Water residence time estimation using seasonal variation of deterium excess

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Seasonal variations in the stable isotope ratios of oxygen and hydrogen (18O or D) in precipitation and subsurface water have been used in recent years to estimate the mean residence time of water within a catchment. Most estimation methods are based on models presented by Maloszewski et al.(1983). In their study, a lumped parameter approach was applied, using 18O or D input signatures and response function models. Using this model, fluctuations in the stable isotope ratio of input signatures permit successful estimation of mean residence times of subsurface water. The deuterium excess is called the d value or d-parameter. The d value mainly represents a kinetic effect produced by primary evaporation, when the water evaporates from the sea surface (Dansgaard, 1964), although it is changed by secondary evaporation, from falling rain in some arid regions (Clark and Fritz, 1997). Kondoh and Shimada (1997) suggested that these variations arise from changes in isotopic water vapor composition associated with seasonal activity of the Asian monsoon mechanism in East Asia. In this region, where the origin of precipitation water vapor changes seasonally, the fluctuation in d values of precipitation is large (Kondoh and Shimada, 1997), and this fluctuation has the potential to be an effective tracer for estimating the residence time of subsurface water.