TRANSIT TIME DETERMINATION USING TRITIUM AT VALLCEBRE RESEARCH CATCHMENTS (NE SPAIN)

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Aims

Tritium measurements are being made in the Vallcebre Research Catchments to investigate transit times of water through the catchments and develop improved perceptual models of the hydrological functioning of Mediterranean mountain catchments. These complement concurrent geochemical and stable isotope, and previous hydrometric, studies. Because tritium identifies longer transit time water in streams (i.e. groundwater), this work contributes to integration of surface and groundwater resources (part of the theme of this conference).

An additional aim of this work is to demonstrate the effectiveness of high-quality tritium measurements for dating of Northern Hemisphere (NH) streams. Previous work has shown their value for Southern Hemisphere (SH) streams.

Methods

Radioactive decay of tritium (with half-life 12.32 years) enables it to be used to determine water ages since deposition as rain. Nuclear weapons testing in the 1950s and 60s produced a large spike of tritium mainly in the NH atmosphere. Since then the NH atmospheric concentration has trended back towards the background cosmogenic level. However, bomb tritium still remains within older groundwater systems in the NH and can cause ambiguity in tritium age interpretation (i.e. several possible ages). Series of samples over say five years are needed for unambiguous age determination. Tritium dating is more straightforward in the SH, because far less bomb tritium entered the SH atmosphere in the 1950s and 60s.

The Vallcebre catchments are located at the headwaters of the Llobregat River, on the southern margin of the Pyrenees (Catalonia, North-east Spain) at an altitude of 1,100 to 1,700 m a.s.l. As well as a long history of well-documented research on the catchments, tritium measurements were carried out in 1996-1998 (Herrmann et al., 1999). These allow current tritium measurements to be compared with the earlier measurements thus extending the series of samples to nearly twenty years and giving greater confidence in the transit times determined.

Results

Herrmann et al. (1999) reported tritium measurements on samples collected in low-flow conditions from wells, streams and springs in each of the years 1996, 1997 and 1998. 65 samples were measured in all. Their estimated mean transit times from the tritium values ranged from 8 - 11.5 years for the wells, 8.5 - 13.0 years for the streams and 10.5 - 13.5 years for the springs. The considerable mean ages of the samples showed dominance of groundwater stores in supplying streamflow in these conditions.

However, recent resampling of some of the features and measurement at GNS are showing that revised age interpretations are necessary. This new work will include revised assessment of the tritium input function and consideration of the much longer time series of samples.

References

Herrmann, A., Bahls, S., Stichler, W., Gallart, F., Latron, J. 1999. Isotope hydrological study of mean transit times and related hydrogeological conditions in Pyrenean experimental basins (Vallcebre, Catalonia). In *Integrated Methods in Catchment Hydrology*. Leibundgut C., McDonnell J., Schultz G. (eds). IAHS Publication No. 258. IAHS Press, Wallingford. 101-109.