Supplemental Information:

Links between spatially heterogeneous pore water geochemistry, fluid migration, and methane hydrate near a seafloor mound venting structure on the south Chilean Margin (41°S)

Authors: Vincent J. Clementi[1], Yair Rosenthal[1,2], Samantha C. Bova[1,3], James D. Wright[2], Elizabeth K. Thomas[4], Richard A. Mortlock[2], Owen C. Cowling[4], Linda V. Godfrey[2], Laurel B. Childress[5], and Expedition 379T Scientists

Affiliations

[1]Department of Marine and Coastal Sciences, Rutgers University, New Brunswick, NJ, USA
(*corresponding author; clementi@marine.rutgers.edu)
[2]Department of Earth and Planetary Sciences, Rutgers University, Piscataway, NJ, USA
[3]Present Address: Department of Geological Sciences, San Diego State University, San Diego, CA, USA
[4]Department of Geology, University at Buffalo, Buffalo, NY
[5]International Ocean Discovery Program, Texas A&M University, College Station, TX, USA

Contents:

1) **Supplemental Figures 1-4**
2) **Supplemental Table 1**
3) **Supplemental References**

Introduction

We provide four supplemental figures and a supplemental table describing expected changes in pore water chemistry from relevant processes.

Figures S1-S4.

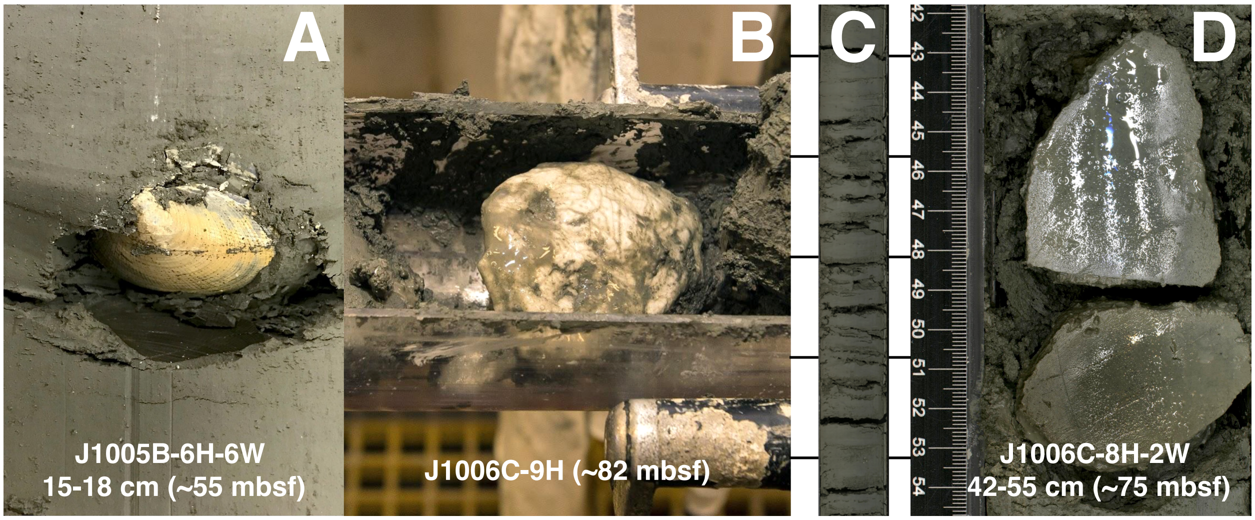

Figure S1: Evidence for (paleo) seepage, methane hydrate presence, and authigenesis. A) *Lucinidae* bivalve shells from ~55 mbsf at Site J1005 (also recovered from ~85 mbsf at Site J1006). B) methane hydrate nodule from ~82 mbsf at Site J1006. C) Example of gas cracks, which resulted in loss of sediment between 88-104 mbsf, in core sections at Site J1006. D) Examples of authigenic carbonate concretions at Site J1006.

