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Microbial activity of anoxic sediments with freshwater and methane seepage in the Baltic Sea

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The Baltic Sea is a relatively shallow shelf sea with a high input of nutrients and organic matter. In some areas on the seabed so-called pockmarks are found, i.e. sites of freshwater seepage and often accompanying methane outflows. Pockmarks can differ microbiologically and consequently the rates of biochemical reactions related to the cycling of nutrients can be diametrically different in relation to the biogeochemical background of the Baltic sediments.

In order to assess the rate of sulphidogenesis, acetoclastic and hydrogenotrophic methanogenesis as well as Anoxic Oxidation of Methane (AOM), sediment samples (every 20 cm from 100 cm sediment core) were collected from three sites: (i) an active pockmark with methane seepage and infiltration of freshwater (MET1-MP), located in the Gulf of Gdańsk, (ii) a shallow-water site with a large regular accumulation of methane (MET2), located in the Puck Bay, and (iii) a reference deep-water site with no methane nor freshwater in the sediments (ZGG), located within the Gdańsk Deep. Implemented methods comprised the rate measurements of sulphate reduction (sulphide analysis), methane production (^{13}C-labelled acetate and ^{13}C-labelled CO_2) and methane consumption (^{13}C-labelled CH_4) were conducted (fig.1a). Additionally, the microbial community (16S rDNA metabarcoding) of the studied sites was analysed.

The results of the study revealed significant different microbiological activity in the three locations. Hence, it can be assumed without any doubts that the environments studied may be characterized by completely different microbiological activities (fig. 1b-c). Following this, it can be assumed that microbiological activity in these three locations may have a different effect on both the rate of biotransformation of organic matter (including various xenobiotics entering the Baltic Sea) and on the processes of biogenic element cycles and the related production of hydrogen sulphide and methane.

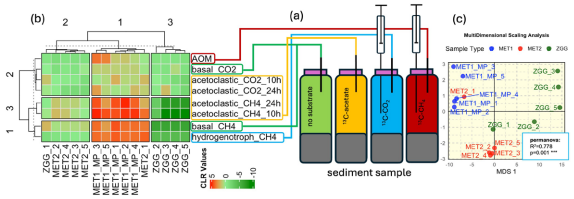

Figure 1. (a) – Microbial activity measured after incubation with ^{13}C-labelled substrates; basal activity concerns the incubation without substrates. (b) – Heatmap with hierarchical analysis (data were transformed with centered-log ratio). (c) – Multidimensional analysis showing statistical significance of the differences.

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