Origin of Life

Life could be at least 3.85 billion years old, we were told by an international team of scientists late last year.[1] Their findings are supposed to have pushed back the emergence of life on Earth by 400 million years.

Only four years ago, the remains of what were almost certainly microorganisms were identified in the claimed 3.45 billion-year-old Warrawoona sedimentary rocks near Marble Bar in Western Australia's Pilbara region.[2] The evidence for life in those rocks rested on the morphology of the carbonaceous remains and the isotopic composition of the contained carbon. In the late 1970s, the presence of claimed earlier life was suggested on the basis of carbonaceous residues in supposedly 3.8 billion-year-old rocks at Isua in western Greenland.[3] However, the rocks at Isua appear to have been deformed at such high temperatures and pressures that the original morphology of the contained organic matter was lost, while the isotopic composition of the bulk carbon probably changed during metamorphism. Thus that claimed evidence for such e?rly life has been weak and equivocal.

Now new evidence has been found in the claimed 3.85 billion-year-old Itsaq Gneiss Complex on Akilia Island in southern West Greenland. Mojzsis *et al.*[4] detected tiny bits of elemental carbon trapped in grains of the mineral apatite (calcium phosphate) within banded iron formation (BIF) and have measured carbon isotopic compositions that span much of the range found in living and ancient microorganisms. They also surveyed similar carbonaceous inclusions in apatite grains in banded iron formations (BIFs) in Australia's Pilbara region and western Greenland's Isua area (supposedly 3.25 and 3.8 billion years old respectively), and produced similar results (see Figure 1). The carbon in all the carbonaceous inclusions was isotopically light, indicative, they claimed, of biological activity, no known abiotic process being able to explain the data.

In modern oceans, both carbonate sediments and organic molecules are derived from CO_2 through precipitation and photosynthesis respectively. Isotopic effects associated with these reaction pathways lead to an isotopic difference, or fractionation, of about 25 parts per thousand, with the organic materials being depleted in ^{13}C relative to the carbonates. A similar isotopic signal persists, with some variations, back through time to rocks that are supposedly 3.5 billion years old.[5] This new finding seems to extend that record to the very bottom of the Earth's sedimentary pile.

However, isotopic fractionations can result from physical phenomena associated with chemical reactions, so it could be argued that the observed fractionations are due to low-temperature chemical reactions or some post-depositional effect, rather than biochemical processes.[6] The magnitude of the observed fractionation seems to favour the biochemical alternative, but does not fit perfectly. About half of the new analyses indicate fractionations larger than any in the 'next-oldest' organic material, found in the Pilbara Warrawoona rocks, which also contain bacterium-like bodies and laminated sedimentary structures (stromatolites) that resemble algal mats. These features are not universally considered a sure sign of life, but the carbon isotope differences are roughly equal to those in younger rocks that have compelling evidence of biology.

These new Itsaq, Isua and Pilbara data were gathered using an ion-microprobe mass spectrometer that can selectively analyse features as small as 20μm.[7] The carbonaceous inclusions in the BIF apatite grains typically have a volume of about $10 \mu m^3$ and contain around 20pg of carbon ($1pg=10^{-12}g$). This is a new technique and new techniques are often fraught with uncertainty, although these results seem to be reliable.[8] Apatite is known for its biological associations, but there have been no previous measurements of the isotopic composition of organic carbon closely associated with it. Thus interpretation of these new data may 'evolve' as points of comparison become available. Although the presumed antiquity of the samples and the tantalizing results command interest, according to the **Nature** commentator, *'the novelty should also inspire caution'*.[9]

For instance, all previous analyses of such 'ancient' materials have dealt only with bulk organic carbon.[10] Second, any early sediment that sits around for long is likely to have been buried by still further sedimentation and then 'dragged' into the 'tectonic traffic' of the Earth's crust. The Itsaq rocks were probably churned downwards and heated to 500°C at pressures of 5,000 atmospheres. If we are now seeking to reconstruct details of their initial, low-temperature environment, they have been badly overcooked, rendering their contained carbon looking more like graphite than biological debris.

During graphitization, mobile chemical products 'wheeze' or 'ooze' from the geological 'pressure cooker', particularly wherever a vent can be found. If carbonate minerals are present, their carbon is thrown into the chemical melee. In the process, isotopic evidence is first altered (as some carbon depleted in ^{13}C is lost) then destroyed (as the residue exchanges carbon with metamorphic fluids). For this reason, results of earlier analyses of the Itsaq materials were set aside, because they showed the damage done by graphitization.

