Syntrophic acetate oxidation between Geobacter and Methanosarcina from the Bothnian Bay facilitated by conductive minerals

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Coastal sediments are rich in conductive minerals, such as magnetite, which are likely to impact microbial processes where acetate is a central intermediate. In the methanogenic zone, acetate is consumed by methanogens and syntrophic acetate oxidizing (SAO) consortia. SAO consortia live under extreme thermodynamic pressure, and their survival depends on successful partnerships. SAO partners were generally described to shuttle H_2 or formate between a donor bacterium and an accepting methanogen. Recently we discovered that SAO could also occur by shuttling electrons between species through a conductive mineral - "*mineral-DIET"* (direct interspecies electron transfer). DIET and mineral-DIET were previously shown to occur between exo-electrogens like *Geobacter* and *c*-type cytochrome-containing methanogens like *Methanosarcina. Mineral-DIET* was also employed by a new species of *Geobacter* (96% related to *G. psychrophilus*) from Baltic Sea sediments, which oxidized acetate by releasing electrons *via conductive minerals* onto their cohabiting *Methanosarcina* (99% related to *M. subterranea*). Our results show that conductive materials can mediate SAO between microorganisms from the environment. SAO by *mineral DIET* could be a vital pathway for CO_2-reductive methanogenesis in the environment, especially in sediments rich in conductive minerals, and is therefore of importance for both iron and methane cycles in sediments and soils.