Auxiliary Material for

Contemporary Ocean Warming Dissociates Cascadia Margin Gas Hydrates

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Introduction

This supplement contains:

Information about a study to determine the sensitivity of the long-term warming trend to underlying assumptions in data compilation and processing.

Supplementary figures with additional sediment model cases and other supporting information.

Online Supplementary Materials.docx: Information about a study to determine the sensitivity of the long-term warming trend to underlying assumptions in data compilation and processing, and information about thermal diffusivity.

Supp Figure 1.pdf: Supplementary Figure 1. Sediment thermal simulations for bathymetric transect P2. a. Initial subseafloor temperature distribution in 1970 based on the regression (see Methods) and a basal heat flow of 60 mW/m [Booth-Rea et al., 2008]. The white line is the base of the gas hydrate stability zone (BGHSZ) in the sediment column for Structure I gas hydrate and hydrostatic pressure following the methods outlined in Tischenko (2005). b. The simulated change in sediment temperature between 1970 and 2013 and corresponding shift in the BGHSZ. The BGHSZ shoals over a broad area in response to warming, accompanied by a retreat of its landward edge (indicated by red arrows). c. Simulated change in sediment temperature between 1970 and 2100 based on the linear extrapolation of seafloor temperature. The upper white line is the BGHSZ in 2100. d. Simulated change in sediment temperature between 1970 and 2100 based on the high-emissions AR4 extrapolation. The upper white line is the BGHSZ in 2100 and the lower white line is the BGHSZ in 1970.

Supp Figure 2.pdf: Supplementary Figure 2. Sediment thermal simulations for bathymetric transect P3. a. Initial subseafloor temperature distribution in 1970 based on the regression (see Methods) and a basal heat flow of 60 mW/m [Booth-Rea et al., 2008]. The white line is the base of the gas hydrate stability zone (BGHSZ) in the sediment column for Structure I gas hydrate and hydrostatic pressure following the methods outlined in Tischenko (2005). b. The simulated change in sediment temperature between 1970 and 2013 and corresponding shift in the BGHSZ. The BGHSZ shoals over a broad area in response to warming, accompanied by a retreat of its landward edge (indicated by red arrows). c. Simulated change in sediment temperature between 1970 and 2100 based on the linear extrapolation of seafloor temperature. The upper white line is the BGHSZ in 2100. d. Simulated change in sediment temperature between 1970 and 2100 based on the high-emissions AR4 extrapolation. The upper white line is the BGHSZ in 2100 and the lower white line is the BGHSZ in 1970.

Supp Figure 3.pdf: Supplementary Figure 3. Shift in the gas hydrate stability field as a function of seafloor depth along transect P2 between 1950 and 2013 for a. seafloor depth = 495 m, b. seafloor depth = 490 m, c. seafloor depth = 480 m, and d. seafloor depth = 475 m. The blue line represents the gas hydrate stability boundary. The 1950 and 2013 geotherms are shown as the black and red lines, respectively. The black dashed line represents the seafloor in each panel.

Supp Figure 4.pdf: Supplementary Figure 4. Heat flow at the seafloor, estimated seafloor temperature, and subseafloor temperature distribution along transect P3 in a. 1950 and b. 2013. The white line represents the BGHSZ.

Supp Figure 5.pdf: Supplementary Figure 5. Bubble plumes near the up-slope limit of gas hydrate stability offshore northern Washington. a. Location map showing locations of known methane seeps along from northern WA to northern OR. The bubble plumes imaged offshore northern Oregon are constrained to depths between 480-500 m. The blue triangle represents the location of the bubble plumes shown in b and c. b. Bathymetry at the location of two bubble plumes surveyed with the R/V Thompson in 2012. The multi-beam data was collected with a Konsberg EM302 echosounder and processed post-expedition with the Fledermaus FMMidwater module. c. Two distinct plumes were imaged with the largest sourced at 515 m and a less intense plume at 506 m water depth. Arrows show approximate rise height of each plume.