ACCUMULATION OF RADIUM DECAY PRODUCTS IN A LAKE RECEIVING EFFLUENTS FROM A UNCONVENTIONAL DRILLING TREATMENT FACILITY

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Hydraulic fracturing and horizontal drilling (i.e., unconventional drilling) for shale gas has emerged as an important technology for supplying energy to the United States and the rest of the world. However, there are many unknown and uncharacterized potential environmental pollution risks. Naturally-occurring radioactive materials (NORM) are some of the least characterized environmental pollutants generated by unconventional drilling. Emerging reports have indicated that NORM is not fully removed from liquid wastes during wastewater treatment processes and can enter riparian environments. Though, these reports have focused on a single radionuclide, radium-226, and have not addressed radium-226 decay products. The goal of this study was to investigate levels and equilibrium status of radium-226 and its decay products (lead-210 and polonium-210) in water and sediment in an aqueous environment impacted by hydraulic fracturing. Water and sediment samples were collected upstream, within, and downstream of a freshwater lake in West Virginia, using routine methods as recommended by the US EPA. All metal, inorganic, organic, gamma spectrometry (HPGe), and water quality measurements were performed by University of Iowa State Hygienic Laboratory in accordance with NELAC standards. Alpha-emitting isotopes (natural uranium, polonium-210) were analyzed by isotope-dilution alpha spectrometry using NIST-traceable standards. Radioactivity concentrations of NORM in stream sediments were generally lower than NORM levels in the lake and well below action levels (180 Bq/kg). We found levels of lead-210 and polonium-210 in sediments of a lake receiving treated unconventional drilling liquid wastes were 3-5 fold higher than levels of the supporting radionuclide, radium-226. This work suggests that lead-210 and polonium-210 cannot be assumed in equilibrium with radium-226. Risk, exposure, and environmental impact assessments to NORM liberated by unconventional drilling should consider radium-226 decay products.