Hydrologic Contributions of Springs to the Logan River, Utah

M.N. Gooseff[1], J.P. Evans[2], P. Kolesar[2], T. Lachmar[2], R. Payn[1,2]

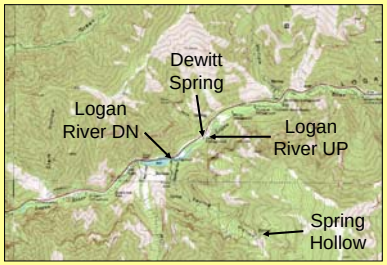
AGU SM05, POSTER H51C-02 1. Colorado School of Mines, Golden, CO 2. Utah State University, Logan, UT

Background

The city of Logan, UT relies on the Logan River for much of its annual water supply. During the late summer and fall, stream flow in the lower Logan River is largely made up of spring discharge from two major springs, Dewitt, on the north side of Logan Canyon, and Spring Hollow, from the south side of Logan Canyon. In this study, we attempt to discern the contribution of these springs to Logan River discharge with chemical and isotopic tracers.

Sampling Sites and Methods

The city of Logan, UT maintains a water diversion structure at Dewitt Spring. We sampled the Logan River above and below Dewitt and Spring Hollow Springs, as well as these two springs.



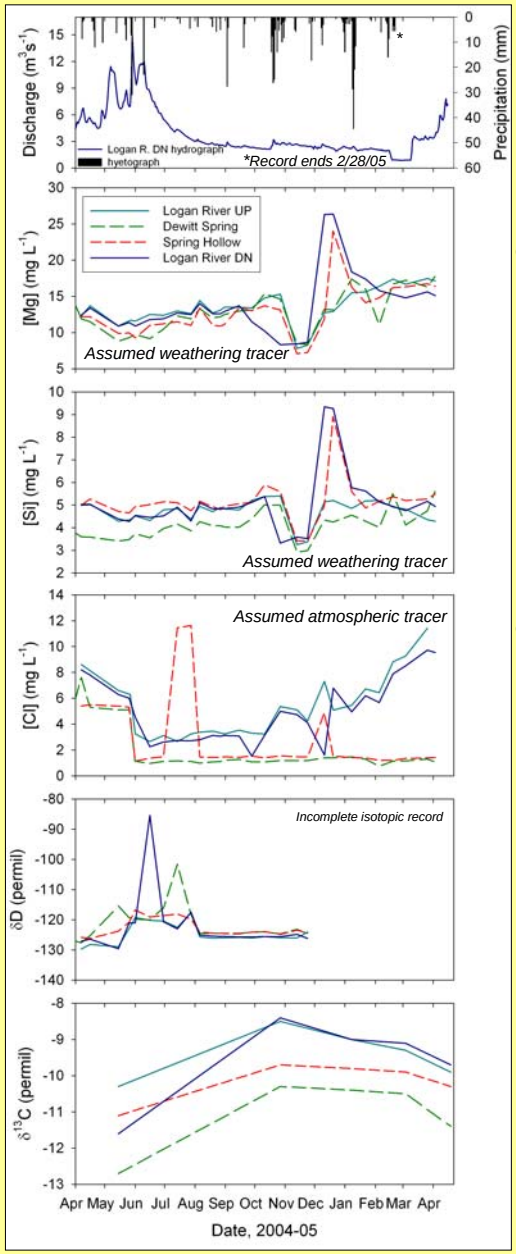
Dewitt Spring

Logan River

Spring Hollow

- Water samples were collected by hand for major ion analysis in acidified and unacidified bottles, filtered in the field.
- Isotopic abundances of D, ^{18}O, and ^{13}C were determined by standard protocol, D and ^{18}O compared to VSMOW.
- We used a 3-End Member Mixing Analysis to determine Q at Logan River UP and Spring Hollow using 4 different tracers.
- Q at Dewitt measured with a datalogger, Q at Logan River DN assumed to be equal to that reported at USGS stream gauge.

Major Ion & Stable Isotope Trends



Logan River discharge is driven by annual snowmelt and periodic storms.

Mg in the river was generally greater than in the spring outputs.

Short residence time in karst landscape?

Si in the Dewitt Spring was generally greater than in the other waters.

Difference in local geology of karst flowpath?

River Cl was greater than in the spring outputs, and follows dilution pattern.

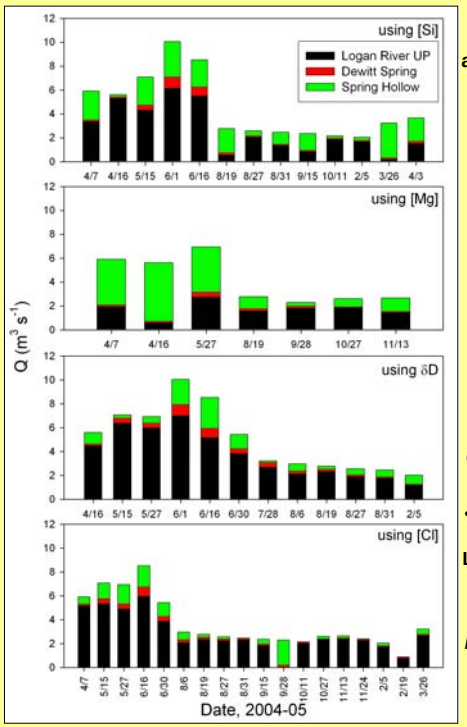
Short residence time in karst landscape?

Stable isotopes show contributing area precip differences with springs being more enriched than the river.

Spring $\delta^{13}C$ is more depleted than river water DIC.

Short residence time and little weathering in karst landscape?

Discharge Contributions



•Q at Logan River DN and Dewitt Spring were measured.

•Use of each tracer suggests differing results.

•Empirical evidence suggests that Spring Hollow Q was always less than Dewitt Q, both of which were less than Logan River UP Q. However, all analyses suggest Spring Hollow Q > Dewitt Q.

•Additionally, tracers do not corroborate for the same date.

•Springs are important contributors to the Logan River during the late summer-fall.

For each sampling date, results are not reported for EMMA results that were unreasonable.

Conclusions

Major ions and stable isotope signatures of Logan River water and contributing springs suggest that spring water spends little time in the karst aquifers prior to surfacing. Furthermore, when these data are used as hydrologic tracers, results suggest that the springs become an important source of water to the river in late summer and fall. Si EMMA suggests that Spring Hollow contributes between 3 and 90% of Logan River discharge, δD EMMA suggests 13-87%, Mg EMMA suggests 3-36%, and Cl suggests 2-91%. Overall, it is apparent that no single tracer is perfect for determining discharge contributions, though analysis of a suite of tracers provides for multiple lines of evidence.

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Project Web site: http://www.mines.edu/~mgooseff/web_research/loganriver.html