20 May 2012 Last updated at 16:54 GMT

Arctic melt releasing ancient methane

By Richard Black Environment correspondent, BBC News

Many of the sites were bubbling methane that has been stored for millennia

Scientists have identified thousands of sites in the Arctic where methane that has been stored for many millennia is bubbling into the atmosphere.

The methane has been trapped by ice, but is able to escape as the ice melts.

Writing in the journal Nature Geoscience, the researchers say this ancient gas could have a significant impact on climate change.

Methane is the second most important greenhouse gas after CO2 and levels are rising after a few years of stability.

There are many sources of the gas around the world, some natural and some man-made, such as landfill waste disposal sites and farm animals.

Tracking methane to these various sources is not easy.

But the researchers on the new Arctic project, led by Katey Walter Anthony from the University of Alaska at Fairbanks (UAF), were able to identify long-stored gas by the ratio of

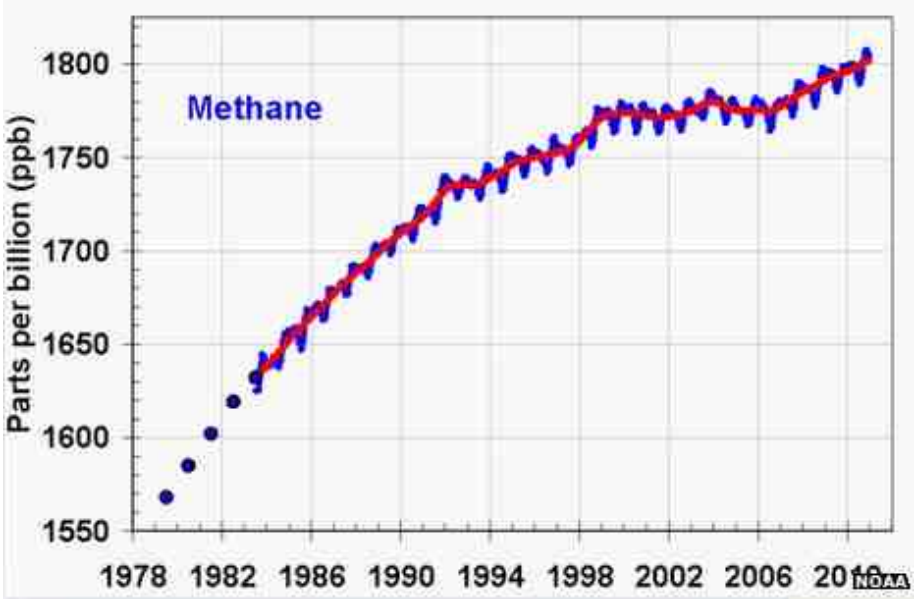
different isotopes of carbon in the methane molecules.

Using aerial and ground-based surveys, the team identified about 150,000 methane seeps in Alaska and Greenland in lakes along the margins of ice cover.

Local sampling showed that some of these are releasing the ancient methane, perhaps from natural gas or coal deposits underneath the lakes, whereas others are emitting much younger gas, presumably formed through decay of plant material in the lakes.

"We observed most of these cryosphere-cap seeps in lakes along the boundaries of permafrost thaw and in moraines and fjords of retreating glaciers," they write, emphasising the point that warming in the Arctic is releasing this long-stored carbon.

"If this relationship holds true for other regions where sedimentary basins are at present capped by permafrost, glaciers and ice sheets, such as northern West Siberia, rich in natural gas and partially underlain by thin permafrost predicted to degrade substantially by 2100, a very strong increase in methane carbon cycling will result, with potential implications for climate warming feedbacks."



Atmospheric methane concentration is rising again after a plateau of a few years

Quantifying methane release across the Arctic is an active area of research, with several countries despatching missions to monitor sites on land and sea.

The region stores vast quantities of the gas in different places - in and under permafrost on land, on and under the sea bed, and - as evidenced by the latest research - in geological reservoirs.

"The Arctic is the fastest warming region on the planet, and has many methane sources that will increase as the temperature rises," commented Prof Euan Nisbet from Royal Holloway, University of London, who is also involved in Arctic methane research.

"This is yet another serious concern: the warming will feed the warming."

How serious and how immediate a threat this feedback mechanism presents is a controversial area, with some scientists believing that the impacts will not be seen for many decades, and

others pointing out the possibility of a rapid release that could swiftly accelerate global warming.

Arctic methane leaks threaten climate

- 18:00 22 April 2012 by **Michael Marshall**
- For similar stories, visit the **Climate Change** Topic Guide

As Arctic sea ice breaks apart, massive amounts of methane could be released into the atmosphere from the cold waters beneath.

High concentrations of the greenhouse gas have been recorded in the air above cracks in the ice. This could be evidence of yet another positive feedback on the warming climate – leading to even faster Arctic warming.

The Arctic is home to vast stores of methane – there are billions of tonnes of methane in permafrost alone. It is a potent greenhouse gas, so a major methane release would greatly accelerate climate change. The gas is found in icy crystals called hydrates beneath the shallow seas that flood some areas of the continental crust, as well as in permafrost. It is also being released from Arctic wetlands.

But this doesn't explain why Eric Kort of the Jet Propulsion Laboratory in Pasadena, California, and his colleagues found patches of methane in remote regions of the Arctic Ocean, far from any of these known methane sources.

The team found the patches during five flights over the Arctic Ocean between 2009 and 2010, as part of a project to systematically map greenhouse gas levels in the atmosphere.

Kort estimates that, in the methane-rich regions, about 2 milligrams of the gas were being released per square metre of ocean every day. Some of the patches were close to the oil and gas plants in Prudhoe Bay, Alaska, but prevailing wind directions make these plants an unlikely source of the release.

Gassy ocean

So where does the gas come from? Since the 1970s, scientists have known that ocean surface waters are rich in methane. It seems to be made by marine bacteria trying to survive in waters that don't have many nutrients in the form of nitrates. "This source appears to be a likely candidate to explain what we observed," Kort says.

Water in the Arctic Ocean doesn't mix well, so the water near the surface tends to remain there. Consequently, the methane ends up trapped near the surface. In other oceans, it would get broken down through reaction with oxygen or consumed by methanotrophic bacteria, but the cold weather helps to preserve it.

Kort saw methane releases close to cracks in the sea ice, or in places where the ice had broken up. This could be because methane only escapes from agitated water, says Ellen Damm of the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven, Germany. This agitation is most likely to occur when autumn sets in and ice crystals start forming in the water, creating turbulence.

Hotter and hotter

The findings will need to be replicated, says Euan Nisbet, an earth scientist at Royal Holloway, University of London. But if the leak is widespread across the Arctic, this mechanism could prove to be a significant source of greenhouse gas.

"We know the Arctic is warming very fast indeed," Nisbet says. And as the warming climate leads to more breaks in the sea ice, more ice-surrounded patches of open water will be able to release their methane, further accelerating global warming.

The question now is: how significant will this new effect on warming be? "It might be small," Nisbet says, "or it could be another serious problem."

Journal reference: *Nature Geoscience*, DOI: 10.1038/ngeo1452