CONSTRAINTS ON THE EVOLUTION OF THE EDIACARA WITH SPECIAL CONSIDERATION OF THE MISTAKEN POINT RANGEOMORPH FAUNA. D.A. Gold[1], M. LaFlamme[2], D.T. Johnston[3], R.E. Summons[4], and D.K. Jacobs[1], [1]University of Califonia, Los Angeles [2] Yale University [3]Harvard University [4]Massachusetts Institute of Technology.

Introduction: The frondose rangeomorphs are a key member of fossil assemblages of late Precambrian (Ediacaran), and likely represent some of the first attempts at complex, multicellular life. It has recently been argued that the rangeomorphs subsisted on dissolved organic carbon, or DOC [1]. This argument is based on the morphology of rangeomrphs. It has also been argued that DOC was unusually high in the late Precambrian, although this point is contended. However, even assuming abundant levels of DOC, available oxidants and labile DOC should be used and eliminated by bacteria. Thus, one is lead to ask whether there is something about benthic rangeomorph form and scaling that permits them to take advantage of DOC. The answer to this question is likely to be positive, and involves details of the benthic boundary flow and the redox gradient. However, there are a number of areas where additional research would greatly clarify the limitations and constraints of such systems. For example, (1) although a range of modern marine animals are known to take up DOC, the relationship of this function to morphology combined with flow has not been systematically addressed; (2) models of the development of the boundary layer in a context such as that suggested by the Mistaken Point sedimentary environment have not been systematically applied in the context of the presence of the rangeomorph garden, which itself affects flow; (3) the fluxes of oxidants and reduced material have not been shown to balance the metabolic demands presented by the rangeomorphs and their surrounding environment; and lastly (4) the metabolic demand and oxidant supply in these contexts are likely to be strongly related to temperature, such that cold glacial bottom waters are likely to be critical to the development of complex multicellular marine heterotrophs. A major premise of our approach is that diffusion in boundary layers is limiting at low or no flow conditions. In this context, objects that can induce greater shear and turbulent mixing near their surfaces by sticking into flow will be at an advantage

Methods: In order to better understand these issues we are involved in several interrelated areas of research:

1) We survey DOC use in modern organisms relative to environmentally and organismal propelled flows over their surface morphology. This provides a better understanding of how morphology combined with flow effect DOC uptake.

2) We develop boundary layer flow models from modern analogue turbidite basin contexts (e.g. , using surface roughness ranging from bacterial mats (including topologically complex mats such as *Beggotia* [2]) to beds of large rangeomorphs. These allow some inferences of how much mixing of oxidants or DOC into the system is possible, and how three dimensional structure influences flux. The processes of advective flow at the at the surface of rangeomorphs will be considered down to the cellular level.

3) Models of fluxes of oxidants and labile DOC into the boundary layer are compared to estimates of the metabolic demand of the bacterial and rangeomorph communities. A variety of models are considered, including models with a benthic source of DOC and a water column source of oxidant, and models with the DOC in the water column. *However, one of the most critical variables is temperature, as bottom temperatures strongly effect benthic oxygen demand* [3].

These results will be discussed and placed in the broader paloeoceaongraphic context as well as the implication that ediacaran “faunal” evolution was likely made possible by the greater redox potential associated with cold water derived from the glacial/post glacial Ediacaran context.

References:

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