Water Sources and Flow Paths on Sonoma Mountain: Tracing Groundwater-Surface Water Interactions With Dissolved Ion Chemistry

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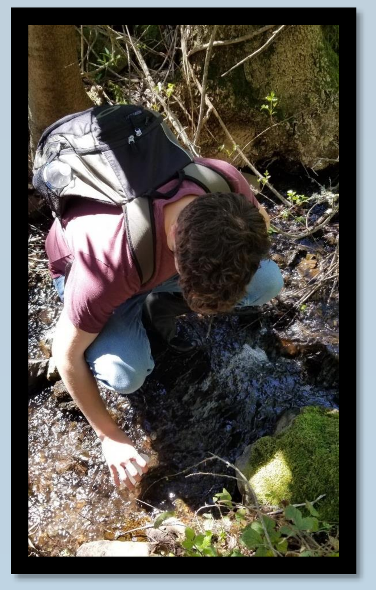
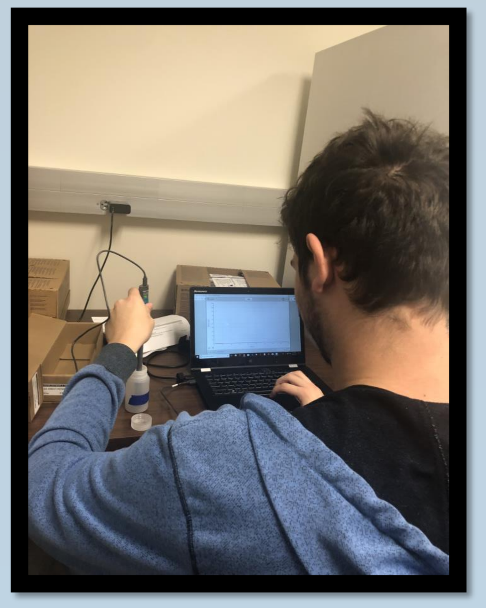
Introduction

Understanding the origin of our water sources has grown increasingly important with the concerns of future shifts in climate. In a previous study, we used total dissolved solids to show the higher conductivity present in groundwater compared to rainwater; we determined Copeland Creek to be a mixture of both. Basalt groundwater systems are known to have higher concentrations of calcium ions, while having lower concentrations of potassium ions. In this study, we observed the change in ion composition along Copeland Creek on the Fairfield Osborn Preserve on April 13th. We used a chloride, calcium, and potassium ion selective probe to track ionic composition while sampling downstream along the creek. Where the ion concentration increased, we conclude that groundwater is being discharged into the creek. Having the ability to track our sources of groundwater can prove helpful in water management to ensure that we use our limited supply consciously and efficiently.

Materials & Methods

- We took a total of 16 sample points downstream of the spring, ephemeral channel, and Copeland Creek (perennial)
- We took 5 samples from the spring, 8 samples from Copeland Creek, and 3 samples from the ephemeral channel
- We brought the samples to the lab and used a potassium, calcium, chloride, and conductivity probe to measure relative concentrations

