

Is Your Water High(on) Concentration?

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Introduction

Samples of water were collected from three different sites: Delanson Pond, Tap Water, and Saratoga Springs spring water. These samples were analyzed in an effort to determine the concentrations of inorganic ions and metals present in the samples.

Goals

Analyze the water samples and compare their respective concentrations of barium, lead, calcium, chloride, and sodium.

Hypotheses

- Delanson Pond: Expected higher metal concentrations, more inorganic ions
- Tap Water: Expected lower metal concentrations, fewer inorganic ions
- Saratoga Springs Water: Expected higher metal concentrations, fewer inorganic ions



Experimental and Procedure

- **Hach field test kits:** nitrate, phosphate, and sulfate ion concentrations were analyzed in the field where samples were collected.
- **Ion Chromatography (IC):** this instrument separates ions by their affinity to interact with the stationary or mobile phase.¹ Samples were run through IC to determine ion concentrations of many different cations and anions found in the water samples.
- **Inductively coupled plasma-mass spectrometry (ICP-MS):** this instrument took atoms and converted them into various metal ions in which we were able to identify specific concentrations in each water sample.
- **Chloride ion selective electrodes:** silver-silver chloride electrodes were used to measure the chloride activity in each sample with KNO_3 used as the ionic strength adjuster.
- **Atomic Absorbance Spectrophotometry (AAS):** used to find concentration of calcium in each sample.
- **Total alkalinity titrations:** total alkalinity was determined by titrating each sample with $0.02\text{N H}_2\text{SO}_4$ with an indicator present in each sample to determine an alkalinity range based on color change of the indicator.

