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The Arctic is full of toxic mercury, and climate change is going to release it

By **Chris Mooney** February 5

We already knew that thawing Arctic permafrost would release powerful greenhouse gases. On Monday, scientists revealed it could also release massive amounts of mercury — a potent neurotoxin and serious threat to human health.

Permafrost, the Arctic's frozen soil, acts as a massive ice trap that keeps carbon stuck in the ground and out of the atmosphere — where, if released as carbon dioxide, the greenhouse gas would drive global warming. But as humans warm the climate, they risk thawing that permafrost and releasing that carbon, with microbial organisms becoming more active and breaking down the ancient plant life that had previously been preserved in the frozen earth. That would further worsen global warming, further thawing the Arctic — and so on.

That cycle would be scary enough, but U.S. government scientists on Monday revealed that the permafrost also contains large volumes of mercury, a toxic element humans have already been pumping into the air by burning coal.

There are 32 million gallons worth of mercury, or the equivalent of 50

Olympic swimming pools, trapped in the permafrost, the scientists wrote in a study published in the journal Geophysical Research Letters. For context, that's "twice as much mercury as the rest of all soils, the atmosphere, and ocean combined," they wrote.

"As permafrost thaws in the future, some portion of this mercury will get released into the environment, with unknown impact to people and our food supplies," said Kevin Schaefer, a scientist with the National Snow and Ice Data Center in Boulder, Colo., and a co-author of the study. The research was led by Paul Schuster, a scientist with the U.S. Geological Survey, and was co-authored by 16 other federal, university-based and independent researchers.

The scientists performed the research by taking cores from permafrost across Alaska. They measured mercury levels and then extrapolated to calculate how much mercury there is in permafrost across the globe, where it covers large portions of Canada, Russia and other northern countries.

"We figure that this represents the buildup of mercury during and since the last Ice Age," Schaefer said.

Mercury, a naturally occurring element, binds with living matter across the planet — but the Arctic is special. Normally, as plants die and decay, they decompose and mercury is released back to the atmosphere. But in the Arctic, plants often do not fully decompose. Instead, their roots are frozen and then become buried by layers of soil. This suspends mercury within the plants, where it can be remobilized again if permafrost thaws.

How much would be released depends on how much the permafrost thaws — which in turn depends on the volume of greenhouse-gas emissions and subsequent warming of the planet. But permafrost thaw has begun in some places and scientists project that it will continue over the course of the century. The study says that with current emissions levels through 2100, permafrost could shrink by between 30 and 99 percent.

The question then becomes where this mercury will go, and what it will do —

and the scientists say they aren't sure of that. It could flush out through rivers into the Arctic Ocean. Or it could enter the atmosphere. Or both. That remains to be determined.

The problem is that mercury, although naturally occurring, is damaging to humans and wildlife, especially in certain forms. We're already causing buried mercury to enter the atmosphere by burning coal, which lofts the element into the atmosphere, where it travels long distances. When it rains out into the ocean or lakes, it enters the food chain, first accumulating in the bodies of microorganisms and then growing increasingly concentrated in predators that feed off smaller organisms — for instance, larger fish.

When humans consume mercury-laden fish in quantities too large, it can be dangerous — especially for pregnant mothers.


In the Arctic, mercury can also accumulate in the bodies of major mammal predators, such as polar bears or narwhal, a phenomenon that has been documented. If the Arctic mercury burden further increases, it could be yet another way that climate change takes a toll on the native communities living there.

“We expect a bunch of it to be released, but we don't know exactly how much, and when, and where it will be released,” Schaefer said.

Sue Natali, a permafrost expert at the Massachusetts-based Woods Hole Research Center who was not involved in the study, said in a statement: “The results of this study are concerning because what we're learning is that not only is permafrost a massive storage for carbon that will feedback on global climate, but permafrost also stores a globally significant pool of mercury, which is at risk of being released into the environment when permafrost thaws. This is especially concerning, given the predominance of wetland ecosystems in the Arctic — these wetland and aquatic ecosystems are areas where mercury is converted into a form that is taken up into the food web, placing humans and wildlife at risk.”

“But the magnitude of this risk is as yet unknown,” Natali continued. “The best option for managing these permafrost-related risks is to keep the permafrost — and the carbon and mercury contained in permafrost — frozen, through immediate reduction of fossil fuel emissions.”

 **51 Comments**

Chris Mooney covers climate change, energy, and the environment. He has reported from the 2015 Paris climate negotiations, the Northwest Passage, and the Greenland ice sheet, among other locations, and has written four books about science, politics, and climate change.  Follow @chriscmooney

