Evaluating the Adsorption of Dissolved Osmium and Rhenium onto Clay Minerals During Salinity Transitions.

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Introduction

Keywords:
- Dissolved Re-Os adsorption onto kaolinite
- Salinity transitions
- Re-Os marine behavior

Introduction:

Rhenium (Re) and Osmium (Os) have been used as geochemical tracers and have provided geoscientists with context for global changes in weather and climate throughout Earth's history [1, 2]. However, very little is known about these rare elements. A critical question is how the adsorption of dissolved Os and Re onto clay minerals changes during salinity transitions. This research investigates this adsorption process under four salinity conditions. These data could provide insight on Rhenium and Osmium's role in mineral weathering reactions that are related to the carbon cycle occurring on both long geologic and short human timescales.

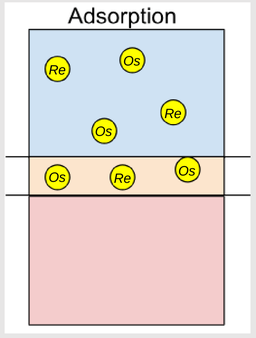
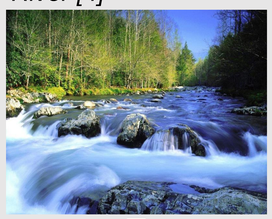


Fig 1) During adsorption, dissolved Os and Re bond with the surface of a mineral [3]. The degree of Re-Os adsorption is dependent on the salinity and pH of the solution.

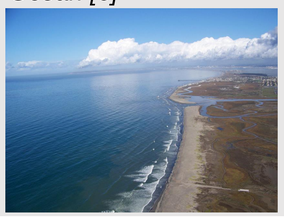
Fig 2) This project studies how osmium behaves between these different aqueous environments.

River [4]



Estuary [5]

Ocean [6]



Method

- A Re-Os bearing synthetic river water solution at a pH of 7.75 containing:
  - 0.8030g of kaolinite, 0.20 $\frac{mmol}{kg}$ of Os and 0.578 $\frac{mmol}{kg}$ of Re
  - pH was fixed using the buffer HEPES
- 6 samples were taken after each salinity transition at the following times:
  - 10 minutes, 1 hour, 4 hours, 8 hours, 24 hours, 72 hours
- Four different salinity conditions were tested and are listed below:
  - Synthetic river water at 0% salinity
  - Synthetic brackish water at 1% and 2 % salinity
  - Synthetic sea water at 3%salinity

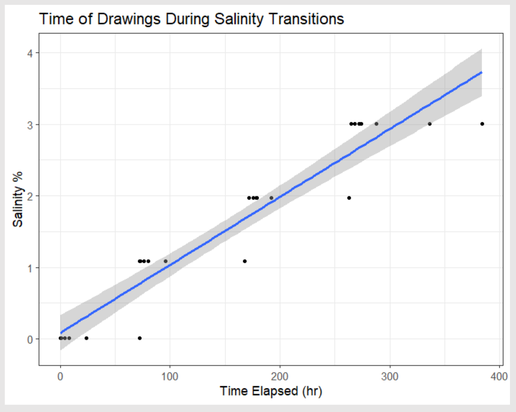


Fig 3) During the experiment, the salinity was changed four times, and six samples were taken at various times during each transition.

Data

Kaolinite's chemical structure is: $Al_2Si_2O_5(OH)_4$ [8]

Fig 4) The clay mineral kaolinite [7]. It is weathered on the crust and deposited into Earth's various aquatic systems [8].

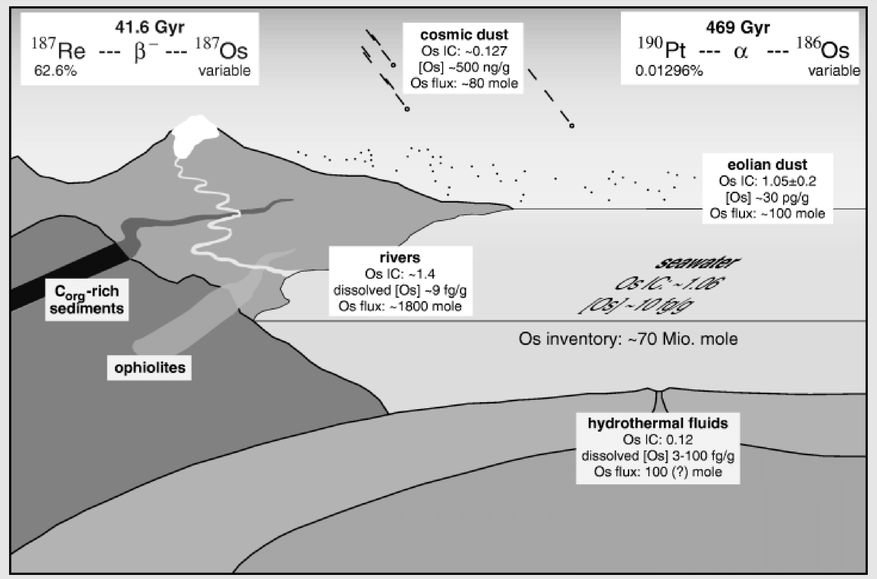


Fig 5) The marine osmium system. Re and Os behave differently during salinity transitions between varying aqueous environments [1].

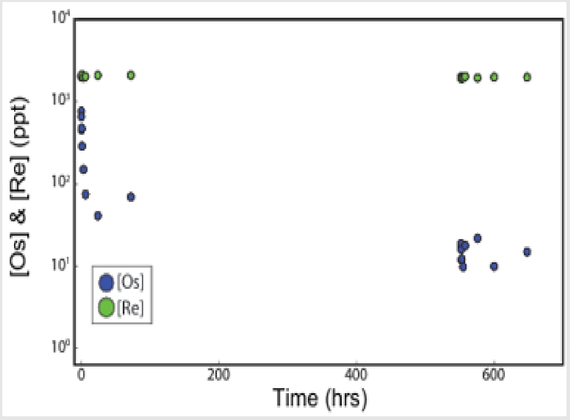


Fig 6) This experiment studied the adsorption of Re-Os by Fe-oxides in seawater. The results show that Os was effectively removed from the solution after the experiment, while Re was not reactive.

Conclusion and Implications

- This project will provide novel results regarding Re and Os behavior in various salt water conditions.
- Samples were taken and are currently awaiting analysis at Yale University
- This adsorption data will allow for a better understanding of the efficacy for Re-Os to be used as a geochemical tracer in a variety of aqueous environments.
- Ultimately, these data will allow for improved deciphering of mineral weathering reactions that relate to carbon cycling reactions

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