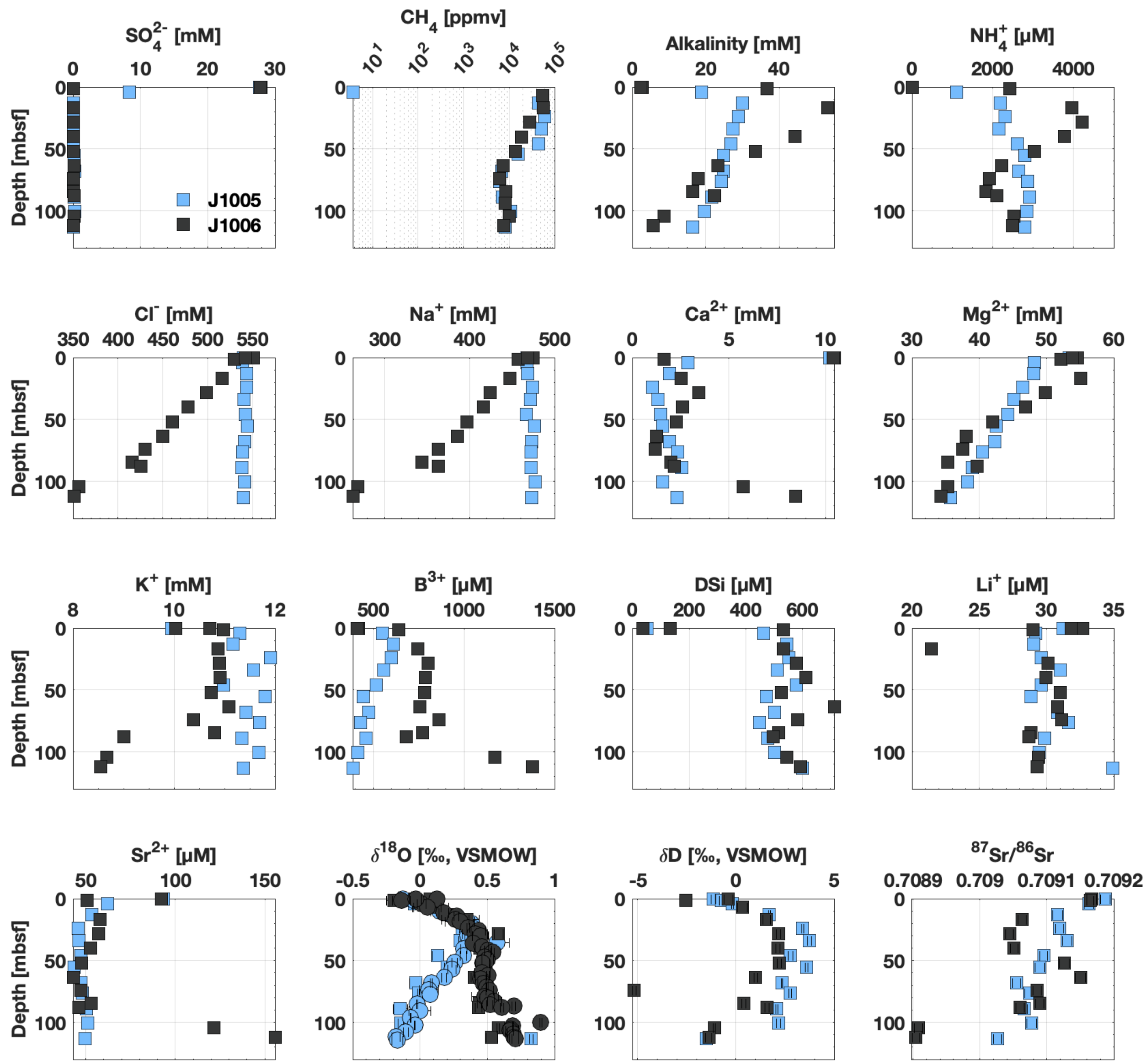

Figure S2: Pore water geochemical profiles for Site J1005 (blue) and J1006 (dark grey). Downcore profiles for SO_4^{2-}, headspace CH_4 concentrations, alkalinity, NH_4^+, Cl^-, Na^+, Ca^{2+}, Mg^{2+}, K^+, B^{3+}, DSi, Li^+, Sr^{2+}, $\delta^{18}O$, δD, and $^{87}Sr/^{86}Sr$. Reported errors for $\delta^{18}O$, δD, and $^{87}Sr/^{86}Sr$ represent 1 SD; uncertainty is smaller than the symbol size. Non-normalized profiles provide context for changes in ion/Cl^- profiles in Figures 2 and 3 in the main paper.

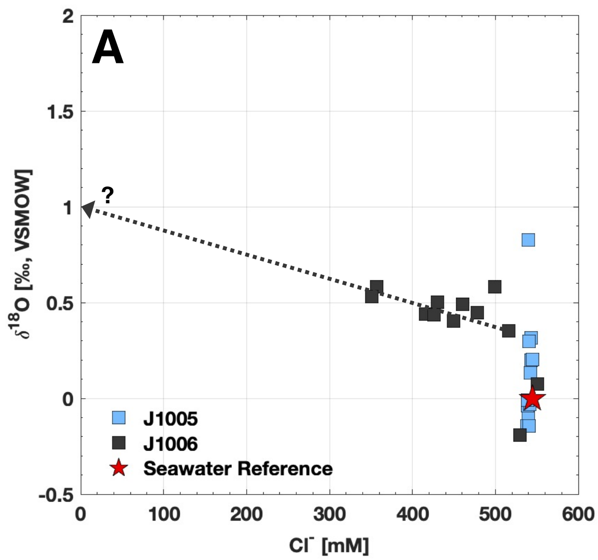

Figure S3: A comparison between pore water $\delta^{18}O$ and δD and Cl^- concentration. A) $\delta^{18}O$ versus Cl^-. B) δD versus Cl^-. Sites J1005 (blue), J1006 (dark grey), and seawater reference (red) are shown. Dotted lines represent approximated linear extrapolation to freshened endmember at $Cl^- = 0$ ($\delta^{18}O = +1.0‰$, $\delta D = -11.5‰$), though the apparent non-linearity adds some uncertainty to these estimates.