Clearly, the difference between the old and the new measurements of Isua rocks is consistent with the view of Mojzsis *et al.* that the isotopic composition of the bulk carbon was altered during metamorphism by equilibration with the carbon in coexisting carbonates, whereas the original $\delta^{13}C$ values of the bits of analysed organic carbon were preserved by their protective apatite envelopes.[11] What is missing, however, is an understanding of why the apatite should act as a virtual 'safe deposit vault'. Until that is known, other questions will claim attention. First, why are the $^{13}C/^{12}C$ ratios so variable and, in half the cases, so low? Biological fractionation is usually very consistent, and ratios like those in the lower half of the data distribution are only present in what are believed to be much younger rocks, where they are thought to have been produced by methane-consuming bacteria.[12] These methanotrophs not only use methane as their carbon source but require oxygen, which isn't supposed to have been in the Earth's atmosphere as early as 3.85 billion years ago. Second, is there a plausible non-biological cause for the fractionation, either an isotope effect associated with one of the infinite number of uninvestigated prebiotic chemical reactions, or some obscure post-depositional effect peculiar to microscopic inclusions in apatite?

So do these data prove that life existed on Earth more than 3.85 billion years ago? No one is dogmatic, and all are cautious and even sceptical. But when pressed, all would like the data to be evidence that life existed on Earth more than 3.85 billion years ago. However, that would present two problems. First, the earliest history of the Earth is believed by uniformitarian geologists to have been very violent, with large meteorite and asteroid impacts being common and thus supposedly sterilising the planet.[13,14] The rate of infall is not supposed to have subsided until about 3.8 billion years ago, so how did this supposed 3.85 billion-year-old early life survive? Perhaps *'our distant ancestors were a truly hardy lot',* or *'life was invented more than once'.*[15] Or perhaps the 3.85 billion year old Itsaq organic material

> *'derives from biochemical processes that developed with breath-taking rapidity after the last large impact'*, or even *'is a product of a biota that was wiped out, then supplanted by our ancestors'.*[16]

Evolutionary origin-of-life theorists have supposed that hundreds of millions of years were available for the conjectured biochemical reactions to have occurred by countless repeated

