Closing the Ocean Carbon Cycle

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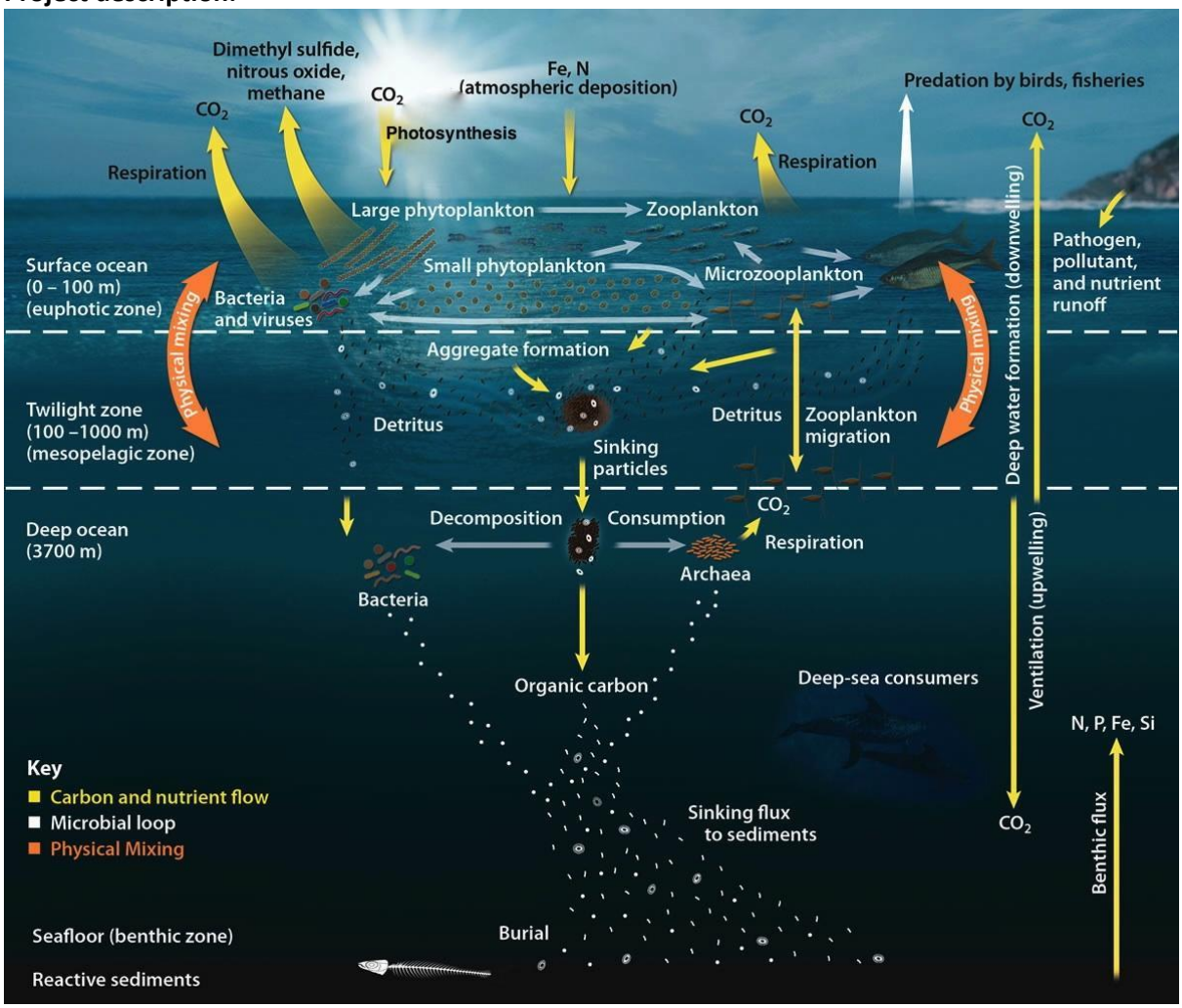
Project description:



The Ocean Carbon Cycle. Image credit: Oak Ridge National Laboratory

The ocean and sea floor stores phenomenal amounts of carbon (more than 10x that in the atmosphere) and changes in the oceanic carbon cycle has important impacts on past and future change. Carbon is stored in the ocean in a number of different forms, and eventually sinks to the bottom where a fraction will be buried into sediments. Buried organic carbon may form hydrates and in the longer term forms oil deposits.

We know that the ocean carbon cycle has changed in the past. The carbon cycle is also intrinsically linked to other biogeochemical cycles and that there have been dramatic changes in the oceanic carbon cycle during past time periods (e.g. about 90 million years ago there was a so called “oceanic anoxic event” in which the deep ocean became depleted in oxygen resulting the formation of

organic rich sediments). We need to be able to quantitatively understand all of these changes to the carbon cycle.

Earth system models of intermediate complexity (e.g. GENIE) now incorporate a relatively detailed ocean carbon cycle, including the burial of organic matter. However, these models are often relatively coarse resolution. More detailed models, such as the Hadley centre climate model HadCM3 and FAMOUS, use higher spatial resolution but have a cruder representation of the oceanic carbon cycle which typically do not include the formation of sediments. Thus these models do not physically conserve carbon.

The project will "close the carbon cycle" in HadCM3/FAMOUS model and then use this model to investigate major changes of this cycle in the past. The model development work will involve adapting aspects of the biogeochemical model of GENIE (specifically the carbonate and sediment modules) and incorporating these into the model complex model. The work may also develop a transport matrix method to speed up the use of tracers within the model.

Once completed, the model will have great potential for investigating numerous aspects of the past (and future) carbon cycle. The applications will focus on the feedbacks between the ocean circulation and carbon cycle, and will have a particular focus on understanding the controls on organic rich sediment formation and preservation. This latter work will be in collaboration with oil companies and the project may be CASE.

Example of carbon cycle work with the GENIE model can be found here.