A review of the Ra isotopes as SGD tracers

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Submarine groundwater discharge (SGD) is considered to be an important source of dissolved chemicals to oceans. One of the most used and cited tracer of SGD are short and long-lived Ra isotopes and Rn. Recently, several papers highlighted that short-lived Ra isotopes also trace small-scale recirculation processes (centimeters to meter) commonly referred to as porewater exchange (PEX). However, the biogeochemical and hydrological consequences of SGD or PEX are different and, therefore, it is important to distinguish between both processes. The use of the same radionuclides (short-lived Ra isotopes and Rn) to trace different processes (i.e. PEX and SGD) requires a detailed evaluation of the driving forces and the underlying physical discharge processes. In this presentation we review several studies and we also analyze the results obtained in some Mediterranean sites, an ideal environment to study driving forces that introduce Ra-isotopes and Rn to the water column without tidal influence. Thus, in systems where PEX is a relevant source of short-lived Ra isotopes, those Ra isotopes might not be an appropriate tracer of SGD because they can trace both processes at the same time. Thus, whilst short-lived Ra isotopes and Rn can be used to trace SGD in karstic environments when Ra and Rn inputs from bottom-sediments and surficial sources are minor, they may be too heavily influenced by the underlying sediment in shallow coastal systems (i.e. lagoons or bays). On the contrary, long-lived Ra isotopes are not generally enriched in small-scale recirculation processes, and thus they appear to be the more appropriate tracers of SGD. The use of the same radionuclides to trace small (PEX) and large (SGD) scale recirculation processes highlights the need to agree on a clear definition of both processes and to clarify what radionuclides best trace what physical process.