Better understanding of degassing and parafluvial exchange for ^{222}Rn baseflow studies

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^{222}Rn is an important tracer for quantifying groundwater inflows to rivers, especially where groundwater and surface water have similar major ion and stable isotope geochemistry. Uncertainties in ^{222}Rn mass balance arise, however, from not accurately estimating the degree of degassing and the extent to which interaction with sediments in the parafluvial zone provides an additional source of ^{222}Rn. This study estimates both ^{222}Rn production in the parafluvial zone and degassing in an upland river (the King River, Australia) in order to more precisely quantify groundwater inflows.

The contribution of ^{222}Rn from the parafluvial zone (Fp) was estimated using ^{222}Rn emanation rates in near-river sediments and estimates of the residence time of water in the parafluvial zone and the volume of the parafluvial zone. Values of Fp decrease down catchment from 40,400±3800 to 8500±550 Bq/m/day corresponding to differences in the mineralogy and volume of the parafluvial zone.

The gas transfer coefficient (k) was estimated by matching groundwater inflows to observed increases in river discharge during a period of extended low flow; k decreases from 25 day^{-1} in the upper catchment to 3 day^{-1} in the lower catchment. k values estimated in this way are higher than those estimated from most empirical formulations, probably due to extensive pool and riffle sections that promote degassing.

Groundwater inflows on a reach scale are as high as 10 m^3/m/day and cumulative inflows along the 75 km studied stretch are up to 19,000 m^3/day. Groundwater inflows increase proportional to total flow reflecting the response of both groundwater and surface water systems to rainfall.

Independently estimating k from the discharge data mitigates one of the major uncertainties in the use of ^{222}Rn as a tracer of groundwater-surface water interaction. Ignoring parafluvial flow results in calculated inflows that are up to 40% higher, indicating that better characterisation is needed.