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Microbial Methane Formation from Coal and Wood in Abandoned Coal Mines – Analogues for biogenic methane formation in Black Shales

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About seven percent of the global annual methane emissions originate from coal mining. Also, mine gas has come into focus of the power industry and is being used increasingly for heat and power production. In many coal deposits worldwide, stable carbon and hydrogen isotopic signatures of methane indicate a mixed thermogenic and biogenic origin. In this study, we have measured in an abandoned coal mine methane fluxes and isotopic signatures of methane and carbon dioxide, and collected samples for microbiological and phylogenetic investigations. Mine timber and hard coal showed an in-situ production of methane with isotopic signatures similar to those of the methane in the mine atmosphere. Enrichment cultures amended with mine timber or hard coal as sole carbon sources formed methane over a period of nine months. Predominantly, acetoclastic methanogenesis was stimulated in enrichments containing acetate or hydrogen/carbon dioxide. Molecular techniques revealed that the archaeal community in enrichment cultures and unamended samples was dominated by members of the Methanosarcinales. The combined geochemical and microbiological investigations identify microbial methanogenesis as a recent source of methane in abandoned coal mines.
Overall, our new results support the assumption that abandoned coal reservoirs have a potential to supply methane gas for energy production over extended time scales. The worldwide increased mining activity will go along with an increased coal weathering and the formation of biogenic methane.
Currently, our research is focussing on the question to which extent and for how long recent biogenic methane production is contributing to shale gas formation as another important future energy resource.