Delineation of Karst Groundwater Divides by In-Cave Dye Tracing, Mammoth Cave Karst Aquifer, Kentucky

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Abstract

Karst groundwater basin divides are currently depicted as two-dimensional lines on maps, but they are better considered as complex, three-dimensional surfaces within the subsurface. Dye traces are necessary to map out these surfaces and to locate conduits inaccessible to cave surveyors, and are indispensable for understanding the geometry of the complex networks of flow paths through the aquifer.

A key reason why the Mammoth Cave System is the world's longest known cave is that its passages extend over several major groundwater basins. The divides between these basins define the drainage system geometry and precise location of them is critical for understanding and protecting the cave and its remarkable aquatic ecosystem. In 1999 we initiated a long-term program of dye tracing within the Mammoth Cave System to more precisely locate the divides and to understand their increasingly apparent complexities. This involves both underground injection and surface injections aimed at underground dye receptors. In addition to identifying the divides, well-designed traces can also connect previously fragmented stream segments.

A trace from a first order cave stream in the Candlelight River area, intended to pin down the divide between the Pike and Echo River Basins, emerged at Floating Mill Hollow Spring, unexpectedly crossing a previously established drainage line. A second trace from Outward Bound, the eastern-most known stream in the cave, went to Ghengis River within the Pike Spring Basin. Dye receptors are in place at Bögli Shafts for a surface injection at Floating Mill Hollow, which will have to wait for the end of this summer's severe drought.