Earth's Carbon Cycle

Long-term Measurements of Oceanic Carbon

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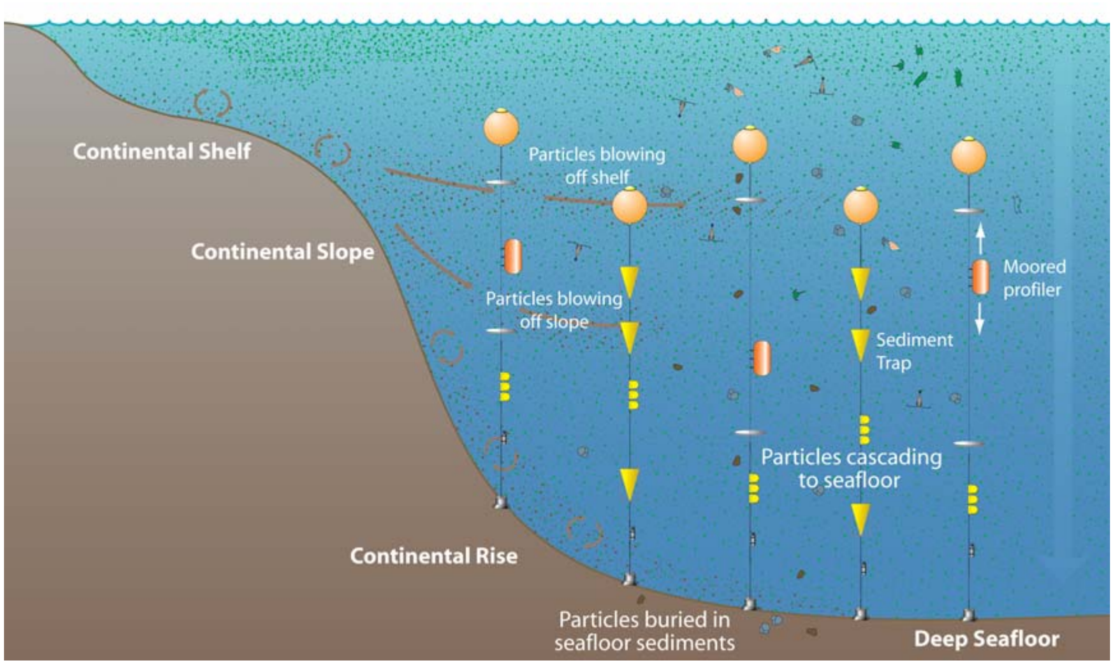
Carbon is the building block of life on Earth. In the form of carbon dioxide gas in the atmosphere, it has a powerful impact on the planet's climate. Carbon also travels around the world and through the oceans – in a complex cycle that, until recently, Earth has kept in balance. Human activity since the Industrial Revolution has interfered with the carbon cycle. We have effectively transferred carbon from pools in which it cycles slowly, such as sedimentary rocks, to actively cycling pools, such as the air and ocean. In a relatively short time, we have extracted large amounts of hydrocarbons from the earth, burned them for fuel, and put an excess of heat-trapping carbon dioxide into the atmosphere.

A crucial question in the global warming debate is, "Can the oceans ramp up correspondingly to absorb this excess carbon dioxide?" The answer will come from addressing key questions about the carbon cycle in the ocean: How much carbon in surface waters is recycled by marine organisms or exchanged back into the atmosphere? How much gets buried on shallow continental margins or exported to the deep ocean? What controls these dynamic processes?

To address these questions, we have launched a project to measure and analyze carbon in the North Atlantic. With support from the Comer-funded program at WHOI, we have augmented a novel long-term mooring system with instruments that trap and measure carbon-containing particles. These instruments, called "sediment traps," are positioned to intercept particles raining down from overlying surface water in currents such as the Gulf Stream; particles being laterally transported eastward off the continental shelf, down the continental slope, and along the seafloor; as well as particles carried southward by the Deep Western Boundary Current (see figure). With these data collected in the sediment traps, we will be able to analyze the chemistry of the material to determine its composition and age, revealing from where the carbon came and when. Our study is demonstrating that carbon charts surprising pathways through the ocean and, with that, we are shedding new light on Earth's carbon cycle and its role in the planet's changing climate.



Eglinton and colleagues deployed moorings equipped with optical sensors and sediment traps that can reveal "clouds" of carbon-containing particles "blowing" laterally from the continental shelf, down the slope, and out into the deep ocean. Analyzing the contents of these sediment traps provides information about the age and origin of carbon that is transported to the ocean, enhancing our understanding of the carbon cycle and the ocean's ability to absorb excess carbon.

[Left] Illustration of particle transport into the deep ocean.

[Right] Recovery of a sediment trap from a 2000-meter mooring in June 2007 (aboard the R/V *Endeavor*). Carbon-laden sediment is clearly visible in the white plastic tubes below the yellow cone. (Note the darker zones at the bottom of the tubes.) Each tube holds a 2-week accumulation of sinking particles. The different levels of material visible in the tubes reflect the time-variability in particle movement throughout the year-long deployment.