Giant Oceanic Fuel Cell Hypothesis for Dark Oxygen and Manganese Nodules

Terry Bollinger
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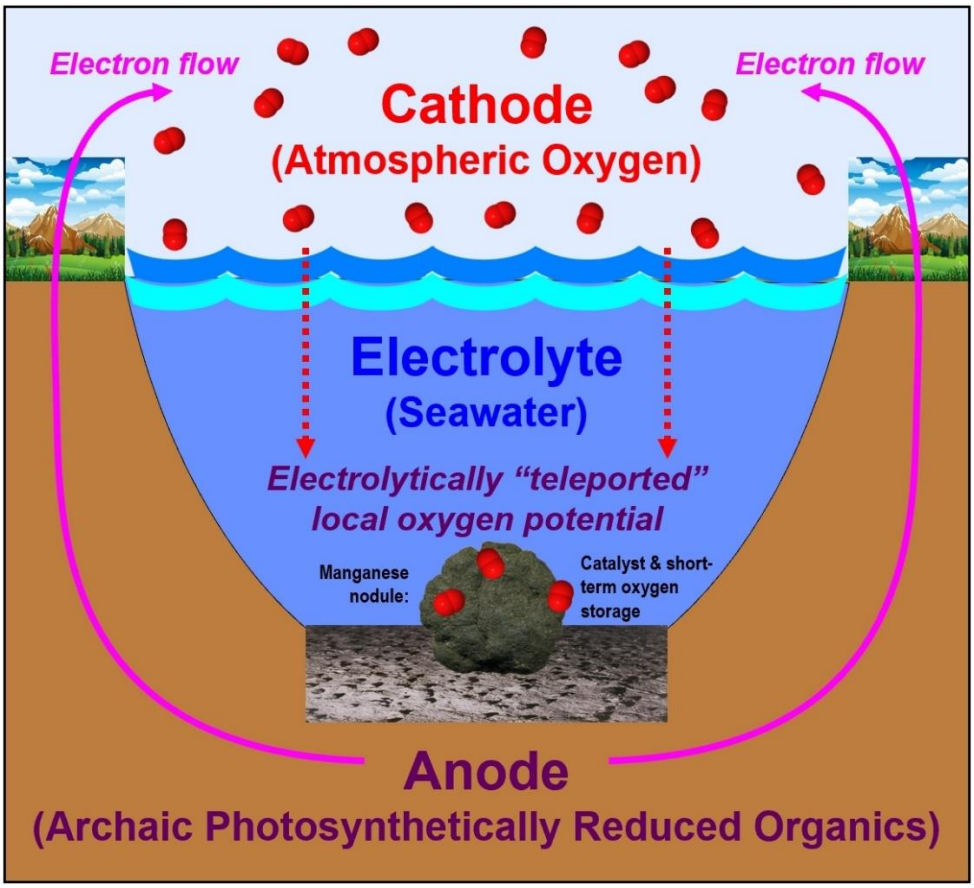

Giant Oceanic Fuel Cell Hypothesis with electrolytically "teleported" oxygen potential

In her July 27, 2024 (Saturday) YouTube video *Discovery of "Dark Oxygen" Produced at the Sea Floor Where No Light Can Reach!* [1], Dr. Rachel Phillips (YouTube GEO GIRL [2]) discusses a recent paper [3] speculating that a battery effect involving seafloor manganese modules might be responsible for generating "dark oxygen" (non-photosynthetic oxygen) at dark ocean depths. The next day, Dr. Ben Miles (YouTube) [4] posted a more detailed (and noticeably more skeptical video) on the same topic [5]. While the premise of these nodules continuously generating oxygen in stable seafloor systems is neither chemically nor energetically plausible, speculation by one commenter on Dr. Phillips' video brought up a more interesting and energetically plausible "giant battery" concept that could prove relevant not just for continuously generating low levels of oxygen on some seafloors, but might also help explain the formation of manganese modules. The mildly edited GEO GIRL discussion is given below.

GS-cl4qg (YouTube) asked on Sunday, July 28, 2024 [6]:
Could the ocean be a giant battery, heated by the sun, producing electrolysis, and the nodules a byproduct?

TerryBollinger (YouTube) replied on Sunday, July 28, 2024 [7]:

GS-cl4qg, hmm, for whatever it's worth, I find your "giant battery" hypothesis a lot more interesting than the energetically implausible dark oxygen generation hypothesis in this paper. It would not use heat, however.

Your giant battery would be something like a fuel cell. Oxygen at the surface would act as the cathode (the carbon rod in an AA battery), the ocean as the electrolyte, and reduced organic sediments in the seafloor as the anode (the metallic part of the battery) that slowly gets eaten up (oxidized) to produce the (very weak) electric current.

That is… oddly plausible! The question would be why and how the tiny electrical current passing out of the anode (seafloor) and into the electrolyte (seawater) generates minuscule amounts of oxygen. This dark oxygen production would be a side effect of the interaction of that tiny electrical current with other components at the seafloor-ocean interface, resulting in localized recreation of the oxygen potential (and actual oxygen) driving the battery from the surface. This process might well include those nodules or perhaps be related to their slow formation. The nodules would not be driving it but would be another byproduct, just like the dark oxygen.

The mental image that comes to mind is a sort of electrochemical "teleportation" of oxygen from the surface down to the microscopic ocean electrolyte interface with the sediment anode. No actual oxygen atoms would be transported, of course, but the weak electric currents would reproduce the oxygen from water in much closer proximity to the seafloor anode.

Most of that oxygen potential would never materialize, and probably even most of what would materialize within be consumed by the sediments of the sea floor. However, even a tiny bit of leakage of the "teleported" surface oxygen would be sufficient to explain the minute levels of dark oxygen observed.

Again, this could also be highly relevant to how the nodules form. Such teleported oxygen would be capable of pulling some minerals out of the seawater and might explain the slow formation of interesting metal oxides on the nodule surfaces.

That's an amazingly interesting speculation you made, madam or sir, whoever you may be in real life. Thank you!

References

[1] R. Phillips, *Discovery of "Dark Oxygen" Produced at the Sea Floor Where No Light Can Reach!*, GEO GIRL (YouTube), 2024-07-27.09:30 EDT [July 27, Sat] (2024). https://youtu.be/tDv09qM_YlE

[2] GEO GIRL (YouTube), https://www.youtube.com/@GEOGIRL

[3] A. K. Sweetman et al., *Evidence of dark oxygen production at the abyssal seafloor*, Nature Geoscience, 1–3, (2024). doi: https://doi.org/10.1038/s41561-024-01480-8.

[4] Dr Ben Miles (YouTube), https://www.youtube.com/@DrBenMiles

[5] B. Miles, *We Just Discovered "Dark" Oxygen on Earth — Breakthrough Explained*, Dr Ben Miles (YouTube), 2024-07-28.11:00 EDT [July 28, Sun] (2024). https://youtu.be/iixZ6UptVNo

[6] @GS-cl4qg (YouTube) at 2024-07-28.11:30 EDT Sun: https://youtu.be/tDv09qM_YlE&lc=UgxGlTq50OjGoazaatx4AaABAg.A6RBNbDX5NkA6RbdRuE7Pa

[7] @TerryBollinger (YouTube) at 2024-07-28.1315 EDT Sun: https://youtu.be/tDv09qM_YlE&lc=UgxGlTq50OjGoazaatx4AaABAg.A6RBNbDX5NkA6RrmLpFbT3