

**Application of Ra-223 as a Tracer of Groundwater in Southern Rhode Island
Watersheds**

Principle Investigators

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Problem and Research Objectives

The key research question addressed is the magnitude and seasonal variability of submarine groundwater discharge (SGWD) on a regional basis and its impact on the ecology and biogeochemistry of coastal waters. It has become increasingly evident that groundwater represents a significant, though poorly constrained, source of dissolved nutrients and contaminants to coastal watersheds. Quantifying the flux of groundwater is therefore of significant economic and environmental importance, particularly given the potential for transporting nutrients in groundwater into coastal waters without the filtering effect of estuaries as in the case of riverine transport. The application of Ra-223, Ra-224, Ra-226, and Ra-228 provides a large-scale measure of the diffuse input of groundwater and associated nutrients and contaminants to coastal watersheds of southern Rhode Island. The objectives of the proposed research are to: 1. develop a Ra-223 tracer analytical capability to assess the impact on salt marsh hydrology and ecology of nutrient input via groundwater and exchange with coastal waters. 2. quantify seasonal changes in the magnitude of groundwater input on a regional basis to southern Rhode Island salt ponds using a combination of Ra-223, Ra-224, Ra-226 and Ra-228 tracers.

Methodology

Ra-224, Ra-226 and Ra-228 have been determined in groundwater, salt ponds, and adjacent shelf waters of Rhode Island using existing techniques in the principal investigator's laboratory. Samples will be analyzed for Ra-223 using a delayed coincidence counting system. We have acquired the components to build a delayed coincidence counting system for the analysis of short-lived Ra-223 (half-life = 11.4 d) and Ra-224 (half-life = 11.4 d). This detection system has only recently been made commercially available, and consists of a data acquisition board, amplifier, PMT's, software, HV supply, preamplifier and counting cells. The time required to acquire the components to build the delayed coincidence counter was considerably longer than anticipated (~8 months), primarily due to delays beyond our control with University of Rhode Island Purchasing. The system is now fully operational.

Principal Findings and Significance

We are accomplishing the primary objectives of this project. Specifically, we have measured the concentrations of Ra-226 in groundwater, shelf water, and coastal ponds of southern Rhode Island. Our work has indicated enrichments of Ra-226 observed in these coastal-zone systems, with the values of approximately 2 dpm /100L for inner shelf waters and ranging from 19-44 dpm/100L for the four coastal ponds examined

(point Judith, Potter, Green Hill, and Ninigret Pond). For these salt ponds, estimated groundwater flows of 0.007-0.077 ml/sq.cm-d were calculated. These inputs correspond to ~1-4200000 L/d. which are 4-60 times less than estimates of stream and river flow to these ponds. An important question that we are currently investigating is the magnitude of seasonal variations in groundwater flux in such coastal environments; we have almost completed a seasonal study of groundwater flow in the Pettaquamscutt River-Estuary. We are attempting to use our radionuclide tracer results to estimate the flux of nutrients, particularly nitrogen, in groundwater to the coastal ponds of southern Rhode Island.

Descriptors

Groundwater, Watershed, Radionuclides, Radium, Pollutants, Nutrients

Articles in Refereed Scientific Journals

Scott M.K., and S. B. Moran (2000) Groundwater input to coastal salt ponds of southern Rhode Island estimated using Ra-226 as a tracer, *Journal of Environmental Radioactivity* (submitted 12/99) Moran, S.B., S.W. Nixon, M.K. Scott, and L. Ernst (2000), Groundwater nitrogen in southern Rhode Island: concentrations and fluxes, *Estuaries* (in preparation) Kelly, R.P., and S.B. Moran (2000) Seasonal changes in groundwater input and mixing within the Pettaquamscutt Estuary estimated using Ra-224, Ra-226 and Ra-228 as tracers. *Oceanography: The making of a Science*, WHOI, March 30-31 Kelly, R.P. and S.B. Moran (2000) Seasonal changes in groundwater input and mixing within the Pettaquamscutt Estuary estimated using Ra-224, Ra-226 and Ra-228 as tracers, *Estuarine, Coastal and Shelf Sciences* (in preparation)

Book Chapters

Dissertations

Kelly, R.P., (2001) Seasonal changes in groundwater input and mixing within the Pettaquamscutt Estuary estimated using Ra-224, Ra-226 and Ra-228 as tracers, M.Sc Thesis, Graduate School of Oceanography, University of Rhode Island (anticipated Spring 2001)

Water Resources Research Institute Reports

Conference Proceedings

Moran, S. B., and M. K. Scott (1999) Ra-226 as a tracer of groundwater input to coastal waters of southern Rhode Island. Conference on Technologically Enhanced Natural Radiation (TENR), Rio de Janeiro, September 13-17

Other Publications