Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.11298

Evaluating Environmental Impacts of Beneficial Use of Oil and Gas Wastewater with Radium and Strontium Isotopic Tracers

NATHANIEL WARNER, KATHARINA PANKRATZ AND BONNIE MCDEVITT

Pennsylvania State University

Presenting Author: nrw6@psu.edu

In the United States, oil and gas wastewater has been released through pathways such as permitted discharges or accidental spills to surface waters. One concern is the potential release of produced water with elevated activities of radium, a known carcinogen. Here we present findings from multiple field and laboratory investigations on the environmental health in areas of both permitted discharges as well as accidental spills. We use a combination of radium ($^{228}Ra/^{226}Ra$) and strontium ($^{87}Sr/^{86}Sr$) isotopic tracers to establish potential impacts to the environmental that could be of concern to human or aquatic health. First, controlled laboratory experiments demonstrate accumulation of radium in aquatic bivalves correlates with the dose of produced water. At concentrations expected downstream of permitted discharges radium activities can more than double and the isotopic ratio ($^{228}Ra/^{226}Ra$) reflects the pollutant source. Second, field studies of aquatic bivalves that live downstream of oil and gas wastewater discharges demonstrate increased radium activity and changes in isotopic ratios of both $^{228}Ra/^{226}Ra$ and $^{87}Sr/^{86}Sr$ that fingerprint the source of the pollution. Third, in areas with accidental spills of wastewater, there appear to be long-term consequences to stream water and sediment quality that limit the ability of bivalves to repopulate the area. Combined these studies indicate that historical releases of oil and gas wastewater has led to increased radium activity in local food webs and increased mortality for aquatic life. Radium and strontium isotopic ratios provide a means to trace the oil and gas produced water releases through the food web.