Energy: A Clue to the Origins of Life

Dr Helen Greenwood Hansma
The Department of Physics
University of California, Santa Barbara
USA

E: hhansma@physics.ucsb.edu

Before the first living organisms were brought into being, molecules were already moving and changing. Many energy sources, including light and heat from the sun, were available to provide the energy needed to drive chemical reactions. Mechanical energy, which describes the energy of motion, was also readily available before life's emergence.

Dr Helen Greenwood Hansma from the University of California in Santa Barbara explores how mechanical energy could have driven the processes that gave rise to early life. She suggests that the prevalence of mechanical energy in living systems today could even be a remnant of the mechanical energy that drove the emergence of life.

Scientific methods that use mechanical energy to drive chemical reactions in the laboratory are a useful tool to understand how mechanical energy at life's origins would behave. Studies have shown that using alternating cycles of dry and wet conditions in conjunction with solid materials can produce the larger molecules essential for life.

These wet and dry cycles have the advantage of concentrating any pre-life molecules during the drying phase, bringing them closer together and increasing the likelihood that they will react to form larger molecules, on the pathway to the origin of life. Such cycles occur on mineral surfaces – such as mica.

Mica is remarkable because it has extremely thin sheets of tightly stacked crystals. These sheets are held together by positively charged potassium ions. Mostly, these sheets remain tightly packed and impenetrable, but over repeated cycles of wetting and drying, water can seep between the edges of the sheets, providing a protective and wet environment – perfect for life.

As the mica sheets move, opening and shutting in response to water flow, a source of mechanical energy is provided. This energy could have powered the chemical reactions that gave rise to life.

Dr Hansma's research has revealed other compelling evidence supporting mica as the site of life's emergence.

All types of living cells have high concentrations of potassium, the origin of which remains a mystery. The simplest hypothesis is that life emerged in an environment that was high in potassium: just like the spaces between mica sheets.

Additionally, both the surface of mica and the molecules of DNA are negatively charged, which means that they are easily held together by positively charged potassium ions between them. This means that longer DNA strands stick to mica surfaces better than shorter ones, providing a longer period for DNA to grow large enough to store the coding information vital to life.

Understanding where and how life on this planet emerged is one of the most enduring scientific pursuits. Dr Hansma's research demonstrating mechanisms for the provision of mechanical energy and potassium could help us build a full picture of how life first emerged from non-living groups of molecules.

Summary of the paper **'Mechanical Energy before Chemical Energy at the Origins of Life?'**, in Sci. doi.org/10.3390/sci2040088