

Project ID: **55284**

Project Title: **Aquifer Transport of Th, U, Ra, and Rn in Solution and on Colloids**

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We have completed a theoretical study of the U-Th and radioactive decay series in an aquifer (Tricca et al, in press). Using this model as a guide, we have reassessed our results on the aquifer associated with Brookhaven National Laboratory. Based on our study and analyses of the U-Th series nuclei in this aquifer and the theoretical results, it was considered mandatory that a new set of samples be acquired. In addition to data from the groundwater samples, information concerning the addition of nuclides into the ground water system from the vadose zone was needed. A field study was then carried out and the samples returned to the laboratory. Sampling was done in consultation with hydrologists from the Brookhaven National Laboratory staff. The analyses are now almost completed and a draft of the final report is in preparation.

Unfiltered, filtered and ultra-filtered water samples were collected to determine the role of particles and colloids in the transport of radio-nuclides. Data were obtained on ^{238}U , ^{234}U , ^{232}Th , ^{234}Th , ^{226}Ra , ^{222}Rn , ^{228}Ra and ^{224}Ra . In addition, chemical analyses were carried out for the standard dissolved load. It was found that there has been an addition of Cl into the ground waters from the surface.

The results show that the waters in the upper glacial aquifer are intruded at some locations by waters from the underlying Magothy unit. The relative effects of U addition to the ground water from alteration in the ground water table itself as compared to the contributions from the vadose and soil zones was investigated. It was found that a substantial to dominant contribution of U in the groundwater comes from the vadose zone. The "dissolved" U in the groundwater is, in several cases, governed by the presence of colloids. It would appear that the variable concentration of ^{238}U along nominal flow lines is due in part to non-conservative behavior involving precipitation and dissolution of colloids. The data indicate that there are both removal (i.e., precipitation mechanisms) available even under oxidizing conditions. Also sharp changes in both the concentration and isotopic composition ($^{234}\text{U}/^{238}\text{U}$) occur due to the dissolution of some phases within the ground water table. The colloids show distinct differences in $^{234}\text{U}/^{238}\text{U}$ relative to the dissolved load and show there is not rapid exchange between these components. It appears the U in the dissolved load <10 KD.

The nominal hydrologic flow lines that were used as the basic guide to the original sampling do not appear to represent the actual flow lines. We consider this to be the more plausible hypothesis. This implies that the transport in an aquifer where the "age" of the water is young ($\leq 2 \times 10^2$ years) is governed by the precise details of the flow from the vadose zone into the aquifer for considerable distances. Any "diffusive" mixing over this distance (time) scale is thus inadequate to smooth gross irregularities from local sources in the soil weathering zone. Percolation appears to be an important to dominant process. The final data sets are now being acquired and a final report will be completed with the next six months.