

**IDENTIFICATION OF SOURCES OF GROUND WATER DISCHARGE IN CELESTUN
LAGOON USING RADIUM ISOTOPES AND MULTIPLE CHEMICAL TRACERS.**

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ABSTRACT.

Measurement of two short lived radium isotopes (^{223}Ra and ^{224}Ra) along with other chemical tracers indicates that there are two chemically distinct permanent sources of ground water discharge into Celestun Lagoon. One source discharges into the far upper section of the lagoon and the other source discharges near the mid-point of the lagoon, along the east side. The upper source is characterized by low radium isotope activities, high strontium concentrations, high silica concentrations, and elevated strontium to calcium ratios in comparison to the mid-point ground water source and sea water entering the lagoon. The upper source also has a higher $^{224}\text{Ra}/^{223}\text{Ra}$ ratio than the mid-point source. In contrast, the mid-point source is characterized by high radium isotope activities and elevated nitrate concentrations. Measurements made over the past two years indicate that there is significant variability in the concentrations of these tracers in the source water and lagoon water, although the overall pattern of tracers in the different ground water sources remained constant.

Radium isotopes and chemical tracers were also used to distinguish seasonal ground water discharge points from continuous ground water sources. During the rainy season, small ground water discharge points can be seen throughout Celestun lagoon by the upwelling pattern created on the surface water. These discharges were present in October 2001 and were not present in July 2002. No differences were detected between these seasonal discharging water and the surrounding lagoon water other than lower salinities, indicating that these discharges are distinct from the upper and mid-point permanent ground water sources. Due to the seasonality of these discharge points, low radium concentrations, and low silica concentrations, it is likely that these ground water discharges are directly related to rainfall, are associated with shallow, fast-recharge ground water flow and are distinct from both the upper and mid-point ground water sources.

Keywords: Ground water, radium isotopes, chemical tracers, Celestun

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