Researchers shed light on ancient origin of life

March 7 2013, by April Reese Sorrow

(Phys.org) —University of Georgia researchers discovered important genetic clues about the history of microorganisms called archaea and the origins of life itself in the first ever study of its kind. Results of their study shed light on one of Earth's oldest life forms.

"Archaea are an ancient form of microorganisms, so everything we can learn about them could help us to answer questions about the origin of life," said William Whitman, a microbiology professor in the Franklin College of Arts and Sciences and co-author on the paper.

Felipe Sarmiento, lead author and doctoral student in the microbiology department, surveyed 1,779 genes found in the genome of Methanococcus maripaludis, aquatic archaea commonly found in sea marshes, to determine if they were essential or not and learn more about their functions. He found that roughly 30 percent, or 526 genes, were essential. We now know which genes are driving the most important functions of the cell. The results of the study were published March 4 in the *PNAS Early Edition* and were performed with Jan Mrázek, an associate professor in the department of microbiology and the UGA Institute of Bioinformatics.

Although archaea are relatively simple organisms, the genetic systems they use to build cellular life are similar to those of more complicated eukaryotic cells found in complex organisms including animals and plants. For this reason, many scientists believe that eukaryotes evolved from ancient archaea.

These genetic systems are what allow information coded on DNA to build life.

"DNA by itself is a rock," Whitman said. "You need all these other systems to make the DNA become a living cell."

Because DNA is so fundamental to the modern cell, DNA synthesis has long been thought to be one of the most conserved processes in living organisms.

"It was a surprise when this study found that the system for making DNA was unique to the archaea," Whitman said. "Learning that it can change in the archaea suggest that ability to make DNA formed late in the evolution of life. Possibly, there may be unrecognized differences in DNA biosynthesis the eukaryotes or bacteria as well."

Other essential genes in these archaea are necessary for methane production. Methanogensis, or the process of making methane gas, is how these microorganisms make energy for life.

"Humans burn glucose and reduce oxygen to water, these guys burn hydrogen gas and reduce CO2 to methane," Whitman explained.

Methanogenesis requires six vitamins not commonly found in other organisms. Understanding how these vitamins are made and how they are involved in the process of changing carbon dioxide to methane sheds light on developing new and better processes for methane production for fuel.

"This was a general investigation, but there are many questions it can answer, like possibly making methane better or more efficiently," Whitman said.

The study yielded many other important results.

"We found 121 proteins that are essential for this organism that we know nothing about," Sarmiento said. "This finding asks questions about their functions and the specific roles that they are playing."

"We are starting to get some insights about how this organism was actually formed," Sarmiento said. "There is a lot of information and it is interesting because it gives insights into a complete domain of life."

More information: The journal article is availabe at www.pnas.org/content/early/201 … 225110.full.pdf+html.

Provided by University of Georgia