

**ROLE OF IONS IN THE SORPTION OF AMINO ACIDS ONTO SERPENTINITE: ESSAYS OF PREBIOTIC CHEMISTRY.** S. Villafañe-Barajas<sup>1</sup>, M. Colín-García,<sup>2</sup> A. Negrón-Mendoza<sup>3</sup>, F. Ortega<sup>2</sup> and A. Becerra Bracho<sup>4</sup> <sup>1</sup>Posgrado en Ciencias de la Tierra, Universidad Nacional Autónoma de México, Ciudad Universitaria, 04510 Cd. Mx., México, saulvillafanephd@gmail.com <sup>2</sup> Instituto de Geología, Universidad Nacional Autónoma de México, Ciudad Universitaria, 04510 Cd. Mx., México maria.colin.g@gmail.com fortega@unam.mx <sup>3</sup>, Instituto de Ciencias Nucleares, Universidad Nacional Autónoma de México, Ciudad Universitaria, 04510 Cd. Mx., México, negron@nucleares.unam.mx <sup>4</sup> Facultad de Ciencias, Universidad Nacional Autónoma de México, Ciudad Universitaria, 04510 Cd. Mx., México, abb@ciencias.unam.mx

**Introduction:** The sorption process of organic molecules is fundamental to understand the mechanisms that could happen during the early stages of the primitive Earth. Although several experiments have shown the sorption capability of different minerals, most of the simulations have been performed using distilled water or simple models of sea-water as reaction milieus<sup>1</sup>. In this way, performing experiments that take into account some of the geochemical variables that were present in a possible "primitive environment" allows one to understand the sorption processes that led to greater molecular complexity. In this work, the sorption of glycine (Gly), alanine (Ala), glutamic acid (Glu) and aspartic acid (Asp) onto serpentinite was performed considering a "hydrothermal water model" (HWM). In the same way, the experiments were performed at different pH values. Our HWM is based in the recipe of Zaia<sup>1</sup>, which is mainly enriched in Na<sup>+</sup>, Cl<sup>-</sup> and Ca<sup>2+</sup> ions.

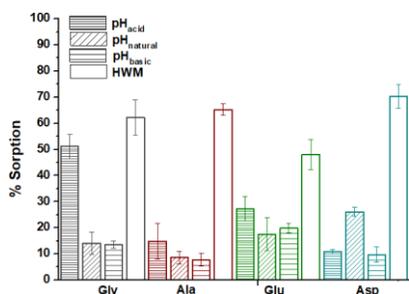


Figure 1. Percentage of amino acid sorption at acid, natural, basic pH and in the presence of dissolved ions, HWM.

**Results:** The results suggest that dissolved ions improve the sorption of amino acids, even at basic conditions (Fig. 1). On the other hand, at natural and acidic pH, the sorption is considerably low (20 %) in all cases. According to Figure 2, the four amino acids are predominantly in their anionic form at basic pH (pH≈12). Similarly, at that pH the surface charge of the serpentinite is strongly negative. Consequently, the interaction by electrostatic charges cannot be the mechanism that dominates the sorption process and therefore, the percentage of sorption does not exceed 15% (Fig. 1). However, in the presence of dissolved ions, the sorption increases considerably. This can be

the result of the formation of "bridges", mediated by the cations present in solution, between the COO<sup>-</sup> group of the amino acids and the negative surface charge of the serpentinite. In addition, the formation of hydrogen bonds and other types of interactions may be relevant in the interaction between amino acids and minerals at different pH values.

The sorption experiments of Gly, Ala, Glu and Asp in serpentinite showed:

1. The presence of dissolved ions (HWM) favors sorption in all cases. Particularly, the divalent cations can act as bridges between the negative charge of the COO<sup>-</sup> group and the surface oxygens.
2. At acid, natural and basic pH the sorption is relatively low (<<20%). In this way, electrostatic interactions are not the dominant sorption mechanism.
3. The formation of hydrogen bonds and / or covalent bonds may be other mechanisms that participate in the sorption process.

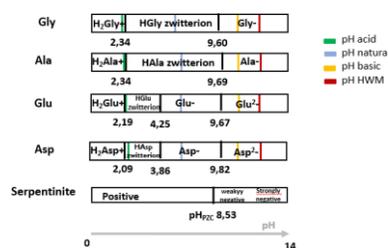


Figure 2. Speciation of the amino acids used and the serpentinite.

## References:

- [1] Lambert, J. F. (2008) *Origins Life Evol B*, 38(3), 211-242.
- [2] Zaia, D. A. (2012). *Int J Astrobiol* 11(4), 229-234.

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