Introduction/ background

Near the end of the Cretaceous, a large perturbation to the global carbon cycle caused a carbon isotopes excursion (CIE) and biological crisis. This is thought to be related to expanded oceanic anoxia and a termed Oceanic Anoxic Event 2 (OAE-2). Using thallium isotopes, we can track any changes in the oxygen content of the oceans. In 2017, Ostrander et al. generated Tl isotope data across OAE-2 to determine if the oxygen content of the oceans changed. Although these data provide evidence ocean oxygenation associated with this event, there is little suggested that oceanic deoxygenation occurred prior to the CIE. The goal of this research is to provide a data provide evidence ocean oxygenation associated with this event, there is little context for well before or after OAE-2. The goal of this research is to provide a better understanding long term trends in oceanic (de)oxgenation during this greenhouse climate. Another goal of this research is to compare a natural analog context for well before or after OAE-2.

Thallium isotopes are used due to their rapid response to changes oxygen change, and its long residence time is longer than the ocean mixing time. Mn oxides burial requires all the inputs of thallium are around values of -2, suggesting that any change in seawater thallium is caused by the outputs. Mn oxides burial requires oxygen that is present in the water column taking $^{205}$Tl into the sediments. This leaves $^{203}$Tl in the water column. We can measure the thallium isotope composition of anoxic sediments to understand the global marine oxygen concentrations.

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Methods

- Crushing the samples using a mortar and pestle
- Weight out the samples to ~100mg
- Remove silicates and dissolve the sample
- Ion exchange column chemistry for purification of sample
- Mass spectrometer prior to the ICP-MS

Results

- Thallium isogenic ppm for conc.
- Takashima et al. (2006)
- Owens et al. (2017)

Discussion

- Ostrander's data are blue
- My data are red
- Samples to be analyzed in near future are along values of -6 as a black dash
- New data are consistent with Tl isotopes right before OAE-2
- The increase in $^{205}$Tl at a depth of 440 could indicate the Jukes Brown event
- More data will be run to fill in the gaps
- After the OAE-2, how long does it take for the values to return to the base line of -4.5? If these water are oxygenated, what is taking them so long?
- The values presented are lower than the modern value of -6. The baseline of -4.5 could be due to the greenhouse climate (compared to the modern), which we interpret to be related to temperature driven gas solubility.

Conclusion

- In the future, I will generate iron speciation to quantify local redox conditions.
- Previous work suggests a link between past ocean deoxygenation and extinction events which is important for predicting our modern ocean oxygenation and possible extinction.
- Previous episodes of ocean deoxygenation could be driven by a combination of volcanism/ temperature, weathering/ productivity, or a change in ocean circulation but we hypothesize long term (~ 10 Myr) first-order control of Cretaceous ocean oxygenation is controlled by temperature.
- With recent evidence of current deoxygenation in our oceans, it is imperative that we reduce greenhouse emissions and nutrient runoff/inputs to curve confounding effects.
- In the future theses data and the interpretations will be submitted for peer review.

Bibliography


Special thanks

This research would not have been possible without the support of the Mag Lab, Jose Sanchez, and the National Science Foundation supporting the Research Experience for Undergraduates.

This research was funded by DMR 1644779