Astrobiology: The Formation of Life-Supporting Amino Acids on Cosmic Dust Particles

Morch, Alexander

Many of the current theories regarding the origin of life on Earth rely heavily on the assumption that amino acids were present in the ‘primordial soup’, some 4 billion years ago. However, recent geological data points to an extraterrestrial origin for these molecules. This has led to an ongoing hunt for glycine (the simplest amino acid) in space. In an astrochemical environment, glycine is very susceptible to photolytic decay due to the intense UV radiation and thus it is more common to search for more stable precursors to glycine that exhibit some photoresistance, known as Gly reservoir molecules. In 2008, such a molecule was found. Glycinonitrile (2-aminoacetonitrile) was similar to glycine, UV-resistant and had been detected in a region of a cosmic dust clouds. Unfortunately, its detection was minimal and a recent revision has confirmed an overestimation of the abundance by about 40%. I cross-referenced radical formation mechanisms in dust clouds with specific grain surface chemistry and discovered the possibility of the formation of a separate organic molecule that exhibited properties similar to the previous candidate. This compound, called glycolonitrile, has not been studied in this respect before. I performed an organic synthesis and a measurement of its IR spectrum (FT-IR) alongside a theoretical analysis of its stability based on bond absorption. The initial chemical data suggests an equal formation rate, a higher photostability and an easier detection probability. If this molecule is eventually detected in outer space it could confirm its role as the source of our amino acids.