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Supporting Information for

# [The Aquitaine Shelf edge (Bay of Biscay): a primary outlet for microbial methane release]

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## Introduction

The supplementary material provides additional information on (1) the identification of MDACs through their acoustic signatures and more precisely their seafloor backscatter characterization (Text S1), (2) the acoustic facies classification map of the surveyed Aquitaine Margin area (Figure S1) from which was derived the sedimentological map presented in the manuscript (Figure 4b), (3) the seafloor at the Aquitaine Shelf edge with near-bottom seafloor images of seeping sites (Figure S2) and (4) a comparative table of the annual flow rate of methane entering the water column at selected shallow-water seeping sites (Table S1).

**Text S1.**

The hard substrates of carbonates contrast acoustically with the surrounding sediments of the external Aquitaine continental shelf which is composed of fine and slightly silty sand (Figures 4b and S1). The mean relative amplitude of seafloor backscatter for the carbonates reaches -21 and -16 dB while that of the sediments is -26 and -20 dB, in EM302 and EM2040 data respectively. The standard deviation for carbonates, 4 dB for both datasets, is up to twice as much as the one for sediments. The variability of carbonate backscatter amplitude is most likely related to the presence of (i) outcropping carbonates, (ii) carbonates partially covered by sediments, and (iii) buried structures within the upper first meter.

