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New Theory about Origin of Life to Be Published by Journal of Theoretical Biology

In a new article published in this week's online edition of the Journal of Theoretical Biology, Helen Hansma, a retired UC Santa Barbara research scientist, has updated her theory about the origin of life and how the secret might lie between sheets of mica. Hansma originally proposed this hypothesis in 2007, first reported here:

<http://www.ia.ucsb.edu/pa/display.aspx?pkey=1697>

The National Science Foundation (NSF) is now featuring Hansma's hypothesis, based on the article in the Journal of Theoretical Biology. Below is the text of the press release, issued today by the NSF.

The Secret of Life May Be as Simple as What Happens Between the Sheets -- Mica Sheets

That age-old question, "where did life on Earth start?" now has a new answer.

If the life between the mica sheets hypothesis is correct, life would have originated between sheets of mica that were layered like the pages in a book.

The so-called "life between the sheets mica hypothesis" was developed by Helen Hansma of the University of California, Santa Barbara with funding from the National Science Foundation (NSF). It was originally introduced by H. Hansma at the 2007 annual meeting of the American Society for Cell Biology, and is now fully described by H. Hansma in the September 7, 2010, issue of *Journal of Theoretical Biology*.

According to the "life between the sheets" mica hypothesis, structured compartments that commonly form between layers of mica—a common mineral that cleaves into smooth sheets—may have sheltered molecules that were the progenitors to cells.

Provided with the right physical and chemical environment in the structured compartments to survive and evolve, the molecules eventually reorganized into cells, while still sheltered between mica sheets.

Mica chunks embedded in rocks could have provided the right physical and chemical environment for pre-life molecules and developing cells because:

1. Mica compartments could have held, protected and sheltered molecules, and thereby promoted their survival.

Also, mica could have provided enough isolation for molecules to evolve without being disturbed and still allow molecules to migrate towards one another and eventually bond together to form large organic molecules.

And mica compartments may have provided something akin to a template for the production of a life form composed of compartments, which are now known as cells.

2. Mica sheets are held together by potassium.

If high levels of potassium were donated by mica sheets to developing cells, the high levels of potassium found in mica sheets could account for the high levels of potassium currently found in human cells.

3. Mica chunks embedded in rocks that were sitting in an early ocean would have received an endless supply of energy from waves, the sun, and the occasional sloshing of water into the spaces between the mica sheets.

This energy could have pushed the mica sheets into up-and-down motions that could have pushed together molecules sitting between mica sheets, thereby enabling

them to bond together.

Because mica surfaces are hospitable to living cells and to all the major classes of large biological molecules, including proteins, nucleic acids, carbohydrates and fats, the "between the sheets" mica hypothesis is consistent with other well-known hypotheses that propose that life originated as RNA, fatty vesicles or primitive metabolisms.

H. Hansma says a "mica world" might have sheltered all the ancient metabolic and fat-vesicle and RNA "worlds."

H. Hansma also says that mica would provide a better substrate for developing cells than other minerals that have been considered for that role.

Why?

Because most other minerals would probably have tended to intermittently become either too wet or too dry to support life.

By contrast, the spaces between mica sheets would probably have undergone more limited wet/dry cycles that would support life without reaching killing extremes.

In addition, many clays that have been considered as potential surfaces for life's origins respond to exposure to water by swelling.

By contrast, mica resists swelling and would therefore provide a relatively stable environment for developing cells and biological molecules, even when it did get wet.

H. Hansma sums up her hypothesis by observing that "mica would provide enough structure and shelter for molecules to evolve but also accommodate the dynamic, ever-changing nature of life."

What's more, H. Hansma says that "mica is old."

Some micas are estimated to be over 4 billion years old.

And micas such as biotite have been found in regions containing evidence of the earliest life-forms, which are believed to have existed about 3.8 billion years ago.

H. Hansma's passion for mica evolved gradually --starting when she began conducting pioneering, NSF-funded research in Paul K. Hansma's AFM lab to develop

techniques for imaging DNA and other biological molecules in the atomic force microscope (AFM) - a high-resolution imaging technique that allows researchers to observe and manipulate molecular and atomic level features.

"Mica sheets are atomically flat, so we can see DNA molecules on the mica surface without having to cover the DNA with something that makes it look bigger and easier to see,"

says H. Hansma. "Sometimes we can even see DNA molecules swimming on the surface of mica, under water, in the AFM. Mica sheets are so thin (one nanometer) that there are a million of them in a millimeter-thick piece of mica."

H. Hansma's "life between the sheets" hypothesis first struck her a few years ago, after she and family had members collected some mica from a Connecticut mine.

When she put water on a piece of the mica under her dissecting microscope, she noticed a greenish organic "crud" at some step edges in the mica.

"It occurred to me that this might be a good place for the origins of life--sheltered within these stacks of sheets that can move up and down in response to flowing water, which could have provided the mechanical energy for making and breaking chemical bonds," says H. Hansma.

H. Hansma says that recent advancements in imaging techniques, including the AFM, made possible her recent research, leading to her "between mica sheets" hypothesis. She adds that direct support for her hypothesis might be obtained from additional studies involving mica sheets in an AFM, being subjected its push-and-pull forces while sitting in liquids resembling an early ocean.

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