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ALDEHYDES IN SIMULATED PREBIOTIC ENVIRONMENTS

A. López-Islas[1], C. A. Fuentes-Carreón[2], and A. Negrón-Mendoza[1]

The simulation of accurate conditions of prebiotic environments provides insight into the formation of the building blocks of life, biomolecules (Cleaves 2013). Only specific conditions and molecules can participate in the chemical reactions that originate more complex biomolecules. Among the group members are aldehydes, carbonyl compounds with a wide distribution in multiple environments, capable of forming carbohydrates and amino acids via condensation reactions (Hollis et al 2000; Jørgensen et al 2012)

The objective of this research was to study the reactivity and stability of formaldehyde and glyceraldehyde in laboratory-simulated conditions similar to extreme prebiotic environments such as a geothermal zone and a simple cometary core.

Archean geothermal zone: Aqueous solutions of DL-glyceraldehyde (1x10^{-2} M) were heated at 50 ^{o}C, and pH 2 was maintained in the presence of FeO(OH) powder. These conditions represent an Archean geothermal zone, particularly a zone of the Kverkfjll volcano (Iceland). High performance liquid chromatography-mass spectrometry (HPLC-MS) was used to analyze the resulting samples.

Cometary core: Aqueous oxygen-free solutions of formaldehyde (0.3 M) were frozen at -196 ^{o}C. The resulting ices were exposed at variable doses of gamma radiation (0-400 kGy), and ^{60}Co was used as a radiation source (Gammabeam 651 PT, Instituto de Ciencias Nucleares, UNAM). Following the irradiation, melted ices were analyzed by gas chromatography (GC). During the analysis, unirradiated aqueous solutions of formaldehyde were used as a control.

Preliminary data suggest that DL-glyceraldehyde forms carbonyl compounds high in molecular weight in conditions analogous to an Archean geothermal zone. The carbonyl compounds detected could be associated with sugar-like molecules (Fig. 1 top). However, it is necessary to perform more analysis to confirm these results. Formaldehyde ices exposed to gamma radiation are resistant to decomposition up to high radiation doses (Fig. 1 bottom). Due to low temperatures, the stability of formaldehyde within a radioactive environment could be explained by the reduction and diffusion of radicals formed in the frozen aqueous system.

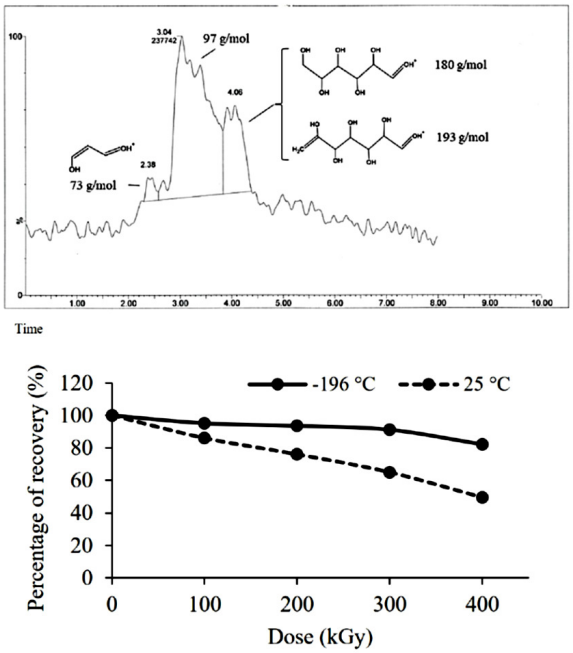

Fig. 1. Top: HPLC-MS chromatograph of glyceraldehyde and their polymers after 15 hrs into sortion process (pH 2 and 50 ^{o}C). Bottom: recovery of formaldehyde after irradiation (25 ^{o}C and 196 ^{o}C).

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[1]Laboratorio de Evolución Química, Departamento de Química de Radiaciones y Radioquímica. Instituto de Ciencias Nucleares, UNAM, Ciudad de México, México, Apartado Postal 04510 (anyelly.lopez@correo.nucleares.unam.mx).
[2]Posgrado en Ciencias de la Tierra, UNAM.