

國立臺灣海洋大學
海洋環境與生態研究所 專題討論

英文題目：Productivity and Temperature as Drivers of Seasonal and Spatial Variations of Dissolved Methane in the Southern Bight of the North Sea

中文題目：生產力及溫度是北海南部海灣甲烷濃度季節性及空間變化的主要驅動因子

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出處：Ecosystems (2018) 21: 583–599

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報告日期：12/04/2019

Abstract

Dissolved CH₄ concentrations in the Belgian coastal zone (North Sea) ranged between 670 nmol l⁻¹ nearshore and 4 nmol l⁻¹ offshore. Spatial variations of CH₄ were related to sediment organic matter (OM) content and gassy sediments. In nearshore stations with fine sand or muddy sediments, the CH₄ seasonal cycle followed water temperature, suggesting methanogenesis control by temperature in these OM-rich sediments. In offshore stations with permeable sediments, the CH₄ seasonal cycle showed a yearly peak following the chlorophyll-a spring peak, suggesting that in these OM poor sediments, methanogenesis depended on freshly produced OM delivery. This does not exclude the possibility that some CH₄ might originate from dimethylsulfide (DMS) or dimethylsulfoniopropionate (DMSP) or methylphosphonate transformations in the most offshore stations. Yet, the average seasonal CH₄ cycle was unrelated to those of DMS(P), very abundant during the *Phaeocystis* bloom. The annual average CH₄ emission was 126 mmol m⁻² y⁻¹ in the most nearshore stations (~4 km from the coast) and 28 mmol m⁻² y⁻¹ in the most offshore stations (~23 km from the coast), 1260–280 times higher than the open ocean average value (0.1 mmol m⁻² y⁻¹). The strong control of CH₄ by sediment OM content and by temperature suggests that marine coastal CH₄ emissions, in particular in shallow areas, should respond to future eutrophication and warming of climate. This is supported by the comparison of CH₄ concentrations at five stations obtained in March 1990 and 2016, showing a decreasing trend consistent with alleviation of eutrophication in the area.

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中文摘要

比利時沿海區域的溶解態甲烷濃度變化從近岸的 670 nmol l^{-1} 到離岸的 4 nmol l^{-1} ，甲烷的空間梯度變化與沉積物中有機質含量及沉積物釋放的氣體有相關性，近岸的沉積物為孔隙較小的泥及細沙，可以觀察到甲烷濃度與水溫的季節性變化相同，推測在富含有機質的沉積物中甲烷的生成是受溫度的控制；而離岸的沉積物孔隙較大，當葉綠素 a 濃度出現高值後甲烷濃度才出現高值，推測在有機質較少的沉積物中，甲烷的生成主要是剛沉降的有機物傳輸影響，不排除甲烷的生成可能是來自於二甲基硫醚(DMS)、二甲基巖基丙酸(DMSP)及磷酸甲酯等甲基化分子的轉化，但是在球型棕囊藻藻華的時期，甲烷濃度的變化與二甲基巖基丙酸(DMSP)沒有相關性；近岸甲烷平均年釋放量為 $126 \text{ mmol m}^{-2} \text{ y}^{-1}$ ，離岸 $28 \text{ mmol m}^{-2} \text{ y}^{-1}$ 是開放海域的 280-1260 倍。在淺海區域的沿岸甲烷生成主要受到沉積物中有機質含量及水溫的控制；反應了未來優養化及氣候暖化可能會造成的趨勢。

參考資料

Borges, A. V., et al. (2017). "Productivity and Temperature as Drivers of Seasonal and Spatial Variations of Dissolved Methane in the Southern Bight of the North Sea." *Ecosystems* **21**(4): 583-599.