Scientists Link Natural Gas Formation by Bacteria to Climate Change and Renewable Energy

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Natural gas reservoirs in Michigan's Antrim Shale are providing new information about global warming and the Earth's climate history, according to a recent study by Steven Petsch, a geoscientist at the University of Massachusetts Amherst. The study is also good news for energy companies hoping to make natural gas a renewable resource. Results were published in the February 2008 issue of *Geology*.

Petsch found that carbon-hungry bacteria trapped deep in the rock beneath ice sheets produced the gas during the ice age, as glaciers advanced and retreated over Michigan. "Bacteria digested the carbon in the rocks and made large amounts of natural gas in a relatively short time, tens of thousands of years instead of millions," says Petsch. "This suggests that it may be possible to seed carbon-rich environments with bacteria to create natural gas reservoirs."

The study also helps explain high levels of methane in the atmosphere that occurred between ice ages, a trend recorded in ice cores taken from Greenland and Antarctica. "When the ice sheets retreated, it was like uncapping a soda bottle," says Petsch. "Natural gas, which is mostly methane, was released from the shale into the atmosphere."

This research can be used in current climate change models to account for the effects of melting glaciers," says Petsch. "Climate scientists haven't focused on the role that geologic sources of methane play in global warming."

Petsch used the chemistry of water and rock samples from the shale, which sits like a bowl beneath northern Michigan, to recreate the past. For most of its history, the Antrim Shale contained water that was too salty to allow bacteria to grow. But areas rich in natural gas showed an influx of fresh water that was chemically different from modern rainfall. "This water, which is similar to meltwater from glaciers formed during the ice age, was injected into the rock by the pressure of the overlying ice sheets," says Petsch.

Glacial meltwater diluted the salt water already present in the shale, allowing the bacteria to thrive and quickly digest available carbon. The natural gas they produced was chemically similar to the surrounding water and had a unique carbon chemistry that proved its bacterial origin. Petsch calculated that trillions of cubic feet of natural gas were eventually stored in the shale under pressure.

At least 75 percent of the gas was released into the atmosphere as the ice sheets retreated, adding to methane from other sources such as tropical wetlands. While methane from the Antrim Shale accounts for a small fraction of the rise in methane observed between ice ages, there are many natural gas deposits that were formed in the same geologic setting. The cumulative effect may have caused large emissions of methane to the atmosphere.

Klaus N?sslein of the UMass Amherst microbiology department analyzed DNA from water samples and identified bacteria capable of breaking down hydrocarbons in the rock. Other microbes were present that produced methane from the break-down products. Both of these groups can live without oxygen. Identifying and studying the needs of these microbes, which are capable of living deep in the Earth, is an important step in creating new natural gas reserves.

Additional members of the team include post-doctoral researcher Michael Formolo and undergraduate student Jeffrey Salacup of the University of Massachusetts Amherst and Anna Martini, a professor of geology at Amherst College.

Source: University of Massachusetts Amherst

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