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MAJOR STEP IN ORIGIN OF LIFE FOUND

Scientists at NASA's Ames Research Center, Mountain View, Calif., have uncovered an important factor in understanding the origin of life on Earth.

The research shows how building blocks of life may have been collected and organized on the shores of the primitive oceans by "natural catalysts" found widely on Earth. This could have been a key step in the chemical evolution of the first living organisms.

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The experiments demonstrate how two basic types of life molecules (amino acids, the building blocks of protein, and nucleotides, the building blocks of the life-directing DNA molecule) might have been concentrated in the primitive oceans.

The research also shows how non-living amino acids can be selectively destroyed, and how life-related amino acids might have linked together in these ancient oceans into the chains needed to make living cells.

The manner in which random collections and small amounts of life-building blocks could have concentrated to eventually produce living organisms has been a longtime mystery to biologists.

Team leader for the work was Dr. James Lawless of Ames Center along with Dr. Nissim Levi, a National Research Council fellow from Israel working at Ames. Their collaborators were Dr. Daniel Odom, now at the University of Houston, Kristi Kjos and Randy Mednick, both students at the University of Santa Clara, also working at Ames. Dr. Lawless gave a paper reporting on the work at the Pacific Conference on Chemistry in Anaheim, Calif., Oct. 14.

Most scientists accept the theory that life began by chemical evolution on the shores of the primitive ocean. The theory says that various forms of energy -- such as lightning, heat and ultraviolet radiation -- converted the abundant, carbon-containing ammonia, methane and water of the primitive Earth into building blocks of life (organic molecules). These molecules, according to the theory, then joined together into ever more complex molecules until a molecule or group of molecules appeared which could replicate itself. This was the first living thing.

In recent years, many scientists have performed a very large number of chemical evolution experiments. These have produced most of the basic life molecules (including amino acids and nucleotides) in small quantities, by applying electrical discharges or other energy releases to ammonia, methane and water. But until now scientists have been unable to explain how the life building blocks in the primordial oceans were organized.

The newly found mechanism involves substances which would have been common on the shores of the primitive oceans -- metal clays. Clays had to be widely spread on the primordial Earth and ocean shores; and, by definition, all clays contain metals.

Metal salts would be found in the oceans. When low concentration solutions of amino acids were mixed with the commonplace metal clays, Dr. Lawless's team found that all clays attract amino acids (of which there are about 1,000 different kinds) out of solution. One metal clay (containing nickel) preferentially attracts the 20 amino acids which make protein, the main structural ingredient of living cells. Nickel clay is a very abundant Earth material. Of eight metal clays tried, only nickel clay does this.

Dr. Levi reported that the other clays destroy non-protein forming amino acids faster than protein amino acids. Thus, a realistic mechanism for the concentration and selection of the life-forming amino acids has been found.

Experiments simulating tidal action on the clays (i.e., dry an amino acid clay solution, warm it, wet it again and repeat the process several times) produces chains of amino acids (eight amino acid molecules linked together, so far). Presumably, time would produce the far longer chains found in life.

A metal clay had a similar effect on the building blocks of DNA. (The very long chain DNA molecule in every living cell, including human ones, contains a blueprint of the entire organism.)

DNA building blocks are concentrated by zinc clays. Only the zinc one, of the nine metal clays tried, did this.

A further significant fact is that zinc is known to play an important role in the enzyme, DNA polymerase, which performs the task of linking DNA building blocks (nucleotides) in living cells. Enzymes are supercatalysts which drastically speed up many life processes.

Dr. Lawless believes that the key role of metals in many biological processes is a result of having had many metals present since the beginning of the life process, and that the presence of metals in living systems today results from early prebiological chemistry.

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