![USGS]

WATER RESOURCES RESEARCH GRANT PROPOSAL

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

FOCUS Category: GW

Descriptors: Groundwater, watershed, radionuclides, radium, pollutants, nutirents.

Duration: March 1, 1999, to February 28, 2000 FY-1999

Federal Funds: $23,500

Non-Federal Funds Allocated: $49,075

Principal Investigator: Dr. S. Bradley Moran Associate Professor Graduate School of Oceanography University of Rhode Isdland Narragansett, RI 02887-1197

Congressional District: Second

Statement of critical regional or state water problems to be addressed by the project, including explanation of need for research:

This proposal will provide the capability to determine both short-lived (223Ra, and 224Ra) and (226Ra, 228Ra) long-lived radium tracers as GSO?URI. These isotopic tracers will be used in field work over the next several years to quantify rates of groundwater discharge and associated nutrients and contaminants and constrain recharge rates in southern Rhode Island. Results from the proposed research can be used to conbstrain and validate models of groundwater flow, provide information on the role of groundwater in coastal eutrophication and non-point source pollution, and contribute to the effective management of coastal waters.

Nature, Scope and Objectives of Research

Submarine groundwater discharge is a significant but poorly quantified source of new nitrogen (particularly nitrate) to the shallow coastal laggons and embayments typical of the east coast of the United States (Lee and Olsen, 1985; Giblin and Gaines, 1990; Valiela et al., 1990, 1992). Nutrient concentrations in groundwater are often several orders of magnitude higher than those of estuarine receiving waters (Lee and Olsen, 1985; Giblin and Gaines, 1990), and there is now convincing evidence for significant input of groundwater to the coastal zone (Bokuniewicz, 1980; Sewell, 1982; Capone and Bautista, 1985: Bokuniewicz and Pavlik, 1990). Groundwater quality can be rapidly compromised by individual on-site waste disposal systems, particularly in sandy coastal sediments, and a close correlation exists between population density and groundwater nitrate concentrations in a number of communities (Johannes, 1980; Nixon et al., 1982;

Sewell, 1982; Persky. 1986; Giblin and Gaines, 1990). The implication is that a significant, though poorly constrained, input of dissolved nutrients (and contaminants) to coastal watersheds may occur via this submarine transport mechanism.

A key question is the magnitude and seasonal variability of submarine groundwter discharge (SGWD) on a regional basis and its impact on the ecology and biogeochemistry of coastal waters.

One of the major difficulties in quantifying the magnitude of SGWD is the diffuse nature of the source term. Conventional methods of estimating groundwater input to the coastal zone generally rely on interpolation between site specific individual measurements made at a single point in time. These techniques do not adquately quantify the large-scale, diffuse, nature of SGWD to the coastal zone and do not provide an integrate measure of SGWD on a regional scale.

The overall objective of this proposal is to quantify the input of groundwater and associated chemicals (nutrients, contaminants) to southern Rhode Island salt ponds and coastal waters using the naturally occuring radionuclide tracers 223Ra (t1/2 = 11.4 days), 224Ra (t1/2 = 3.6 days), 226Ra (t1/2 = 1600 years) and 228Ra (t1/2 = 5.7 years). These radionuclides typically have higher activities in groundwaster than in coastal seawater, which makes them useful tracers of the groundwater signalm(Moore, 1996; Rama and Moore, 1996; Scott and Moran, 1998) Measrements of the distribution of these tracers in groundwater, coastal salt ponds, sediment pore water, and adjacent shelf waters can be used to provide an integrated measure of submarine groundwater input on a regional basis. In addition, the differing hal-lives of these tracers provide information on both annual times-scales (226Ra. 228Ra) and short-term "event driven" temporal varations (223Ra, 224Ra) in SGWD to salt ponds and coastal waters.

Over the past two years, the PI and graduate student Meg Scott have determined 226Ra tracer estimates of groundwater input to coastal ponds in southern Rhode Island (Moran and Scott, 1998). This proposal would expand on this groundwater research by developing the capability for Ra-223 analysis at GSO/URI.

Specifically, the PI presently has the capability to determine the tracers 224Ra, 226Ra and 228Ra (Scott, 1998). However, analysis of the short-lived 223Ra isotope require a delayed coincidence detection system recently developed by Dr. W. S. Moore at the University of South Carolina (Moore and Arnold, 1996). As discussed by Moore (1997) the combination of 223Ra and 224Ra, specifically the 223Ra/224Ra activity ratio, provides a powerful tracer method of estimating the age of groundwater and mixing rates in coastal waters.

The objectives of the proposed research are to:

1. develop a 223Ra 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 223Ra, 224Ra, 226Ra and 228Ra tracers.

Results from the proposed research can be used to constrain and validate models of groundwater flow, provide information on the role of groundwater in coastal eutrophication and non-point source pollution, and contribute to the effective management of coastal waters.