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MEMORANDUM FOR: Philip Justus, Acting Chief

THROUGH: John Trapp, Acting Section Leader

FROM: Charlotte Abrams, Project Manager

SUBJECT: TRENCH 14 CALCITE-SILICA VEIN DEPOSITS, OBSERVATIONS AND IMPLICATIONS

Trench 14 is located between the east slope of Yucca Mountain and Exile Hill, and cross-cuts the Bow Ridge fault. The calcite-silica vein deposits exposed in trench 14 are presently being studied to determine their origin and significance. Possible origins are:

1) Pedogenic - implies emplacement from descending water.
2) Spring - emplacement from below, ascending waters.
3) Hydrothermal - emplacement from below, ascending higher temperature waters.
4) Multiple origins - a combination of more than one of the above.

The south wall of a shallower precursor to the present trench 14 was mapped in May, 1982, by Swadley, Parrish, and Huckins. A diagram of that map appears in USGS OFR 84-788 (Swadley and others, 1984).

The possible implications of the calcite-silica deposits in trench 14 were recognized by Rice and Cutler on a geologic data review in September, 1984. Trench 14 was subsequently deepened after that site visit, but prior to July, 1985 (see Prestholt's weekly report for July 29, 1985). Additional calcite-silica veining was exposed in the deepened trench. As a result of the September, 1984, data review, NRC Draft EA comments 2 and 6-88 (3-20-85) addressed the potential for hydrothermal activity in the area of Yucca Mountain and suggested the possibility that deposits associated with fault zones adjacent to Yucca Mountain may result from hydrothermal activity.

In May, 1985, the USGS proposed a study of the calcite-silica deposits. This study was not specifically limited to the deposits in trench 14 and included all known secondary deposits of calcite and silica on or near Yucca Mountain. Proposed investigators included personnel from the USGS and Los Alamos. Some preliminary results were released by Dave Vaniman (LANL) in July, 1985, but based on these results no origin for the deposits could definitely be determined.

Workers with the USGS have presented evidence interpreted to suggest a

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pedogenic solution for the calcite-silica vein deposits (see McKague, trip report, May 6, 1986). Evidence cited to support a pedogenic origin is:

1) isotope data which may support a low temperature origin;
2) inclusion of basaltic ash in the veins;
3) the presence of sepiolite in the vein deposits;
4) the presence of opal CT;
5) possible similarity to deposits in sand ramps at Busted Butte; and
6) lateral persistence of the calcite-silica deposits.

The degree to which each of these lines of evidence supports a pedogenic origin is uncertain at this time. Responses to this evidence are:

1) Preliminary ^{18}O values suggestive of a low temperature origin are not definitive and more isotopic work is being done.

2) The inclusions of basaltic ash may have resulted from downward movement of water, or may have originated by deposition into a spring or hydrothermal environment.

3) The presence of sepiolite in small quantities in the vein deposits has been used as an argument for a low temperature origin for the calcite-silica deposits. The origin of sepiolite is not clearly understood and sepiolite formed by hydrothermal solutions is reported from Utah and Nevada (Ehlmann and others, 1962).

4) The presence of opal CT in the calcite-silica deposits has also been used as an argument for a low temperature origin. Fournier (1985) showed opal CT to be stable up to 250°C and recognized the presence of opal CT in hydrothermal systems.

5) Although the deposits at Busted Butte may be an analogue, more work needs to be done to confirm this idea.

6) This criterion is inconclusive until further trenching and removal of surface material is accomplished to demonstrate the lateral extent of the deposits.

On April 28, 1986, the DOE held a workshop to determine a strategy and work plan for resolution of the calcite-silica deposits. Trip reports by McKague and Abrams explain the outcome of that meeting.

Resolution of the origin of the calcite-silica deposits in the area of the proposed HLW repository is of concern. If studies indicate that deposits

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result from the downward movement of water through soil (pedogenic deposits) adverse effects from such deposits would be minimal. Waste isolation could, however, be adversely affected if hydrothermal or spring activity should occur within the area of the HLW repository.

1. A spring interpretation may indicate possible fault related perched water which could be a problem if found in areas of proposed excavations for the repository and surface facilities. It has been suggested that the calcite-silica deposits may result from springs which formed in the Pleistocene epoch when the water table in the area was higher.

2. If the deposits are hydrothermal in origin a heat source (possible magmatic activity) could be indicated as the driving mechanism for the emplacement of the veins. Movement of hydrothermal waters through the storage site could adversely affect waste isolation.

3. Basaltic ash found in the vein deposits is either 1.2 million years or 290,000 years old (See Calcite-silica workshop summary, March 20, 1986). If the latter is correct, and the ash was deposited into an active hydrothermal or cold spring environment, then the deposits could be Quaternary.

4. Hydrothermal veins associated with volcanic rocks are commonly hosts for precious metal deposits. Gold deposits at Tonopah (north of the site) and in other areas of Nevada are associated with vein deposits. If the calcite-silica veins in trench 14 are hydrothermal in origin, natural resources potential of the area should be closely evaluated.

/S/

Charlotte Abrams, Project Manager

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