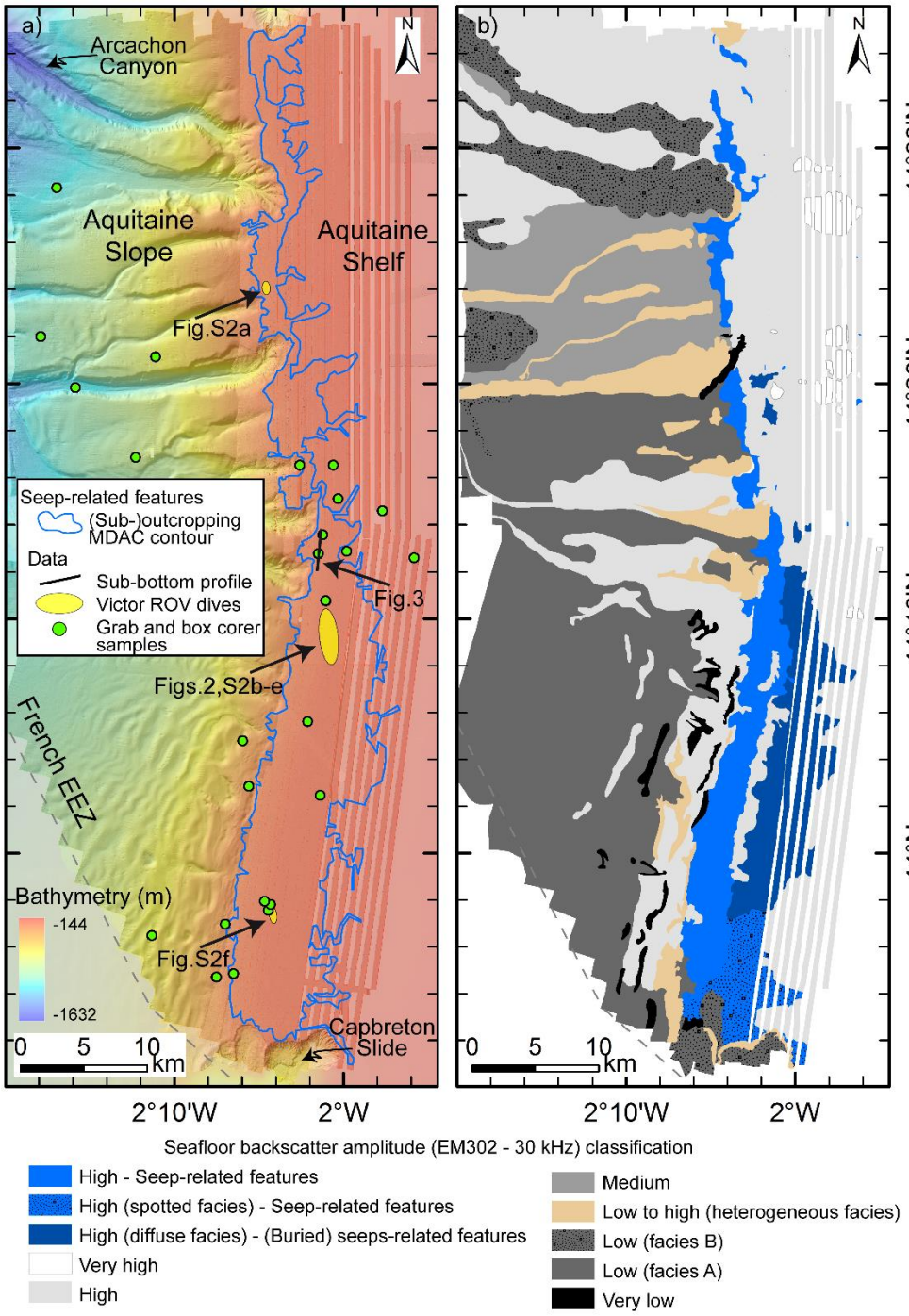


**Figure S1.** (a) Shaded bathymetry map of the Aquitaine Shelf edge area with location of the grab and core samples collected during the GAZCOGNE1 marine expedition (2013). Yellow patches indicate the areas investigated with the Victor ROV during three dives; from north to south: GZ2-ROV536-A, GZ2-ROV535-D, and GZ2-ROV537-G. (b) Acoustic facies map of the Aquitaine Shelf edge and upper slope area based on EM302 seafloor backscatter amplitude and texture classification.

