

Anaerobic sediments host an efficient microbial barrier that consumes deep-subsurface-derived oil and gas

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In deep marine sediments, geothermal heat transforms organic matter into crude oil and natural gas, primarily composed of alkanes. The alkanes tend to migrate towards the sediment surface, however an efficient microbial barrier refuses their passage to the water column. My team studies the coupling of alkane oxidation to sulfate reduction and methane formation, the primary sinks of alkanes in the seafloor and reservoirs. From gas and oil-rich sediments, such as the Guaymas Basin, Gulf of California, we culture key taxa and resolve their function. The cultures consist of dual-species consortia of archaea and bacteria. The archaea face the challenge to activate substrates with only very stable C-H bonds. They master it with specific variants of methyl-coenzyme M reductases (MCR), an enzyme class that was before described to release methane in methanogens. All alkane-oxidizing archaea completely oxidize their substrates to CO₂, but they do not have respiratory pathways. In contrast, they transfer the reducing equivalents to their sulfate-reducing partner bacteria, organized via direct interspecies electron transfer. Our research illuminates the role of archaea in alkane transformations, and emphasizes the syntrophic interrelations microorganisms, which have the key role in the gas and oil transformations in the largest known microbial REACTOR on Earth, also known as the oceanfloor.