EPSC
European Planetary Science Congress

Amino Acid Interaction with Mineral Surfaces – Implications for Life Detection Strategies

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Abstract

Amino acids are an important class of biomarkers in the search for life on other planets. Their interaction with mineral surfaces is of great interest to the astrobiology and planetary science community. We present results from a study analyzing the extraction properties of several amino acids on various mineral surfaces (including clay) and their relevance for current and upcoming planetary exploration missions.

1. Introduction

In the search for life on Earth and beyond, scientists scan for molecular organic compounds indicative for life, called biomarkers. Efficient extraction and detection of these biomarkers is of great importance. It is well known that amino acids degrade over time. This is caused either by enzymatic and oxidative processes as well as by UV- and ionizing radiation from the Sun, unless they are shielded from these influences. Mineral substrates in particular clays such as montmorillonite are adsorbing organic compounds efficiently and may have played a central role in the evolution of life [1, 2]. Rock formations, built up from clay-rich minerals, are therefore a priority target for life detection strategies.

2. Amino Acid Adsorption and Extraction

The aim of this study was to determine the extraction efficiency of amino acids from several distinctive (clay-rich) minerals. This was achieved by spiking minerals with amino acid solutions. After spiking, the samples were subjected to an extraction method[3]. The abundances of recovered amino acids were then compared to the content of the original spiking solutions. We analysed the extraction efficiency of amino acids by minerals and noticed that especially clay-minerals inhibits extraction, resulting in low recovery rates. Before the extraction experiments were conducted, several parameters were determined that could influence extraction rates (particle size, swelling capacities of the minerals and carbon/nitrogen content). We discuss results of adsorption properties of amino acids and major Mars relevant minerals.

3. Summary and Conclusions

The properties of mineral surfaces strongly influence the interaction with biomarkers such as amino acids. Understanding those interactions is vital in order to efficiently extract and detect amino acids from soil samples. Optimised extraction methods and detection techniques will be of great interest for upcoming Mars exploration missions in order to increase detection sensitivity and specificity.

Acknowledgements

References

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