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Did the emergence of animals have an impact on the carbon cycle of the ocean floor?

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The first animals appeared at or near the ocean floor, and paleontologists have suggested that the ensuing Cambrian explosion resulted in a regime shift in the biogeochemical functioning of the ocean floor. The newly evolved animals rapidly adopted a burrowing lifestyle, and as result, sediments became mixed and reworked, thus "bulldozing" the microbial mats that had covered the ocean floor in the Precambrian. Sedimentary redox conditions also changed, as burrow networks were flushed with oxygenated overlying water. But did the emergence of large burrowing fauna truly have an impact on the carbon cycle of the ocean?

Here, we try to answer this question by looking at the present-day situation, that is, we estimate how large the impact is of large burrowing fauna on organic carbon processing in the ocean floor. We addressed this by a global synthesis and model analysis of the in situ oxygen uptake rate in marine sediments, where the oxygen uptake is used as a proxy for organic carbon mineralization. The total oxygen uptake can be split into a diffusive oxygen uptake, linked to oxygen supply by diffusion across the sediment water interface, and a faunal mediated uptake, linked to faunal respiration and bio-irrigation. Our results show that the faunal mediated contribution to the total oxygen uptake is about 20% for the global ocean floor and 45% for the global continental shelves. About 25% of this faunal mediated contribution is explained by direct respiration of macrofauna and meiofauna, the other 75% is linked to the stimulation of microbial decomposition through bio-irrigation.

Overall, our analysis suggests a large imprint of benthic fauna on the sedimentary processing of organic carbon, particularly in continental shelves and coastal sediments. This then suggests that the evolution of large burrowing fauna may have had a substantial impact on the rate of mineralization and sequestration of organic matter in marine sediments.