



Deuterium labelling of drilling fluid during the Heidelberg basin drilling project

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The Upper Rhine Valley aquifer in Germany is known as the largest groundwater reservoir in Western Europe, while the Heidelberg basin hosts the thickest and most continuous succession of Plio- / Pleistocene sediments of the Upper Rhine Valley. In 2008 a research drilling project in the city of Heidelberg was realized to explore the Quaternary deposits to a depth of 500 m. During the drilling work the stable isotope deuterium (^2H) was used as an artificial tracer for a labelling of the drilling fluid. The experiment aimed to test if drilling fluid contaminates the environmental isotope concentrations of the cores or if it is possible to use core water to interpret deep aquifer isotope composition. Deuterium is non-toxic, completely soluble, chemically and biologically stable and not subject to radioactive or light-influenced decay. The labelling experiment was conducted in July and August 2008 with deuterium enriched water (6 kg of 70% $^2\text{H}_2\text{O}$). Samples were collected directly from drilling fluid effluent every 2 to 4 h during two weeks of ongoing drilling activity. Sediment cores were sampled and core water was extracted using the vacuum extraction method approximately every 10 m in depths between 300 and 500 m. The drilling fluid shows $\delta^2\text{H}$ values of 700‰ at the beginning to about 50‰ above the background value at the end of the experiment. Water extracted from the samples shows an influence of label indicating direct impact of drilling fluid in almost all layers. An interpretation of natural isotope concentrations is difficult even for very fine (silt and clay) sediments. The labelling technique has shown to be a good indicator to assess the influence of drilling fluid and groundwater mixing in deep drillings. We discuss the results in the context of similar experimental designs for a quantification of groundwater mixing from drilling fluids and estimations of hydro-geological parameters.