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► To cite this version:

Andreas, P Teske, Paraskevi Mara, Mirna Vázquez, Brett Baker, Yuki Morono, et al.. Investigating microbial constraints on hydrocarbon processing in Guaymas Basin subseafloor sediments with sill intrusions . EGU, 2022, Vienne, France. 10.5194/egusphere-egu22-3278 . hal-04000461

HAL Id: hal-04000461

<https://hal.science/hal-04000461v1>

Submitted on 22 Feb 2023

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EGU22-3278

<https://doi.org/10.5194/egusphere-egu22-3278>

EGU General Assembly 2022

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Investigating microbial constraints on hydrocarbon processing in Guaymas Basin subseafloor sediments with sill intrusions

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Guaymas Basin is a young marginal rift basin in the Gulf of California characterized by active seafloor spreading and rapid deposition of organic-rich sediments derived from highly productive overlying waters and terrigenous sediments from nearby continental margins. Catalyzed by the steep geothermal gradient, sedimentary organic material of photosynthetic origin turns into a diverse spectrum of hydrocarbons that accumulate especially in deep, hot sediments, and might supply substrates for hydrocarbon-degrading microorganisms. The “from magma to microbe” perspective on these processes motivated International Ocean Discovery Program Expedition 385 “Guaymas Basin Tectonics and Biosphere.”

Hydrocarbon concentrations were determined in sediment samples selected from eight drilling sites on the flanking regions and in the northern axial graben of Guaymas Basin. Total petroleum hydrocarbon (C9-C44) concentrations increased from ca. 50-250 mg/kg towards >2000 mg/kg at in-situ temperatures above 80°C. A similar increase from ca. 10 mg/kg towards >100 mg/kg was observed for total saturated hydrocarbons. These gradients are shaped by abiotic hydrocarbon generation above 80°C at depth, and possibly by microbial hydrocarbon degradation at cooler temperatures in the upper sediment column. In a two-pronged approach, we are currently investigating the activity of bacterial/fungal consortia, isolated from Guaymas Basin surficial sediments, in the oxidation of selected alkanes and polyaromatics that occur at Guaymas Basin. In parallel, we explore the diversity, depth range and in-situ temperature range of bacteria, archaea and fungi in the Guaymas Basin subsurface sediments using PCR and metagenomic sequencing, to constrain microbial hydrocarbon cycling in the deep subsurface. Updates on these ongoing investigations will be presented.

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Florian Neumann; Lucie C. Pastor; Manet Peña-Salinas; Ligia L. Pérez Cruz; Lihua Ran; Armelle Riboulleau; John A. Sarao; Florian Schubert; S. Khogenkumar Singh; Joann M. Stock; Laurent M.A.A. Toffin; Wei Xie; Toshiro Yamanaka; Guangchao Zhuang