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Determining Iron Concentrations in Seawater using Flow Injection Analysis

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Abstract

Iron concentrations in the ocean are important for the health and success of the ocean because it is an essential micronutrient for phytoplankton. However, iron is insoluble in oxygenated seawater and so most iron precipitates and sinks out of the water column. Here we present a method to analyze these low concentrations of iron using flow injection analysis, which we built following Lohan et al. (2006).

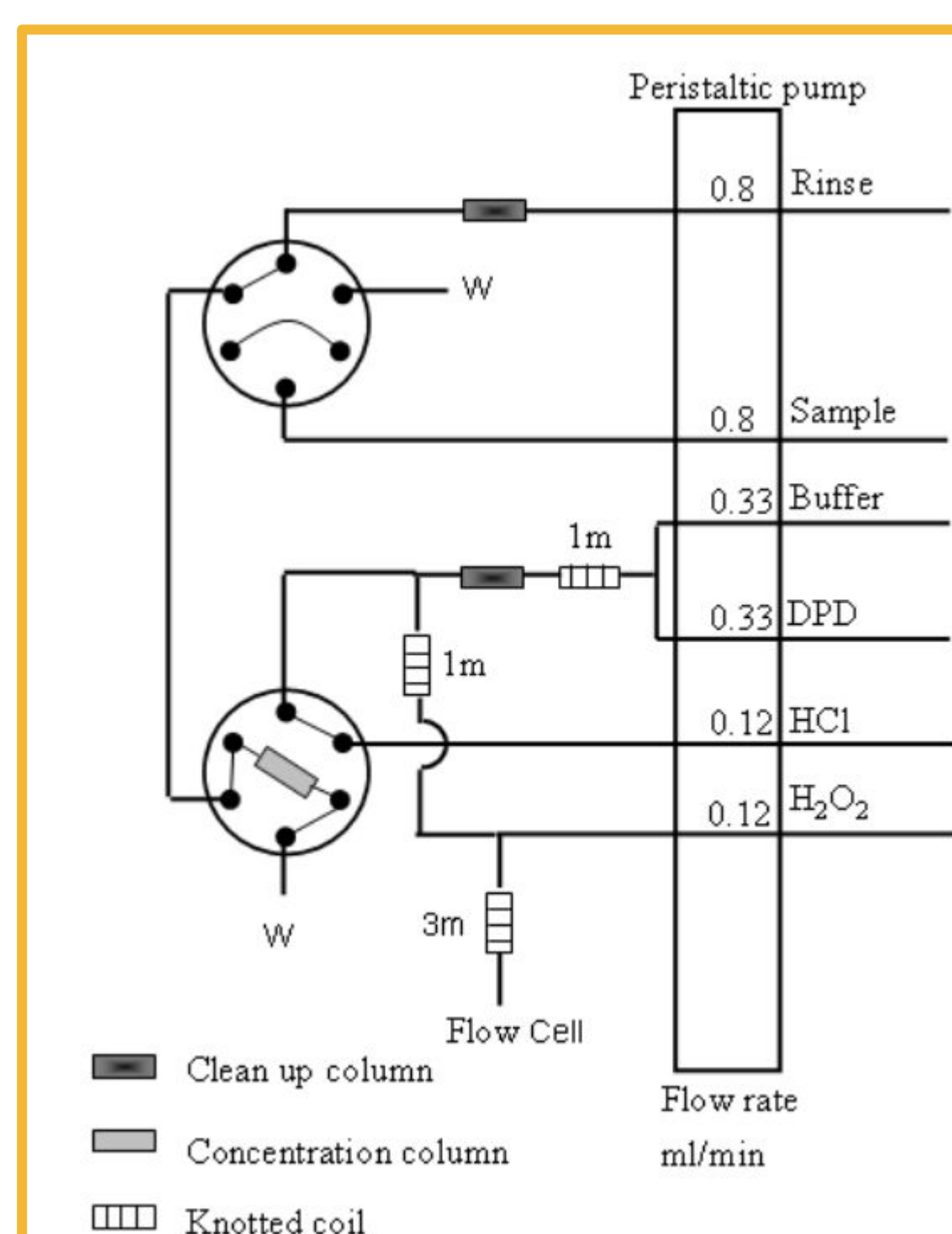
Introduction

Iron is necessary for photosynthetic activity and greatly affects the growth and development of phytoplankton in the ocean. Phytoplankton supply the ocean with the majority of the dissolved oxygen. However, iron is at extremely low concentrations in the ocean, which makes it a challenge to measure. To analyze the concentration of iron in solution, a UV-Vis flow through spectrophotometer is employed. This allows for a the absorbance of the iron to be analyzed while the reaction is running.

However, if the concentration of the iron is too low, the UV-Vis

will be unable to detect small differences between samples. To remedy this, the iron is first concentrated before it is ran through the UV-Vis to obtain the absorbance.

