Temporal Trends in Dissolved Metal Concentrations in Tempe Town Lake

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Introduction

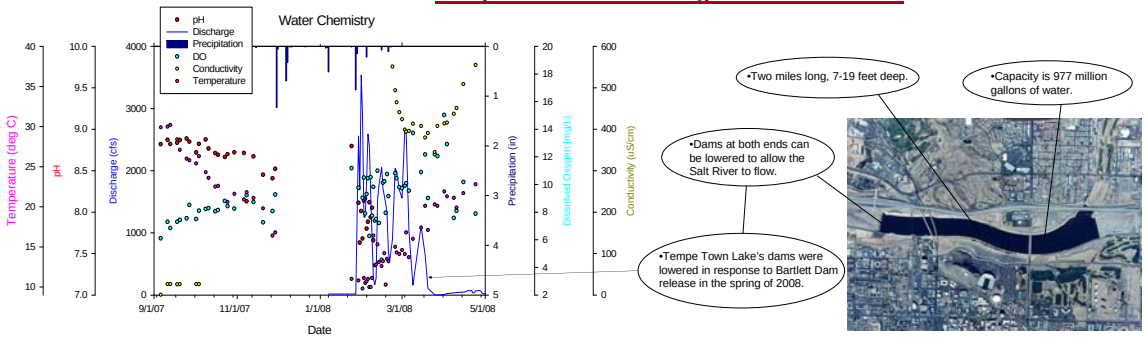
Trace element concentrations were measured in Tempe Town Lake (TTL) Sept. 2007 through April 2008. This includes the period in the spring when the dams were lowered and the Salt River flowed through the lake. The period before the dams were released represents aged lake water that we are comparing to the fresh source water after the dams were released. By observing temporal trends in elemental composition before and after the dams were released, we can begin to elucidate the chemical and physical processes that affect metal concentrations. For example, evaporation is expected to concentrate metals, urban runoff is expected to increase some metals (Pb, and Zn for example), and some metals will be affected by biological processes, for example Fe and Mo.

Presented here are total dissolved metal concentrations. Metals are grouped based on the behavior they exhibited in the lake after the dams were lowered. Metals that increased with the water release are considered river sourced, with the lake water relatively depleted in their concentration. Metals that decreased were relatively concentrated in the lake, and diluted by the water release. There are also a handful of elements that remain constant throughout the time-series. By monitoring these concentration changes we can begin to think about the affect management has on river chemistry and use TTL as a model for larger river-reservoir systems.

Methods

- pH, temp, dissolved oxygen, and conductivity were measured in the field.
- Samples were collected and filtered through a 0.2 µm pore sized filter
- ICP samples were acidified with H_2NO_3
- IC samples were refrigerated until analysis
- Dissolved metals were measured via high-resolution inductively coupled mass spectrometry (ICP-MS)
- Major ions were measured via ion chromatography (IC)

