Introduction

Dye traces are designed to track subsurface water flow directions and travel times from the point where dye is introduced to a karst conduit system to the point where it emerges from a spring, seep or well. In the Fountain sinkhole plain, sinkholes in the carbonate Prosser Formation drain surface water that rapidly discharges at springs in the bottom of the shaly-carbonate Cummingsville Formation or top of the Dicodus Shale (see Cross Section). Three decades of dye tracing in this area have identified three springsheds in total. The Fountain Springshed is a springshed from which water discharges to four springs collectively known as the Fountain Big Springs Complex (A37, A44, A45, A51), forming the headwaters for Rice Creek—a Minnesota designated trout stream. Water in the Mahoney Springshed discharges into Rice Creek (A144), which forms the headwater for Mahoney Creek. A third, unnamed springshed, the North Fork Springshed, drains southeast toward the Mahoney Springshed and to delineate source areas for cold-water springs that feed the Fountain Big Springs Complex.

Methods

Dye was poured into three sinkholes on 21 May 2012: eosin into Klop Sinkhole, Rhodamine WT into D4373, and uranine C (a.k.a. fluorescein) into D1075. Passive charcoal detectors were placed at springs (A37, A44, A45, A51, A123, A124, A144), exchanged at regular intervals and returned to the University of Minnesota Department of Earth Sciences. Charcoal was extracted with an eluent, which was then qualitatively analyzed using a Shimadzu RF-5000U Spectrofluorophotometer. The resultant spectra curves were fitted using PeakFit v4.0 software. The results of historic dye traces near Fountain, MN were compiled and summarized for this poster. Preliminary data on structural geology was provided by geologists at the Minnesota Geological Survey (Runkel and Steenberg, private communication, 2012) based on well logs, natural gamma logs, and outcrop observation from Fillmore County. A final map was created in ESRI ArcMap10 and edited with Adobe Illustrator CS5.

Results

Eosin dye from Klop Sinkhole emerged in A123. Rhodamine WT dye from D4373 emerged in A37 of the Fountain Big Springs Complex. Uranine C (a.k.a. fluorescein) dye emerged from D1075 in springs A44 and A51 of the Fountain Big Springs Complex.

Discussion

The result of the Fountain East 2012 trace contributed additional data to refine springshed boundaries in the Fountain sinkhole plain. Future dye trace efforts in this sinkhole plain can seek to further define the Fountain and Mahoney Springsheds, and to define the new springshed feeding springs A123, A124 and A25 from the north and northwest edges of the currently mapped springshed. The integration of historic dye trace data and structural contours provides clear evidence that the local dip of bedrock geology can be a significant control on groundwater flow.

Conclusion

The results of the Fountain East 2012 trace contribute additional data to refine springshed boundaries in the Fountain sinkhole plain. Future dye trace efforts in this sinkhole plain can seek to further define the Fountain and Mahoney Springsheds, and to define the new springshed feeding springs A123, A124 and A25 from the north and northwest edges of the currently mapped springshed. The integration of historic dye trace data and structural contours provides clear evidence that the local dip of bedrock geology can be a significant control on groundwater flow.

References


Acknowledgments


Author Biography

KELSI R. USTIPAK received her Master of Science in Geology from the University of Minnesota in 2011. She is currently a Research Assistant at the National Environmental Research Center in Boca Raton, Florida. Her research interests are in karst geology and environmental processes in karst systems.