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Period 8

This sheet provides easy access for later use whenever you read an article, pertinent book chapter, or research on the web, use the following format to make an electronic record of your notes for later use. Put quotation marks around any exact wording you write down so that you can avoid accidental plagiarism when you later cite the article.

Complete citation.

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| [1] | M. Levy and S. L. Miller, "The stability of the RNA bases: Implications for the origin of life," *Proc. Natl. Acad. Sci. USA,* vol. 95, pp. 7933-7938, 8 May 1998. |

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Key Words: Nucleotides, Origin-of-life

General subject: High-temperature origin-of-life theories, origins of life in general, nucleotides and their half-lives, stability of nucleotides.

Specific subject: The impact of temperature on the half-lives of nucleotides.

Hypothesis: At high temperatures (100 degrees Celsius), the half-lives of nucleotides would be impacted.

Methodology:

Chemicals were provided by Sigma, Caliochem, and Aldrich. For the nucleic bases, adenine was provided by Aldrich while the others were provided by Sigma.

A Beckman model was used to analyze samples.

To calculate decomposition rates, and ultimately half-lives, the time of disappearance of at least 10% of each base was used.

Rates for Cytosine and Adenine were calculated from the appearance of decomposition products for some low temperature reactions.

The concentration of all bases other than xanthine was 1\*10-3 M.

Buffers were used to control the pH levels of each base.

To avoid Oxygen interference, all samples were cooled in dry ice and sealed in a vacuum.

Result(s):

The half-lives for the bases at 350 degrees Celsius did not exceed 15 minutes. At 250 degrees, these half-lives do not exceed 35 minutes. At 100 degrees, half-lives range from 19 days (C) to 56 years (T). Going down to 25 degrees, these half-lives range from 340 years to roughly 10000 years. At 0 degrees, these half-lives range from 6000000 years to 200000000 years with the exception of Cytosine.

Summary of key points:

Based on these results, the Earth most likely did NOT start off super, super hot due to the shorter half lives at higher temperatures. Also, Cytosine is very unstable and it was concluded it may have not been a suitable base for the first genetic material.

Context (how this article relates to other work in the field; how it ties in with key issues and findings by others, including yourself): This article offers insight to the origins of life, a field with conflicting theories. Articles cited in this article disagree with each other regarding high-temperature origin-of-life theories at temperatures of 80-110 degrees Celsius. Some articles discuss theories involving temperatures up to 350 degrees Celsius.

Significance (to the field; in relation to your own work): This article proves that there is no way that the Earth started out at 350 degrees Celsius with the nucleotides A, G, C, T, and U. It also showed that the higher the temperature, the shorter the half-life. This conclusion suggests that Earth possibly did not start out at a high temperature origin.

Important Figures and/or Tables (brief description; page number):

Figure 1 – This graph shows Adenine and Guanine decomposition rates at different pH and at different temperatures. It shows that for both nucleotides and for all temperatures, the decomposition rate is fastest at 0 and slowest at around 5.5, while increasing gradually as it approaches 10. No data was collected for any pH levels beyond 10. It is also notable that at all pH levels, temperature increase increased the decomposition rate.

Figure 2 – This graph shows the five nucleotides in DNA and RNA and their half-lives by temperatures. It is notable that the half-lives exponentially decrease as temperature decreases. It is also notable that Cytosine has the shortest half-lives, Guanine and Adenine have roughly equal half-lives, and Thymine and Uracil has roughly equal half-lives, with Thymine just ahead of it.

Figure 3 – This graph is the same graph as Figure 2, except it shows different nucleotides, which are Hypoxanthine, Diaminopyrimidine, and Xanthine.

Cited References to follow up on (cite those obviously related to your topic AND any papers frequently cited by others because those works may well prove to be essential as you develop your own work):

Reference number 15 was cited by 162 other journals according to Springer. This article, Origins Live Evol, Biosphere was written by EL Shock and offers insight to high-temperature theories of life. This article is one of few mentioned that promote theories starting at 350 degrees Celsius and contradicts Miller’s conclusion.

Other Comments:

This article was very clear, and the graphs were easy to comprehend. I did not know that origin of life theories could be concluded by nucleotides themselves.