Results

ICP-MS Data Results

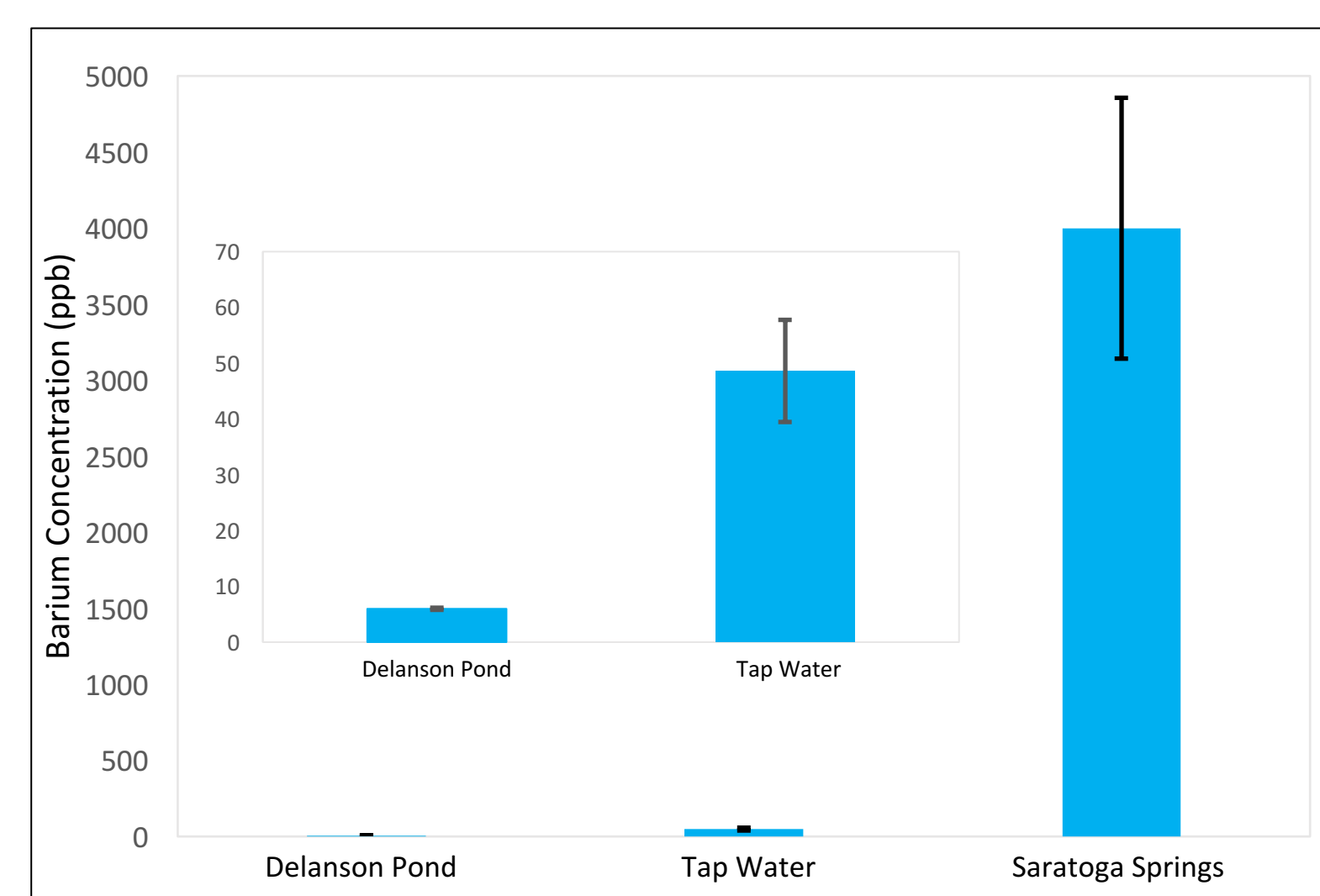


Figure 1. Average barium concentrations (ppb) of water samples collected from Delanson Pond, Tap Water, and Saratoga Springs analyzed by ICP-MS.

