Carbonate CZO August 2020 Central PA Field Trip

The goals of this field trip are to provide attendees a view of recent and historic monitoring in the well-known Central Pennsylvania springs described in Shuster and White (1971) and visit a current CZO. We will visit with researchers from the Susquehanna-Shale Hills CZO at one of their monitoring sites. Data loggers and sensors used to characterize springs will also be demonstrated. These stops will help provide attendees context for developing research questions around a carbonate CZO. A guide book will be provided, the summary here is for planning purposes.

Sunday Aug 2:
5:00 pm Depart Philadelphia Airport, (approximately 200 miles)
8:30 pm Arrive State College Box dinner on bus
Hotel: Penn Stater Hotel, State College
For attendees not departing from Philadelphia, they can meet in State College Sunday evening or Monday morning. Car pooling is encouraged for field trip stops.

Monday Aug 3:
8:00 am Depart hotel for Shale Hills CZO, Scare Pond Road
Approximately 20 miles, 30 min drive time plus detour to sinkhole on Penn State Ag campus to view allogenic recharge. There is little surface drainage in this valley and dolines are observed along the valley flanks.

9:30-10:50 Shale Hills CZO
This 8 ha site has been a CZO since late 2007 and is one of several monitoring stations in the Susquehanna Shale Hills CZO. Monitoring and analysis includes soil, bedrock, groundwater, stream, soil pore water, soil gas, vegetation sensors, precipitation, eddy flux, as well as remote sensing. Researchers from the CZO will discuss how these are linked to provide a model of weathering rates.
http://criticalzone.org/shale-hills/infrastructure/sensors-field-instruments-shale-hills/

PHOTO: *Geophysical survey of dye tracer test on the Shale Hills CZO conducted by Temple University.*

10:50 Depart for Tyrone PA (Approximately 30 miles, 40 minutes)
View Tyrone-Mount Union lineament and good road cuts along the way

11:30-12:30 Lunch stop
Multiple fast food restaurants where attendees can pick up food for lunch.

12:30-1:30 Hundred Springs on private property (4 miles, 5 minutes from Tyrone)

Here we will introduce the series of springs from the Shuster and White study. At this locations there are dozens of springs along a dolomite ridge. Recent temperature logger data show that there are different recharge pathways for nearby springs based on varied seasonal and storm responses. We will also demonstrate nutrient and CO2 loggers that can be used to obtain time series data on spring chemistry, in addition to more tradiational temperature, water level, conductivity, and pH loggers.

PHOTO: *Hank Edenborn (NETL) evaluates field CO_2 measurements at Hundred Springs pool.*

1:30-1:45 Hundred Springs to Tytoona Cave and Arch Spring (8 miles, 15 minutes) Along route with road cuts.

1:45-3:30 Tytoona Cave and Arch Spring

PHOTO: Arch Spring (on private property): We can view the Arch along the path to the spring and view the spring from the ridge top. This spring is the rise of Sinking Creek at Tytoona Cave and is another spring in the Shuster and White study. Contrast 1971 geochemical data and recent studies including REEs.

This is an NSS preserve. Tytoona cave entrance is a fenster, the underground route of Sinking Creek. Has been explored to 300 m, about ¼ the distance to Arch Spring. There are additional siphons. Can look at sediment in the entrance of the cave. We might be able to do short walk in the cave in small groups (see end notes).

PHOTO: *Will and Bet White lead a cave tour*

3:30 Depart for Philadelphia Approximately 215 miles, arrive 6:30 or 7:00 pm
Check in at Temple dormitory, dinner on your own. Numerous eateries on and adjacent to campus. Pick your favorite nationality.

ACCESSIBILITY: Many of the stops are accessible with just a short walk from our vehicles (most attendees travelling by bus), but they may be dirt paths. Full access requires some walking on hilly terrain.

What to bring?

- Good hiking shoes for some walking although a lot of the sites are drive-up locations.
- Rain gear in case you need it.
- Money for a lunch stop.
- We will provide water bottles and some simple snacks, but you might want something extra for the drive back to Philly.

Tentative Trip in the Tytoona wild cave – if we can arrange small groups for a short walk in the cave, you are likely to get wet or muddy or both. Here is a tentative gear list (stay tuned for updates):

- Good boots you don't mind getting wet or rubber boots (don't count on them being dry for Arch spring and the drive back to Philly).
- An extra layer that get can dirty
- A change of clothes for after we finish in the cave and spring
- We will pack helmets for small groups, but you should a headlamp and working flashlight if you have both
- You might want to bring some gloves such as neoprene gardening gloves.

Suggested reading (look for updates closer to the field trip):

Shuster ET, White WB (1971) Seasonal fluctuations in the chemistry of limestone springs: A possible means for characterizing carbonate aquifers. Journal of Hydrology 14: 93–128

Toran, L., Herman, E.K., and Berglund, J.L. (2018) Advances in monitoring to understand flow paths in karst: comparison of historic and recent data from the Valley and Ridge of Pennsylvania. In: Younos, T., Schreiber, M., Kosic-Ficco, K. Eds. Karst Water Environment: Advances in Research, Management and Policy. Handbook of Environmental Chemistry Series V 68. Heidelberg, Germany: Springer International.

Brantley, S.L., Goldhaber, M.B. and Ragnarsdottir, K.V., (2007) Crossing disciplines and scales to understand the critical zone. *Elements*, *3*(5), pp.307-314.

Sullivan, P.L., Wymore, A.S., McDowell, W.H. et al. (2017): New Opportunities for Critical Zone Science. *2017 CZO Arlington Meeting White Booklet*