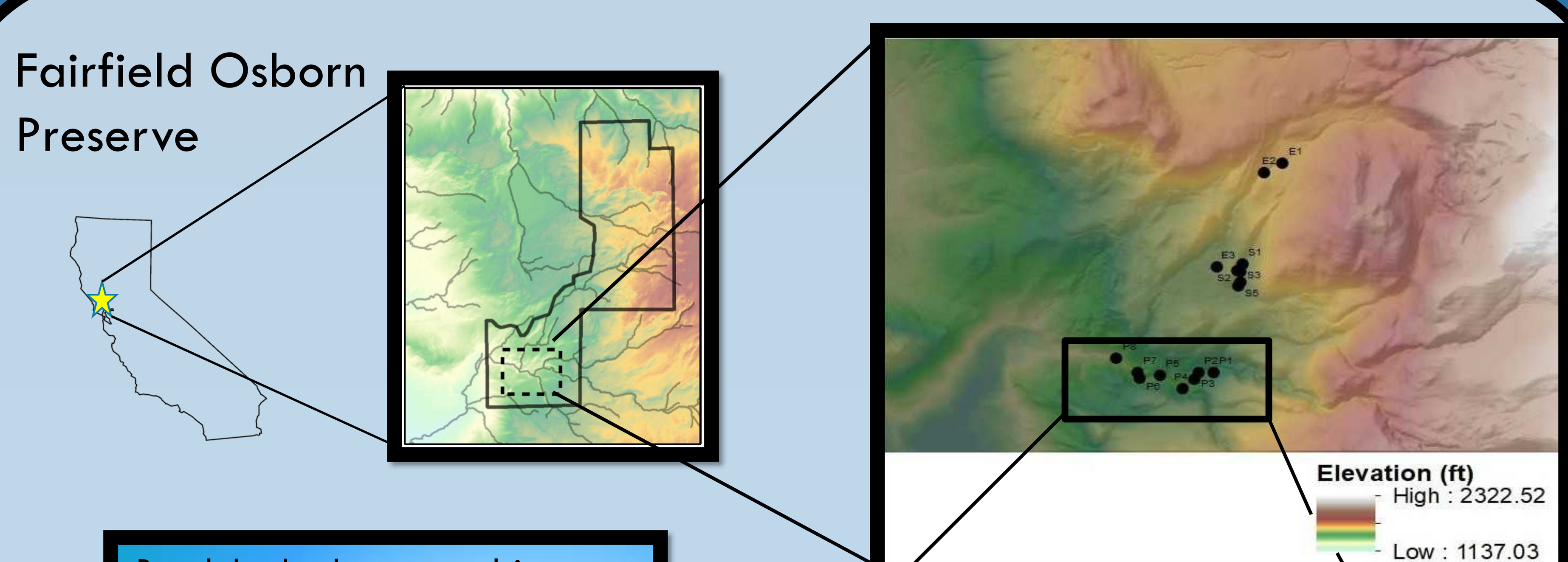
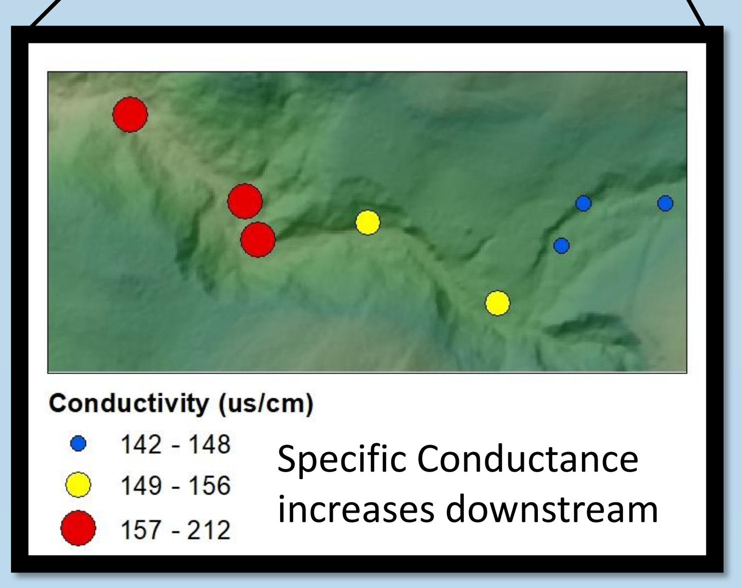
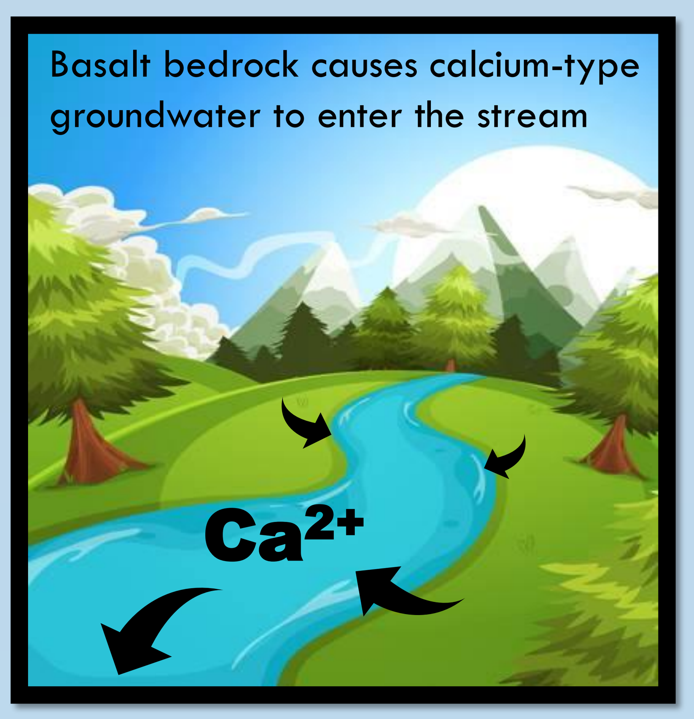


