

GEOCHEMICAL AND TEXTURAL CHARACTERIZATION OF FRESH WATER MICROBIALITES OF LAGUNA, BACALAR, MEXICO

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Microbialites are amongst the oldest direct evidence of life [1]. Understanding how they are formed and the biosignatures they may disclose is important in understanding the evolution of early life on Earth. Microbialites reached their peak during the Proterozoic (>542 Ma) and drastically declined thereafter. The cause of which has been attributed to either grazing and/or burrowing by metazoans [2], or to changes in ocean chemistry leading to a drop in [CO₃²⁻] [3]. The recent discovery of rare, freshwater endolithic microbialites in Laguna Bacalar, Mexico offers a unique opportunity to test the interaction between burrowing and grazing organisms, calcium carbonate precipitation, and microbialite growth. The Bacalar microbialites vary from centimetre- to metre-sized structures. The larger of these show two distinct layer types: (a) stromatolitic layers composed of millimetre-thick laminae of cyanobacterial cells encrusted in a low Mg-calcite matrix, and (b) thrombolitic, centimetre-thick layers of rounded micritic peloids, randomly distributed in microsparite cement. In contrast, the smaller microbialites are always laminated with a stromatolitic fabric. We observe that unlike stromatolitic layers, thrombolitic layers occur during a period of higher sediment and contain a lower abundance of biolimiting trace elements (e.g., Mn, Mg, Fe). This suggests that the rapidity of such migration (due to cementation) leads to an increase in binding/trapping and the resulting thrombolitic texture. Additionally, microbialites and sediment have a similar C- and O-isotopic signature, unlike those of associated gastropods and bivalves, suggesting no vital effect and the preservation of an environmental signature. In conclusion, while the rate of microbialite growth is largely a function of CO₃²⁻ ion saturation, the texture is especially dependant on accretion rate. Furthermore, the variability of the trace element concentrations is highly dependant on texture dependant. The very coexistence of these thriving microbialites with grazing and burrowing organisms implies that these do not inhibit growth and, therefore, suggest that the decline in microbialite abundance and diversity during the Phanerozoic was likely due to other factors.

[1]Lowe (1980) *Nature* **284**, 441-443. [2] Garrett (1970) *Science* **169**, 171-173. [3] Grotzinger (1990) *Am J Sci* **290A**, 80-103

Deep water coral reefs as important sites of benthic mineralization?

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Benthic Oxygen Uptake rates measured on deep-water coral reef by Eddy Covariance (EC)

Deep-water coral reefs are unique biodiversity hotspots that are vulnerable to future environmental changes in response to climate change or fishing activities [1]. Accurately assessing the coral reef community metabolism is needed to ensure a suitable monitoring and management of these areas, but traditional methods are inadequate to map the complex 3D structure of these reefs.

Therefore the non-invasive EC technique has been used to measure in situ benthic respiration rates of a deep-water coral reef ecosystem and surrounding sponge-beds in the Træna Deep (Norway). EC measurements were contrasted with on-board oxygen incubations of living coral and bare sediments.

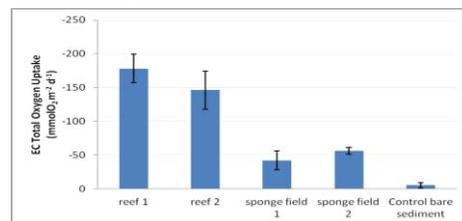


Figure 1: EC Total Oxygen Uptake rates (TOU, mmolO₂ m⁻² d⁻¹) at the Træna Deep site in June 2011.

Deep-water coral reefs: active benthic ecosystems

The Træna deep-water coral reefs have benthic oxygen consumption rates that are comparable to coastal benthic systems (TOU > 50 mmolO₂ m⁻² d⁻¹) and 35 times higher than bare sediments at comparable depth. If such high consumption rates are a common feature, deep water coral reefs are likely to play an important role in regional carbon cycles and need to be accounted for in global carbon budgets.

[1] Van Oevelen (2009) *Limnol. Oceanogr.*, **54**(6), 1829–1844