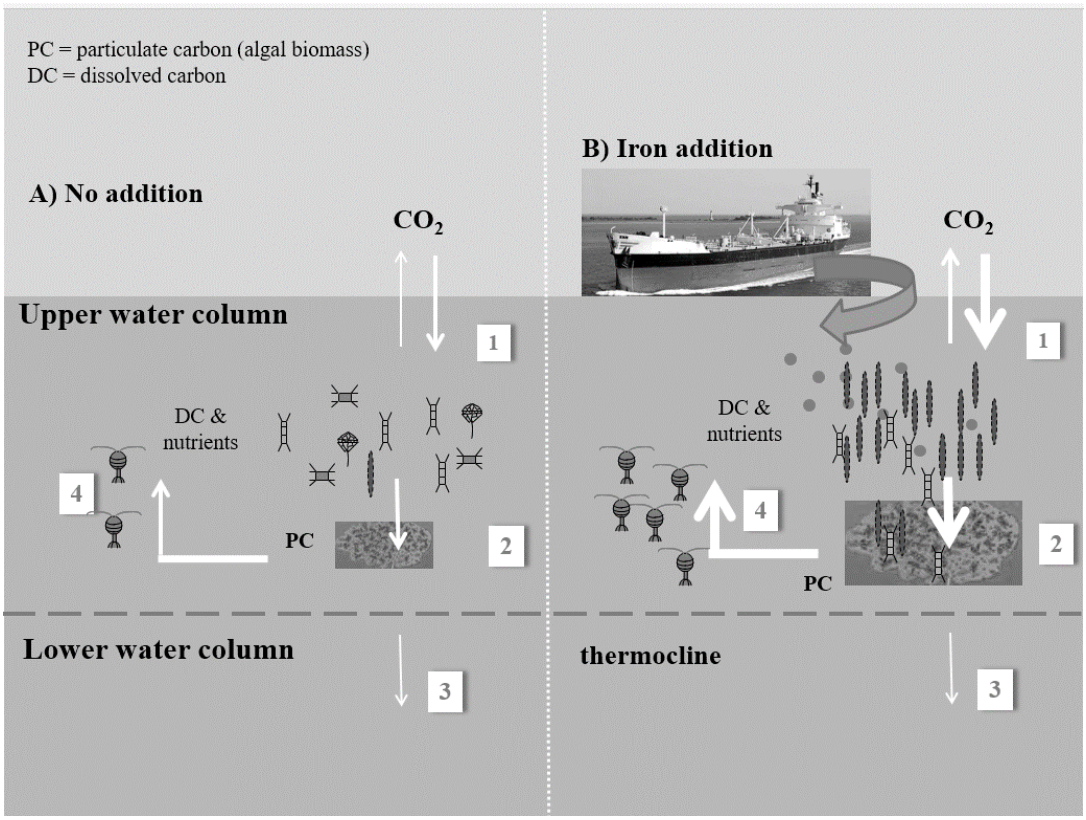
Iron Fertilization Experiment

NAME_____

Background: The iron fertilization hypothesis relies on the principles of the biological carbon pump where increased nutrients (i.e. iron) lead to higher algal productivity and export of carbon to deeper, colder water below the thermocline. The exported carbon is remineralized at depths and eventually transported back to the surface (over ~100s of years) as dissolved carbon (DC) and nutrients which then become again available to primary producers. This diagram illustrates changes in the magnitude of carbon flux (white arrows) at a control site (A) compared to an iron fertilization experimental site (B).



1. **Assign** the processes to the correct number

Remineralization of algal biomass via zooplankton grazing and bacterial decomposition ____4_____

Carbon being fixed as algal biomass (Particulate Carbon = PC) ____2_____

Sinking of PC to depth _____3_____

Carbon exchange with atmosphere _____1_____

2. **Examine** relative changes in the magnitude of carbon flux, indicated by the thickness of the white arrows, within parts of the water column between the control (A) and experimental (B) site. Briefly describe where in the water column most of the carbon is recycled and what the major changes (if any) are in carbon flux in response to the iron addition. Compare all processes (i.e., all 4 major fluxes indicated by the white arrows).

B site compared to A site:

1. carbon sequestration (drawdown from the atmosphere) is enhanced
2. more C is incorporated into algal biomass (more PC)
3. more PC is available for zooplankton consumption and is remineralized in the upper water column – remineralization and turnover of PC is stimulated
4. carbon export into the deeper water (below the thermocline) is seemingly unchanged

3. Was this iron fertilization experiment successful? Was iron fertilization efficient in leading to carbon drawdown from surface to deep water? Describe the evidence that supports your conclusion.

The outcome of this experiment shows that iron fertilization is not an efficient strategy for long-term removal of CO2 from the atmosphere. The biological feedback within the food web in the upper layer is strong and the additional PC material (algal biomass) simply turned over faster. Export flux to the deep is unchanged at site B compared to the control site A – hence, carbon is not removed for longer periods of time.

4. How do the **algal communities** compare at sites A and B in regard to overall abundance and algal diversity? How did algal diversity change due to iron addition and how does that affect marine food webs?

At the B site the phytoplankton increase in number but one group/species (type of algae) takes over the entire community and dominates under the iron-enriched scenario. Diversity is decreased and this may ultimately lead to trophic cascades within the food web where upper level consumers cannot be supported sufficiently by the altered prey availability.