

Characterising groundwater movement and residence time near a lowland Chalk river

Dr D.C. Goody⁺, Dr W.G. Darling⁺, Dr P. Shand⁺ and Prof. D.W. Peach⁺
⁺ British Geological Survey

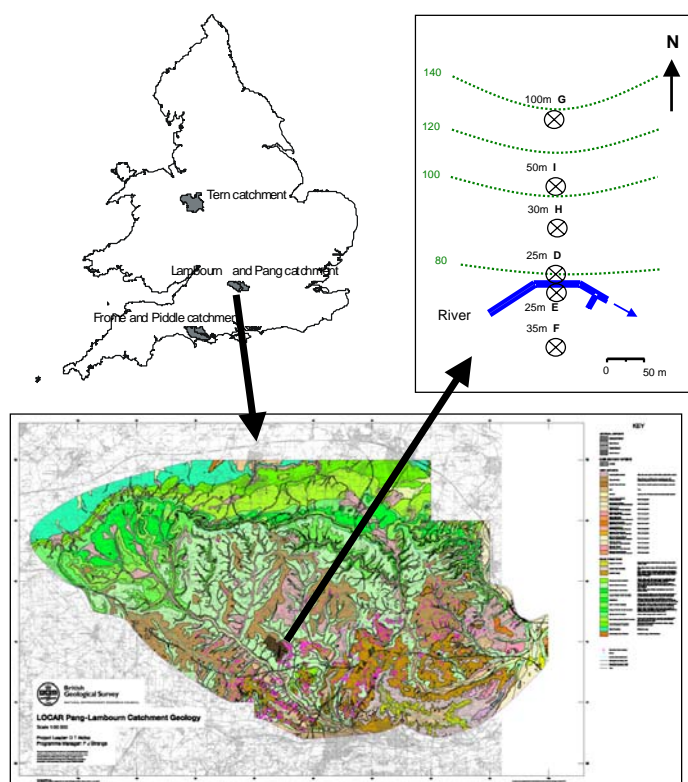


Key questions

- How does water move from aquifers to Chalk rivers?
- What are typical residence times for Chalk groundwaters near Chalk streams?
- What environmental tracers can be used to age groundwater in Chalk catchments?

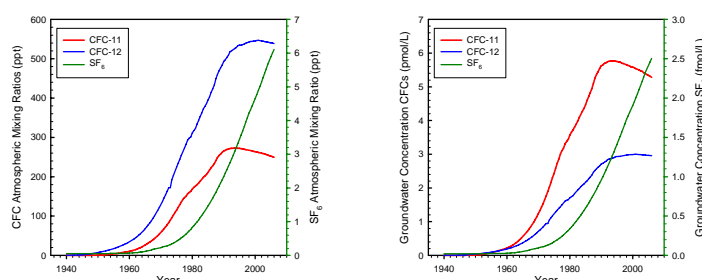
Site investigation - Boxford

The focus of this particular part of the programme was in the Chalk catchments of the Pang-Lambourn. The study site (PL26) consists of a series of boreholes located on either side of the River Lambourn at Boxford. The figure below shows the location of the boreholes relative to each other and to the River. Boreholes D, E and F were drilled in gravels of the flood plain of the river while G, H and I are located on the Chalk outcrop which rises northwards from the valley. Most of the boreholes contain two piezometers set at different depths. The boreholes used in this study all lie in an approximate north-south line. Groundwater samples were collected from 10 piezometers and the River Lambourn at an adjacent point

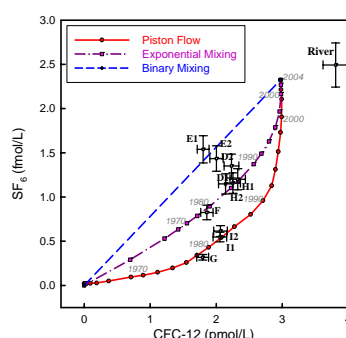


Location of the Pang-Lambourn catchment, the Boxford field site and plan view of the borehole layout at the Boxford site.

Dating & mixing of groundwaters



Groundwater dating with chlorofluorocarbons (CFCs) and sulphur hexafluoride (SF6) is based on historical data for the atmospheric mixing ratios of these compounds over the past 50 years. Compared with some groundwater 'dating' techniques, CFCs and SF6 can be rapidly determined, they require no sophisticated sampling equipment, and analysis is relatively simple.

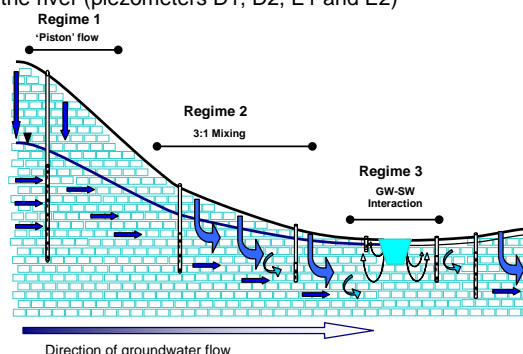


The concentration of CFCs and SF6 can provide information on groundwater residence times and mixing processes. As the three atmospheric environmental tracers considered here have differing temporal patterns to their input functions, plots of one tracer against another can be useful in distinguishing the hypothetical groundwater mixing processes that may affect the samples, in addition to identifying anthropogenic contamination.

Groundwater movement

Three principal flow regimes have been identified:

- Regime 1 on the interfluvium, where the unsaturated zone is very deep and flow appears to follow a piston flow model (piezometers G, I1 and I2)
- Regime 2 where the unsaturated zone is much thinner and there is mixing between the old groundwater from up gradient and modern water from recent recharge in a roughly 3:1 ratio (piezometers H1, H2 and F)
- Regime 3 where there is interaction between groundwater and surface water in the river (piezometers D1, D2, E1 and E2)



Find out more...

Goody et al. (2006). *Journal of Hydrology*, 330(1-2), 44-52
 Wheater, Peach, Neal, Johnes, Whitehead (2006) *Hydrogeochemical functioning of lowland permeable catchments*. Final Report. NERC LOCAR Programme NER/T/S/2001/00942

Contact: Daren Goody dcg@bgs.ac.uk