ON THE FATE AND TRANSPORT OF RADIUM IN MARCELLUS SHALE PRODUCED FLUIDS

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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 and ionic strength are among the most challenging parameters to control during disposal of liquid wastes.

Very little is known about the effects of ionic strength and other matrix parameters on the partitioning of NORM within waste fluids or in the environment. The goal of this study was to investigate the effect of ionic strength on the partitioning of U, Th, Ra, Pb, and Po isotopes in Marcellus Shale fluids both observationally and experimentally. Specifically, this study investigated the sediment accumulation of NORM from a large volume spill of mining waste at Dunkard Creek, West Virginia that occurred in 2009. The low levels of NORM observed at this site prompted laboratory-based, radiochemical experiments to understand the particle reactivity of U, Th, Ra, Pb, and Po in Marcellus Shale drilling wastes. Additionally, this study applied sequential extraction techniques to determine the fate of Ra, Pb, and Po in riparian environments impacted by these fluids. This study finds that U, Th, and Po are particle reactive in Marcellus Shale brines, while Ra and Pb are exceptionally soluble. Although ionic strength appears to play a role in the solubility of Ra, we found the single greatest predictor for Ra solubility was the concentration of Ba.