9th FTSES 2024 Penghu, Taiwan

9th France-Taiwan Symposium in Earth Sciences
Session: Marine Geology/ Underwater Geophysics

Relating sulfate and methane dynamics to geology: Accretionary prism offshore SW Taiwan

Pei-Chuan Chuang[1]

[1] Department of Earth Sciences, National Central University, Taiwan

Geochemical data (CH_4, SO_4^{2-}, I^-, Cl^-, particulate organic carbon (POC), $\delta^{13}C$-CH_4, and $\delta^{13}C$-CO_2) are presented from the upper 30 m of marine sediment on a tectonic submarine accretionary wedge offshore southwest Taiwan. The sampling stations covered three ridges (Tai-Nan, Yung-An, and Good Weather), each characterized by bottom simulating reflectors, acoustic turbidity, and different types of faulting and anticlines. Sulfate and iodide concentrations varied little from seawater-like values in the upper 1–3 m of sediment at all stations; a feature that is consistent with irrigation of seawater by gas bubbles rising through the soft surface sediments. Below this depth, sulfate was rapidly consumed within 5–10 m by anaerobic oxidation of methane (AOM) at the sulfate-methane transition. Carbon isotopic data imply a mainly biogenic methane source. A numerical transport-reaction model was used to identify the supply pathways of methane and estimate depth-integrated turnover rates at the three ridges. Methane gas ascending from deep layers, facilitated by thrusts and faults, was by far the dominant term in the methane budget at all sites. Differences in the proximity of the sampling sites to the faults and anticlines mainly accounted for the variability in gas fluxes and depth-integrated AOM rates. By comparison, methane produced in situ by POC degradation within the modeled sediment column was unimportant. This study demonstrates that the geochemical trends in the continental margins offshore SW Taiwan are closely related to the different geological settings. A further highlight of this study was the prediction of gas hydrates. This hypothesis was unverified at the time of publication, but later confirmed in sediment cores recovered offshore SW Taiwan in June 2018; a clear example of how models can guide the fieldwork.

Keywords: gas hydrate, methane flux; bubble irrigation; anaerobic oxidation of methane; POC degradation; accretionary wedge; Taiwan, Marion Dufresne