CHEMISTRY MASTER'S THESIS DEFENSE

Role of Anthropogenic Fly Ash in Ocean Fertilization and its Impact on Diatom Growth, *Cyclotella meneghiniana*

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Lopez 106

Diatoms play a pivotal role in Earth's biogeochemical cycles, serving as primary agents of carbon dioxide sequestration and foundational elements of aquatic food webs. Despite their significance, diatom proliferation is constrained by the scarcity of iron in vast oceanic regions, a critical component for their photosynthetic machinery. This study delves into the dynamics of ocean fertilization, a natural phenomenon where atmospheric deposition of iron-rich dust facilitates diatom growth. We further investigate the augmentation of iron solubility via titanium nanoparticles, highlighting a novel synergy between naturally occurring and anthropogenically synthesized iron sources in promoting diatom biomass.

However, our research also unveils a concerning interaction with anthropogenic fly ash, which, despite delivering iron, introduces a suite of deleterious heavy metals (Hg, Pb, As, Cd, Zn, Cr, and Cu) into aquatic systems. These contaminants were observed to precipitate a marked decline in populations of *Cyclotella meneghiniana*, underscoring the toxic threshold beyond which metal deposition negates the benefits of iron fertilization. Intriguingly, disparities in diatom populations between marine and freshwater environments were attributed to phosphorus limitations in artificial seawater (ASW), predisposing smaller diatom species to heightened sensitivity to metal toxicity.

Our findings illuminate the delicate balance between nutrient augmentation and metal pollution in aquatic ecosystems, providing critical insights into the mechanisms that govern diatom distribution and abundance. The study underscores the need for cautious evaluation of geoengineering strategies like artificial ocean fertilization and highlights the broader ecological consequences of airborne pollutants on marine primary producers.