Shock-synthesis of amino acids via the impact of comets

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Comets are agglomerates of ices, silicate dust and organic molecules, including some of the building blocks of life and their precursors. For example, glycine, the simplest of the amino acids has been detected on comet 81P/Wild-2 [1]. Comets may have exogenously delivered these prebiotic compounds to the early Earth 4.6 to 3.8 million years ago, just before life originated on our planet [2-4]. In addition the impact of comets onto rocky surfaces could have been responsible for the synthesis of complex organic molecules through a process of shock synthesis [5-8]. Goldman et al (2010) showed, via *ab initio* molecular dynamics simulations, that shock waves passed into comets could theoretically synthesise amino acids [9]. Laboratory experiments were performed to determine whether amino acids could be shock synthesised by emulating a comet impact [10]. The results show that the impact-shock of a typical cometary ice mixture produces several α-amino acids, including racemic mixtures of alanine (D/L≈1), the non-protein amino acids α-aminoisobutyric acid (α-AIB) and isovaline as well as their precursors. Therefore, the impacts of comets onto rocky surfaces, and also the impact of meteorites onto icy surfaces (such as the Jovian and Saturnian satellites) synthesise some of the building blocks of life, expanding the inventory of resources available by the first living organisms on Earth and possibly elsewhere in our solar system.

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