Assessing trace metal incorporation using a flow through culturing system for benthic foraminifera

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I. Background

Many redox-sensitive micronutrients and trace metals have been constrained for punctuated events indirectly as they are inferred from black shale enrichments[1-3]. Paleoclimate studies have utilized foraminiferal elemental concentrations that were incorporated during original precipitation[4], but redox-sensitive trace metal research has been limited. We are testing the utility of foraminifera to track the global seawater trace metal inventory using controlled culture experiments in order to assess the viability of using well preserved foram tests as a proxy to reconstruct the marine trace metal concentration of redox-sensitive elements. First, we must determine the best method that does not impact the trace metal uptake by these forams.

II. Hypothesis

Our flow through culturing system design, utilizing the specified fabricated components, does not significantly incorporate Mo into the system.

III. Methods

- Three flow through culturing systems (Fig. 1) were evaluated for use in following experiments:
  - a) Apparatus using a plastic culture tray[5];
  - b) Modified scheme utilizing a customized block of polytetrafluoroethylene (PTFE) instead[6]; and
  - c) Serial system of synthetic perfluoroalkoxy alkane (PFA) vials connected by PTFE tubing.
- Source seawater was filtered to 0.22 µm and spiked with molybdenum (≈280 nM). Samples were collected at variable intervals at the onset and then every 12 hours (Fig. 2).
- Subsequent experiments will utilize living benthic foraminifera to measure the uptake of Mo.

