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# Analyzing Trace Levels of Iron in Seawater: Expanding the Measurable Concentration Range

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Point Beyond Linear Range

## ABSTRACT:

Iron exists in the ocean in extremely low concentrations, and can be affected by a number of things, such as upwelling and biological/chemical processes. Exploring iron concentrations at different depths and various locations can help further the understanding of iron availability in the ocean. Because we are measuring such low concentrations of iron, the system is currently optimized for 0.5-5 nanomolar concentrations. We aim to expand the range of concentrations (5-30 nanomolar) that can be measured using this method.

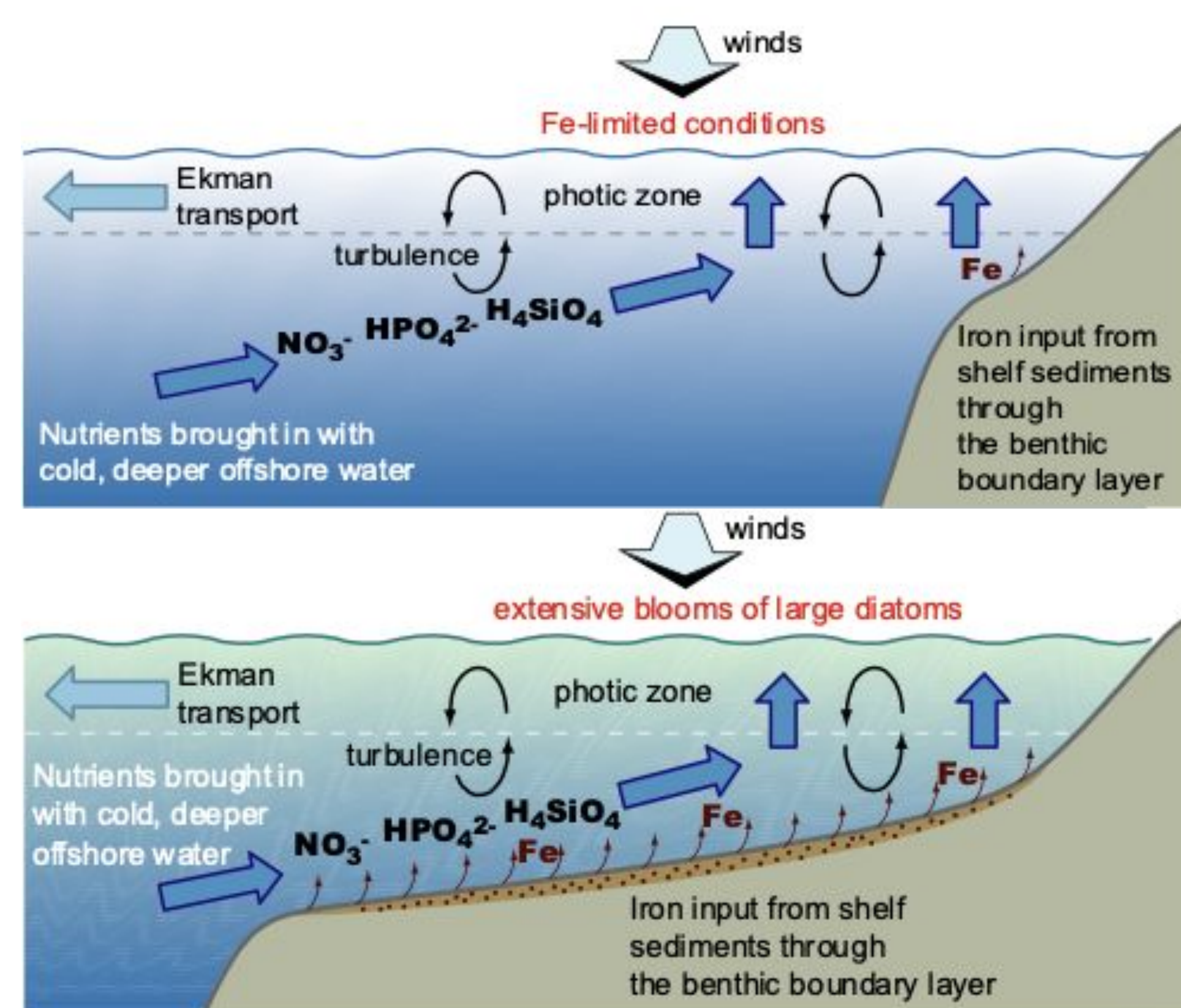


Fig 1. Iron input to the surface waters for narrow and wide continental shelf regions: northerly winds drive coastal upwelling, but only in wide shelf regions does enough Fe come to the surface to stimulate growth.

## BACKGROUND:

Iron is a vital trace metal for marine life. It typically exists as oxidized iron ( $\text{Fe}^{3+}$ ) in marine settings due to the availability of dissolved  $\text{O}_2$ . However, this oxidized form of iron is insoluble in seawater, and precipitates and sinks to the bottom. In coastal regions with a wider continental shelf, that iron is captured and can be brought back to the surface with coastal upwelling of deep water. Thus the availability of iron depends on upwelling and shelf width.

## METHOD:

The iron in seawater is concentrated within the column: the load phase (Fig. 2). Then the iron is flushed out with HCl: the elute phase (Fig. 3).

In this state,  $\text{Fe}^{3+}$  is the dominant species in the system. DPD is then introduced to the  $\text{Fe}^{3+}$ , reducing the iron and oxidizing the DPD into a rich red color.  $\text{H}_2\text{O}_2$  in the reaction mixture converts the  $\text{Fe}^{2+}$  back to  $\text{Fe}^{3+}$ . This process of  $\text{H}_2\text{O}_2$  converting  $\text{Fe}^{2+}$  to  $\text{Fe}^{3+}$  then oxidizing DPD repeats, so each iron atom oxidizes many DPD molecules.

The fluid then passes through the absorbance spectrometer, measuring the absorbance of the DPD. Higher absorbance values correspond with more iron in the reaction mixture: thus we can measure the concentration of iron in seawater.

This method is effective up to a point of concentration, wherein absorbance and concentration no longer have a linear relationship given a specific load time. We were able to effectively measure absorbance of a higher suite of standards by decreasing the load time.