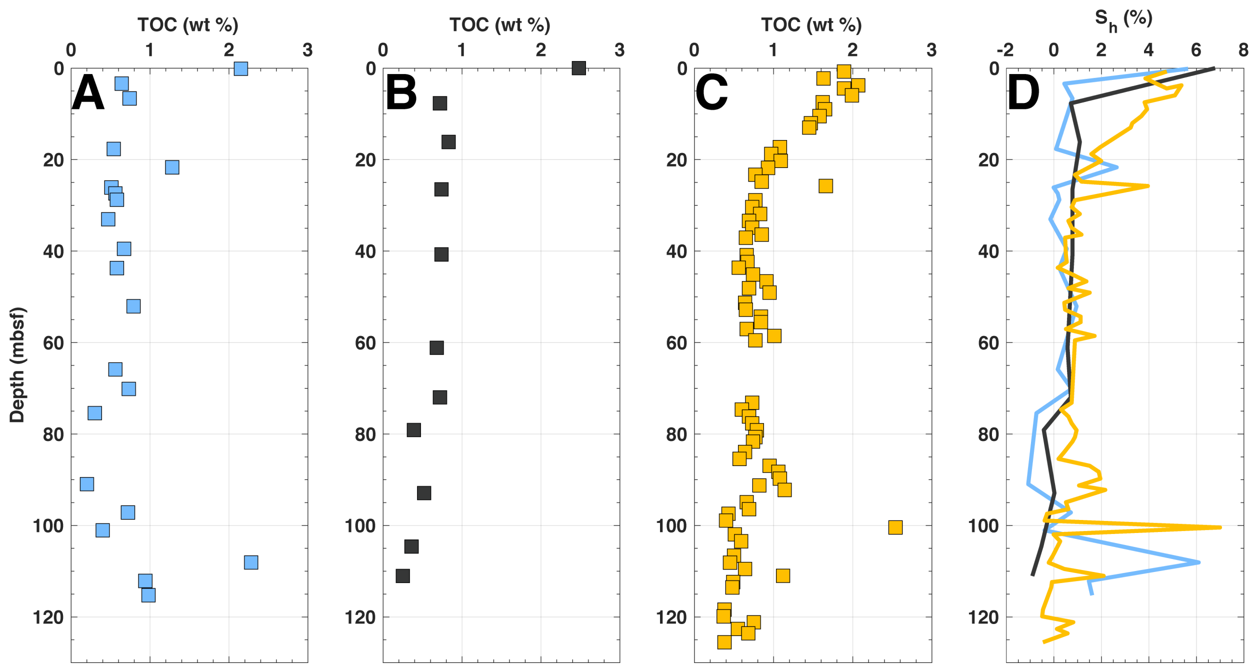

Figure S4: TOC-based methane hydrate saturation. A-C) Downcore bulk sediment TOC for J1005 (blue), J1006 (dark grey), and ODP Site 1233 (yellow). D) Methane hydrate saturation index (S_h) derived using the following equation: $S_h = 3.45*(TOC) - 1.77$ [*Waseda*, 1998]. Methane hydrate saturation is <1% omitting the highest TOC content, which is generally limited to the upper few mbsf, though discrete horizons are also found at depth at sites J1005 and ODP 1233.

Supplementary Table

Table S1: **Changes in pore water Cl^-, $\delta^{18}O$, and $\delta^{18}O$ from different sedimentary or diagenetic processes. Adapted from Kastner et al. [1991], Dahlmann and de Lange [2003], and references therein.**

Process	Cl^-	$\delta^{18}O$	δD
Gas hydrate dissociation	-	+	+
Clay mineral dehydration	-	+	-
Ash alteration	o/+	-	+
Oceanic crust alteration (<200°C)	-	-	+
Anaerobic oxidation of methane	-	o	-
Meteoric water infiltration	-	-	-
Clay membrane filtration	-	-	-

(-) decrease in value | (+) increase in value | (o) no change

Supplementary References

Dahlmann, A., and G. J. de Lange (2003), Fluid-sediment interactions at Eastern Mediterranean mud volcanoes: a stable isotope study from ODP Leg 160, *Earth and Planetary Science Letters*, *212*(3-4), 377-391, doi:10.1016/s0012-821x(03)00227-9.

Kastner, M., H. Elderfield, and J. B. Martin (1991), FLUIDS IN CONVERGENT MARGINS - WHAT DO WE KNOW ABOUT THEIR COMPOSITION, ORIGIN, ROLE IN DIAGENESIS AND IMPORTANCE FOR OCEANIC CHEMICAL FLUXES, *Philosophical Transactions of the Royal Society of London Series a-Mathematical Physical and Engineering Sciences*, *335*(1638), 243-259, doi:10.1098/rsta.1991.0045.

Waseda, A. (1998), Organic carbon content, bacterial methanogenesis, and accumulation processes of gas hydrates in marine sediments., *GEOCHEMICAL JOURNAL*, *32*(3), 143-157, doi:10.2343/geochemj.32.143.