CALCITE FLUID INCLUSION, PARAGENETIC, AND OXYGEN ISOTOPIC RECORDS OF THERMAL EVENT(S) AT YUCCA MOUNTAIN, NEVADA

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Yucca Mountain, Nevada, is under consideration as a potential high-level radioactive waste repository situated above the water table in 12.7 Ma tuffs. A wealth of textural and geochemical evidence from low-temperature deposits of calcite and silica, indicates that their genesis is related to unsaturated zone (UZ) percolation and that the level of the potential repository has never been saturated. Nonetheless, some scientists contend that thermal waters have periodically risen to the surface depositing calcite and opal in the tuffs and at the surface. This hypothesis received some support in 1996 when two-phase fluid inclusions (FIs) with homogenization temperatures (Th) between 35 and 75°C were reported from UZ calcite.

Calcite deposition likely followed closely on the cooling of the tuffs and continues into the present. The paragenetic sequence of calcite and silica in the UZ is early stage calcite followed by chalcedony and quartz, then calcite with local opal during middle and late stages. Four types of FIs are found in calcite assemblages: 1) all-liquid (L); 2) all-vapor (V); 3) 2-phase with large and variable V:L ratios; and 4) a few 2-phase with small and consistent V:L ratios. Late calcite contains no FI assemblages indicating elevated depositional temperatures.

In early calcite, the Th of type 4 FIs ranges from ~ 40 to ~ 85°C. Such temperatures (sub-boiling) and the assemblage of FIs are consistent with deposition in the UZ. Some delta 18O values <10 permil in early calcite support such temperatures. Type 4 FIs, however, seem to be restricted to the early calcite stage, during which either cooling of the tuffs or regional volcanism were possible heat sources. Nonetheless, at present there is no compelling evidence of upwelling water as a source for the calcite/opal deposits.