Figure 1: Sample locations





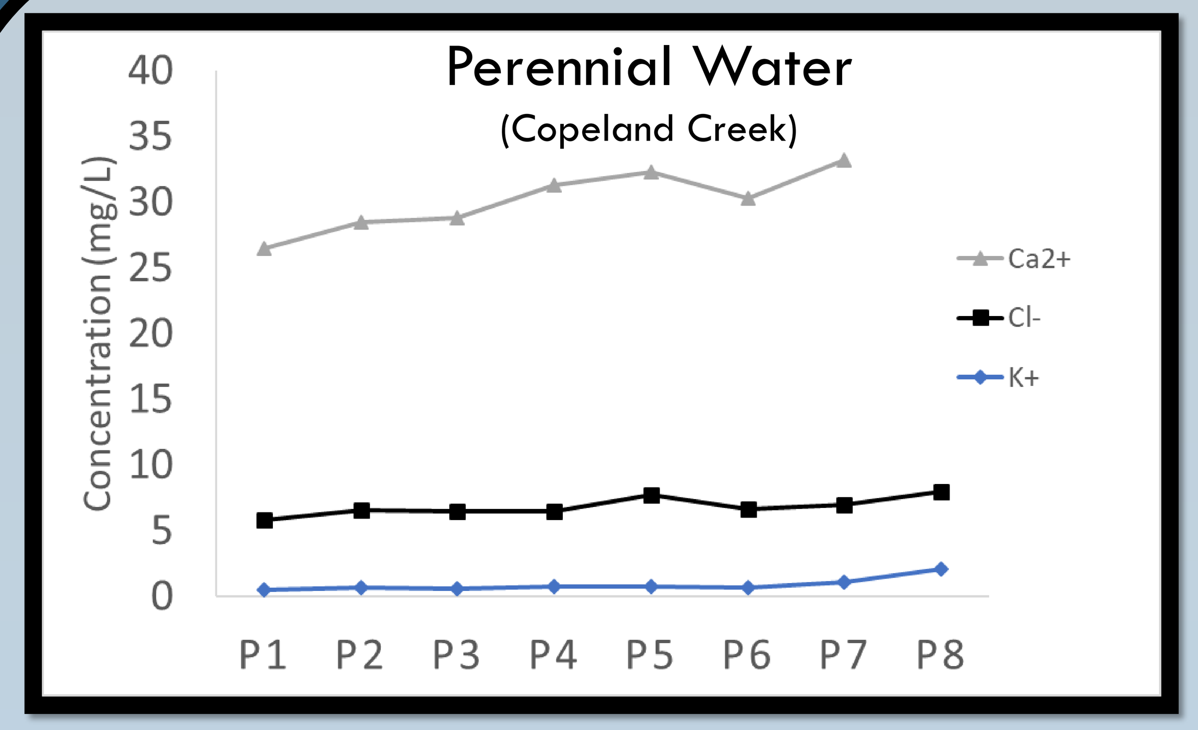


Figure 2: The potassium we measured in Copeland Creek was found to be lower than the Ephemeral Channel. We suspect this is due to potassium's ability to absorb and react with both biotic and abiotic components of the ecosystem. Chloride also showed no relationship with specific conductance of the water, which is to be expected in basaltic bedrock waters.

