New hypothesis for origin of life proposed

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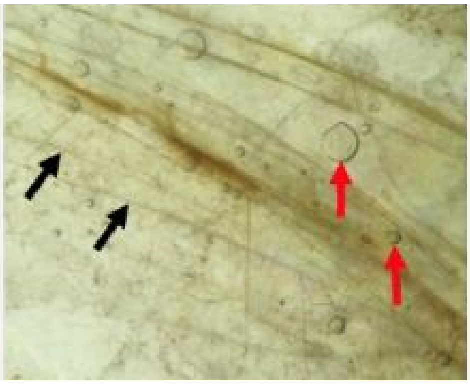

Photo of mica from an abandoned mica mine, with water between some layers, showing edges of mica sheets [e.g., black arrows] and air bubbles in the water [red arrows] and brown bands of organic crud and dirt. Credit: Helen Greenwood Hansma, UC Santa Barbara

Life may have begun in the protected spaces inside of layers of the mineral mica, in ancient oceans, according to a new hypothesis.

The hypothesis was developed by Helen Hansma, a research scientist with the University of California, Santa Barbara and a program director at the National Science Foundation. Hansma will present her findings at a press briefing on Tues., Dec. 4, at the annual meeting of the American Society for Cell Biology in Washington, D.C.

The Hansma mica hypothesis proposes that the narrow confined spaces between the thin layers of mica could have provided exactly the right conditions for the rise of the first biomolecules — effectively creating cells without membranes. The separation of the layers would have also provided the isolation needed for Darwinian evolution.

“Some think that the first biomolecules were simple proteins, some think they were RNA, or ribonucleic acid,” said Hansma. “Both proteins and RNA could have formed in between the mica sheets.”

RNA plays an important part in translating the genetic code, and is composed of nitrogenous bases, sugar, and phosphates. RNA and many proteins and lipids in our cells have negative charges like mica. RNA’s phosphate groups are spaced one half nanometer apart, just like the negative charges on mica.

Mica layers are held together by potassium. The concentration of potassium inside the mica is very similar to the concentration of potassium in our cells. And the seawater that bathed the mica is rich in sodium, just like our blood.

The heating and cooling of the day to night cycle would have caused the mica sheets to move up and down, and waves would have provided a mechanical energy source as well, according to the new model. Both forms of movement would have caused the forming and breaking of chemical bonds necessary for the earliest biochemistry.

Thus the mica layers could have provided the support, shelter, and an energy source for the development of precellular life, while leaving artifacts in the structure of living things today.

Besides providing a more plausible hypothesis than the prebiotic oceanic “soup” model, Hansma said her new hypothesis also explains more than the so-called “pizza” hypothesis. That model proposes that biomolecules originated on the surfaces of minerals from the Earth’s crust. The “pizza” hypothesis cannot explain how the earliest biomolecules obtained the right amount of water to form stable biopolymers.

A biophysicist, Hansma has worked with mica for decades beginning with her work in biological Atomic Force Microscopy (AFM) in the late 1980s. “We put our samples on mica, because it is so atomically flat, so flat that we can see even bare DNA molecules as little ridges on the mica surface,” said Hansma. “The layered mineral is made of sheets so thin (one nanometer) that there are a million of them in a millimeter-thick sheet of mica.”

Hansma came upon her idea one day last spring when she was splitting some mica under her dissecting microscope. She had collected the specimens in a mica mine in Connecticut. The mica was covered with organic material. “As I was looking at the organic crud on the mica, it occurred to me that this would be a good place for life to originate — between these sheets that can move up and down in response to water currents which would have provided the mechanical energy for making and breaking bonds,” said Hansma.

Source: University of California - Santa Barbara