Introduction

Coastal upwelling, caused by wind stress curl away from the coast of western North America, forces deep water up to replace the water that is being pushed away. As a result, deep water nutrients are made available to the marine life in the sunlit surface ocean, causing coastal upwelling zones to be the most productive regions in the world’s oceans. They are believed to contribute 30-50% of total marine plant life (Jahne, 1996) and about 80-90% of organic carbon burial (Sarmiento and Gruber, 2006), while underlying only 10% of the ocean surface. Upwelling in the Southern California Bight is not consistent year-round. Instead, it fluctuates with the seasons, reaching the highest velocities in late spring and lowest velocities in fall/winter. Our goal for this project is to measure the upwelling velocity with a geochemical tracer as it changes from its lowest anticipated velocity to its highest anticipated velocity.

Methods

Beryllium-7 is a radioactive isotope that is transported to the ocean in rain. Because it is introduced at the sea surface, it can be used as a tracer to measure the movement of water in the upper water column. In this study, a mass balance of Be input by rain, and vertical advection diluting the Be concentration in the mixed layer is used to estimate upwelling velocity. Be is extracted from seawater by a FeOH co-precipitation technique measure by gamma spectroscopy on a well-type Germanium iodide detector. A yield tracer of stable Be is added to each sample before precipitation, which can be measured by Microwave Plasma Optical Emission Spectroscopy (MP-OES). However, because there is interference between Fe and Be signals in optical emission, it is necessary to separate the Be and Fe using ion-exchange resin. The resin was put into 50mL centrifuge tubes, cleaned with 6 M HCl and prepared for sample loading with 0.4 Oxic Acid. The samples were then loaded in 0.4M Oxic Acid, which complexes the Be with the resin. The Fe was washed off and the resin was rinsed with DIW. Then the Be was released in 1 M HCl. After each step, the resin was centrifuged to separate from the overlying liquid. After separation, each sample was put into 5% Nitric Acid matrix for analysis by MP-OES.

Results

When the upwelling velocity is greatest, the concentration of PO₄ and Si is the lowest.

Conclusion

- From January 2013 to June 2013, we observed that the highest upwelling velocity occurred in April 2013.
- Wind speeds vary throughout the year and have an impact on upwelling velocity in the Southern California Bight.
- The similarity between Graph 3 and Graph 4 suggests that a similar mechanism in the ecosystem affects the concentration of both Si and PO₄.
- During high upwelling velocity, the low PO₄ and Si concentrations might be due to diatoms, a group of algae that is present during times of high upwelling velocity and consumes both PO₄ and Si, lowering the concentration of these two.

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