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RADON AND RADIUM ISOTOPES TRACE GROUNDWATER DISCHARGE INTO THE OCEAN

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Thermal mineral waters, such as those of Mariánské Lázně in the Czech Republic, are often reported to have exceptional therapeutic properties. Such waters are also typically enriched in natural radioactive isotopes of radium and radon. Are the perceived health effects examples of hormesis, folklore, or coincidence? What is not folklore is the growing recognition that radon and radium serve as excellent tracers for many geophysical processes. We describe here an application of these nuclides to evaluate the flux of groundwater into coastal waters.

Our measurement of radon in coastal seawater has been greatly facilitated by use of a newly developed continuous radon monitor. This approach has greatly enhanced the resolution we obtain in our measurements. For example, we can now discern tidal-scale variations of groundwater discharge (Fig. 1).

We construct a mass balance for radon to match inputs via groundwater discharge and diffusion from sediments with outputs via decay, atmospheric evasion, and mixing with offshore waters. The net change in inventory per unit time provides an estimate of the net flux after corrections are made for atmospheric loss. Minimum losses by mixing can be evaluated by use of observed negative net fluxes after other corrections are applied. After estimates for mixing are factored in, one can convert the derived total radon fluxes to water fluxes by dividing by the measured or estimated concentration of radon in the groundwater. This produced results comparable to more labour-intensive methods in recent intercomparison experiments.

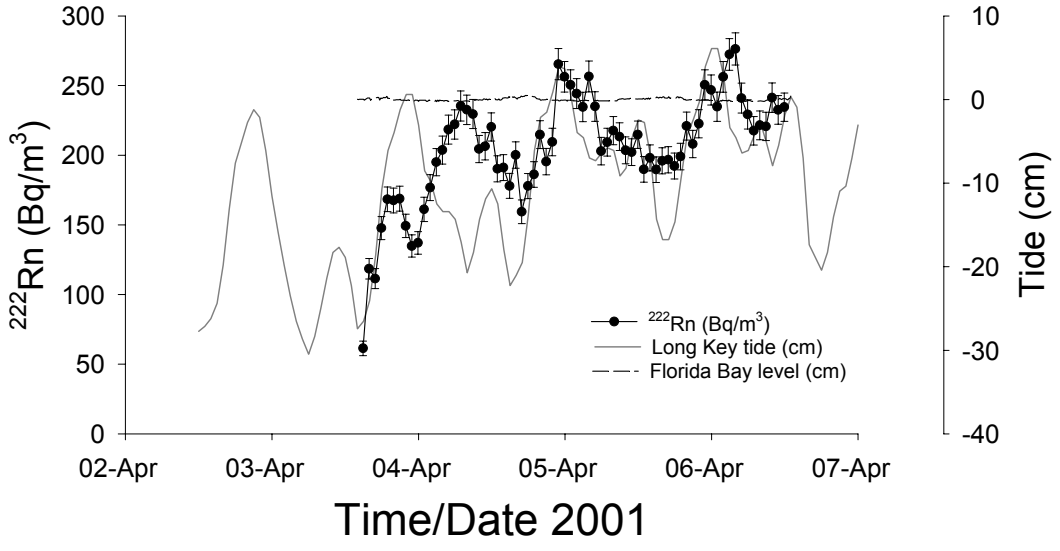

Figure 1 Concentrations of ^{222}Rn in Florida Bay waters off Key Largo (left-hand scale) and the water levels in Florida Bay and the Atlantic (right-hand scale). The rhythmic pattern of ^{222}Rn is responding to tidal forcing on the opposite (ocean) side of the island that drives subsurface waters into Florida Bay.