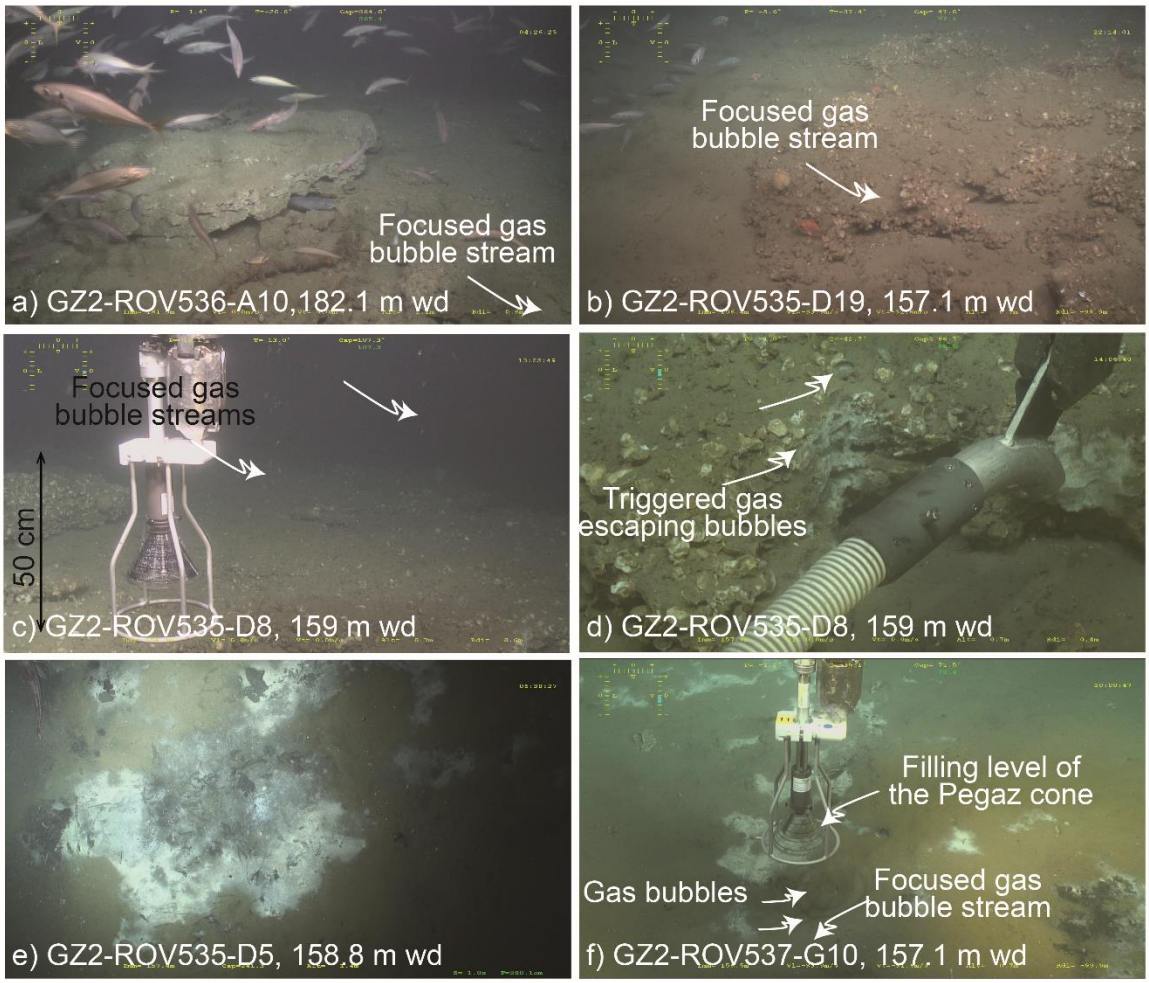


**Figure S2.** Near-bottom seafloor images of seeping sites at the Aquitaine Shelf edge (Figures 2 and 4) taken by the Victor ROV. Focused methane flows (a) in the vicinity of carbonate mounds and (b) through carbonate pavement. (c) Seeping site characterized by one of the highest measured methane flow rates (341 mL/min, volume normalized to standard atmospheric conditions, Ruffine et al. 2017); (d) Zoom on carbonate pavement (Figure S2c) with escaping gas bubbles triggered during the sampling. (e) Seeping site with meter-scale, dark reduced sediment patches partly covered by white microbial mats. f) Focused methane flow (199 mL/min normalized to standard atmospheric conditions, Ruffine et al. 2017) through sediments in the proximity of dark reduced patches.

| Location of studied seeping sites | Methane flow rate into the water | Number of seeps | Water depth | Reference |
|---|---|---|---|---|
| | Mg/yr | | m | |
| Continental Shelf of the Northern US Atlantic Margin | 4.5 | 90 | <180 | Skarke et al. 2014 |
| Tommeliten (North Sea) | 26 | 735 | 73-74 | Schneider et al. 2011 |
| Continental Shelf of the Aquitaine Margin (Bay of Biscay) | 144 | 2612 | 140-220 | *This study* |
| Continental shelf area offshore west of Prins Karls Forland (Western Svalbard) | 115-180 | not available information | 67-117 | Veloso et al. 2019 |
| Dutch Dogger Bank seep area (North Sea) | 478 | 850 | 40 | Römer et al. 2017 |
| Western Black Sea continental shelf | 511 | 2709 | 70-112 | Greinert et al. 2010 |
| Continental Shelf of the Cascadia Margin | 1 490 | 730 | <250 | Riedel et al. 2018 |

**Table S1.** Annual flow rates of methane emitted from the seafloor into the water column at selected shallow-water seeping sites. Along the Aquitaine Shelf edge, the methane emissions are evidenced by acoustic water column records since 1998 (Dupré et al. 2014). The annual methane flow rate at continental shelves has been estimated at 8-65 Tg/yr (Hovland et al. 1993).