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Paleobiology

Hydrothermal Vents and the Origin of Life (2008)

**Article Summary**

This article dives into the question: what is the origin of life? The authors state that there is sufficient evidence pointing to hydrothermal vents as the place where life began. They begin by demonstrating the importance of organic compounds in relation to geology, chemistry and biology. Additionally, we are told that black smokers, which lie directly above a magma chamber, differ from hydrothermal vents, like the Lost City, in that they lie several kilometer away from a mid ocean ridge. The microbial life at the Lost City is able to survive due to anaerobic methane oxidation, as well as sulfur oxidation. The authors suggest that the Lost City methanosarcinales group and ANME-1 are oxidizing, enabled by hydrogen in the surrounding setting. This leads to the concept of autotrophic origins – that autotrophs used carbon in and an electron from hydrogen to begin simple organic carbon compounds. Furthermore, a pH of 9-10 at the interior of chimneys during the Hadean were crucial for the life of the microbes. Overall, the authors believe that there is sufficient evidence supporting the idea that organic carbon/life could have begun at hydrothermal vents, but they need to be studied further.

**Things you liked about the paper**

I think the additional boxes with extra information helped support various topics that were left of the actual article. They were in depth into difference fields of science that may be unbeknownst to the reader. The table with anaerobic and aerobic microbial metabolic reactions and potential energy yields in hydrothermal vent environments helped to organize the information they were giving in the article. It was a good way to show the data in a clear manner. Additionally, I think the pictures of hydrothermal vents and black smokers helped to visual what they were talking about. It can be difficult to imagine the environment surrounding these structures without prior knowledge or research on them.

**Things you did not like about the paper**

When rereading the article, I noticed that it mentions RNA at both the introduction and the conclusion. RNA is not mentioned anywhere else in the paper (with the exception of Box 3, but there is not a lot of information bringing the two concepts together). The authors talk about other organic carbons, but not about hypotheses about how the organic carbon became RNA. Mentioning RNA and then not signaling the importance it has to their topic creates more questions than answers. Adding their ideas of how RNA formed at hydrothermal vents or black smokers in the paper, and not in the box, would have helped to highlight the importance of mentioning RNA in the beginning.

Throughout the article, there was a plethora of references noted, but a lack of explanation. For an article that seems to be a summary based on others research, there was a lot of assumptions that the reader would have prior knowledge to many difference areas of science: geology, biology, and chemistry. I think more in depth explanations and analyses would have made the paper an easier read for a larger audience.

**Evaluate the graphs and figures (if any)**

The first figure shows the distribution of known hydrothermal vents across the globe. The figure conveys that even though many sites of hydrothermal vents are known, there are many places where we can estimate them to be, even though detailed explorations have not been conducted in those areas. Including an additional map or combining this map with a map of black smokers would show the relative distances they form from one another, and help convey that the two exist in different environments.

The second figure first shows five images: a black smoker picture, a temperature gradient of the black smoker, and the last there are pictures of hydrothermal vents at the Lost City. The figure contrasts black smokers and hydrothermal vents, as well as shows microbial and fish life in the Lost City environment. I think add additional pictures of these would help improve the article, because not every reader will be familiar with the strange environments surrounding these features.

The third figure is a table showing anaerobic and aerobic microbial metabolic reactions with examples of their vent environments and their potential energy yields. The figure shows the various ways in which microbes have learned to survive in a variety of harsh environments. If they added examples of more commonly known reactions’ potential energy yields, I think it would have been easier to comprehend the significance of the large range of values.