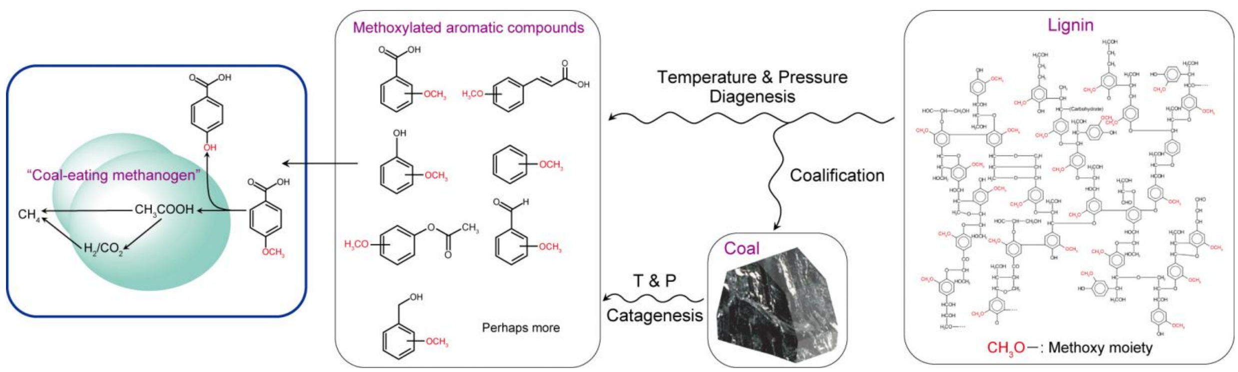
Researchers discover microbes able to convert compounds released from coal directly into methane

October 14 2016, by Bob Yirka



Discovery of the first "coal-eating methanogen" that can directly produce methane from coalderived methoxylated aromatic compounds through an unexpected pathway. Credit: Daisuke Mayumi

(Phys.org)—A team of researchers with the National Institute of Advanced Industrial Science and Technology in Japan has discovered the existence of a microbe that is able to convert organic compounds released from coal directly into methane. In their paper published in the journal *Science*, the team describes the experiments they conducted and the microbes they found. Cornelia Welte, with Radboud University in the Netherlands, offers a Perspective piece in the same journal issue explaining the work done by the team and the implications of their findings.

Scientists have known for a long time that underground seams of coal can produce methane—it is commonly used as a form of natural gas (and also accounts for approximately 7 percent of the methane that makes its way into the atmosphere as a greenhouse gas). But how the coal was converted to methane has been a bit of a mystery—many have speculated that methyl compounds were involved in breaking down coal emissions (a mixture of methoxylated aromatic compounds [MACs]), which microbes then converted to methane. It was also believed that microbes could not directly consume MACs because such microbes, known as methanogens, typically used small carbon compounds to produce methane. But that theory has been overturned by the researchers with this new effort; they discovered two strains of a type of a methanogen called *Methermicoccus shengliensis* that were able to directly convert MACs to methane.

To find these two microbes (ZC-1 and AmaM), the researchers grew several strains of likely possibilities by incubating them in 40 known MACs—these two were able to produce methane without assistance from any other methyl compounds. They found that the microbes also pulled carbon dioxide from the air as part of the process.

These findings suggest that coalbeds, including those in abandoned mines, could one day serve as a major source of methane, perhaps usurping shale gas, which has been receiving a lot of negative press lately—but before that can happen, as Welte explains, more research will have to be conducted to find out if there are other methanogens that are also able to make the conversion directly and to find out if the types of methanogens capable of directly converting MACs are widely found in coalbeds.

More information: D. Mayumi et al. Methane production from coal by a single methanogen, *Science* (2016). DOI: 10.1126/science.aaf8821

Abstract
Coal-bed methane is one of the largest unconventional natural gas resources. Although microbial activity may greatly contribute to coal-bed methane formation, it is unclear whether the complex aromatic organic compounds present in coal can be used for methanogenesis. We show that deep subsurface–derived Methermicoccus methanogens can produce methane from more than 30 types of methoxylated aromatic compounds (MACs) as well as from coals containing MACs. In contrast to known methanogenesis pathways involving one- and two-carbon compounds, this "methoxydotrophic" mode of methanogenesis couples O-demethylation, CO2 reduction, and possibly acetyl–coenzyme A metabolism. Because MACs derived from lignin may occur widely in subsurface sediments, methoxydotrophic methanogenesis would play an important role in the formation of natural gas not limited to coal-bed methane and in the global carbon cycle.

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