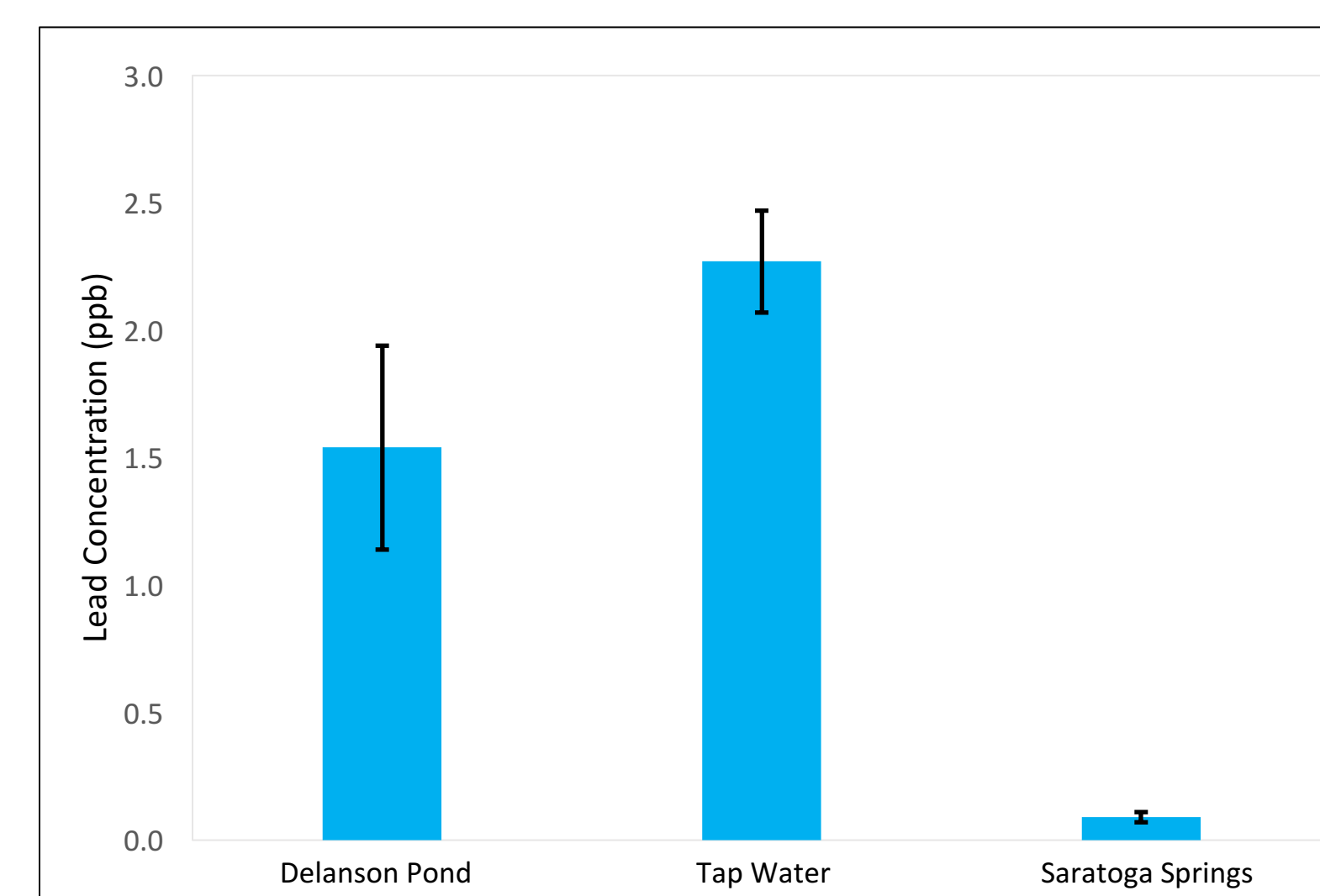


Figure 2. Average lead concentrations (ppb) of water samples collected from Delanson Pond, Tap Water, and Saratoga Springs analyzed by ICP-MS.

