Cosmochemistry and Astrobiology

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June 9, 2013 · Cosmochemistry and Astrobiology

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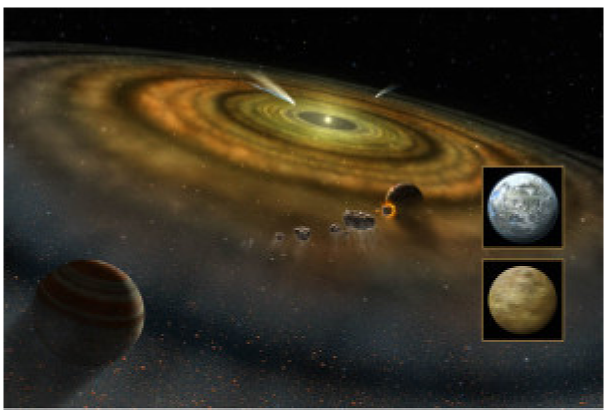
Waller WH. Cosmochemistry and Astrobiology: William H. Waller Ph.D.. The Galactic Inquirer. 2013 Jun 9 [last modified: 2015 Jul 19]. Edition 1.

Abstract

INTRODUCTION:

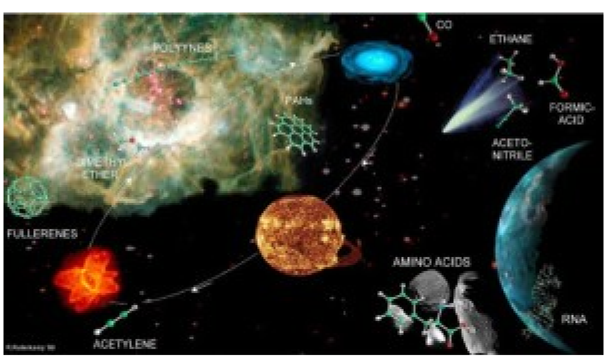
We are "the stuff of stars," as connected to the cosmos as the Galaxy that spawned us. This stuff includes the light elements of hydrogen and helium that emerged from the Hot Big Bang some 14 billion years ago, along with the heavier elements of carbon, nitrogen, oxygen, and silicon that were forged in the bellies of giant stars, and the even heavier elements of iron, lead, cobalt, uranium, and other weighty isotopes that were created and dispersed by supernova explosions.

Thanks to the especially promiscuous ways of the carbon atom, interstellar space positively reeks with organic compounds. These include polycyclic aromatic hydrocarbons (PAHs), alcohols, sugars, and perhaps even amino acids. Water abounds – as vapors within star-forming clouds, as ices in pre-planetary disks, and in the flamboyant comets that have been found in orbit around nearby stars.



Artist's rendering of the disk that surrounds the star Beta Pictoris. The disk is known to contain both exoplanets and exocomets. Image courtesy of Lynette Cook, the Far Ultraviolet Spectroscopic Explorer (FUSE), and NASA

Within our own Solar System, we have found clear evidence for amino acids in the tarry makeup of carbonaceous chondrites – a type of meteorite. On Earth, the flourishing of extremophilic organisms in the most hostile of environments attests to the incredible hardiness of microbial life. What awaits our further investigations?



Chemical pathways in the Milky Way begin with sites of molecule formation in the atmospheres of red giant stars. Further processing occurs inside star-forming nebulae, within pre-planetary disks, and on the surfaces of planets. Image by R. Ruitterkamp (see P. Ehrenfreund and S. B. Charnley 2000, Annual Review of Astronomy and Astrophysics, vol. 38, pp. 427-483

Will we find fossil evidence for life on Mars? Could the watery subsurfaces of Europa and Enceladus be hosting life today? And what about the nitrogen and hydrocarbon-rich chemistries that may be slowly evolving in the lakes and atmospheres of Titan? Beyond the Solar System, what are the prospects for detecting a planet whose atmosphere contains free oxygen – the clarion call of photosynthesizing life?

These and many other questions have motivated cosmochemists to consider what kinds of chemical pathways might ensue within interstellar clouds, upon the surfaces of exoplanets, and within the interiors of these myriad worlds. Meanwhile, many astrobiologists have pursued a policy to “follow the water” within the Solar System and beyond in hopes of assessing the prospects for life beyond Earth.

CALL FOR CONTRIBUTIONS:

In this exploratory spirit, the editors of The Galactic Inquirer welcome publicly-accessible communications that help to illuminate the topics of Cosmochemistry and Astrobiology. We seek non-technical articles, commentaries, book reviews, profiles, and photo-essays that are well-crafted and engaging.

Submissions should be in Word 97-2003 (.doc) or later formats (.docx), and should contain from 500 to 2000 words. The latter requirement is to ensure that The Galactic Inquirer is much more than an aggregator of word “bites.” All photos and figures should include captions, credits, and associated permissions. Any references at the end of a contribution should help the general-interest reader make greater sense of the subject at hand. Articles in Scientific American and American Scientist can provide a helpful template for formatting your submission.

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APPENDIX 1