Shallow gas at the Paardenmarkt WWI munition dumpsite

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Preliminary research has shown that the Paardenmarkt WWI munition dumpsite contains a substantial amount of shallow gas. The source, composition, concentration and potential implications for buried grenade shells, however, have barely been studied. Therefore, project DISARM focuses on the analysis of gas in both sediment samples and seawater from the Paardenmarkt area, using basic sedimentological analysis techniques as well as gas headspace GC-MS, IC and in-situ sensor measurements. Vibrocores are largely composed of an alternation between sand and organic silt. Flaser beds and rhythmic layers dominate the depositional architecture, which typically reflects a dynamic depositional environment characterised by phases of accumulation and erosion, associated with a range of coastal processes, such as wave action, storms, tidal currents and anthropogenic disturbances. Results of a Principal Component Analysis (PCA) reveal i.a. strong positive correlations between silt fraction, water and organic content, which, in turn, are negatively correlated with sand fraction and density. These sedimentological properties, together with burial depth and oxygenation level, control most of the dataset's variability. Projections of CH_4 and CO_2 relate positively to the absence of oxygen and an increased organic content; anaerobic circumstances are preferred by the majority of biomass-degrading and gas-producing microbes. Methanogenesis is expected to play an important role in the subsurface, explaining the very high methane concentrations measured. However, methanogen abundance in the studied deposits remains limited, potentially pointing towards a main source area that is located deeper down the stratigraphy, beyond the cores' reach. A high-sulphate zone in the topmost 0.5 m suggests the presence of sulphate reducing bacteria, of which some likely operate via a methanotrophic pathway. Dissolved oxygen, salt water, and biogenic gases at the Paardenmarkt can definitely influence corrosion rates of buried munition shells. Methane is unlikely to play an important role in this process, because of its balanced electron-configuration, but a lot of the microbiologically-associated products and gases (mostly CO_2 and H_2S) and their derivative ions can significantly acidify porewater, driving the formation of a coating on metal alloys. Both sensor and GC-MS measurements have shown that seawater as well contains different gases, however, in much lower concentrations than in sediment. Sediment-water flux rates are currently hard to quantify and will need more extensive measurements and advanced modelling in order to obtain accurate results.

Keywords: Paardenmarkt; Shallow gas; Methanogenesis; Sulphate reduction; Munition