Comparing Analytical Methods

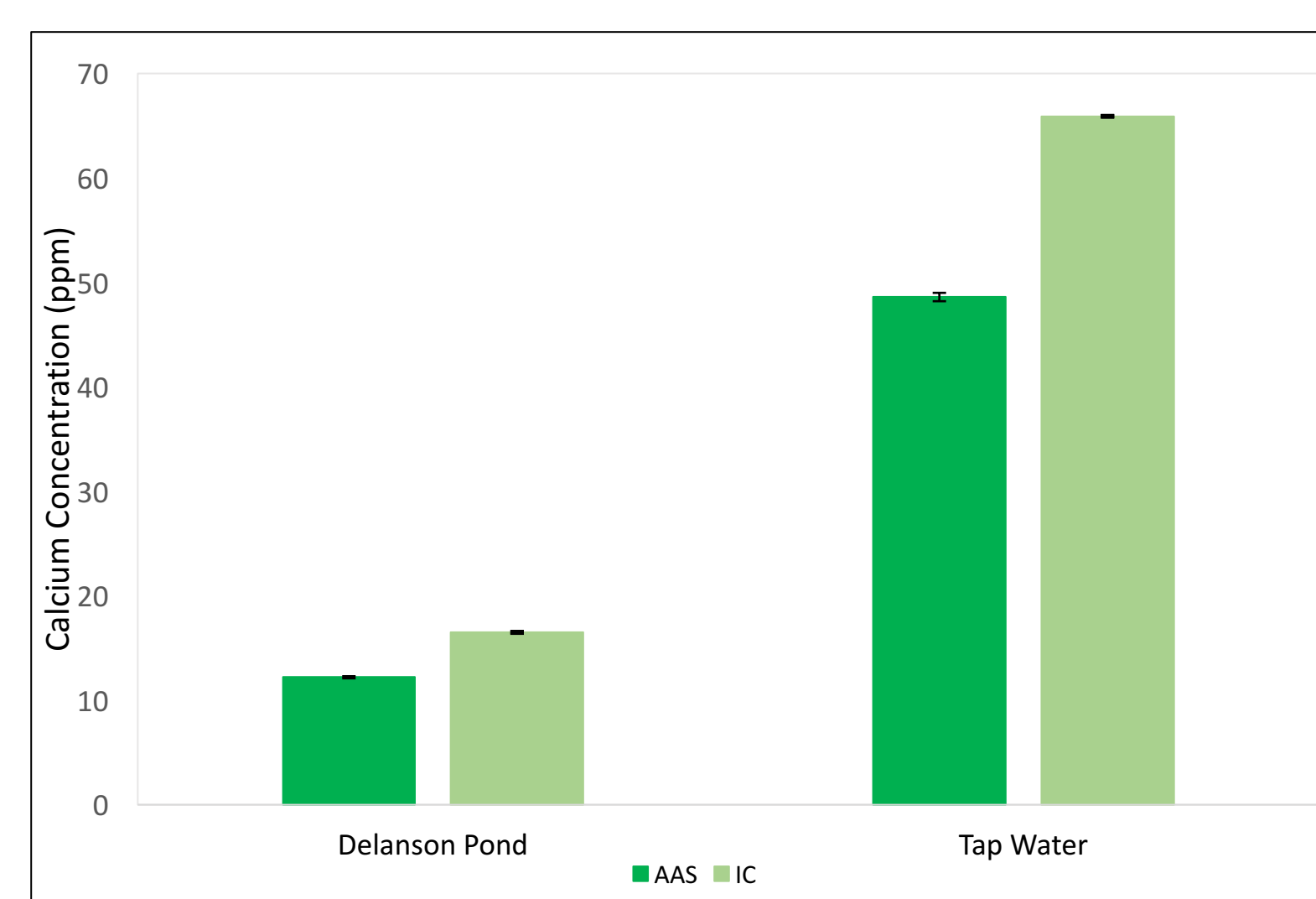


Figure 3. Average calcium concentrations (ppm) of water samples collected from Delanson Pond and Tap Water analyzed by AAS and ion chromatography. Saratoga Springs calcium levels were not quantifiable.