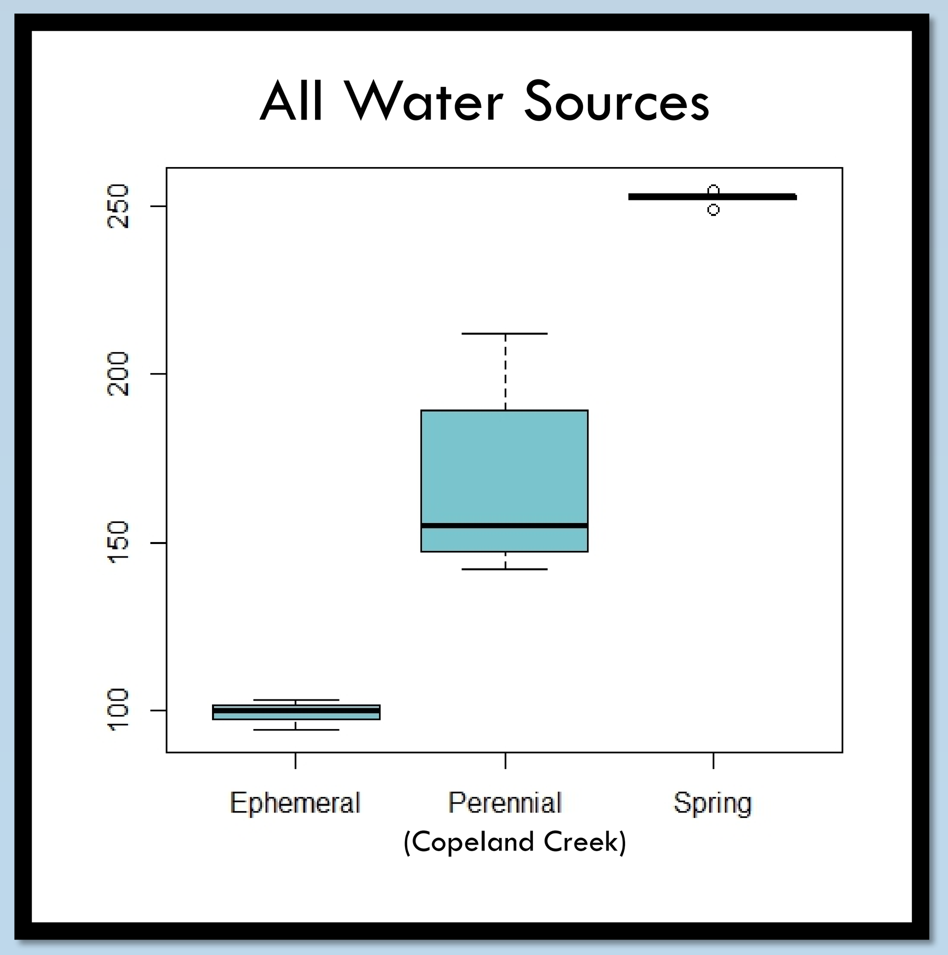


Figure 3: Our results tell us that Copeland Creek is a mixture of groundwater and rainwater.

