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Methane, sulfide and oxygen fluxes at methane and brine seeps of the Nile Deep Sea Fan (Eastern Mediterranean)

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Numerous active seep structures have been discovered on the Nile Deep Sea Fan (NDSF) in eastern Mediterranean Sea. Here we report on their investigation in the framework of the ESF EUROCORES project MEDIFLUX during the BIONIL (M70-2) expedition.

At cold seeps diverse and rich biological communities are fueled by upward flow of fluid and gas from deep subsurface sources. Microbial sulfate reduction (SR) which is often coupled to anaerobic oxidation of methane (AOM) is an important process in these seep ecosystems. It is mediated by consortia of bacterial and archaeal cells, resulting in the production of H_2S and CO_2. The produced sulfide can be used by thiotrophic bacteria, which form dense bacterial mats at the sediment surface. Vice versa the formation of the thiotrophic mats is always a good indication for SR coupled to AOM in the sediment below. During the BIONIL cruise we measured *in situ* benthic oxygen consumption and methane turnover at different seeps of the eastern and central provinces of the NDSF in water depths of 1000 – 3000 m. All 3 assessed ecosystems are characterized by different types of bacterial mats: (1) a Beggiatoa like mat in the center of the Amon mud volcano, (2) a Thiomargarita type mat at the rim of the volcano and (3) an Arcobacter like mat in the central province of the NDSF.

Here we compare flux rates (sulfide, methane, oxygen) as well as microbial turnover rates associated with the different mat communities to investigate their link to fluid flow velocity and other environmental parameters. Our data show an approx 20- and 200-times higher rate of oxygen consumption and sulfate reduction, respectively, at all bacterial mat sites as compared to non-seep sites. Sulfide oxidizing bacteria seem to be associated with different flux rates of sulfide: Arcobacter type (3) with high sulfide fluxes and fluidic sediments, Beggiatoa (1) with medium to high sulfide fluxes and Thiomargarita (2) with low fluxes. In all investigated habitats, methane oxidation explained only 15 % of sulfate reduction Indicating that a substantial proportion was fueled by higher hydrocarbons. Our results indicate that these bacterial mat habitats are hot spot ecosystems for sulfate, hydrocarbon and oxygen consumption.