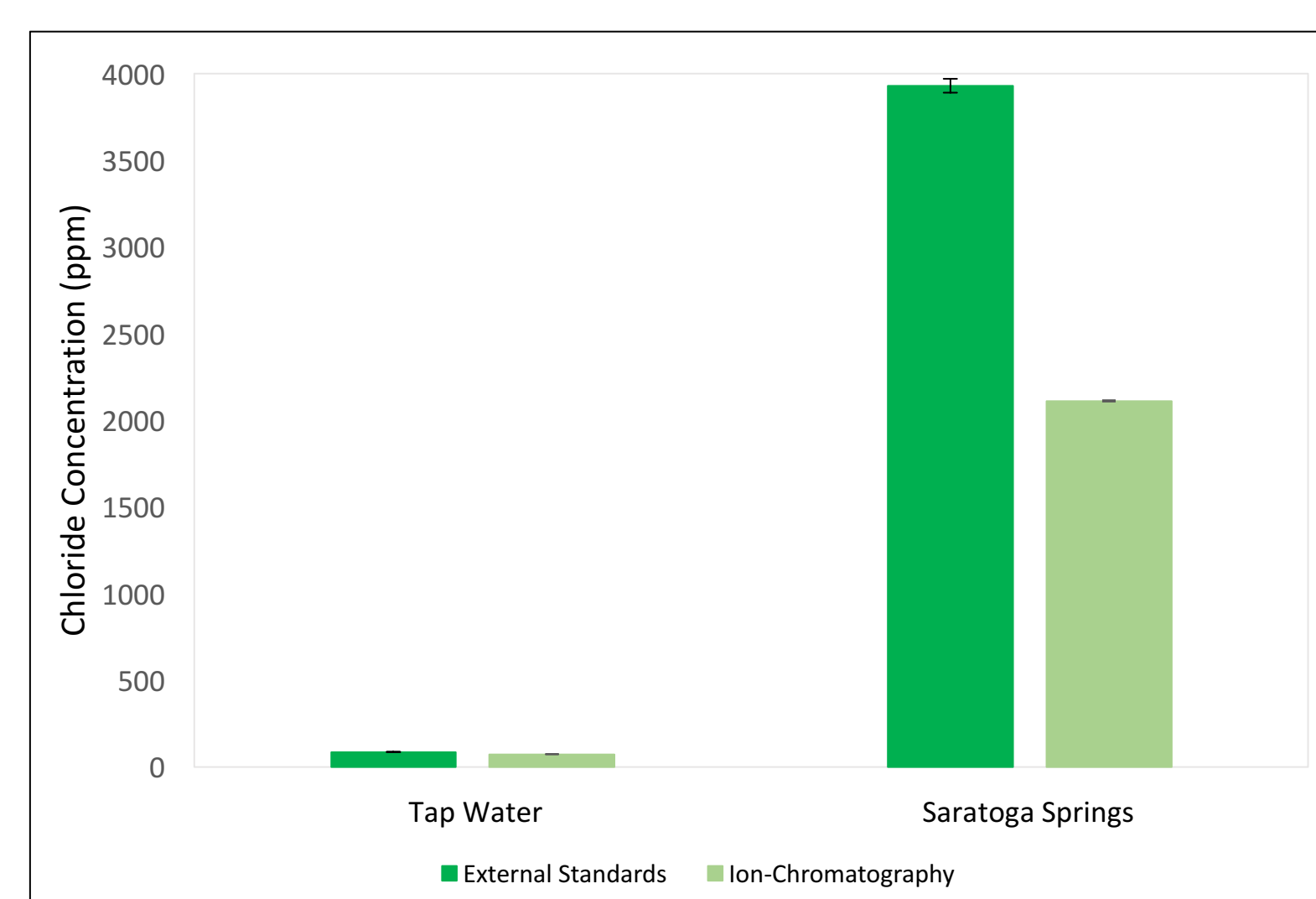


Figure 4. Average chloride concentrations (ppm) of water samples collected from Tap Water and Saratoga Springs analyzed by external addition and ion chromatography. Standard addition provided results closer to IC. Delanson Pond chloride levels were not quantifiable.

