

LR-287-17
11/24/85

LETTER REPORT

TITLE: Review of "Reaction of the Topopah Spring Tuff with J-13 Well Water at 90° C and 150° C," UCRL-53552, May 30, 1984, by V.M. Oversby.

AUTHOR: K.L. Von Damm

PROJECT TITLE: Technical Assistance in Geochemistry

PROJECT MANAGER: G.K. Jacobs

ACTIVITY NUMBER: ORNL #41 88 54 92 4 (FIN No. B0287)
NRC #50 19 03 01

The subject report documents a study of the interaction between J-13 well water and crushed tuff from an outcrop of the Topopah Spring Member at Yucca Mountain at temperatures of 90° C and 150° C. The purpose of the study was "to define the changes in water chemistry that would result from temperature changes caused by emplacement of high level nuclear waste in a repository in the Topopah Spring Tuff." J-13 well water is, at present, assumed to have the same composition as any groundwater in the unsaturated zone at Yucca Mountain and the producing horizon in the J-13 well is indeed the Topopah Spring Member. The results show that for the conditions studied, the changes in solution chemistry are relatively minor (once the caliche is removed), due primarily to the low concentration of anions available from the rock and the starting solution. Silica increases are the largest, with smaller increases observed for potassium, aluminum and pH, while decreases are observed for calcium and magnesium. Silica appears to be approaching cristobalite solubility, aluminum is supersaturated but is approaching gibbsite solubility, and calcium and magnesium decrease due to the formation of a magnesium calcite.

The experiments were performed in teflon-lined reaction vessels (Parr bombs) for up to 72 days at 90° C and for up to 64 days at 150° C and at water/rock mass ratios of 15, 30, 60 and 120. The temperatures were chosen to bracket the boiling point of water (95° C) at Yucca Mountain. Although a range of water/rock ratios were studied, no very low ratios (approximately 1:1) were used. Extremely low ratios may be more appropriate for what is considered to be an unsaturated zone. Several of these experiments show results that correlate with the water/rock ratio. At lower water/rock ratios the concentration of a species present in solution is less likely to be limited by the total amount available from the rock, yielding a higher solution concentration. Solubility controls may therefore become more important in controlling solution composition.

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A major difficulty is encountered with the use of outcrop material as it contains a caliche-type material evaporated from surface runoff. This study documents one procedure to remove this material prior to experimentation. The solids are washed for approximately one hour in J-13 water, which removes most of this caliche-type material. A second treatment, heating the solids overnight in J-13 water to 90° C or 150° C (the experimental temperature) was also done in most cases. Significant changes in some of the solution constituents (silica, calcium and magnesium) unrelated to caliche dissolution were observed. This heating may induce changes attributed to caliche dissolution which are really water/rock interactions. These reactions begin to occur on the time scale of a day or less at elevated temperatures. Since the report demonstrates how effective one low temperature rinse is, additional low temperature rinses may be more appropriate. This potential difficulty in the analytical procedure may have an effect on the magnitude of the change observed in the groundwater chemistry, but should not affect the direction of the changes or the major conclusions of the report.

All of the steps in the study are extremely well documented, especially as to changes in groundwater composition. Changes in the compositions of the solids are addressed in a separate study. The author recognizes potential problems associated with the procedures (quenching of samples, limited time duration of the experiments) and materials (gas uptake and possible fluoride release by teflon). She clearly states that studies still in progress are addressing some of these problems and should resolve some of the questions not answered by this study.