Process used by microges to make greenhouse gases uncovered

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Researchers here now have a picture of a key molecule that lets microbes produce carbon dioxide and methane – the two greenhouse gases associated with global warming.

The findings relate to organisms called methanogens and are explained in the latest issue of the journal *Proceedings of the National Academy of Sciences*.

The publication capped a 12-year effort and can offer some insights into how industrial processes might be improved, explained Michael Chan, professor of biochemistry, and Joseph Krzycki, professor of microbiology, both of Ohio State University.

"This enzyme is the key to the whole process of methanogenesis from acetic acid," Krzycki said. "Without it, this form of methanogenesis wouldn't happen. Since it is so environmentally important worldwide, the impact of understanding this would be enormous."

Methanogenesis is the process by which the gas methane is made, and it takes place everywhere across the globe, from swamps to landfills, releasing the gas that ultimately seeps into the atmosphere.

One central player in this process is the microbe called Methanosarcina barkeri, a member of an unusual group of organisms called the Archaea that is similar to both bacterial and animal cells. This organism possesses large amounts of the enzyme so important for making methane.

"We often think only of humans putting carbon dioxide and methane into the atmosphere but natural biology itself actually provides its own sizeable share," said Chan. "This enzyme plays an important role in the process that converts acetate into these two gases."

The research can be traced to work that Krzycki did as a graduate student in the mid-1980s studying the protein known as acetyl-CoA decarbonylase/synthase (ACDS). He was focusing on whether carbon monoxide oxidation was part of the process of methanogenesis from acetate, which had not been suspected before.

In 1995, Chan approached Krzycki about working with this protein as one of the first projects Chan took on after coming to Ohio State. The goal was to use protein crystallography to get a picture of it and figure out how it works.

An important initial step in this kind of research is to "grow" crystals of the protein molecules, and from these crystals, scientists can actually map out the protein's structure.

"We tried for six months when I first arrived at Ohio State but at the end of that period, we couldn't get any crystals to grow," Chan said.

Two years later, Chan and a former graduate student, Bing Hao, went back to look at those previous crystallization experiments and discovered that crystals had eventually grown.

"The identification of these crystals allowed us to solve the structure of the protein making up the crystals, although it took 10 more years to do that," he said. "From the structure, we got a beautiful picture of the protein that we could use to understand how it works. Viewing a structure is somewhat like looking at the schematics of an engine."

Krzycki said that processes similar to those performed by this protein are currently being used in industry, although in those cases, high temperatures are required.

"From studying this process in these microbes, hopefully scientists can understand how their natural catalysts make this reaction work at lower temperatures," he said.

Source: Ohio State University