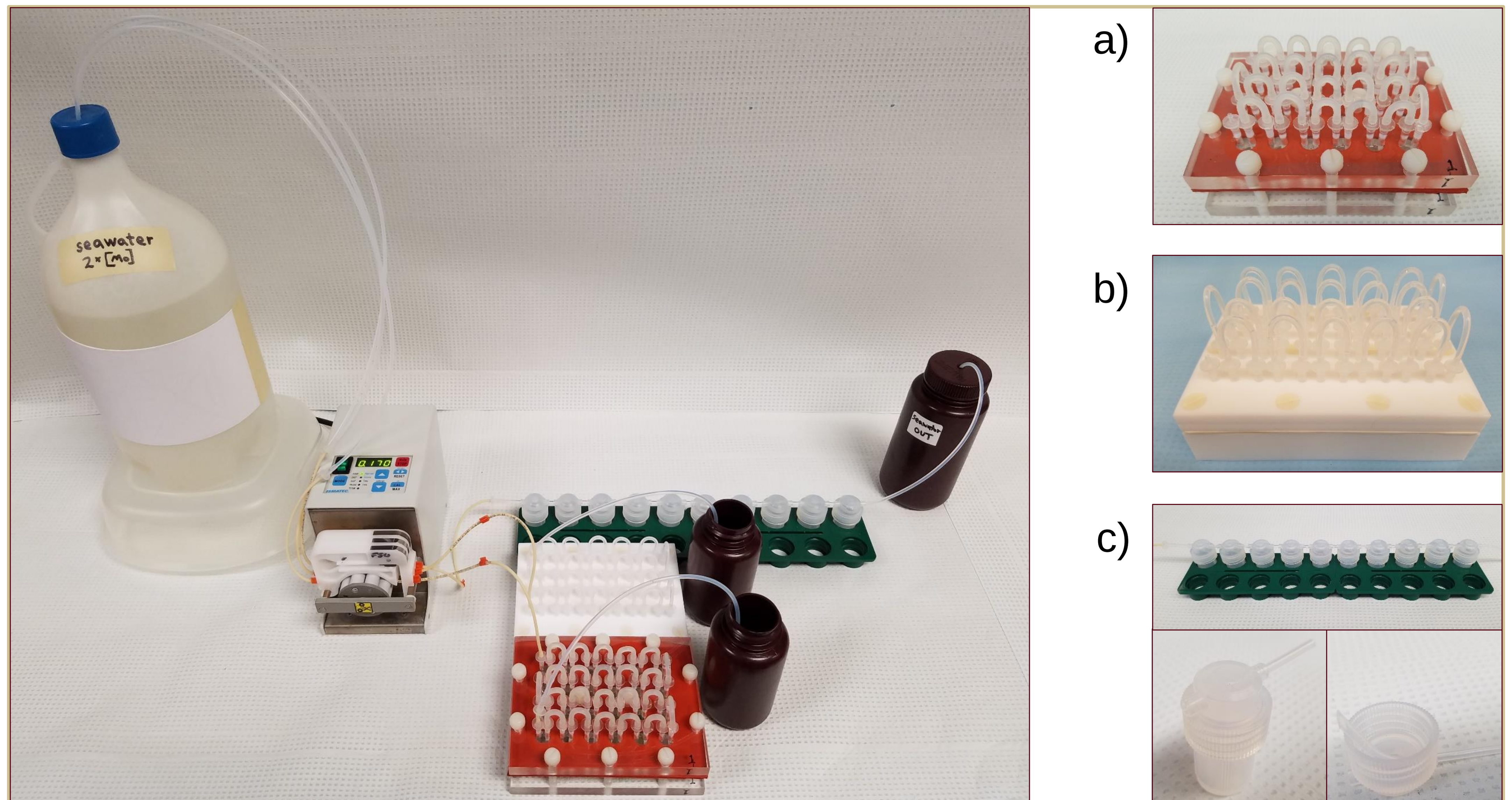


Figure 1. Configuration of components and culturing systems employing: a) plastic culture tray, b) PTFE block with wells, and c) PFA vials.

IV. Results and Discussion

- System A displayed a decline in [Mo] until hour 120 before returning to the source level.
- System B seemed to reach equilibrium at hour 24 or 60, but a few outliers were present.
- In contrast, system C reached equilibrium with the source seawater at hour 1 where no significant difference, $t(14) = 1.52$, $p = .15$, was reported in [Mo] from the source through the entire time period.
- Preliminary results suggest lower [Mo] variability when the pump pulls the seawater into the systems.

