Pyrite formation from FeS and H_2S: a novel microbial energy metabolism

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123

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The exergonic reaction of FeS with H_2S to form FeS_2 (pyrite) and H_2 was postulated as an early form of energy metabolism on primordial Earth. With an annual production of more than 5 million tons, pyrite is also today the stable end product of iron compounds reacting with sulfide in reduced sediments. We present enrichment cultures, which grew with FeS, H_2S, and CO_2 as their sole substrates to produce pyrite and methane [1]. Pyrite formation followed a clear biological temperature profile with maximum activity at 28°C. Methane formed concomitantly with pyrite and exhibited the same temperature dependence. Addition of either penicillin or 2-bromoethanesulfonate inhibited both pyrite and methane production, indicating a syntrophic coupling of pyrite formation to methanogenesis. We identified a novel type of microbial metabolism driven by FeS transformation to pyrite that could sustain part of the deep biosphere in sediments and which may serve as a model for a postulated primordial iron-sulfur world.

[1] Thiel, J., Byrne, J.M., Kappler, A., Schink, B., and Pester, M. (2019) Pyrite formation from FeS and H2S is mediated through microbial redox activity. Proc Natl Acad Sci USA: published ahead of print: doi:10.1073/pnas.1814412116.