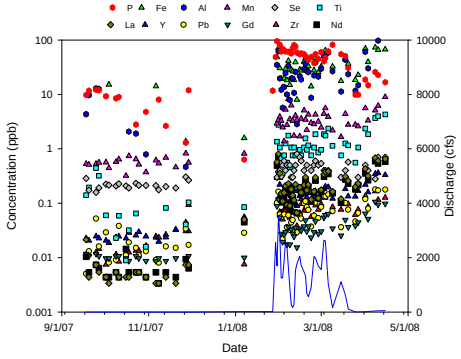
Tempe Town Lake: background information



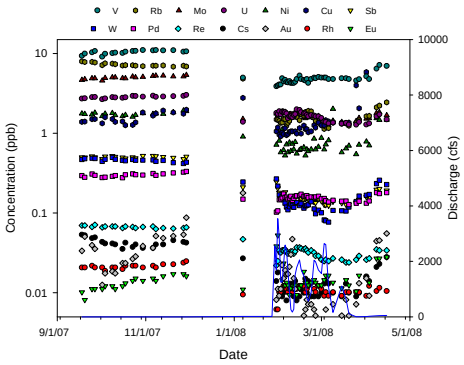
http://www.tempe.gov/lake/

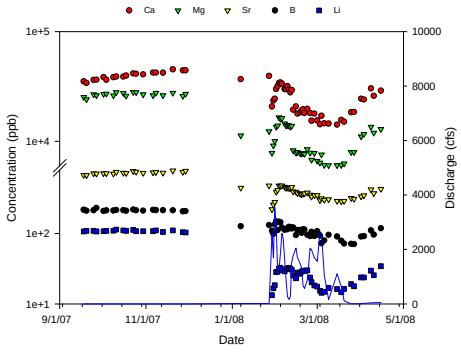
Results: How did trace elements in TTL respond to the spring dam release?

Metals that **Increase** with Dam Release

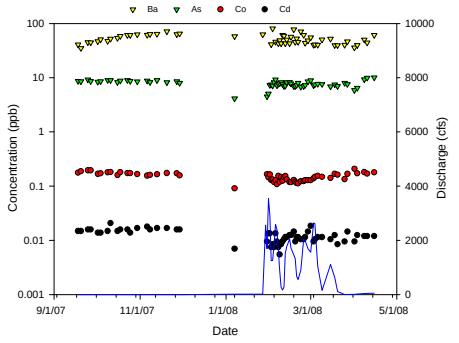


Metals that **Decrease** with Dam Release

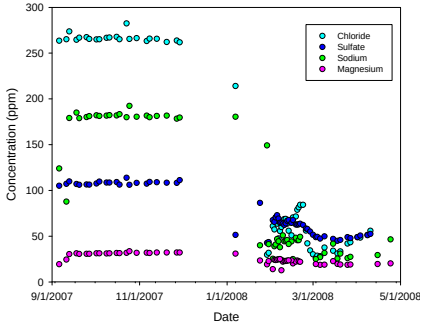




Metals with Relatively **No Change** with Dam Release



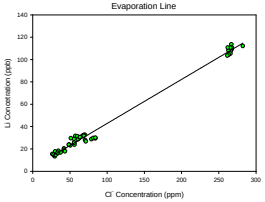
Major Ions



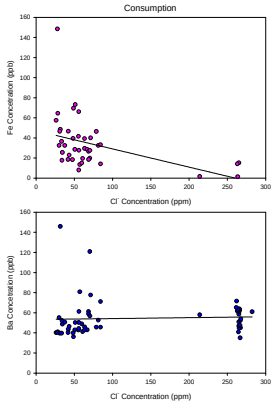
Processes affecting lake composition

- Evaporation/Dilution*
- Sorption
- Anthropogenic Inputs
- Biological Activity

*In order to determine if concentration changes are driven by evaporation, dissolved elements can be plotted against Cl ion concentration. A straight line through the origin reflects an evaporation/dilution line. Trend lines that do not plot through the origin indicate that processes other than evaporation are affecting the concentration trend.



Metals that decrease with the dam release have a positive slope when plotted against Cl ion concentration. Li and Rb are the only metals whose trend line extrapolates to the origin.



Metals that increase with the dam release have a negative slope when plotted against Cl ion indicating their consumption in the lake.

Metals that don't have concentration changes have a horizontal trend line when plotted against Cl ion concentration.

Conclusions

- 19 metals decreased in concentration after the dam release and thus seem to be concentrated in the lake. Evaporation is the likely process controlling this concentration; but Li and Rb were the only elements that clearly showed an evaporation trend. Other processes that could increase metal concentration are biological production/release and urban runoff.
- 12 metals increased in concentration after the dam release and are therefore likely being consumed in the lake. Processes possibly responsible are sorption and biological activity.
- We hypothesize that larger river-reservoir systems may behave similar to TTL and that reservoirs could also exhibit similar trends in concentration due to changes in river flow or composition.

Acknowledgements

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References

Stumm W. & Morgan J. 1996. Aquatic Chemistry, 3rd ed. New York: John Wiley and Sons. p. 632.