

Groundwater Geochemical Research for Wetlands

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Abstract

In August 2017, two wetlands were restored behind the Passionist Earth & Spirit Center in Louisville, Ky. These wetlands have been monitored and there is a difference in growth patterns between the two wetlands. This is usually attributed to differences in nutrients or potential contaminants getting into the wetlands. Two contaminants that could affect these wetlands are road salts and fertilizers. So in order to understand the water flow paths, a stable water Isotope test was done at Colorado Plateau Stable Isotope Laboratory. Knowing these flow paths can help identify where the contamination could be coming in from and what water had similar signatures.



Figure 1: Wetland 1 located on the south east side of the property.

Figure 2: Wetland 2 located on the south west side of the property.

Introduction

Many ecosystems hold a multitude of beneficial qualities and wetlands are one that is crucial to the ecology of watersheds. Wetlands use the surrounding ecosystems in the watershed to provide an abundance of food for species in that location and even can provide flood control for areas (Wetlands Important, 2018). As the rise of urban development occurs, this can affect wetlands by causing a rise in the usage of various materials. In particular, the usage of fertilizers and road salts seem to be increasing as the years go by and that can cause increases in NaCl and nitrate into water systems. Road salts are a popular use of deicer because of how abundant, inexpensive, and efficient it is (Gedlinske,2013). When road salts or NaCl infiltrates a water system, there is an increase in the waters salinity and the chloride acts as a precursor to other contaminants. Fertilizers mess with the nitrogen cycle when it is used abundantly. In wetlands, it can contribute to large algae growths, which can lead to algal blooms (Khatri, 2014). To know if this is affecting the two wetlands being studied and to see where it is coming from, a Stable Water Isotope Test must be run by a lab. The Stable Isotope lab will run a test for stable water isotopes, which will help determine where in the water cycle the water in the wetlands is coming from to determine potential pathways for pollution. This study looks at how different flow paths of water can affect what contaminants flow into a water system, like the two wetlands being studied.

Methods

- 8 water samples collected in a 250ml plastic bottle (Table 1)
- Filtered with a filter apparatus and 0.45-micron cellulose acetate filter
- Transferred to a 15ml glass vial with little to no headspace
- Packaged and ship to Colorado Plateau Stable Isotope Laboratory for a stable water isotope test
- Graphical analysis of dD and DO18 (Figure 3)

Results

- The isotopic signatures of Wetland 1, vernal pool, and groundwater spring to wetland 2 were similar.
- The Grotto Spring and The Unknown Stream isotopic signatures match well.
- The isotopic signature of rainwater is very different than the rest of the water samples.

Table1: Sample Description from the eight water samples collected at the Passionist Earth & Spirit Center in Louisville, KY on February 18, 2020.

Deuterium and Oxygen-18		
Sample		Description
01	RW	Rainwater
02	GR	The Grotto spring
03	G1	Ground water 1
04	G2	Ground water 2
05	VP	Vernal Pool
06	W1	Wetland 1
07	W2	Wetland 2
08	US	Unknown Stream