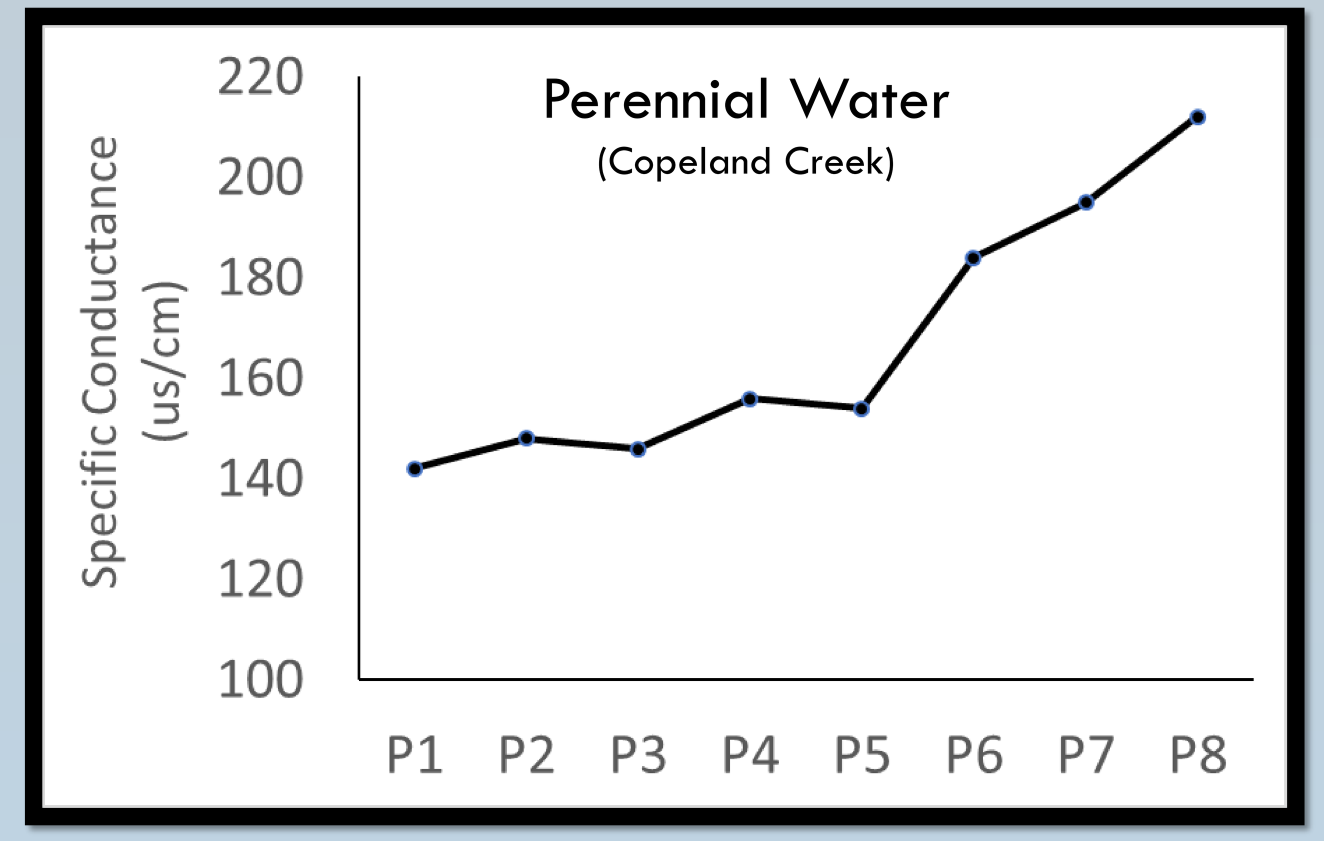


Figure 4: The conductivity gradually increased down the length of the stream. This provides evidence that groundwater is entering Copeland Creek throughout the stream.

