Abstract

The thesis summarizes experimental and theoretical findings that form a coherent set of arguments supporting the hypothesis of the origin of life as a result of interplanetary matter impacts during the early evolution of the Earth. The first part of the thesis deals with the identification of complex organic matter in a sample of original primitive interplanetary matter collected by the Japanese probe *Hayabusa-2* directly on the surface of asteroid 162173 Ryugu. Water-altered minerals, which have been shown to have catalytic effects in prebiotic synthesis in original scientific studies, were also found. The sample set from the *Hayabusa-2* mission has been made available to only a few laboratories in the world, including our facility. The second part of the thesis deals comprehensively with the direct effects of impacts on the prebiotic chemistry of planetary surfaces and the transformation of planetary atmospheres by impact plasmas. In addition to a comprehensive description of the initiation of radical prebiotic synthesis by impact plasmas at the moment of impact, the results obtained in the ELISE apparatus of our own design have provided information on the change in the equilibrium chemical composition of planetary atmospheres that could be detected by the JWST and ARIEL telescopes, together with typical molecules produced by plasmochemical means. The results on the transformation of HCN, benzene, formamide, and other molecules not only allow us to describe the role of the transformation of early planetary atmospheres by impacts and to assess the stability of key chemicals such as HCN, but in the future will offer the possibility to detect impacts in early planetary atmospheres and to determine whether impacts and early planetary bombardment represent a general scenario of early terrestrial planetary evolution. The last part is devoted to a comprehensive view of prebiotic synthesis at the site of impact craters. The work puts into context the mechanisms of de novo synthesis of prebiotic compounds directly by the effects of impact plasmas and then the thermochemical synthesis in the hot environment of impact craters. The catalytic effect of clays and heavy metals has been demonstrated, for which the unique ability to form quantum dots exhibiting catalytic effects and also possessing the properties of primitive protoenzymes has been put into context with prebiotic chemistry for the first time. The thesis provides a detailed exploration of how asteroid impacts directly and indirectly influenced the prebiotic chemistry of early planets.

Keywords: prebiotic synthesis, chemical evolution, origin of life, planets, organic matter, impacts, asteroids, meteorites, Ryugu, Ivuna, impact plasma, formamide, hydrogen cyanide, spectroscopy