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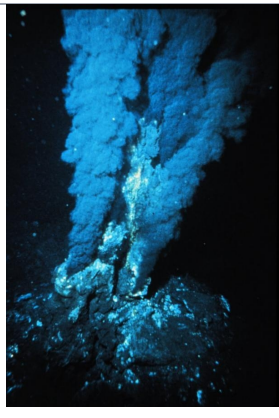
Earth's Original Ancestor Was 'LUCA'

December 19, 2008

University of Montreal

Evolutionary geneticists have published a ground-breaking study that characterizes the common ancestor of all life on earth, LUCA (last universal common ancestor). Their findings show that the 3.8-billion-year-old organism was not the creature usually imagined.



Black smoker at a mid-ocean ridge hydrothermal vent. Researchers generally believe that LUCA (Last Universal Common Ancestor) was a heat-loving or hyperthermophilic organism, similar to those found today that live deep under the ocean in hot vents along continental ridges. New evidence, however, suggests that LUCA was actually sensitive to warmer temperatures and lived in a climate below 50 degrees.

Credit: P. Rona; OAR/National Undersea Research Program (NURP); NOAA [Click to enlarge image]

An evolutionary geneticist from the Université de Montréal, together with researchers from the French cities of Lyon and Montpellier, have published a ground-breaking study that characterizes the common ancestor of all life on earth, LUCA (Last Universal Common Ancestor).

Their findings, presented in a recent issue of Nature, show that the 3.8-billion-year-old organism was not the creature usually imagined.

The study changes ideas of early life on Earth. "It is generally believed that LUCA was a heat-loving or hyperthermophilic organism. A bit like one of those weird organisms living in the hot vents along the continental ridges deep in the oceans today (above 90 degrees Celsius)," says Nicolas Lartillot, the study's co-author and a bio-informatics professor at the Université de Montréal. "However, our data suggests that LUCA was actually sensitive to warmer temperatures and lived in a climate below 50 degrees."

The research team compared genetic information from modern organisms to characterize the ancient ancestor of all life on earth. "Our research is much like studying the etymology of modern languages so as to reveal fundamental things about their evolution," says professor Lartillot. "We identified common genetic traits between animals, plant, bacteria, and used them to create a tree of life with branches representing separate species. These all stemmed from the same trunk – LUCA, the genetic makeup that we then further characterized."

Reconciling conflicting data

The group's findings are an important step towards reconciling conflicting ideas about LUCA. In particular, they are much more compatible with the theory of an early RNA world, where early life on Earth was composed of ribonucleic acid (RNA), rather than deoxyribonucleic acid (DNA).

However, RNA is particularly sensitive to heat and is unlikely to be stable in the hot temperatures of the early Earth. The data of Dr. Lartillot with his collaborators indicate that LUCA found a cooler micro-climate to develop, which helps resolve this paradox and shows that environmental micro domains played a critical role in the development of life on Earth.

From RNA to DNA: Proof of evolution

"It is only in a subsequent step that LUCA's descendants discovered the more thermostable DNA molecule, which they independently acquired (presumably from viruses), and used to replace the old and fragile RNA vehicle. This invention allowed them to move away from the small cool microclimate, evolved and diversify into a variety of sophisticated organisms that could tolerate heat," adds Dr. Lartillot.

The study was authored by Bastien Boussau (CNRS, Université Lyon), Samuel Blanquart (LIRMM, CNRS: France), Anamaria Necsulea (CNRS, Université Lyon), Nicolas Lartillot (Université Montreal), and Manolo Gouy (CNRS, Université Lyon).

Funding was provided through grants from Action Concerteé Incitative IMPBIO-MODELPHYLO and ANR PlasmoExplore.

Story Source:

The above story is based on materials provided by **University of Montreal**. *Note: Materials may be edited for content and length.*

Journal Reference:

1. Bastien Boussau, Samuel Blanquart, Anamaria Necsulea, Nicolas Lartillot, Manolo Gouy. **Parallel adaptations to high temperatures in the Archaean eon**. *Nature*, 2008; 456 (7224): 942 DOI: 10.1038/nature07393

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