Ion Chromatography

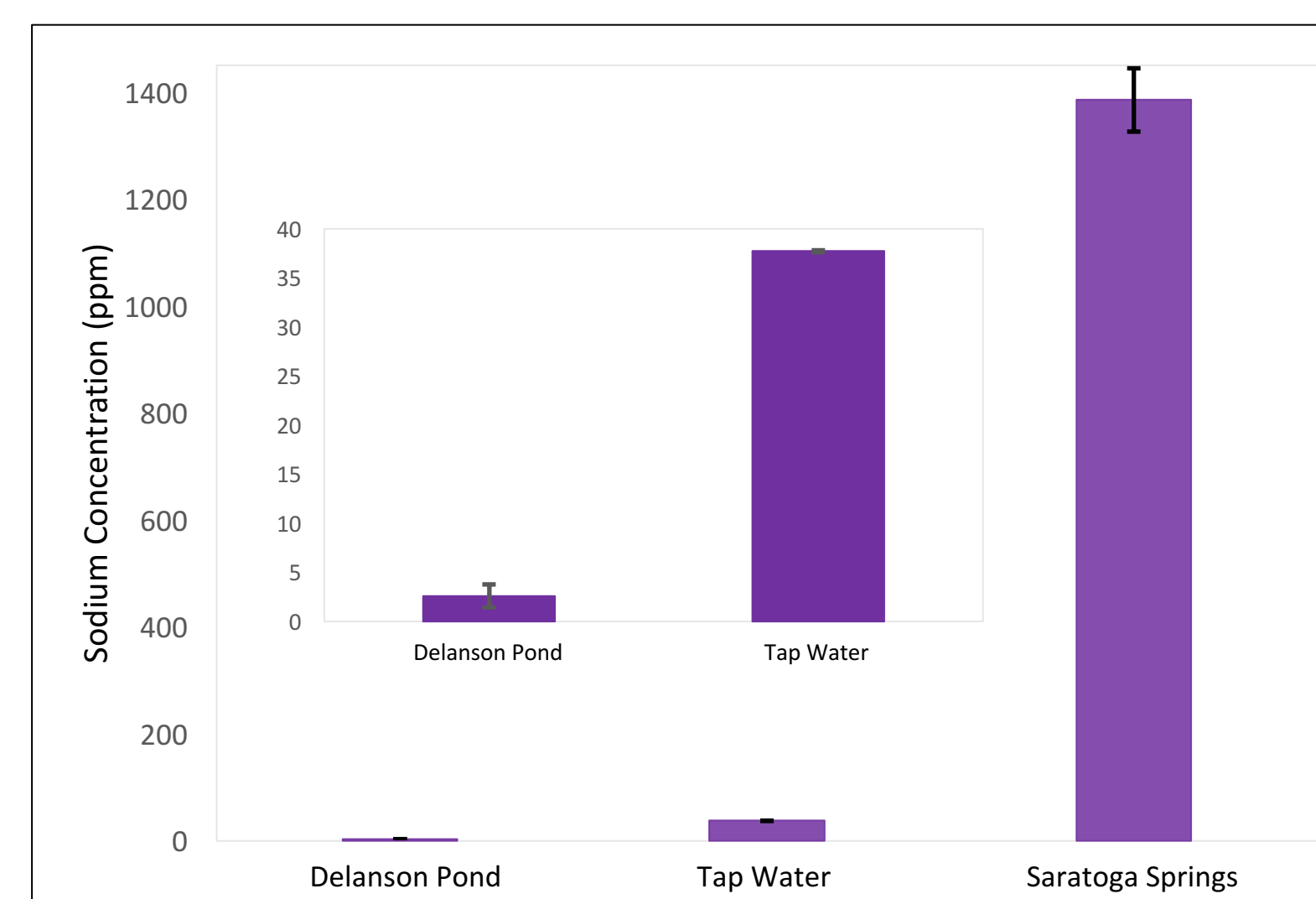


Figure 5. Average sodium concentrations (ppm) of water samples collected from Delanson Pond, Tap Water, and Saratoga Springs analyzed by ion chromatography.

