From Stardust to Life: Decoding the Role of Ionic Minerals on the Formation of Prebiotic Molecules

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Interstellar grains and cometary and meteoritic seeds have undoubtedly been found to be key for the formation of interstellar simple and complex organic molecules (iCOMs) [1]. To this date, over 200 molecular species have been identified in our galaxy and beyond [2]. Many studies have focused on identifying the effect that the interstellar bodies play on the formation process of these molecules; however, computational studies have mainly focused on the role of the icy surfaces that usually surround them, for at initial stages of planetary formation, these have been shown to provide surface sites where primordial molecules adsorb, diffuse and eventually react.

In our study, the vast diversity of materials present in the currently analysed stellar objects and the predicted presence of liquid water and exposed mineral surfaces in the latter stages of planetary evolution [3] led us to assess how the solid surface of interstellar, cometary and meteoritic grains interact with the molecular species in the interstellar medium. While the former are usually composed of silicates and pyroxenes of different compositions, *ca.* 275 different minerals have been found to constitute the latter two [4]. In order to thoroughly study this variety of surface compositions and interacting molecular species, we propose a novel and unexplored approach to automatically investigate, using state-of-the-art quantum chemistry simulations, how most molecules in the observed universe interact with the known surface compositions. This thorough analysis will lay down the path to rationalise the abundance of certain molecular species in meteoritic samples, as well as provide a foundation for the investigation of how very complex molecular species, such as amino acids and sugars, are formed along the planetary formation stages.

References

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