Press release

Discovery of a Primordial Metabolism in Microbes

Microbiologists from Brunswick, Konstanz und Tübingen in Germany discover how microbes can grow from iron-sulfur-mineral conversions

(Braunschweig – 21 March 2019): **Microorganisms are well known to grow at the expense of almost any chemical reaction if it can deliver a small fraction of the cell internal "energy currency "ATP.** Now, a team of German environmental microbiologists from the Leibniz Institute DSMZ–German Collection of Microorganisms and Cell Cultures in Brunswick, the University of Konstanz, and the University of Tübingen could show that microorganisms can mediate the conversion of iron sulfide and hydrogen sulfide to pyrite. This reaction was postulated to have operated as an early form of energy metabolism on primordial Earth.

Pyrite, better known as fool's gold, is the most abundant iron-sulfur mineral in sediments. Over geological times, its burial in sediments controlled oxygen levels in the atmosphere and sulfate concentrations in seawater. The conversion of iron sulfide and hydrogen sulfide to pyrite was also postulated as the energy-delivering process to drive autocatalytic synthesis of organic matter in micro-compartments of marine hydrothermal vents. The latter are currently regarded as the most likely place for life to have emerged on Earth. To date, pyrite formation was considered to be a pure (geo)chemical reaction. The new results presented here show that also microorganisms can mediate pyrite formation at ambient temperature and gain energy for growth from its overall conversion from iron sulfide and hydrogen sulfide. Michael Pester from the Leibniz Institute DSMZ/TU Braunschweig, Joana Thiel and Bernhard Schink from the University of Konstanz in collaboration with James M. Byrne and Andreas Kappler from the University of Tübingen published these results now in the Proceedings of the National Academy of Sciences U.S.A (https://www.pnas.org/content/early/2019/03/15/1814412116).

Under the exclusion of oxygen, the scientists enriched environmental microorganisms from different sediments and even wastewater treatment plants using iron sulfide, hydrogen sulfide, and carbon dioxide as the only substrates. Here, pyrite formed concomitantly with methane over extended time periods of several months. Pyrite formation showed a clear biological temperature dependence profile and was strictly coupled to parallel methane formation. The presented results provide insights into a metabolic relationship that could sustain part of the deeply buried biosphere in sediments and lend support to the iron-sulfur-world theory that postulated iron sulfide transformation to pyrite as a key energy-delivering reaction for life to emerge.

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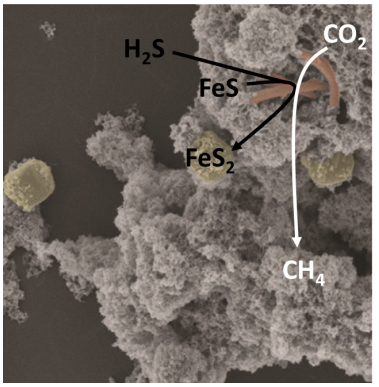

Electron microscopy image of a pyrite forming culture enriched from a wastewater treatment plant. Microbial cells are highlighted in red and pyrite crystals in yellow. The interdependency of pyrite (FeS_2) and methane (CH_4) formation is illustrated schematically.
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Thiel J., Byrne J. M., Kappler A., Schink B., Pester M. (2019) Pyrite formation from FeS and H_2S is mediated through microbial redox activity. Proc. Natl. Acad. Sci. U.S.A., in press. https://doi.org/10.1073/pnas.1814412116

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About the Leibniz Institute DSMZ
The Leibniz Institute DSMZ-German Collection of Microorganisms and Cell Cultures is the world's most diverse collection of biological resources (bacteria, archaea, protists, yeasts, fun-gi, bacteriophages, plant viruses, genomic bacterial DNA as well as human and animal cell lines). Microorganisms and cell cultures are collected, investigated and archived at the DSMZ. As an institution of the Leibniz Association, the DSMZ with its extensive scientific services and biological resources has been a global partner for research, science and industry since 1969. The DSMZ is the first registered collection in Europe (Regulation (EU) No. 511/2014) and certified according to the quality standard ISO 9001:2015. As a patent depository, it offers the only possibility in Germany to deposit biological material in accordance with the requirements of the Budapest Treaty. In addition to scientific services, research is the second pillar of the DSMZ. The institute, located on the Science Campus Braunschweig-Süd, accommodates more than 69,00 cultures and biomaterials and has 198 employees. www.dsmz.de

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