The critical importance of mangroves to ocean life

Another case of beneficial isotopic research

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Mangroves, the backbone of the tropical ocean coastlines, are far more important to the global ocean's biosphere than previously thought. And while the foul-smelling muddy forests may not have the scientific allure of tropical reefs or rain forests, a team of researchers has noted that the woody coastline-dwelling plants provide more than 10 percent of essential dissolved organic carbon that is supplied to the global ocean from land, according to a report to be published in Global Biogeochemical Cycles, a publication of the American Geophysical Union.

Thorsten Dittmar at Florida State University in Tallahassee reports that mangrove plants, whose finger-like roots are known to protect coastal wetlands against the ocean and as important fish habitats, cover less than 0.1 percent of the global land surface yet account for a tenth of the dissolved organic carbon (DOC) that flows from land to the ocean. Dittmar and his colleagues at several German research institutions analyzed the carbon output from a large mangrove forest in Brazil and suggest that the plants are one of the main sources of dissolved organic matter in the ocean.

The researchers note that the organic matter that is dissolved in the world oceans contains a similar amount of carbon as is stored in the skies as atmospheric carbon dioxide, an important greenhouse gas. Dissolved organic matter is an important player in the global carbon cycle that regulates atmospheric carbon dioxide and climate.

"To understand global biogeochemical cycles it is crucial to quantify the sources of marine dissolved organic carbon," Dittmar writes. "Here we show that mangroves play an unexpected role in the global carbon cycle."

Dittmar reports that the mangrove root system slows carbon-rich leaf litter running from continental land and allows it to settle into shallow sediment, where dissolved organic matter is leached in large quantities into the coastal waters. The daily rise and fall of the tides then flushes the dissolved carbon into the open ocean (like a teabag being dipped in an out a cup). Once in the ocean, however, the intense tropical sunlight destroys some of the most delicate dissolved organic carbon molecules. But more than half of the dissolved organic matter survives the attack from sunlight or bacteria.

The authors measured the chemical signature in water samples from the massive mangrove forest in northern Brazil, **using natural carbon isotopes and nuclear magnetic resonance spectroscopy**--an established and common technique for determining the structure of organic compounds--to determine that mangroves are indeed a main source of dissolved organic carbon in the open ocean. In total, they concluded that the carbon exported from mangroves is approximately 2.2 trillion moles of carbon per year [2.2 x 10(12), similar to the annual Amazon River discharge], nearly triple the amount estimated from previous smaller-scale estimates of the carbon released into the ocean.

Mangrove foliage, however, has declined by nearly half over the past several decades because of increasing coastal development and damage to its habitat. As the habitat has changed, ever-smaller quantities of mangrove-derived detritus are available for formation and export of dissolved organic matter to the ocean. The researchers

speculate that the rapid decline in mangrove extent threatens the delicate balance and may eventually shut off the important link between the land and ocean, with potential consequences for atmospheric composition and climate.