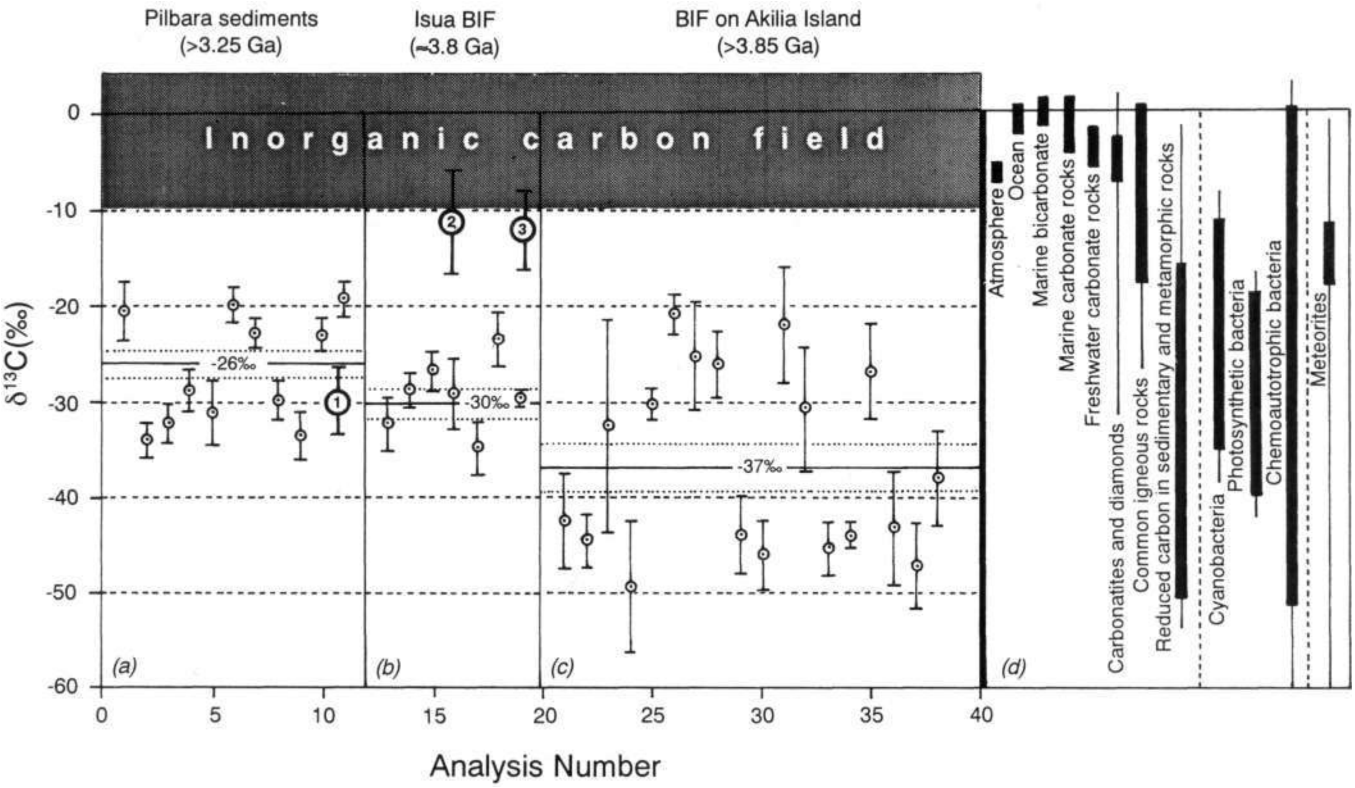

Figure 1. *Carbon isotopic compositions of carbonaceous inclusions in individual apatite grains from early Archaean sediments measured by ion microprobe (after Mojzsis* et al.*).*

(a) West Pilbara sediments, Roebourne Belt, Western Australia (>3.25 Ga); the data indicated by ① are previous whole-rock measurements of Warrawoona Group sediments.

(b) Isua belt BIF, West Greenland (~3.8 Ga); ② and ③ indicate whole-rock measurements from two previous studies.

(c) BIF from Akilia Island, southern West Greenland (3.85 Ga).

(d) Carbon isotope variations found on the Earth.

Standard deviations for the ion microprobe data are indicated by the vertical lines (1σ). Dotted lines above and below the weighted means of the data correspond to the 2σ confidence interval. The inorganic carbon field is the region of carbon isotopic compositions defined as characteristic of inorganic carbonate carbon and non-bioorganic reduced carbon.

chance trials, so now it all supposedly happened with 'breath-taking rapidity' in no time at all! However, the second problem is that the supposedly produced life-forms required oxygen, at a time when none was supposedly in the Earth's atmosphere. Being thermophilic and thus able to survive in the oceans supposedly heated by volcanoes, hot springs and bolide impacts would still not solve the problem if the required oxygen was not available. How then could life have arisen from lifeless molecules so rapidly under such impossible conditions when we can't duplicate the process in our laboratories today, even with the planned input of intelligent scientists?

What if further investigations confirm that this is organic material in these ancient rocks and it is indeed the remnants of life-forms (for example, algae)? The evolutionary generation of life from non-life will not have been proven, as the same obstacles to that supposed process will remain. No, such *non-nephesh* life-forms that display purposeful design were created according to the Genesis account, so their fossilised remnants could possibly attest to the rocks that entombed them having been deposited with other sediments in the ocean during the Creation Week.[17] Thus all such research data are welcomed, as they serve to aid creationist geologists in their effort to unravel the rock record within the biblical framework of Earth history.

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A. A. Snelling

Self-Replicating Enzymes?

Evolutionary origin-of-life theories have many hurdles to overcome.[1-3] To form a self-reproducing cell from non-living chemicals requires the generation of a large amount of information, or specified complexity. A cell must be able to perform many chemical reactions in the right order, place and degree, which requires a number of specific catalysts (enzymes). It must also be able to reproduce the information needed to produce these enzymes.

In all known cells, the specific catalysts are proteins, while the information storage/retrieval and reproduction tasks are carried out by the nucleic acids DNA and RNA. Proteins are polymers of amino acids, while nucleic acids are polymers of nucleotides. Nucleotides themselves are a combination of a sugar (deoxyribose for DNA, ribose for RNA), a nitrogenous base and a phosphate group.

But the DNA **itself** codes for the proteins, yet **requires** at least 50 proteins for the necessary decoding, and still others for replication. The noted philosopher of science, the late Sir Karl Popper, commented:

> *'What makes the origin of life and of the genetic code a disturbing riddle is this: the genetic code is without any biological function unless it is translated; that is, unless it leads to the synthesis of the proteins whose structure is laid down by the code. But . . . the machinery by which the cell (at least the non-primitive cell, which is the only one we know) translates the code consists of at least fifty macromolecular components* ***which are themselves coded in the DNA.*** *Thus the code cannot be translated except by using certain products of its translation. This constitutes a baffling circle; a really vicious circle, it seems, for any attempt to form a model or theory of the genesis of the genetic code.*
>
> *Thus we may be faced with the possibility that the origin of life (like the origin of physics) becomes an impenetrable barrier to science, and a residue to all attempts to reduce biology to chemistry and physics.'*[4]

The obvious conclusion is that both the DNA and proteins must have been functional from the beginning, otherwise life could not exist.

RNA WORLD?

To avoid this conclusion, some evolutionists have theorised that one