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Radon-222 as a tracer in groundwater-surface water interactions

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The groundwater-surface water interface is a dynamic system that plays an important role in the hydrogeological functioning of many catchments. The physical properties of this interface can influence the discharge and recharge of aquifers, while chemical attenuation processes that take place during water transfer can affect the quality of both groundwater and river water. The properties of radon (half-life 3.8 days, chemically inert) make it a powerful and potentially useful tracer of hydrological processes at the interface between surface and sub-surface water bodies. Radon provides a signal for these processes because groundwater typically is enriched in radon with respect to surface water. Radon has been applied to investigations of groundwater-river interactions in the Cretaceous Chalk catchments of the Pang and Lambourn in southern England. Groundwater and river water samples from the two catchments were analysed for radon between July 2003 and May 2006. Spatial and temporal variations in radon concentrations have led to a better understanding of the flow generation processes in these types of river catchments. There is a consistent vertical profile in groundwater samples across sampling sites, with both greater and more variable radon concentrations observed in the near surface. These observations of groundwater radon are linked to the degree of weathering in the rocks and soils, and to the concentrations of radium in the different lithological units. Variations in the radon concentration of groundwater entering the river have been linked to the rise and fall of the local water table of the Lambourn and changes in river accretion. In the Pang catchment, geology and the resulting spring systems are shown to have significant control over stream radon. Spring water radon concentrations are found to be highly variable and subject to hydrological event responses. Radon is therefore able to provide useful information about the flow

paths of groundwater entering rivers.