and which models are most strongly supported by the currently available results from DOE's studies. In addition, useful discussion occurred with regard to the need to recognize when to bring an activity to an end, i.e., when further investigations appear unlikely to substantially reduce the uncertainty in the understanding of some aspect of the site.

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AGENDA

DOE-NRC TECHNICAL EXCHANGE ON CALCITE-SILICA VEIN DEPOSITS

FEBRUARY 6 AND 7, 1990, LAS VEGAS, NV
 ROOM 450, SAIC OFFICES - VALLEY BANK CENTER
 Tuesday 8:00 a.m. - 5:30 p.m.
 Wednesday 7:00 a.m. - 6:30 p.m. (field trip)

PURPOSE: To discuss preliminary results of activities directed toward the identification and characterization of hydrogenic deposits in the vicinity of Yucca Mountain. Such information is important in the evaluation of future performance of a geologic repository beneath Yucca Mountain.

SCOPE: This technical exchange will concentrate on topics related to the preliminary efforts of hydrogenic studies primarily at Trench 14 and Busted Butte. The discussions on Tuesday will address results of previous and current work, possible analogs, analytical techniques that may be applicable to the studies, and future plans. The field trip scheduled for Wednesday will provide an opportunity for participants to examine these and other hydrogenic deposits near Yucca Mountain.

Tuesday, February 6, 1990

<u>AGENDA TOPICS</u>	<u>DISCUSSION LEADER</u>
Opening remarks .	DOE, NRC, State
o Background and SCP setting	DOE
o Field studies of laminated, authigenic deposits and soils and development of working hypothesis for origin at Trench 14	DOE
Discussion	all
o Results of chemical and mineralogical studies of laminated deposits in faults:	DOE
- Trench 14 and Busted Butte vein deposits	
- possible analog sites (hot and cold spring deposits)	
Discussion	all

Tuesday, February 6, 1990
(continued)

<u>AGENDA TOPICS</u>	<u>DISCUSSION LEADER</u>
o Microfossil studies:	DOE
- ostracodes	
- chrysophytes	
Discussion	all
o Stable isotope studies	DOE
Discussion	all
o Tracer isotope studies:	DOE
- principles of radiogenic isotope systems	
- strontium isotopes in Yucca Mountain studies and regional ground-water systems	
- preliminary lead isotope results for Yucca Mountain studies	
- use of U-series isotopes in tracer studies	
Discussion	all
o Geochronology of hydrogenic deposits	DOE
Discussion	all
o Breccia studies:	DOE
- petrology of breccia types	
- geochronology related to breccias	
Discussion	all
o Conclusions regarding preliminary work, including paleohydrologic implications and future plans	DOE
Discussion	all
Closing remarks	DOE, NRC, State
Field trip plans	DOE
Adjourn	

Wednesday, February 7, 1990

Field Trip to Hydrogenic Deposits in the Yucca Mountain Area

Morning:

Stop 1 - Calcite-silica veins and other deposits at Trench 14

Stop 2 - Soil and fault in-fillings at Trench 16

Stop 3 - Calcite-silica veins and other deposits at Busted Butte

Lunch

Afternoon:

Stop 4 - Calcite and/or travertine deposits at Site 106 on Stagecoach Road south of Yucca Mountain

Stop 5 - Travertine deposits in south Crater Flat

Stop 6 - Possible marsh deposit at "Horse Tooth" site

Note: Will leave Las Vegas for the site at 7:00 a.m.; Expect to return to Las Vegas by 6:30 p.m.

ATTENDANCE LIST

NRC/DOE TECHNICAL EXCHANGE ON CALCITE-SILICA VEIN DEPOSITS

February 6, 1990
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NRC/DOE TECHNICAL EXCHANGE ON CALCITE-SILICA VEIN DEPOSITS

February 6, 1990

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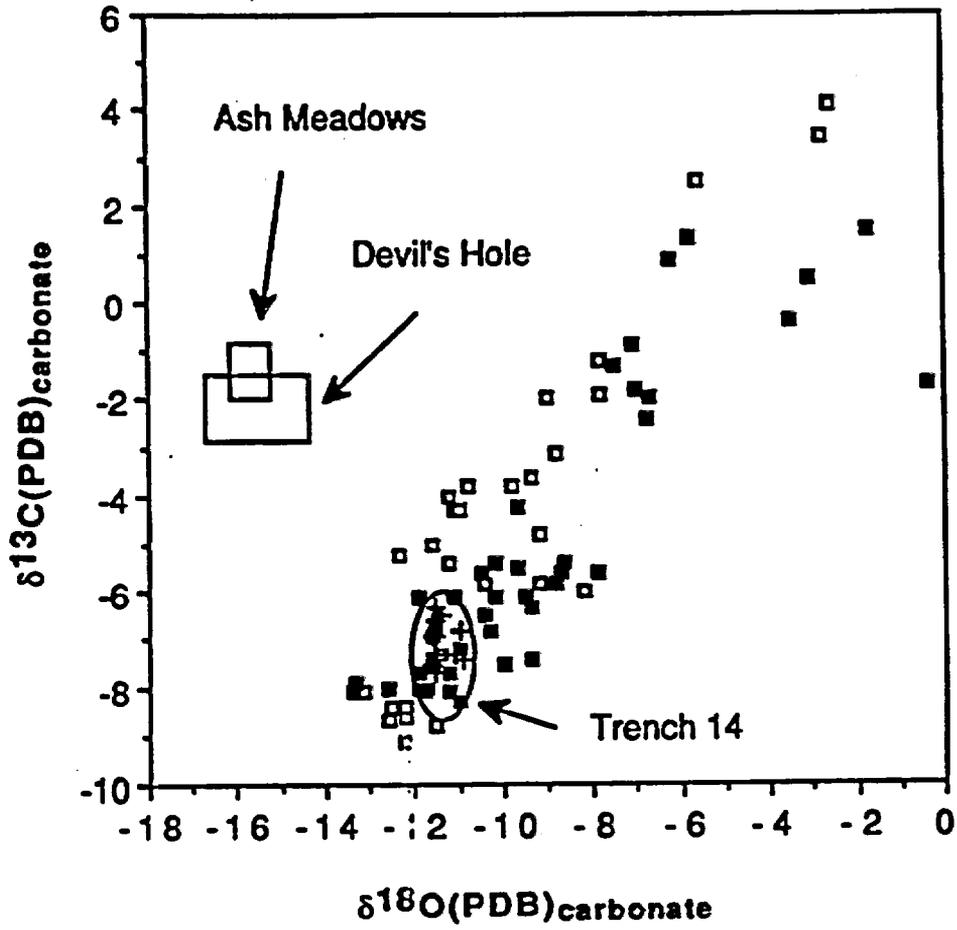
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CONCLUSIONS (FOR TRENCH 14 EFFORTS)