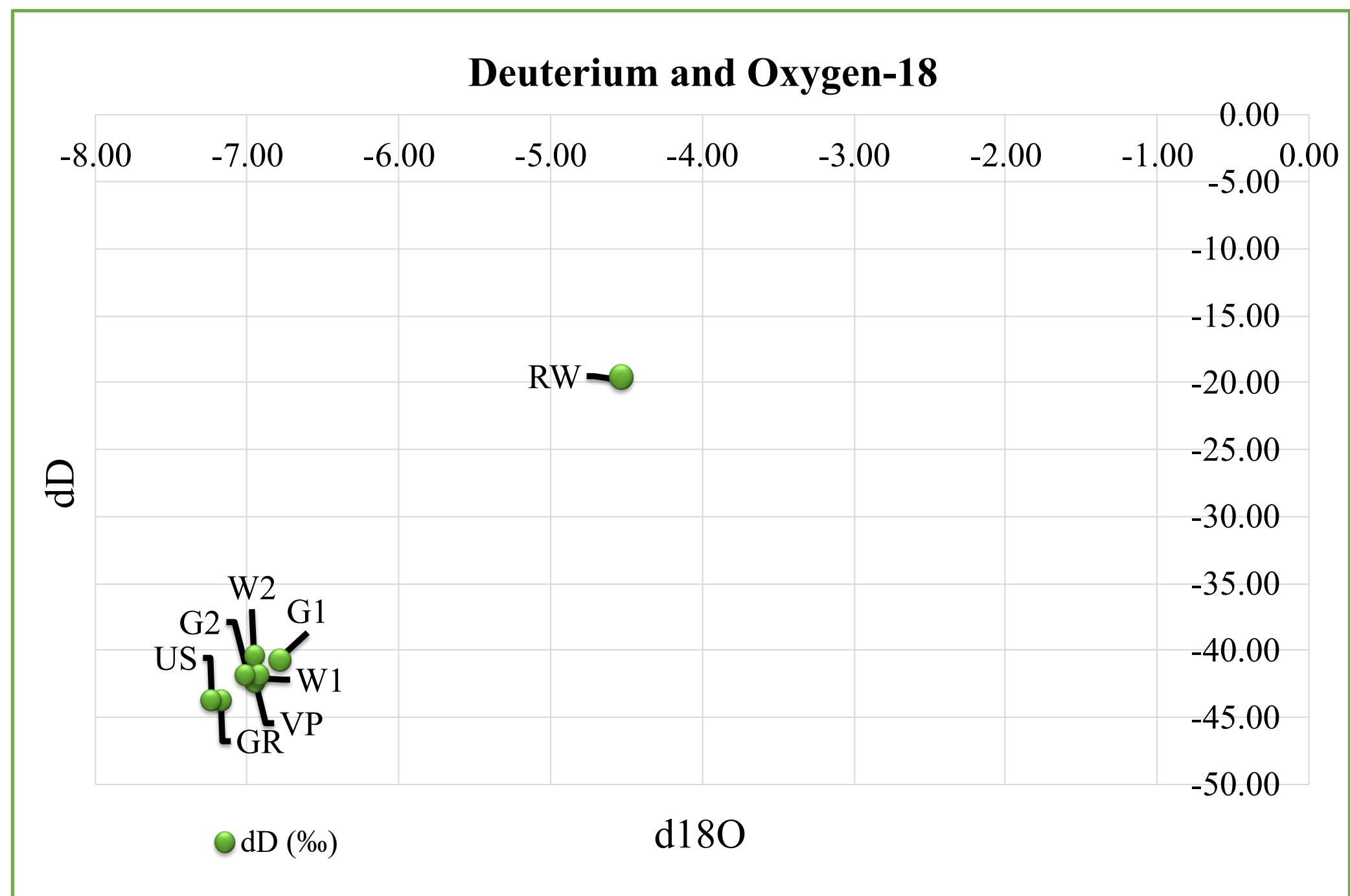


Figure 3: Deuterium and Oxygen- 18 Isotopic Values from eight water samples collected at the Passionist Earth & Spirit Center in Louisville, KY on February 18, 2020



Figure 4: Map of The Passionist Earth & Spirit Center showing seven of eight water samples taken on February 18, 2020 in Louisville, KY.

Discussion

The two restored wetlands behind The Passionist Earth & Spirit Center showed a difference in growth pattern of algae that is suspected to be from fertilizer contamination. Wetland 2 showed less growth than Wetland 1. A stable water isotope tested were run on water from the two wetlands along with six other water sources. The tests showed that the wetlands had similar isotopic signatures to the vernal pool and the ground water sources. This means that the wetlands consist of more water that comes from the ground. The test also showed that the stream has water from the grotto flowing through it and rainwater is not a large contributor to the wetlands or groundwater sources.

Running this research has shown what water sources are similar and this can help determine where potential pollutants, like road salts or fertilizers, could mainly be flowing through. The wetlands have mainly groundwater flow so it can be suspected that pollutants are flowing in from there. This can be seen for the water tests but also the large growth of algae in the wetlands, which can increase from a surplus of nutrients coming from pollutants. Further research needs to be done with tests like figuring the cation and anions in the water samples. This can help determine the nutrient make up in those waters, which can help to act on the pollutants flowing in by proposing cleaner alternatives.

Literature Cited

Daley ML, Potter JD, Mcdowell WH. 2009. Salinization of urbanizing New Hampshire streams and groundwater: effects of road salt and hydrologic variability. [accessed 2020 Feb 17]; 28(4):[929-940]. <https://www.jstor.org/stable/10.1899/09-052.1>

Corsi SR, Graczyk DJ, Geis SW, Booth NL, Richards KD.2010. A Fresh Look at Road Salt: Aquatic Toxicity and Water-Quality Impacts on Local, Regional, and National Scales. [accessed 2020 Feb 17]. <https://pubs.acs.org/doi/pdf/10.1021/es101333u>

Khatri N, Tyagi S. 2014 Sep 2. Influences of Natural and Anthropogenic Factors on Surface and Groundwater Quality in Rural and Urban Areas. [accessed 2020 Feb 17]. <https://www.tandfonline.com/doi/full/10.1080/21553769.2014.933716?scroll=top&needAccess=true&>

Wetlands: What is a Wetland?. Environmental Protection Agency; [Updated 2018 Jun 12; accessed 2020 Feb 16]. <https://www.epa.gov/wetlands/what-wetland>

Wetlands: Why are Wetlands Important?. Environmental Protection Agency; [Updated on 2018 June 13; accessed 2020 Feb 16]. <https://www.epa.gov/wetlands/why-are-wetlands-important>