Resilient Form of Plant Carbon Gives New Meaning to Term 'Older than Dirt'

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A particularly resilient type of carbon from the first plants to regrow after the last ice age – and that same type of carbon from all the plants since – appears to have been accumulating for 11,000 years in the forests of British Columbia, Canada. It's as if the carbon, which comes from the waxy material plants generate to protect their foliage from sun and weather, has been going into a bank account where only deposits are being made and virtually no withdrawals.

Modelers of the Earth's carbon cycle, who've worked on the assumption that this type of carbon remains in the soils only 1,000 to 10,000 years before microorganisms return it to the atmosphere as carbon dioxide, will need to revise their thinking if findings reported in the Nov. 24 issue of *Science* are typical of other northern forests.

"Our results about the resilience of this particular kind of carbon suggest that the turnover time of this carbon pool may be 10,000 to 100,000 years," says Rienk Smittenberg, a research associate with the University of Washington School of Oceanography and lead author of the paper. He did the work while at the Royal Netherlands Institute of Sea Research.

Soils harbor the third-largest pool of carbon in the world behind the carbon locked deep in the Earth as fossil fuel oils and coal and the carbon that is dissolved in the world's oceans.

In soils, the more edible kinds of carbon from plants are quickly digested by bacteria and turned back into carbon dioxide. But about half the

organic carbon in soils is less edible or protected from the bacteria, making it ultimately responsible for long-term carbon storage on land, the authors say.

This carbon pool is not likely to have a role in offsetting increased greenhouse carbon dioxide in the atmosphere any time soon because of the very slow processes at work, Smittenberg says. Instead a better estimate of how long that carbon persists in soils is important for modelers interested in carbon reserves on a timescale of 1,000 years or who are interested in changing carbon storage on land through time as vegetation changes.

For this work, the researchers obtained sediment cores from Saanich Inlet, a fjord on Vancouver Island in British Columbia. There low-temperature oxygen-starved bottom waters help preserve annual layers of sediments, some no less than a half-inch thick, that include matter from forest soils carried by water into the inlet.

Smittenberg used organic chemistry to isolate the plant wax molecules from other kinds of carbon, such as that derived from marine algae. Co-author Tim Eglinton of Woods Hole Oceanographic Institution did the radiocarbon testing.

Today's soils are comprised of a mix of organic matter that is 11,000 years old, zero years old from today's input and every age in between, Smittenberg says. The average age of the resilient waxy carbon is 5,500 years right now.

"It is likely that at least some of the resilient carbon has disappeared from the soils," he says. "It wouldn't be possible, for instance, to measure any in the fjord sediments if some of it hadn't eroded away," he says. "But this loss is relatively small compared to what is staying in the soils and the addition of more resilient organic matter.

“Thus the system is far from equilibrium as current models assume,” he says.

If the findings hold true in other northern forests, it would put the terrestrial biosphere in a more prominent position as a slow but progressively important atmospheric carbon sink on geologic time scales. It could even influence current predictions about carbon cycling and soil carbon storage in response to increasing amounts of carbon dioxide in the atmosphere, the co-authors conclude.

Other co-authors are Stefan Schouten and Jaap Sinninghe Damsté of the Royal Netherlands Institute of Sea Research.

Source: University of Washington