Pathways of organic carbon degradation in sand

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Permeable marine sediments are dynamic environments, with oxic-anoxic boundaries constantly changing due to wave oscillations and tidal cycles [1]. These are unlike conditions seen in cohesive (muddy) sediments and consequently the sediments possess unique biogeochemistry, not following classical heterotrophic carbon mineralization models [2-4]. A major question is therefore what carbon mineralization processes dominate in these permeable sands? Here we measured the carbon degradation pathways taking place within permeable and cohesive sediments by incubation with ^{13}C labelled glucose (1-^{13}C; 2-^{13}C; 3-^{13}C; $^{13}C_6$). Based on the ratio of $^{13}CO_2$ produced, results show that anoxic sands across a variety of sites (temperate to tropics) undertake fermentation via the Embden-Meyerhof fermentation pathway. This is in agreement with recent work of Kessler *et al.*, where it was shown that fermentation dominates anoxic carbon mineralization and is largely uncoupled from anaerobic respiration [5]. In contrast, cohesive anoxic sediments showed complete oxidation of the ^{13}C glucose to $^{13}CO_2$. This follows the classical biogeochemical model, whereby complete carbon oxidation takes place through anaerobic processes utilising terminal electron acceptors such as sulfate, iron and nitrate.

[1] Precht *et al.* (2004) *Limnol. Oceanogr.* **57**, 1217-1232. [2] Bourke *et al.* (2016) *Nat. Geosci.* **10**, 30-35. [3] Evrard *et al.* (2013) *Biogeochemistry* **113**, 563-572. [4] Kessler *et al.* (2012) *Limnol. and Oceanogr.* **57**, 1217-1232. [5] Kessler *et al.* (2019) *Nat. Microbiol.* **4**.