Methane dynamics at abandoned wells and natural seepage sites in the North Sea (Dutch EEZ)

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Large quantities of methane are stored along continental margins, originating either from microbial production or from thermogenic process. In the North Sea, subsurface methane is extensively exploited for commercial purposes, and the wells are usually sealed with concrete once the reservoirs are depleted. Nevertheless, leakage from abandoned wells can occur, releasing methane into the water column and potentially to the atmosphere. With respect to the several thousand of abandoned wells scattered across the North Sea, such emissions raise concern, however, the source strength of these emissions and the balance between microbial oxidation and release to the atmosphere remains poorly understood. During a research cruise in the North Sea (August 2024), we investigated methane dynamics in the water column at three different locations in the Dutch sector of the North Sea (A15-03 and B17-05 abandoned wells, B17-04 likely natural seepage). To assess methane fluxes from the seafloor, we deployed a mini-lander equipped with a methane sensor and an ADCP. For a time period of 3 days, we recorded several episodic events characterized by increasing methane concentrations. In addition, we carried out repeated hydro casts over a 24-hour period and collected discrete samples to resolve vertical methane distributions, which also revealed events of rising water column methane concentrations. Preliminary results revealed distinct peaks of elevated water column methane concentrations superimposed on a low-frequency background pattern. The high frequency features appeared to correlate with current direction, whereas the low frequency feature could be linked to changes leakage rate, potentially linked to tides. Further samples were collected to quantify the activity of methanotrophs, providing insight into the extent to which these bacteria mitigate methane release to the atmosphere. In this presentation, we will discuss our data in relation to environmental drivers, including tides, currents and biological factors such as methanotrophic community dynamics.