Global warming could accelerate from thawing Siberian permafrost

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Permafrost soil blanketing northeastern Siberia contains about 75 times more carbon than is released by burning fossil fuels each year. That means it could become a potent, likely unstoppable contributor to global climate change if it continues to thaw. So conclude three scientists in a paper set to appear Friday in the journal *Science*.

"Unfortunately, it's another large pool of carbon on the list that could move into the atmosphere with continued warming," said co-author Ted Schuur, an assistant professor of ecology in the University of Florida botany department. "You start thawing the permafrost, microbes release carbon dioxide, that makes things warmer, more permafrost thaws and the process continues."

The permafrost soil, which covers nearly 400,000 square miles of northeast Siberia and averages 82 feet in depth, contains about 500 billion metric tons of carbon, the scientists concluded. Cars, power plants and other fossil fuel consumers release at least 6 billion metric tons annually. If all the Siberian permafrost thawed, decomposed and released its carbon in the form of heat-trapping carbon dioxide, it could nearly double the 730 billion metric tons of carbon in the atmosphere presently — an outcome that would have huge warming impact.

Scientists have long known that permafrost, short for permanently frozen earth, contains carbon. But this latest research is the first to examine in detail the huge swath of permafrost soil blanketing northeast Siberia.

That soil is composed of layer upon layer of frozen windblown dust called loess. This dust fell from the air and accumulated as glaciers advanced and retreated over hundreds of thousands of years during the last ice ages

There are other similar regions around the world, including the Midwestern United States, that have loess soils. But what sets Siberia apart is that the dust is frozen in the permafrost, which trapped layer upon layer of roots and other organic matter that never decomposed. The authors showed that bacteria and fungi can eat this ancient carbon and release it as carbon dioxide to the atmosphere as soon as the soil thaws.

In a typical year in Siberia, plants and the surface soil thaw and become active in the summer, then refreeze in the winter. In ancient Siberia, as the dust accumulated, the deepest layer of previously thawed soil remained frozen in the summer. That's because that year's layer of dust effectively insulated the deepest soil.

"Every year, plants were growing new roots down into the soil, and then the new dust fell, and some deeper roots didn't thaw out again – they become permanently frozen, and the process was repeated for thousands of years as this deep loess soil accumulated," Schuur said, adding that preserved grass roots are readily visible in the ancient frozen soil.

In warmer regions, the usual process is for plants to die, decompose and return their carbon content to the atmosphere as carbon dioxide. When spring comes, new plant growth takes up this carbon dioxide by photosynthesis, producing oxygen. The process repeats itself, with the amount of carbon consumed roughly proportional to the amount of carbon produced.

Although this occurs in Siberia with the plants and surface soil, the result of the deepest organic matter staying frozen was a huge build-up of undecomposed, carbon-rich soil. This soil contains anywhere from 2 to 5 percent carbon –10 to 30 times more carbon than generally found in most deep mineral soils, according to the Science paper.

Equally significant, this soil appears to shed its carbon relatively quickly when thawed. Schuur collected loess samples and brought them to Florida from Siberia in their frozen state. In laboratory tests, he found that they produced carbon dioxide at rates roughly comparable to productive northern grassland soils as they thawed. Using carbon dating techniques, he also confirmed that the carbon dioxide was "old carbon" dating back tens of thousands of years.

Today, most loess remains frozen, but it is known to be thawing. Depending on how much thaws, the result could well be a rapid release of ancient carbon dioxide. "If these rates are sustained in the long term, as field observations suggest, then most carbon in recently thawed (loess) will be released within a century – a striking contrast to the preservation of carbon for tens of thousands of years when frozen in permafrost," the Science paper says.

Schuur said the authors also found that thawing permafrost could have contributed to changing atmospheric carbon dioxide concentrations during past warming and cooling events in the earth's history.

Source: by Aaron Hoover, University of Florida provided for information purposes only.