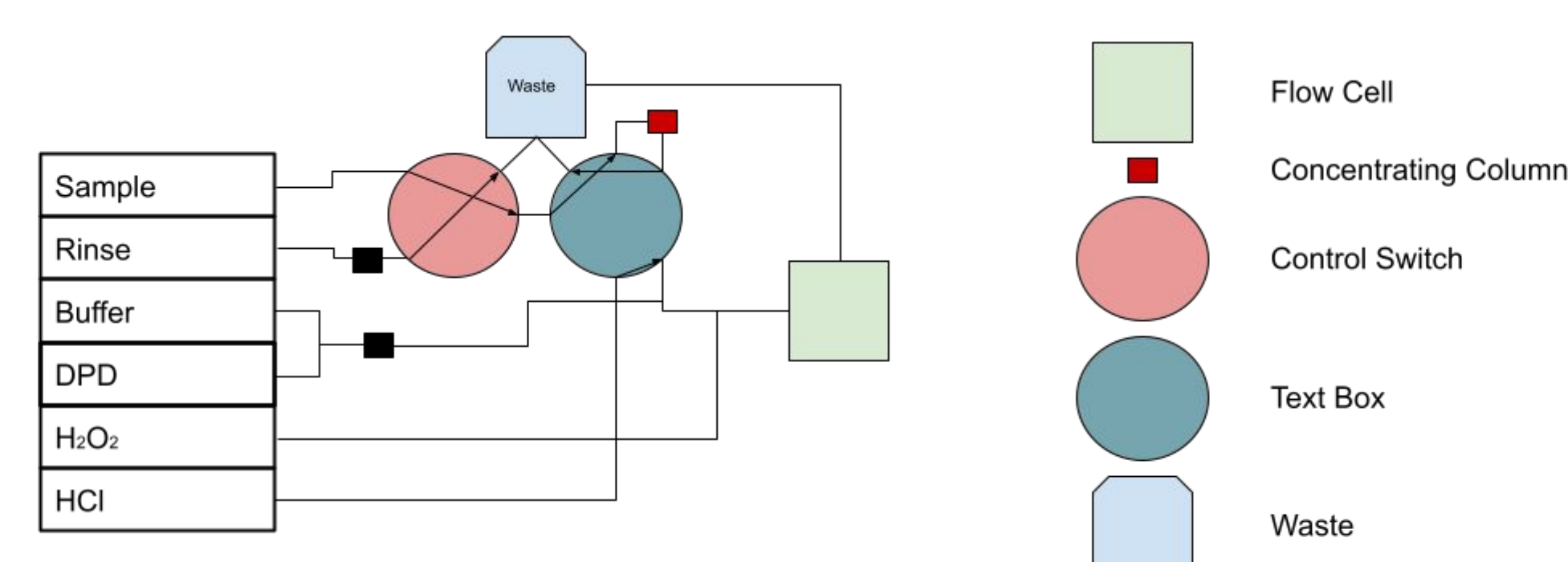


Fig 2. Load Phase Diagram

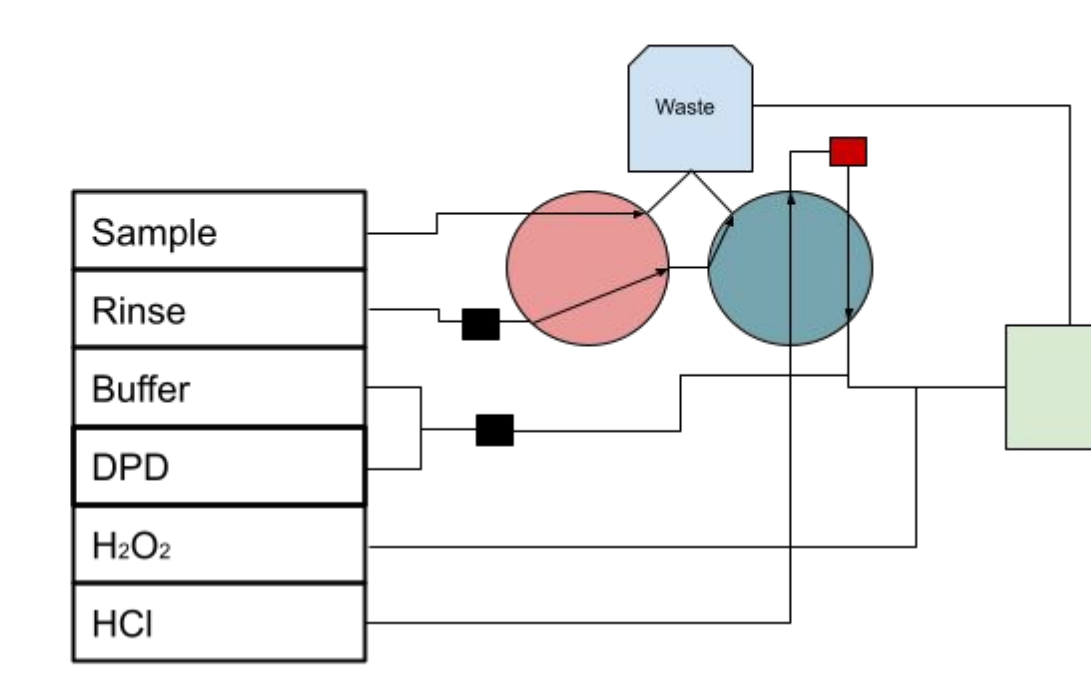


Fig 3. Elute Phase Diagram

## RESULTS:

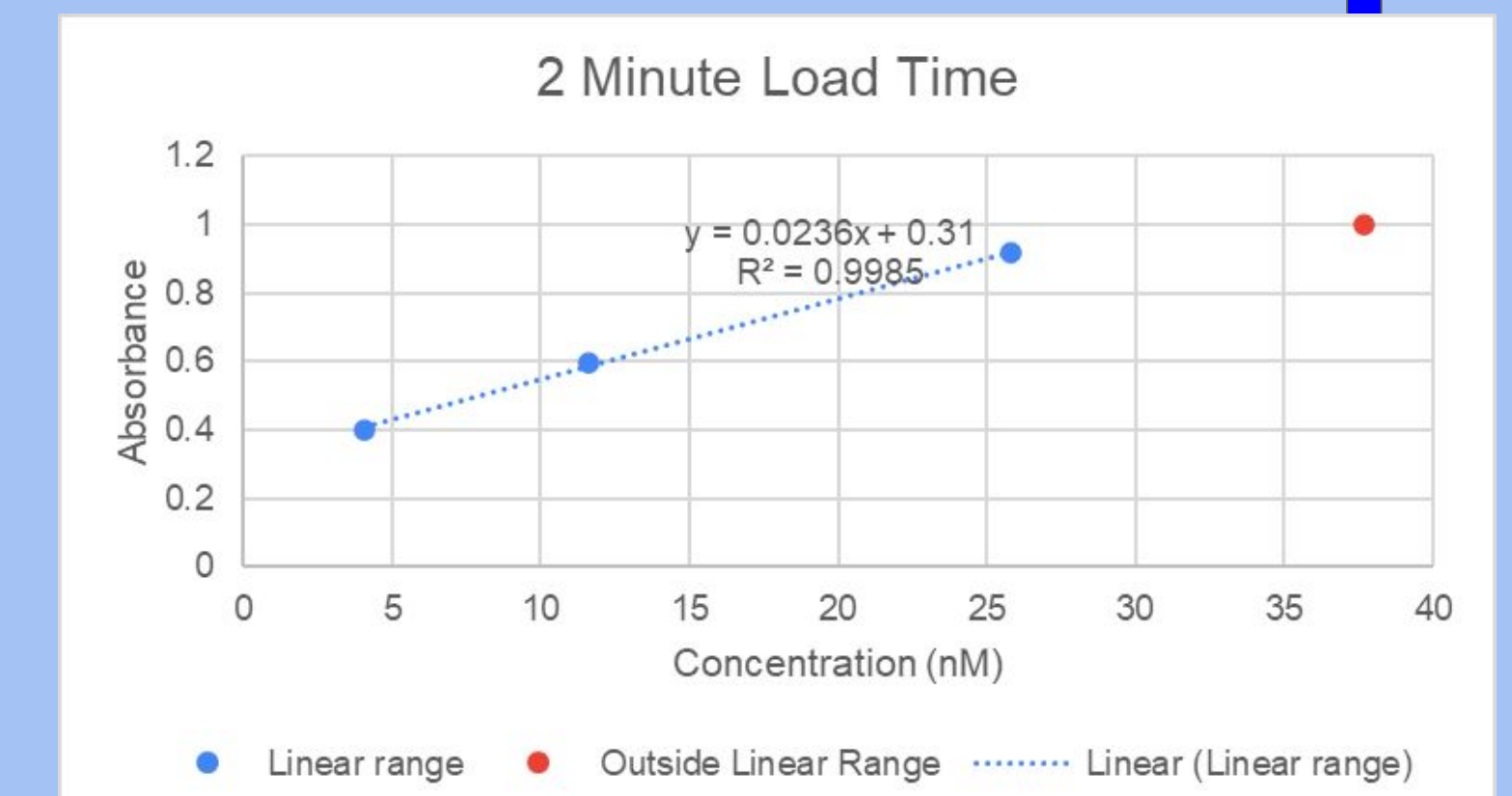


