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1 Tectonically induced fluid flow into a nearly anoxic water column: Methane cycling at Quepos Slide, Costa Rican continental margin

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The continental margin off Cost Rica is characterized by active cold venting induced by the subduction of the Cocos Plate underneath the Caribbean Plate. Submarine landslides, often triggered by the subduction of seamounts, have been shown to considerably contribute to the fluid discharge in the area. At the same time, the hydrographic conditions are characterized by very low oxygen conditions in the oxygen minimum zone centred around 400m, as a result of the reinforcement of the already low oxygen content in the Eastern Tropical Pacific by the local upwelling of the Costa Rica Dome. Here we report on the injection of methane-rich fluids into nearly oxygen-free waters at Quepos Slide. The slide resulted in the formation a plateau at approximately 400 m water depth, with walls in the NW and NE. In the northern part of the slide, the seafloor is paved with bacterial mats along an elongated, weakly pronounced elevation oriented in NW-SE direction, dominated by filamentous Beggiatoa, often covering more than

80% of the seafloor for more than 200m. The colour of the bacterial assemblages shows strong zoning from white to yellow-orange, while grey assemblages were often associated with bathymetric elevations and smaller, circular- shaped patches. A remarkable characteristic is the almost complete lack of all other forms of vent-specific fauna.

Sampling included transects of pushcores across the geochemical gradient, the deployment of the Benthic Chamber Lander (BCL), and the use of the KISP *in situ* fluid sampler. Due to the highly productive area and low oxygen content of the water column, even background sediments not affected by fluid ascent show strong gradients in dissolved sulphate and high concentrations of nutrients, alkalinity and sulphide reflecting the rapid degradation of organic matter via microbial sulphate reduction. In contrast, sediments from below bacterial mats are strongly depleted in dissolved chloride due to the ascent of deep fluids freshened by clay mineral dewatering. They are dominated by AOM rather than sulphate reduction. The sediment transects across the bacterial mats indicate the formation of convection cells within the upper sediment layer as well as, in some cases, a remarkable spatial decoupling of fluid flow and AOM.

The (BCL) was deployed at three different bacterial mat sites in the Quepos Slide area. Both, water samples from the enclosed bottom water and the underlying incubated sediments were retrieved. The deployments show very different benthic turnover rates at the sites, with times for oxygen depletion ranging from less than 5 min to more than 8 hours and a decrease of sulphate concentrations within approximately 8 hours ranging from 6 mmol to below detection limit. Sediment profiles show a distinct decrease in clorinity with depths for all deployments.

The methane inventory in the water column was investigated with a grid of 17 stations, verifying the highest methane emission in the northern corner of the slope, with concentrations more than two orders of magnitude above local background. Together with current meter data from ADCP deployments, these will be used to estimate the integrated methane flux from Quepos slide.