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Geochemical processes and fluxes at a methane gas chimney on the Hikurangi Margin (New Zealand)

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The initial results presented in this study focus on the pore water geochemistry of Takahe methane seep located at 1050 m water depth on the Hikurangi Margin. The main objectives are to characterize and quantify the geochemical processes occurring in the upper meters of sediment. Parasound images of the study site showed a well-defined seismic blanking zone of around 230 m in diameter that is likely generated by trapped methane gas. At the northern edge of this seismic gas chimney bubble release has been observed by using hydroacoustic methods (singlebeam and multibeam echosounders). At the seafloor the more northern part of the chimney area showed white Beggiatoa bacterial mats and in places dark sediment patches due to geochemically reduced environments. No other "seep specific" fauna as tube worms or clams as well as no massive chemoherm carbonate where found in the area. This points towards a rather young seepage history.

Geochemical data measured in 8 gravity cores across the gas chimney support this notion and gas hydrate layers several cm thick were observed in several cores. Sulphate and total alkalinity concentrations varied little from seawater values in the upper 50 to 100 cm towards the southerly end of the seismic gas chimney area; a feature attributed to irrigation by escaping methane gas bubbles. At these stations, the pore fluids were highly enriched in biogenic methane. However, the dissolved methane was mostly consumed anaerobically by sulphate, resulting in steep gradients of sulphate, methane, total alkalinity and hydrogen sulphide. Geochemical gradients at reference site immediately outside the chimney area were essentially vertical, indicating very little upwards transport and dissolution of methane. The geochemical data are applied to a numerical reaction-transport model to quantify the total upward flux of methane at each station and, ultimately, for the entire gas chimney.

Temperature measurements of thermistor probes attached to the barrel of the gravity core show no significant differences between inside and outside the gas chimney. XRF core scanner data did not show significant changes in any of the cores. However, increased Ca concentrations were found and the sulphate-methane transition zone clearly indication authigenic precipitation of Ca-rich carbonates.