Fig 4. Two minute load time standard curve

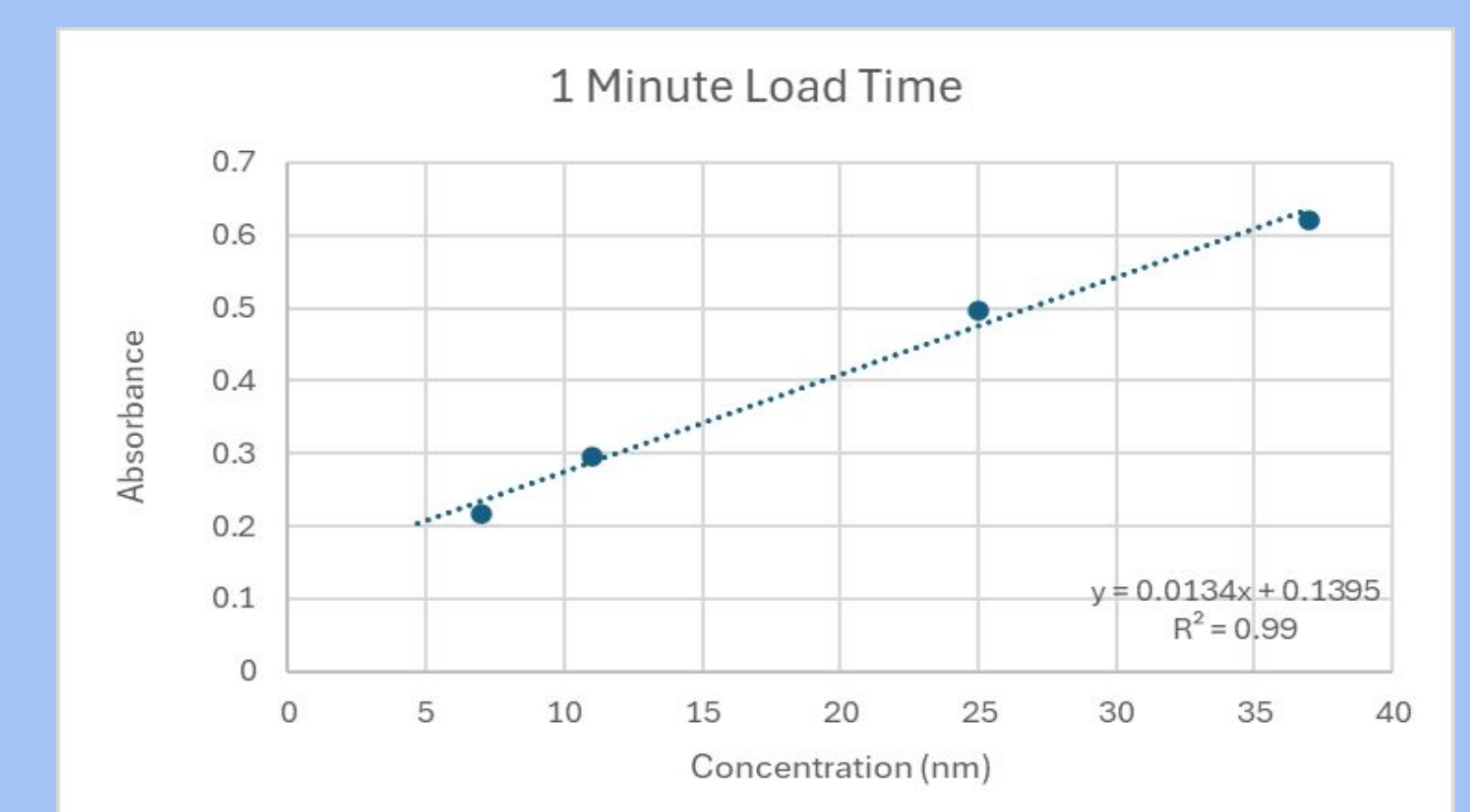


Fig 5. One minute load time standard curve

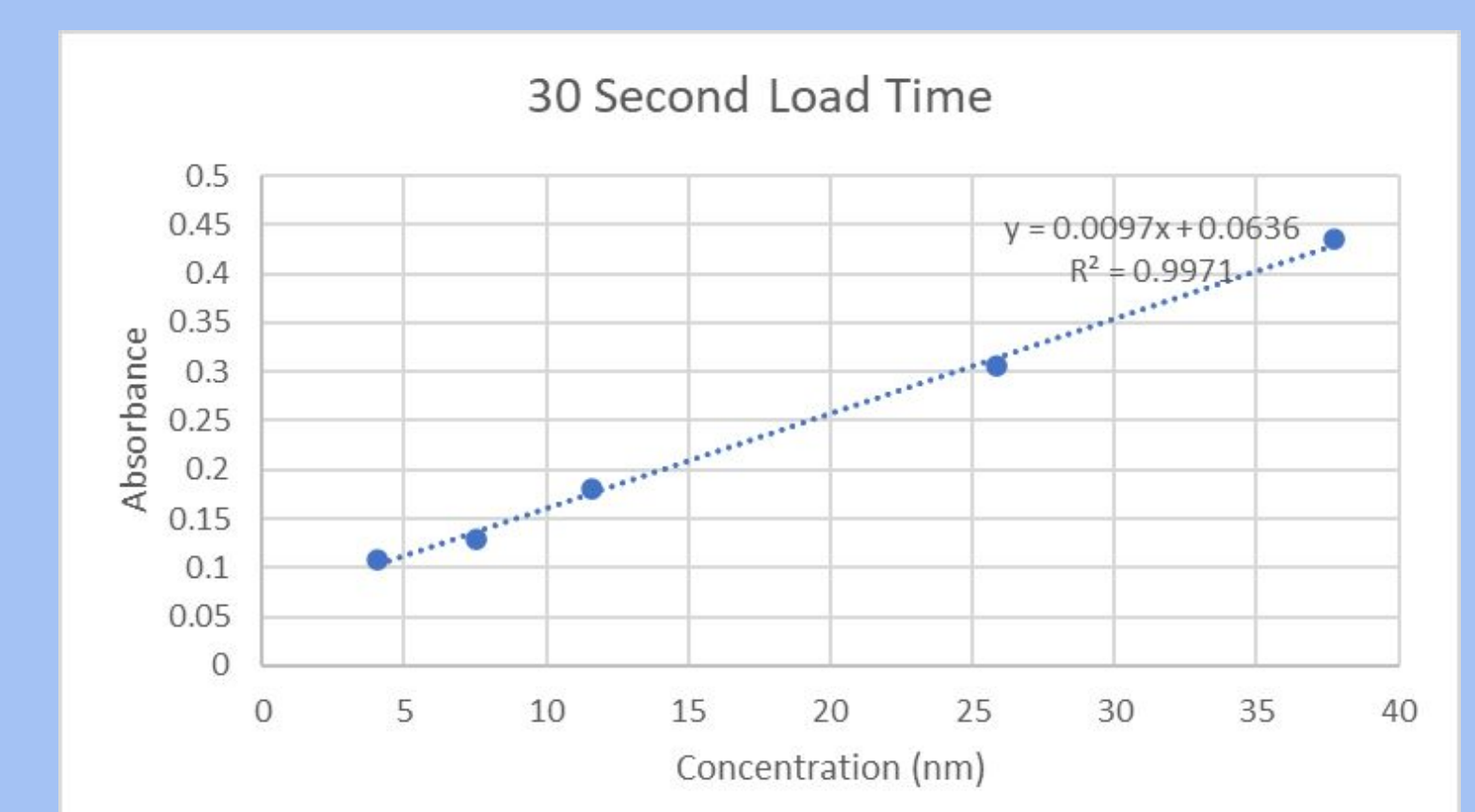


Fig 6. 30 second load time standard curve

## CONCLUSIONS:

With two minute load time, we were able to measure up to 25 nM within our linear range. With a one minute load time we were inconclusively able to measure up to 37 nM. During a 30 second load time, we were able to conclusively measure up to 37 nM in linear range.

## Acknowledgements

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