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Sediment: a permanent sink for radium?

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Radium is a naturally occurring radioactive element and its longest-lived isotope, ^{226}Ra, has a half-life of 1602 years. The exploitation of natural resources (i.e., mining, natural gas...) leads to its mobilization from the earth's crust to the aquatic surface environment where it accumulates in sediment. It has been proposed as an environmental impact indicator of the shale gas industry where its level and partitioning in sediment of nearby river are used to establish the dispersion of any potential pollution [1]. However, the geochemistry and mobility of radium in sediment is still poorly understood: natural geochemical processes such as early diagenesis might favor its release from the solid phase to porewater and later to the overlaying water. Sediments which were initially a sink for radium might become overtime a source for the water column. For the last 20 years, shale gas has been extracted in the Kennebecasis river watershed in New Brunswick, Canada. Its sediments and their ^{226}Ra content represent therefore an opportunity to determine the environmental impact of the shale gas industry and to investigate the geochemistry of this radionuclide. In the summer 2021, 4 sedimentary cores (15 to 25 cm length) were sampled along the river. Each core was cut into 1 cm slices under inert atmosphere and porewaters were extracted by centrifugation. ^{226}Ra and other key elements to geochemical processes (Fe, Mn, U...) were measured in the sediment solid phase, porewaters, and surface waters of the river. Historical radium deposition as well as contamination zones were established. The influence of early diagenesis processes on radium geological cycle will be discussed.

[1] McDevitt, B., McLaughlin, M., Cravotta, C. A., Ajemigbitse, M. A., Sice, K. J. V., Blotevogel, J., Borch, T., & Warner, N. R. (2019). Environmental Science: Processes & Impacts, 21(2), 324-338.