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## The O and H stable isotope composition of freshwaters in the British Isles. 2. Surface waters and groundwater

W. G. Darling<sup>1</sup>, A. H. Bath<sup>2</sup>, and J. C. Talbot<sup>1</sup>

<sup>1</sup>British Geological Survey, Wallingford, OX10 8BB, UK

<sup>2</sup>Intellisci Ltd, Loughborough, LE12 6SZ, UK

Email for corresponding author: wgd@bgs.ac.uk

**Abstract.** The utility of stable isotopes as tracers of the water molecule has a long pedigree. The study reported here is part of an attempt to establish a comprehensive isotopic "baseline" for the British Isles as background data for a range of applications. Part 1 of this study (Darling and Talbot, 2003) considered the isotopic composition of rainfall in Britain and Ireland. The present paper is concerned with the composition of surface waters and groundwater. In isotopic terms, surface waters (other than some upland streams) are poorly characterised in the British Isles; their potential variability has yet to be widely used as an aid in hydrological research. In what may be the first study of a major British river, a monthly isotopic record of the upper River Thames during 1998 was obtained. This shows high damping of the isotopic variation compared to that in rainfall over most of the year, though significant fluctuations were seen for the autumn months. Smaller rivers such as the Stour and Darent show a more subdued response to the balance between runoff and baseflow. The relationship between the isotopic composition of rainfall and groundwater is also considered. From a limited database, it appears that whereas Chalk groundwater is a representative mixture of weighted average annual rainfall, for Triassic sandstone groundwater there is a seasonal selection of rainfall biased towards isotopically-depleted winter recharge. This may be primarily the result of physical differences between the infiltration characteristics of rock types, though other factors (vegetation, glacial history) could be involved. In the main, however, groundwaters appear to be representative of bulk rainfall within an error band of 0.5‰  $\delta^{18}\text{O}$ . Contour maps of the  $\delta^{18}\text{O}$  and  $\delta^2\text{H}$  content of recent groundwaters in the British Isles show a fundamental SW-NE depletion effect modified by topography. The range of measured values, while much smaller than those for rainfall, still covers some ‰ for  $\delta^{18}\text{O}$  and 30‰ for  $\delta^2\text{H}$ . Over lowland areas the "altitude effect" is of little significance, but in upland areas is consistent with a range of  $-0.2$  to  $-0.3$ ‰ per 100 m increase in altitude. Groundwaters dating from the late Pleistocene are usually modified in  $\delta^{18}\text{O}$  and  $\delta^2\text{H}$  owing to the effects of climate change on the isotopic composition of rainfall and thus of recharge. Contour maps of isotopic variability prior to 10 ka BP, based on the relatively limited information available from the British Isles, allow a first comparison between groundwaters now and at the end of the last Ice Age. The position of the British Isles in the context of the stable isotope systematics of NW Europe is reviewed briefly.

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