- (1) THERE ARE CARBONATE HORIZONS THAT PHYSICALLY AND MORPHOLOGICALLY MATCH PEDOGENIC CARBONATE HORIZONS THROUGHOUT THE WORLD. MOBILIZATION OF CARBONATE AND SILICA INTO VERTICAL VEINS BY THE SAME MECHANISM THAT FORM THE HORIZONTAL LAYERS PROVIDES THE MOST REASONABLE WAY TO FORM THE VEINS AT TRENCH 14.
- (2) THE MINERALOGY AND CHEMISTRY OF THE VEINS MATCH THOSE OF PEDOGENIC DEPOSITS. THE MICRO-SITE DISEQUILIBRIUM ARGUES AGAINST FORMATION IN A SATURATED ENVIRONMENT SUCH AS MIGHT BE EXPECTED NEAR A SPRING ORIFICE. MINERALOGY AND CHEMISTRY CAN AND WILL BE USED TO INSURE THAT ALL PARTS OF THE VEIN FORMED BY A SINGLE MECHANISM.
- (3) THE APPARENT LACK OF OSTRACODES ARGUES AGAINST AN ENVIRONMENT WITH STANDING WATER FOR PERIODS OF 3 MONTHS OR MORE AS MIGHT BE EXPECTED AT A SPRING DISCHARGE SITE.
- (4) THE PRESENCE OF RARE CHRYSOPHYTE CYSTS SUGGESTS FORMATION BY DILUTE WATERS SUCH AS THOSE THAT WOULD EXIST AT AN EPHEMERAL RECHARGE SITE AND ARGUE AGAINST EVEN AN EPHEMERAL DISCHARGE SITE FOR DEEP SEATED GROUNDWATERS.
- (5) CARBON AND OXYGEN ISOTOPIC COMPOSITIONS OF THE VEINS MATCH WELL WITH THOSE FOR PEDOGENIC CARBONATES, AND THE $\delta^{18}\text{O}$ VALUES ARE CONSISTENT WITH PRECIPITATION OF CALCITE FROM MODERN METEORIC WATERS AT REASONABLE NEAR-SURFACE TEMPERATURES. CONVERSELY, $\delta^{18}\text{O}$ VALUES FOR THE VEIN CARBONATES ARE HEAVIER THAN THOSE THAT WOULD FORM IN EQUILIBRIUM WITH CURRENT GROUNDWATERS AT THEIR PRESENT-DAY TEMPERATURES.
- (6) STRONTIUM ISOTOPIC COMPOSITIONS OF THE VEINS ARE MUCH MORE RADIOGENIC THAN WATERS IN EQUILIBRIUM WITH THE PALEOZOIC CARBONATES AND MORE RADIOGENIC THAN ANY OF THE WATERS ANALYZED THUS FAR FROM BENEATH YUCCA MOUNTAIN. THE VEINS ARE LESS RADIOGENIC THAN THE HOSTING VOLCANIC ROCKS BUT ARE NEARLY IDENTICAL IN ISOTOPIC COMPOSITION TO PEDOGENIC CARBONATES IN THE VICINITY OF TRENCH 14.
- (7) THE $^{234}\text{U}/^{238}\text{U}$ RATIOS IN GROUNDWATERS OF SOUTHERN NEVADA AND VEINS FORMED FROM THOSE WATERS DURING THE LAST 600 KA ARE ANOMALOUSLY LARGE (GENERALLY >2.5). THIS IS ESPECIALLY TRUE FOR THE FEW ANALYSES FROM JACKASS FLATS (>4.5). THE CALCITE IN THE TRENCH 14 VEINS COULD NOT HAVE FORMED FROM SUCH WATERS BUT THE VALUES OF <1.5 WOULD BE CONSISTENT WITH DOWNWARD PERCOLATING WATERS OF A PEDOGENIC SYSTEM.
- (8) EVIDENCE GATHERED TO DATE DOES NOT YET PROVE A SINGLE MODE OF ORIGIN FOR ALL OF THE VEIN CARBONATE AND OPALINE SILICA, BUT NOTHING SUGGESTS A MULTI-MECHANISM MODE OF ORIGIN.
- (9) NO SINGLE LINE OF EVIDENCE PROVES A PEDOGENIC ORIGIN, BUT THE WEIGHT OF EVIDENCE OF ALL DATA TAKEN TOGETHER MAKE IT EXTREMELY UNLIKELY THAT ANOTHER MECHANISM THAT INCORPORATED EXCEPTIONS TO EACH DATA SET COULD BE FOUND.



- \square calcareous
- \blacksquare non-calcareous
- $+$ Trench 14