The Oceans As Carbon Dioxide Sinks Increasing Our Understanding

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German and British scientists have studied the ocean off south-western Africa and have discovered that particles are transported to the deep ocean over thousands of years before being deposited on the seabed. This discovery may increase our understanding of how the oceans act as carbon dioxide sinks and how oil deposits form.

Areas of extremely high marine productivity are confined to small sections of modern continental margins. Despite their limited size, these areas are considered to be important sinks of atmospheric carbon dioxide, arguably with relevance for global climate.

The most productive coastal upwelling area of the modern ocean is the Benguela upwelling system off south-western Africa, an area that is considered to represent an important modern analogue of petroleum source rocks deposited in the geological past. Off south-western Africa, upwelling of cold nutrient-rich waters along the coast causes extraordinary strong growth of plankton, which binds carbon in their biomass.

When remnants of dead plankton sink to the sea floor, organic matter from their biomass is buried, as manifested by sediments exceptionally enriched in organic carbon. This process is capable to sequester huge amounts of carbon dioxide from the atmosphere over longer time scales. It is commonly thought that the distribution of such carbon-rich sediments directly links to surface water productivity through settling of particles vertical through the water column.

In the current issue of Geology, (Volume 34 Issue 3), Inthorn and his co-workers from the Research Center Ocean Margins in Bremen, the University of Newcastle, and the BGR Hannover report unprecedented process observations from the Benguela, where they collected surface sediments and fine particles floating in cloudy water layers above the sea floor.

In determining the sedimentological and geochemical composition as well as the age of the samples, they show that organic particles in cloudy water layers drift over large distances from near shore to deeper waters on the continental slope, where they get finally buried at water depths of 400 to 1500 meters. The age of organic matter reveals that this seaward journey can take up to a few thousand years.

This journey also effectively displaces the area of final burial of organic matter (and thus former atmospheric carbon dioxide) from their place of production. These results place general questions on widely acknowledged vertical particle flux models, which apparently do not fully explain the relationship between primary production and organic carbon burial in high productive areas.

The broader implications of this study suggest that carbon budgets of the deep ocean in the past and thus climate relationships may have been much stronger affected by these processes near the sea floor than previously thought. Inthorn contemplates that enhanced and widespread downslope transport of organic carbon in cloudy water layers may have been much more vigorous at times when sea level was fluctuating and lower than today.