Figure 1. Schematic of the peristaltic pump from Lohan et al (2006).



Methods

To analyze the concentration of iron in samples of seawater, a peristaltic pump (Figure 1) sends the sample and reagents through a flow injection analysis system (Figures 1 and 2). The amount of each sample and reagent is controlled by selecting a tubing size that allows for appropriate delivery of the various solutions. The sample flows over a column of Toyopearl Chelate-650 resin, which holds onto all of the iron. A small volume of acid releases the iron from the resin and the iron is now concentrated to a measurable level. This iron(III) then oxidizes the DPD running through the system to cause it to change from a clear liquid to a pink liquid. The color change in the DPD is what the UV-Vis analyzes. The absorbance that is obtained is proportional to the concentration of iron in the seawater sample. This spectrophotometer was connected to a laptop that was continuously running a LabView program that allowed for real time graphing of the absorbance and the time (Figure 3, 4). This program allowed for a visual aide to determine when the DPD was interacting with the UV-Vis and what the peak absorbance was.

Reagents:

- Rinse (3.25 M ammonium acetate, pH 3)
- Buffer (1.5 M ammonium acetate, pH 9)
- HCl (1.5 M)
- DPD (0.05 M)
- H₂O₂ (5%)

Figure 2. Peristaltic pump set up with temporary metal clean space, attached to a UV-Vis spectrophotometer.



