Extended Photo Feature

Hydrological anomalies in Magpie Sough, Ashford, Derbyshire, UK

John Gunn

Magpie Sough, which discharges into the River Wye upstream of Ashford in the Water at British National Grid Reference SK 17950 69613 (Photo 1), was the last of the great Peak District lead-mine drainage levels (soughs), being driven between 03 March 1873 and 18 August 1881. In 1966 the rock roof near the tail of the sough collapsed, water backed-up behind the blockage, and access was lost until 1974, when it was dug out by members of the Peak District Mines Historical Society (Willies, 1974). Butcher (1975) described the geology that the sough passes through, and suggested that 80% of the water discharging from the sough tail is derived from a "boil-up" on a mineral vein (Townhead Vein) that was intersected *c*.915m southsouthwest of the sough tail. The Magpie Mine shaft is about 700m southsouthwest of the boil-up and when the vein was crossed the water elevation in the shaft dropped, demonstrating a hydraulic connection. Christopher (1981) noted that there are, in fact, two boil-ups where the sough has intersected Townhead Vein, one entering from the east and one from the west that has a higher discharge (Photo 2). Christopher found that on 04 February 1978 the Boil-up East water was 1.1°C warmer than the Boil-up West water, and that there were small differences in the major-ion chemistry, despite the two inputs being part of a single conduit system prior to the driving of the sough. Six subsequent spot measurements by the present author between May 2006 and April 2025 found a smaller temperature difference of 0.6°C and similar conductance.

Photo 1: *Magpie Sough tail.*

Photo 2: *View facing northnortheastwards down Magpie Sough from the intersection with Townhead Vein. Water entering on the left is from Boil-up West, with Boil-up East water entering from the right.*

***Photo 3**: Fieldgrove Vein west input.*

***Photo 4**: Fieldgrove Vein east input.*

About 570m southsouthwest of the sough tail, workers driving the sough intersected Fieldgrove Vein where – although it has not previously been noted – groundwater enters from the west (Photo 3) and from the east (Photo 4). This is similar to the situation at the sough's intersection with Townhead Vein, but in this case the dominant flow enters from the east. The differences are are also greater and in the opposite direction, with the western input being 0.7 – 0.9°C warmer, with a conductance 65 – 85 µS/cm higher, than the water entering from the east.

It is reasonable to assume that, before the sough was driven, water flow along each of the mineral veins was uni-directional, most likely from west to east on the basis of surface topography. As water now flows into the sough from both west and east, it must also be the case that the original outlet(s), or at least some point between the sough and the outlet(s), is higher than the elevation of the point where the sough intersects the vein, thereby creating a hydraulic gradient towards the sough. The depth of water in the channel between the sough tail and the River Wye was measured at 15-minute intervals between 01 October 2009 and 07 October 2013 and, based on an approximate depth versus discharge rating curve, the average flow was 476 L/s, a substantial amount of water. Water-tracing experiments with fluorescent dyes have shown that some of the discharge is derived from Knotlow Mine in the River Lathkill topographic catchment but there must also have been recharge from the local area. This raises the interesting question of where any water was discharged before the sough was constructed, because there are no records of springs in the area to the east of the sough drying up following its construction.

The differences in temperature (and at Fieldgrove Vein in chemistry) between the inputs from west and east require further study and it is hoped that the water tracing experiments can be repeated with fluocapteurs at each of the sough inputs to gain greater understanding of flow processes

In addition to this being an interesting case study, there are two generic points to be made. The first is a very simple message that without measurements being made, the evidence of anomalous behaviour would not have come to light. A combined temperature and conductance meter can be purchased for less than £50, and should be a standard item of kit for cave explorers! Secondly, many studies, particularly those undertaken by persons who are precluded from underground sampling, either by lack of expertise or by restrictive employer Health and Safety regulations, involve sampling at groundwater output points, principally springs and the outfalls of adits/soughs. Results of such sampling provide a good indication of the load of metals, nutrients, and other substances being discharged into a surface stream, but they do not help to identify from where any substances of potential concern might be derived. Underground sampling is essential to narrow-down the limits of catchment areas and to allow source – receptor – pathway modelling.

Acknowledgements

Photo 1 by Rob Eavis; Photos 2–4 by John Gunn, assisted by Cathy Hollis and Dave Shearsmith.

References

Butcher, N, 1975.The geology of Magpie Sough and Mine. *Bulletin of the Peak District Mines Historical Society*, Vol.6(2), 65–70.

Christopher, N J C, 1981. *The karst hydrogeochemistry of the Carboniferous Limestone of North Derbyshire*. Unpublished PhD thesis, University of Leicester, UK.

Willies, L, 1974. The re-opening of the Magpie Sough. *Bulletin of the Peak District Mines Historical Society*, Vol.5(6), 324–331.