Thawing microbes could control the climate

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As the Arctic permafrost melts over the coming decades, long-frozen microorganisms will thaw out and start feasting on the soil. The first have already begun to wake up – and early signs are that they will have a major impact on how Earth's climate changes.

As the Arctic permafrost thaws, runaway global warming may ensue, because the huge amounts of organic carbon the permafrost contains will escape into the atmosphere.

To find out how the permafrost's microorganisms will respond to a thaw, Janet Jansson of the Lawrence Berkeley National Laboratory in Berkeley, California, and colleagues collected three cores from permafrost soil in central Alaska. Back in the lab, they thawed samples of each core and kept them at 5 °C. For the first two days the melting ice released lots of methane that had been trapped when it formed, but the rate then quickly dropped.

That's because soil microorganisms thawed out, and although some began making methane that added to the emissions, others consumed it and converted it into carbon dioxide instead. "It's a very rapid response," Jansson says. Her team took samples of DNA from the permafrost as it warmed up, allowing them to track how the microbial population changed.

Many studies have examined the gases that escape from thawing permafrost, but we knew little about how the microbes within influence the process, says Torben Christensen of Lund University in Sweden. The permafrost ecosystem is almost entirely unexplored. "Most of the microorganisms in permafrost have never been cultivated, and more than 90 per cent are unidentified," Jansson says.

Chilly microbes

Methane is a stronger greenhouse gas than CO_2, although it does not stay in the atmosphere as

long. Jansson says a release of CO_2 is still bad news, but preferable to methane.

It's long been known that methane-munching microorganisms will get to work in thawing permafrost, Christensen says. "At least 50 per cent of the gross production of methane will be oxidised." In other words, consumed.

The question is, will the methane-eaters be able to consume the bulk of the gas once the permafrost starts melting in a big way? Christensen says that will depend on what happens to the water table. Higher water tables mean more methane and fewer microorganisms to eat it, while lower water tables mean the opposite.

No laughing matter

Also adding to our worries are indications that thawing permafrost may release large quantities of nitrous oxide – aka laughing gas – which is an even more powerful greenhouse gas than methane, and damages the ozone layer into the bargain.

As the team's permafrost samples thawed they saw no boost in the levels of microbes that produce nitrous oxide reductase, an enzyme that converts nitrous oxide into harmless nitrogen. Without this boost, the nitrous oxide could escape.

Christensen has set up a monitoring system to track greenhouse gas emissions from thawing permafrost, and is increasingly tracking nitrous oxide as well as CO_2 and methane. "It may be a player," he says.

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