Astrobiology News October 2016:
Rosetta Mission Update: The Building Blocks of Life

In 2014, I wrote two articles about the European Space Agency's *Rosetta* Mission to comet 67P/Churyumov-Gerasimenko for the CLP e-newsletter – one in August, when *Rosetta* became the first spacecraft to orbit a comet, and one in November, when *Rosetta's* lander, *Philae*, performed the first touchdown on a comet. (You may want to check these out in the Astrobiology News Archive on the CLP website for more background on this mission.[1]) This month, I wanted to share a couple of *Rosetta's* critical discoveries, which were published earlier this year.[2]

More than 140 different molecules have been discovered in interstellar space. Many of these discoveries were made at the 12-meter radio telescope on Kitt Peak[3], the instrument I'm pleased to have used for my doctoral dissertation at the University of Arizona over two decades ago. Recent years have seen a rise in the discovery of increasingly complex organic molecules such as polycyclic aromatic hydrocarbons or "PAHs", which permeate the Milky Way and provide some of the raw material that may be incorporated in new generations of planetary systems. The Atacama Large Millimeter/submillimeter Array's (ALMA)[4] high resolution and sensitivity has provided many new discoveries, including isopropyl cyanide, which has a "branched" carbon backbone, a common feature of molecules needed for life, such as amino acids.

Rosetta has now provided the first unambiguous detection of the amino acid glycine in the thin atmosphere (coma) surrounding a comet. The detection of other organic molecules that can be precursors to glycine, and the fact that glycine is the only amino acid known to be able to form without liquid water, suggest it is formed within interstellar icy dust grains before becoming trapped and preserved in the pristine environments of comets for billions of years. *Rosetta* also detected a key element found in cell membranes and the structural framework of DNA - phosphorus. Phosphorus is present in all living organisms and plays an important role in metabolism, transporting chemical energy within cells.

These discoveries realize one of the key goals of the *Rosetta* mission - to determine whether comets could have delivered molecules essential for prebiotic chemistry to the primordial Earth. Of course, there is still a huge gap in our understanding of the evolution of life from life's raw ingredients, but one thing is increasingly clear – the basic building blocks of life pervade the depths of interstellar space. If evidence for a

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[1] http://theclergyletterproject.org/Resources/Astrobiology.html

[2] Altwegg, K. et al. 2016, "Prebiotic chemicals – amino acid and phosphorus – in the come of comet 67P/Churyumov-Gerasimenko," *Science Advances*, Vol.2, no.5, e1600285, DOI:10.1126/sciadv.1600285

[3] http://aro.as.arizona.edu/12m_docs/12_meter_description.htm

[4] https://almascience.nrao.edu/

second genesis of life is found elsewhere in our Solar System, whether on Mars or perhaps in a subsurface ocean on the Jovian satellite Europa or the Saturnian satellite Enceladus, the likelihood that life is ubiquitous in the cosmos will skyrocket!

Until next month,

Grace