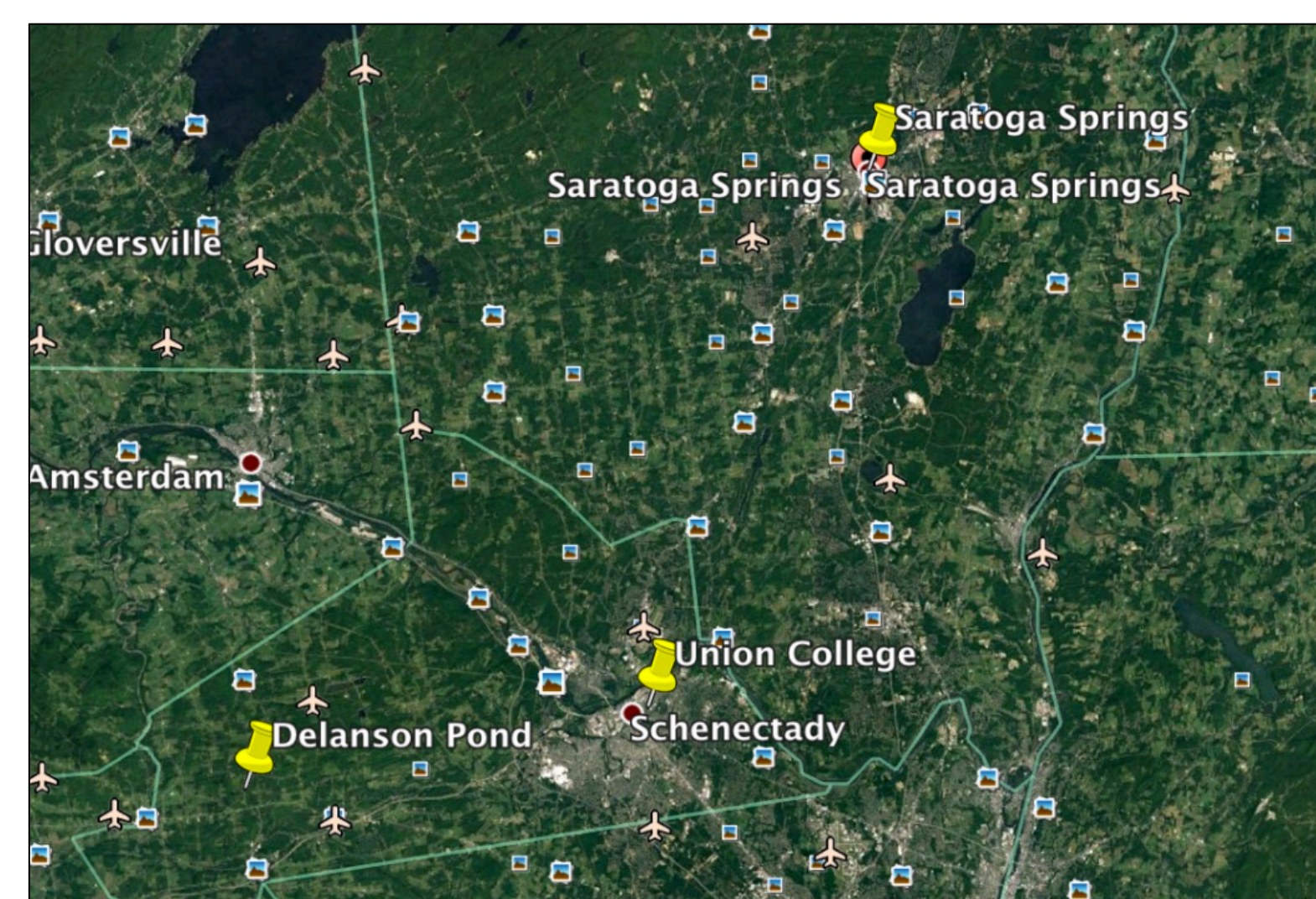


Figure 6. Yellow pins on the map represent the location of each of the samples obtained. Union College is where Tap Water was collected.

Discussion and Conclusion

- Barium concentration was significantly higher in the Saratoga Springs sample compared to the other two. The EPA maximum contaminant level for barium is 2000 ppb.² Saratoga Springs has almost double. Consequences of consuming high levels of barium can cause gastrointestinal issues, high blood pressure, and can effect the nervous and circulatory systems.²
- Lead concentrations in Delanson Pond and Tap Water were much higher than Saratoga Springs. The EPA maximum for lead is 15 ppb.³ All three samples are well below this standard.
- IC gave higher calcium concentrations than AAS for both Delanson Pond and Tap Water. Overall, Tap Water had the highest concentration of calcium. Calcium is naturally occurring and does not pose serious health concerns. However, it can impact the water "hardness". When hard water (high calcium) reacts with soap, it leaves an unwanted residue and can make washing things difficult. For Delanson Pond, water is soft and for Tap Water, it's moderately hard.^{4,5}
- External standards and IC were used to compare chloride concentrations. External standards gave higher concentrations for both water samples. Saratoga Springs overall had a higher concentration compared to Tap Water. Chloride in the water is due in-part from salts in the environment. These salts could be coming from road salts, fertilizers, or other sources.⁶
- Sodium concentration was analyzed using IC. Saratoga Springs had the highest concentration. Sodium in water can also be attributed to certain salts that are exposed to the water. The EPA sets a standard of 20 ppm as the maximum for drinking water.⁷ Saratoga Springs and Tap Water both exceed this limit.

Acknowledgements

- Professor MacManus-Spencer and Professor Lou
- Matt Manon in Geology
- The Geology Department

References

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