

LETTER REPORT

TITLE: Review of: Mobility of Radionuclides in High Chloride Environments, NUREG/CR-4237 RW, April 1985, by H.J. Simpson, A.L. Herczeg, R.F. Anderson, R.M. Trier, G.G. Mathieu and B.L. Deck.

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This report contains data on the concentrations of several isotopes of U, Th, Ra and Rn as well as limited data for Pu and several stable chemical species (pH, Cl, Fe, Mn, CH₄, DOC, pCO₂, total CO₂ and total alkalinity) in ground and surface waters from within and near the Delaware Basin, southeastern New Mexico. The waters ranged from low to high salinity and from oxic to anoxic. The authors make three major statements about their findings:

1. The concentrations of uranium and radium correlate slightly with the chloride content of the water samples.
2. Uranium is present in much lower concentrations in anoxic compared to oxic waters while radium is present in much higher concentrations in anoxic waters. They calculate a retardation factor of approximately 1 for radium indicating its high mobility in anoxic brines.
3. Their chemical recoveries (yields) of thorium and to a lesser degree uranium are much lower than usual. They suggest that these elements are present as unreactive dissolved or colloidal complexes with organic matter - implying that the uranium and thorium may be highly mobile, even though they are present at low concentrations.

The correlation of uranium and radium with chloride is not very strong and may reflect another parameter or combination of parameters, such as increased CO₃²⁻, SO₄²⁻, or PO₄³⁻ (no PO₄³⁻ data are reported; the SO₄²⁻ data are for other, similar water samples). The correlation of uranium and radium with oxic or anoxic conditions is very strong. The authors suggest that the radium is high in anoxic waters as a result of the absence of Fe- and Mn- oxide, hydroxide coatings that (especially Mn coatings) are known to strongly scavenge radium. An additional explanation could be the absence, or low levels, of SO₄²⁻ inhibiting the

formation of $BaSO_4$, a phase which may incorporate radium in solid solution. A weakness in the argument of the authors pertaining to oxic/anoxic conditions is the use of the presence or absence of H_2S as the sole criterion without giving the detection limit or quantitative values. All H_2S data are presented as either "not detected" or "present." The consistently low chemical yields obtained for thorium and uranium are disturbing and the suggested explanations may be valid. The authors do not stress enough that the reported values of thorium and uranium should be treated as minima due to these problems. Further work should include a method to destroy the organic matter, e.g. ultraviolet oxidation of the water, prior to the precipitation with $Fe(OH)_3$ to obtain a better total value.

The report provides some of the only data relevant to radionuclide migration in high salinity solutions, such as might be found in or near a repository in salt. The report also includes data for brines under both oxic and anoxic conditions. The sampling and experimental difficulties experienced by these authors (e.g. low thorium and uranium yields) should be useful for future studies to further address the importance of organic and/or colloidal transport of these elements in brines.