Chemists claim to have solved riddle of how life began on Earth

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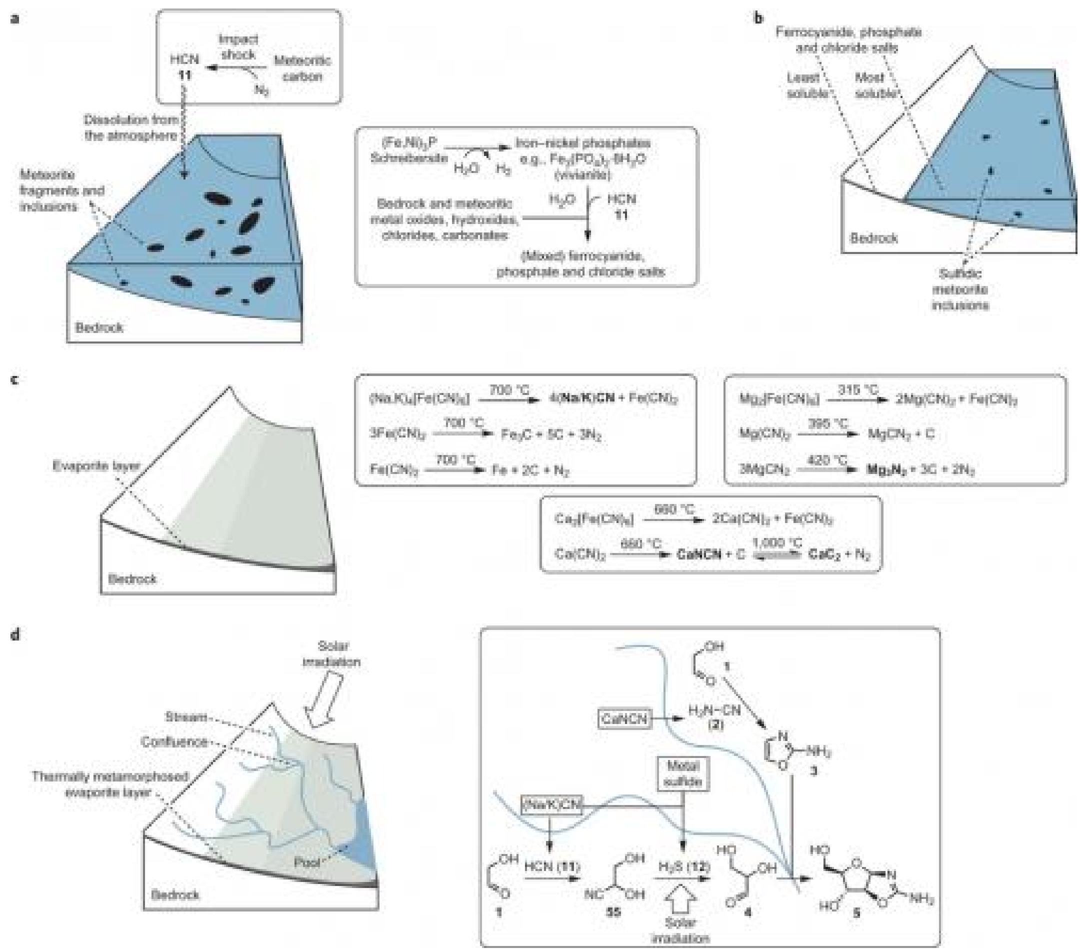

Chemistry in a post-meteoritic-impact scenario. A series of post-impact environmental events are shown along with the chemistry (boxed) proposed to occur as a consequence of these events. a, Dissolution of atmospherically produced hydrogen cyanide results in the conversion of vivianite (the anoxic corrosion product of the meteoritic inclusion schreibersite) into mixed ferrocyanide salts and phosphate salts, with counter cations being provided through neutralization and ion-exchange reactions with bedrock and other meteoritic oxides and salts. b, Partial evaporation results in the deposition of the least-soluble salts over a wide area, and further evaporation deposits the most-soluble salts in smaller, lower-lying areas. c, After complete evaporation, impact or geothermal heating results in thermal metamorphosis of the evaporite layer, and the generation of feedstock precursor salts (in bold). d, Rainfall on higher ground (left) leads to rivulets or streams that flow downhill, sequentially leaching feedstocks from the thermally metamorphosed evaporite layer. Solar irradiation drives photoredox chemistry in the streams. Convergent synthesis can result when streams with different reaction histories merge (right), as illustrated here for the potential synthesis of arabinose aminooxazoline at the confluence of two streams that contained glycolaldehyde, and leached different feedstocks before merging. Credit: (c) *Nature Chemistry* (2015) doi:10.1038/nchem.2202

(Phys.org)—A team of chemists working at the MRC Laboratory of Molecular Biology, at Cambridge in the UK believes they have solved the mystery of how it was possible for life to begin on Earth over four billion years ago. In their paper published in the journal *Nature Chemistry*, the team describes how they were able to map reactions that produced two and three-carbon sugars, amino acids, ribonucleotides and glycerol—the material necessary for metabolism and for creating the building blocks of proteins and ribonucleic acid molecules and also for allowing for the creation of lipids that form cell membranes.

Scientists have debated for years the various possibilities that could have led to life evolving on Earth, and the arguments have only grown more heated in recent years as many have suggested that it did not happen here it all, instead, it was brought to us from comets or some other celestial body. Most of the recent debate has found scientists in one of three chicken-or-the-egg first camps: RNA world advocates, metabolism-first supporters and those who believe that cell membranes must have developed first.

The chemists with this new effort believe they have found a way to show that all three arguments are both right and wrong—they believe they have found a way to show that everything necessary for life to evolve could have done so from just hydrogen sulfide, hydrogen cyanide and ultraviolet light and that those building blocks could have all existed at the same time—in their paper, they report that using just those three basic ingredients they were able to produce more than 50 nucleic acids—precursors to DNA and RNA molecules. They note that early meteorites carried with them ingredients that would react with nitrogen already in the atmosphere, producing a lot of hydrogen cyanide. By dissolving in water, it could have very easily come into contact with hydrogen sulfide, while being exposed to ultraviolet light from the sun. And that, they claim, would have been all that was needed to get things going.

The findings by the team are sure to garner a great deal of interest in the scientific community and others will no doubt be testing and commenting on their findings. If what they claim passes muster, their work will likely be remembered as one of the great achievements of our time.

More information: Common origins of RNA, protein and lipid precursors in a cyanosulfidic protometabolism, *Nature Chemistry* (2015) DOI: 10.1038/nchem.2202

Abstract
A minimal cell can be thought of as comprising informational, compartment-forming and metabolic subsystems. To imagine the abiotic assembly of such an overall system, however, places great demands on hypothetical prebiotic chemistry. The perceived differences and incompatibilities between these subsystems have led to the widely held assumption that one or other subsystem must have preceded the others. Here we experimentally investigate the validity of this assumption by

examining the assembly of various biomolecular building blocks from prebiotically plausible intermediates and one-carbon feedstock molecules. We show that precursors of ribonucleotides, amino acids and lipids can all be derived by the reductive homologation of hydrogen cyanide and some of its derivatives, and thus that all the cellular subsystems could have arisen simultaneously through common chemistry. The key reaction steps are driven by ultraviolet light, use hydrogen sulfide as the reductant and can be accelerated by Cu(I)–Cu(II) photoredox cycling.