UNIVERSITÀ DEGLI STUDI DI TRENTO

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PRESS RELEASE

Sun, iron and sulfur: How life began

A research team led by the CIBIO - University of Trento reveals how solar energy could have contributed to the activation of the iron-sulfur clusters needed for the origin of life on our planet. The study in Nature Chemistry

July 17th 2017. A new study led by the University of Trento explains the biochemical mechanism that might have originated **life** on Earth. The article, published in *Nature Chemistry*, unveils the role of the iron-and-sulfur clusters in the probiotic evolution, solving at the same time a long-lasting paradox about the first living cells on our planet.

To survive, all organisms need **energy**. But to produce that energy, living creatures depend on the metabolic activity of a complex of metal ions that are coordinated to proteins: the so-called **iron-sulfur clusters**.

Although iron-sulfur clusters are thought to be evolutionarily ancient, it has also been presumed that iron-sulfur clusters were not present on the prebiotic Earth. That was the paradox: how is it possible that the first living cells were born without energy?

The new study in *Nature Chemistry* answers this question for the first time. According to the scientists, the iron and sulfur clusters, at the base of what enzymes needed for life, could have occurred in the primordial sea about **4 billion years ago**. This process was triggered by some primitive biomolecules, iron salts, 'activated' by a previously unknown ingredient: **ultraviolet (UV) light**.

This suggests that nothing but the **Sun** was primarily responsible for the birth of life, together with the **iron-sulfur clusters** that started the first metabolic activities thanks to the energy produced by our star.

"We found that prebiotically plausible short peptide precursors to modern day proteins could have served as a scaffold for the assembly of iron-sulfur clusters" says **Sheref Mansy**, researcher at the CIBIO – Centre for Integrative Biology at the University of Trento and leader of the study. "Amazingly, the process was aided by sunlight in a manner that was reminiscent of the types of chemistry exploited by modern day cells."

The resulting iron-sulfur peptide complexes could perform similar chemical reactions as modern day iron-sulfur proteins. This work helps to delineate a logical, prebiotically plausible path from the molecules that were likely present on the prebiotic Earth to contemporary proteins.

"More importantly," the researcher continues, "our work gives insight into how metabolism could have emerged. This is important, because without metabolism, a cell cannot survive. Indeed, we all must eat to survive."

The condition described by Mansy and colleagues is compatible with the famous **warm little pond** that **Darwin** hypothesized for the origin of life more than 150 years ago.

"A warm little pond hypothesis," Many explains, "implies surface conditions on prebiotic Earth, and thus sunlight exposure."

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“The role of metals,” he concludes, “has been surprisingly ignored by the origins of life community. This is strange, because between 1/3 to 1/2 of all proteins are metalloproteins. Life as we know it is completely dependent on metals and Earth is rich in metals. Therefore, it’s logical that life began by exploiting metals. I hope that our work brings more attention to the importance of metals to life and the origins of life.”

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Sheref Mansy, leader of the study, moved to Trento after winning the **Career Development Award** grant of the Armenise-Harvard Foundation. At CIBIO Mansy’s laboratory focuses on finding, at the cellular level, any intermediate steps between what is inanimate and what is not. More specifically, creating cells that can “breathe” artificially: cellular models to investigate thoroughly the distinction between living and non-living chemical systems. This approach may help better understanding the precise biochemical mechanisms that led to the ‘very first instant of life’ on Earth.

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