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Discussions

# *Interactive comment on* "Long-distance electron transport occurs globally in marine sediments" *by* Laurine D. W. Burdorf et al.

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This article addresses the question of how widespread is the occurrence of electrogenic cable bacteria in marine sediments. These novel bacteria were discovered in recent years and found to produce unique biogeochemical signatures in surface sediments. Oxygen reduction and sulfide oxidation mediated over centimeter scales by cable bacteria are readily detected by measuring microsensor profiles of porewater dissolved oxygen, pH, hydrogen sulfide and electrical potential. Cable bacteria belong to the family Desulfobulbaceae and may be identified by fluorescence in situ hybridization molecular staining techniques and by electron microscopy. The paper describes how a combination of these methods has been applied to detect cable bacteria presence in sediments from locations from around the globe.



I read the paper with great interest and offer only a few comments/suggestions for consideration along with some minor editorial suggestions.

Comments:

1. A distinctive ridge pattern that runs in parallel to the longitudinal axis of cells in filaments is described by the authors in section 2.6 of the paper as a characteristic that "unequivocally confirms that cable bacteria are present". This pattern is observed using scanning electron microscopy and illustrated in Figure 2. However, other SEM images of filaments in Figures 5 and 7 do not appear to show longitudinal ridges. How do the authors explain this? Are there cable bacteria species that do not have the ridges? Can the ridges be covered by sheath materials? Do the authors attribute cell diameters of 0.7-3 $\mu$m to be all inclusive and/or to indicate different species?

2. The direct measurement of an electrical potential (EP) that is generated in the sediment in the presence of electrogenic sulfide oxidation separated in space from oxygen reduction is described as a means to demonstrate cable bacteria activity. This EP is likely a new concept for most readers, and its measurement involves a new microsensor described by Damgaard et al. (2014). The paper would be improved if more background information was given to explain the origin of these electrical potentials and how they differ from the concept of sediment "redox potential". What does it mean that a voltmeter was used for the measurements with "MB 11mV"? How much signal drift was observed? If as stated the authors averaged readings taken from two profiles, one going down into the sediment and the second in reverse, then measurements at the base of a profile would be measured close in time (with little drift) while measurements at the top of the profile would be affected by the most possible drift. This could impose drift artifacts. Furthermore, how was the salinity of the overlying water "set to match the salinity of the porewater"? How small a difference in salinity in the overlying water would bias the EP measurements?

3. Profiles of pH that show a near surface maximum and low subsurface values leading

to pH excursions > 1 pH unit are described as indicative of spatially separated redox half reactions mediated by cable bacteria. The authors note in section 4.1.4 a pH profile from Santa Monica Basin measured by Reimers et al. (1996) has this form. However, they say little more about this location or the profile. Several studies have characterized Santa Monica Basin porewater chemistry including a paper by Jahnke, R. A. (1990) Early diagenesis and recycling of biogenic debris at the seafloor, Santa Monica Basin, California. J. Mar. Res 48:413-436. Of note, bottom water pH values are relatively low in Santa Monica Basin and so is the bottom water dissolved oxygen concentration. This may be why the pH excursion observed is only about 0.4 pH units. It would seem that sites where the overlying water is in equilibrium with atmospheric oxygen and atmospheric CO2 are more poised to produce the large pH excursions described by the authors.

Minor Editorial Suggestions:

Page 1, Line 20: The locales listed here in the abstract are not "oceanographic regions or climate zones". It would be more accurate to say "(coastal sites off The Netherlands, Greenland, the USA and Australia)".

Page 1, Line 29. Change to "induce electron transport" (drop "an").

Page 2, Line 4. Change to "electro-active marine sediments hosting cable bacteria."

Page 2, Lines 24-25. Change to "cable bacteria may extend well beyond the sediment and impact the water column chemistry".

Page 2, Lines 33-34. Change to "only a few reports from a restricted number of coastal sites and habitats describe cable bacteria."

Page 3, Line 13. Change to "cable bacteria in seafloor sediments". If you were considering "the seafloor" you would be considering all types of substrates including bare rock. Same comment applies on page 4, line 10.

Page 4, Line 18. Reword as "Metabolic activity in the field can be detected either by in



situ microsensor profiling. . ... either on shipboard. . ."

Page 4, Line 23. Reword as "Cores from deeper areas were retrieved using a gravity core sampler. . .."

Page 5, Line 5. Reword as "in a fashion similar to previous studies. . ."

Page 5, Line 9. Reword as "allows assessment of cable bacteria effects on the. . .."

Page 6, Line 18. Provide after "the R package marelac" some reference or description to explain what this is, who developed it, and where it is available.

Page 16, Line 13. Reword as: "The subsequent development of e-SOx can be rapid."

Page 16, Line 21. The evidence here is only suggestive so best to reword as "however, suggest the presence of cable bacteria. . .."

Figure 3. Give units for EP.

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