Hydrothermal origin of life?

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Some Japanese researchers have claimed to prove that life could have arisen in a submarine hydrothermal vent. However, the most complex molecule their 'simulation' produced was hexaglycine, in the microscopic yield of 0.001%. Compared to the complexity of even the simplest living cell, hexaglycine is extremely simple. High temperatures would degrade any complex molecules over the alleged geological time.

Introduction

The simplest possible cell, according to recent theoretical analysis, would need a bare minimum of 256 genes coding for the required enzymes, which are long polypeptides. And it is doubtful whether such a hypothetical organism could survive, because such an organism could barely repair DNA damage, could no longer fine-tune the ability of its remaining genes, would lack the ability to digest complex compounds, and would need a comprehensive supply of organic nutrients in its environment.[1]

One major difficulty is linking up the building blocks at all, let alone in the right sequence. This is because thermodynamic considerations show that long molecules like proteins and nucleic acids tend to break up into their component monomers (amino acids and nucleotides respectively).[2] Any undirected energy input is more likely to be destructive rather than constructive, like 'a bull in a china shop', and to increase the variety of undesirable side reactions possible.

Hydrothermal vents

Some researchers have proposed that life began in submarine hydrothermal vents, where superheated subterranean water pours into the sea. The idea is that the heat can help synthesize polymers, which would then be quenched in the surrounding sea water — this would prevent the same energy from destroying the products soon after they were formed.

Five researchers in Nagaoka, Japan, claimed to have simulated such conditions in a flow reactor.[3] They circulated 500 ml of a strong solution of glycine (0.1 M) through several chambers at a high pressure of 24.0 MPa. The first chamber was heated mainly to 200-250 °C; from there, the liquid was injected at the rate of 8-12 ml/min into a cooling chamber kept at 0 °C. Then the liquid was de-pressurized before samples were extracted at various intervals. The whole cycle was completed in 1-1.3 hours. In some of the runs, 0.01 M $CuCl_2$ was added to the 0.1 M glycine solution, which was also acidified to pH 2.5 by HC1 at room temperature.

Experimental results

The most spectacular results occurred in the runs with the extra $CuCl_2$ and HC1. The Cu^{2+} ions catalyzed the formation of tetraglycine (yield 0.1 %). Even some hexaglycine formed (yield 0.001%). But the product with the highest yield was the cyclic dimer, diketopiperazine, which peaked at about 1% yield, then dropped. The reader is not informed as to how much effort was invested in optimizing the conditions to maximize the amount of larger polyglycines.

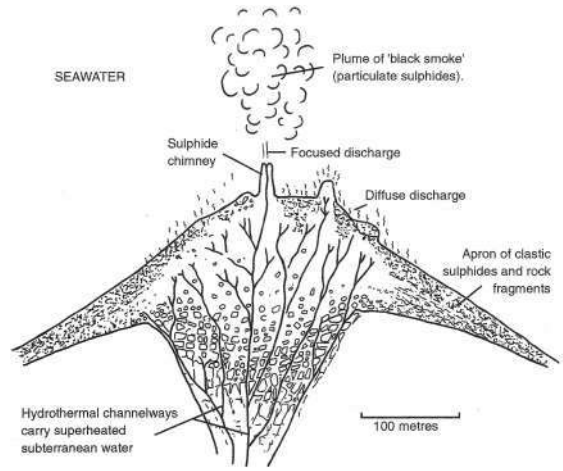
Assessment

The team leader, Koichiro Matsuno, was quoted as follows:

'For 10 years, underwater hydrothermal vents have been thought to be the place where life began — and we were able to prove it.' [4]

But is this justified by the experimental results? No! As shown by the following reasons, Matsuno's claim is based on evolutionary faith, which results in over-optimistic interpretation of the data.