Results

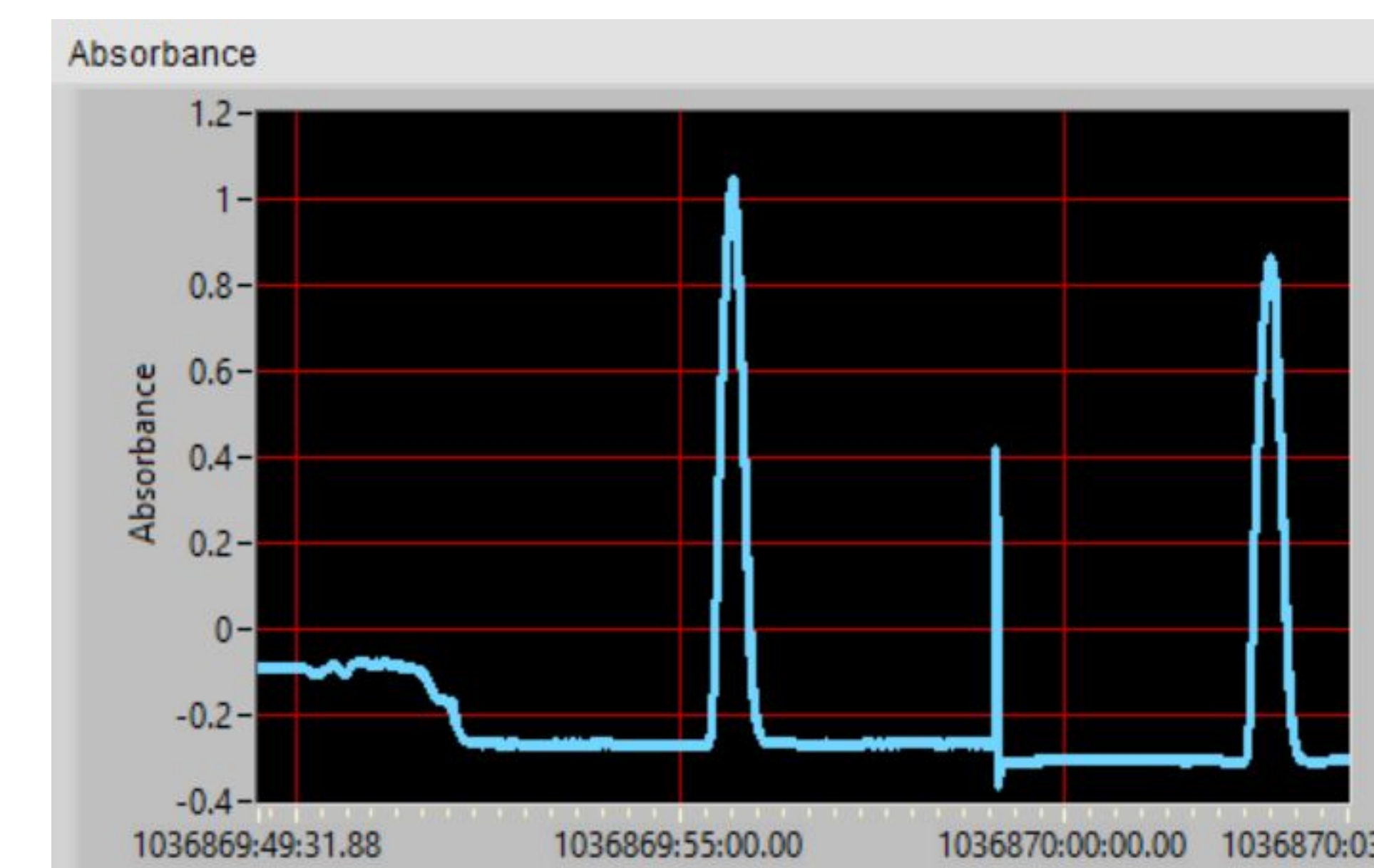
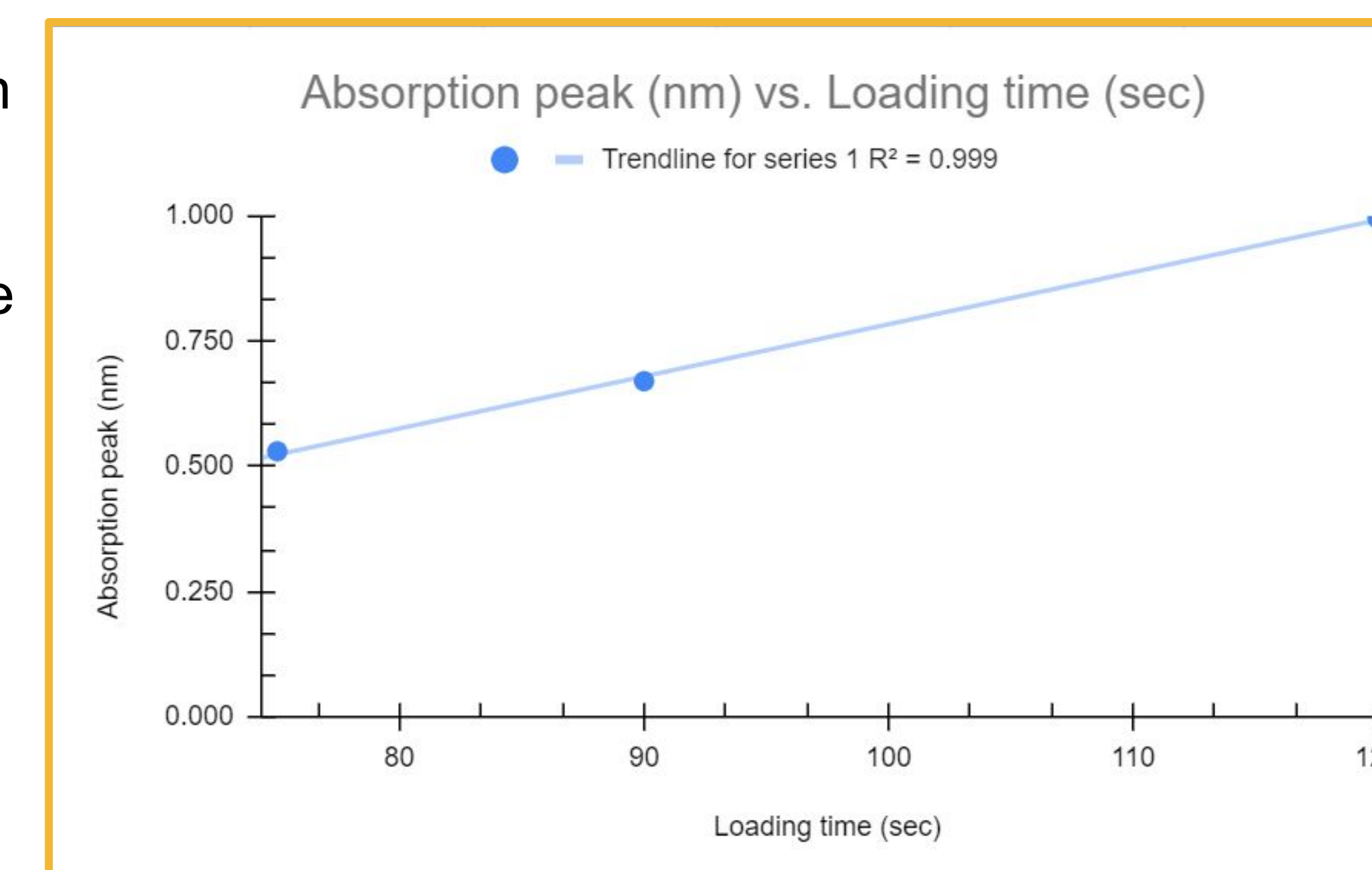


Figure 3. Evidence of repeatable peaks of the same concentration of Iron from the flow injection apparatus

Figure 4. Data taken from a range of column loading times with the same concentration sample shows a linear relationship between the concentration and the loading time.



Next Steps

- Compilation of known iron(III) to form a standard curve from which we compare unknown concentrations of iron.
- Measure samples from Little River and the Mad River estuary to compare iron concentrations in relation to high salt concentrations found in estuaries.

Acknowledgments



References

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