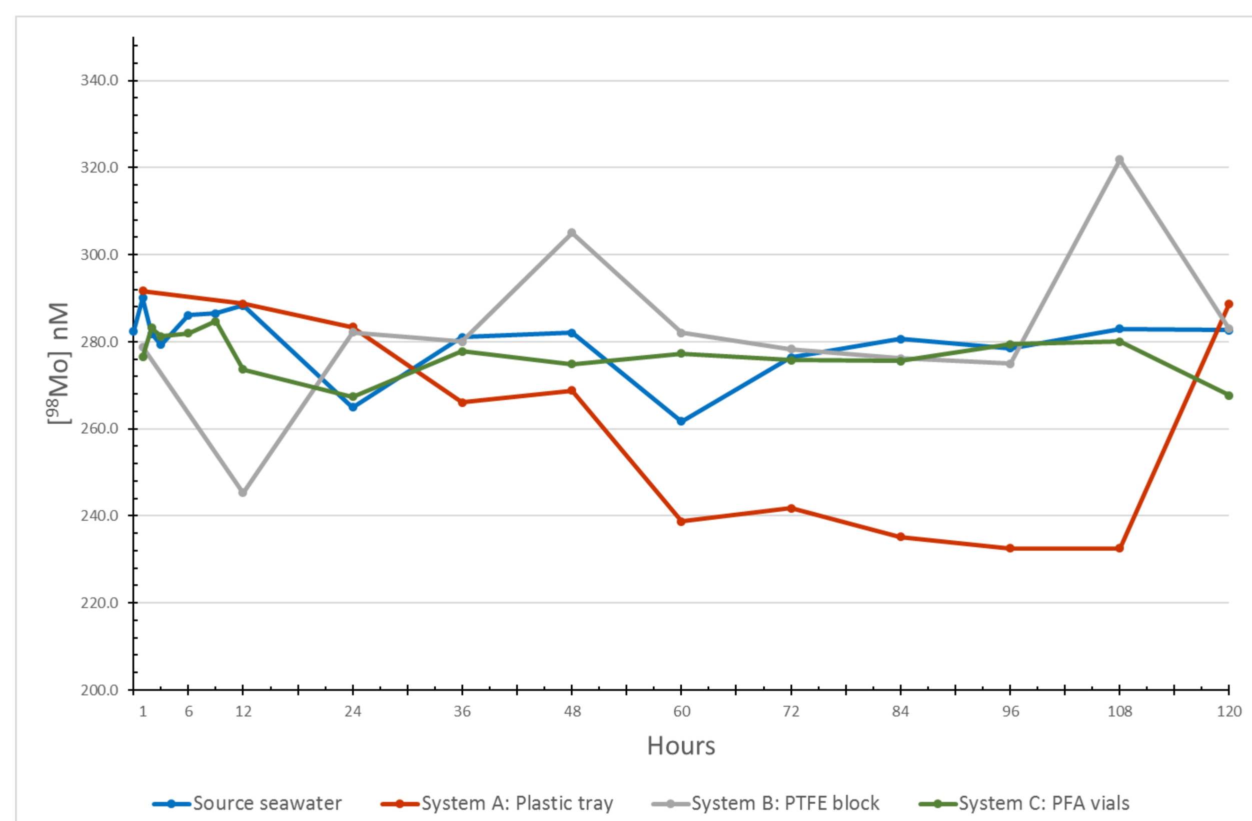
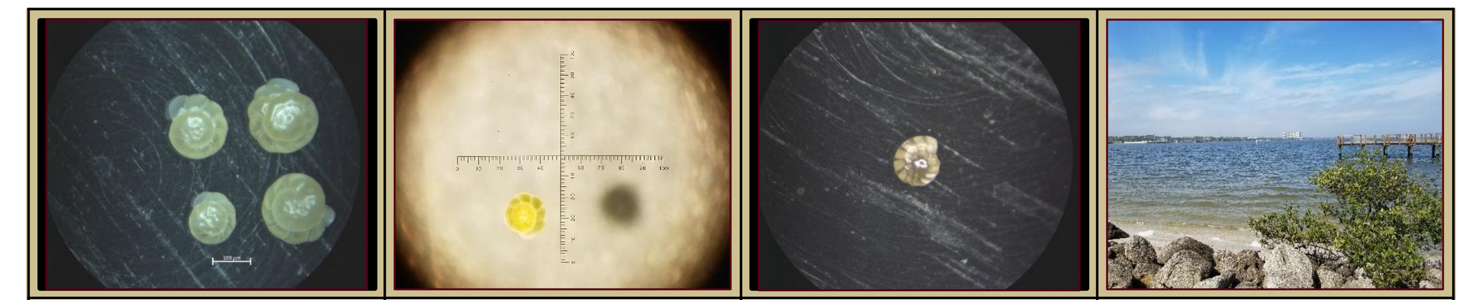


Figure 2. ^{98}Molybdenum concentration of seawater after flowing through each culturing system.

System C was chosen for the uptake experiments due to consistency, interchangeable parts, and configuration flexibility. These results advocate incorporating fluoropolymer products when conducting trials that culture calcifying organisms to study their incorporation of trace metals.



Ammonia tepida spiral side	***Ammonia tepida*** after consuming algae, *Dunaliella quartolecta*	***Ammonia* sp.** collected from the east coast of Florida near Daytona	**Sediment sampling site** Port Orange, FL

Figure 3. Benthic foraminifera.

V. Future Research

Foraminiferal culturing work:

- Collect and culture *Ammonia tepida*
- Analyze molybdenum (Mo) incorporation
- Investigate vanadium (V) incorporation
- Evaluate responses of other species

Paleoceanography analyses:

- Collect benthic foraminiferal fossils conspecific with or analogous to modern species
- Analyze concentrations of Mo, V, and similar redox-sensitive trace elements

VI. Acknowledgements

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VII. References

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