1. The concentration of glycine of 0.1 M was far higher than could be expected in a real primordial soup. In reality, prebiotic simulations of glycine production produce far lower yields. Also, any glycine produced would be subject to oxidative degradation in an oxygenic atmosphere. Or else, if there was a primitive oxygen-free atmosphere,[5] the lack of an ozone layer would result in destruction by ultraviolet radiation. Also, adsorption by clays, precipitation or complexation by metal ions, or reactions with other organic molecules would reduce the concentration still further. A more realistic concentration would be 10^{-7}M.[6]
2. While the hydrothermal conditions might be right for this experiment, overall, they would be harmful in the long term to other vital components of life. For example, the famous pioneer of evolutionary origin-of-life experiments, Stanley Miller, points out that polymers are *'too unstable to exist in a hot prebiotic environment'.* [7] Miller has also pointed out that the RNA bases are destroyed very quickly in water at 100 °C — adenine and



Schematic representation of a submarine hydrothermal vent on the ocean floor.

guanine have half lives of about a year, uracil about 12 years, and cytosine only 19 days.[8] Intense heating also readily destroys many of the complex amino acids such as serine and threonine.[9] Another problem is that the exclusive 'left-handedness' required for life is destroyed by heating, i.e. the amino acids are *racemized*.[10] But this was not put to the test because the Japanese team used the simplest amino acid, glycine, which is the only achiral amino acid used in living systems. It seems incomprehensible that after designing this experiment with such care other amino acids would not have been tested. The fact that they are all known to undergo various non-peptide bond reactions has surely not escaped the researchers' attention.

3. The longest polymer (or rather, oligomer) formed was hexa-glycine. Most enzymes, however, have far more than six amino acid residues — usually hundreds. And even the hexaglycine produced was found only in minuscule amounts.
4. This experiment gave a simple homo-oligomer, i.e. all monomers are the same. But life requires many polymers in *precise sequences* of 20 *different* types of amino acids. Thus Matsuno's experiments offer not the slightest explanation for the complex, high-information polymers of living organisms.

Conclusion

As the non-creationist information theorist Hubert Yockey observed over 20 years earlier (and he has not revised his opinion since):

'Research on the origin of life seems to be unique in that the conclusion has already been authoritatively accepted .... What remains to be done is to find the scenarios which describe the detailed mechanisms and processes by which this happened.

One must conclude that, contrary to the established and current wisdom a scenario describing the genesis of life on earth by chance and natural causes which can be accepted on the basis of fact and not faith has not yet been written.'[11]

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Genomic imprinting

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Virtually everyone has heard of Dolly the sheep, cloned from DNA isolated from mammary gland cells.[12] Cloning (or making a genetically identical copy of an organism) by replacing the DNA of an egg cell with non germ-cell DNA, is promising to become a very lucrative business for the generation of improved domestic animal strains. But difficulties in the cloning of other mammals such as cows, mice, goats and monkeys shows that Dolly's easy success may have been somewhat of a fluke.[3] Also, as now discovered with Dolly, successful clones may have short life-spans due to the inheritance of 'pre-aged' genes from 'old' parent cells.[4]

Currently, the process of cloning is a health risk, often proving lethal to the pregnant mothers and to the clones themselves — on the way to a successful clone there are lots of placental and embryonic defects resulting in death of the foetuses or death of the animal shortly after birth.[5] But why does this occur? Scientists are actively trying to unravel this problem, and have recently become aware of the importance of **genomic imprinting.**

Offspring normally have two copies of virtually all their genes, one complement from each parent. But in many sets, one of the genes carries a biochemical mark that keeps it switched off. This mark is established during the development of egg and sperm cells to distinguish between the maternal and the paternal copies. The imprinted mark is maintained through embryo development but is erased in the gonads (testicles and ovaries) to allow fresh imprinting for the next generation of offspring.[6]

So how does imprinting occur? Researchers are still uncertain of the hows and whys. But the biochemical process of **methylation** appears to be important in imprinting, since all imprinted genes have DNA sequences that are methylated (called differentially methylated regions or DMRs; see