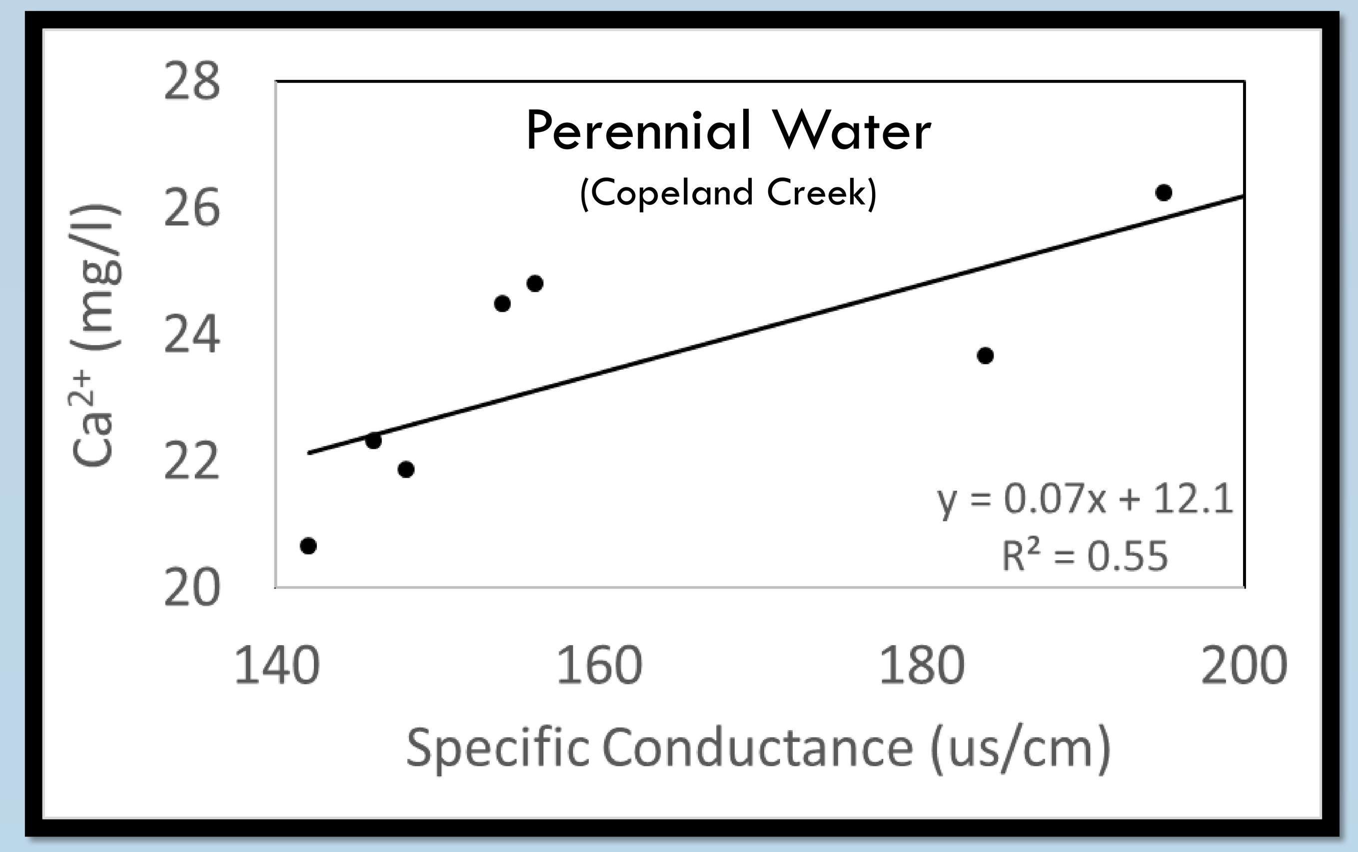


Figure 5: Calcium appears to have a moderate positive relationship with the total conductivity in Copeland Creek. The more calcium present in the stream, the higher the conductivity. We can conclude that Ca2+ is sourced from basalt rocks and accumulates in groundwater. This calcium-rich groundwater then discharges to the creek as it progresses downgradient as evidenced by the progressively higher concentrations downstream.

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- Gutchess, K. (2016, May 13). Chloride sources in urban and rural headwater catchments, central New York. Retrieved from https://www.sciencedirect.com/science/article/pii/S004896971630883X
- Cruz, J., & Andrade, C. (2015). Natural background groundwater composition in the Azores archipelago (Portugal): A hydrogeochemical study and threshold value determination. *Science of The Total Environment, 520*, 127-135. doi:10.1016/j.scitotenv.2015.03.057

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Our results tell us that Copeland Creek is a mixture of groundwater and rainwater. Calcium appears to have a moderate positive relationship with the total conductivity in Copeland Creek. The more calcium present in the stream, the higher the conductivity. We can conclude that Ca2+ is sourced from basalt rocks and accumulates in groundwater. This calcium- rich groundwater then discharges to the creek as it progresses downgradient as evidenced by the progressively higher concentrations downstream. The potassium we measured in Copeland Creek was found to be lower than the Ephemeral Channel. We suspect this is due to potassium's ability to sorb and react with both biotic and abiotic components of the ecosystem. Chloride also showed no relationship with specific conductance of the water, which is to be expected in basaltic bedrock waters.