Considerations on the formation mechanisms of emitting species from organic and carbon-containing inorganic compounds in CO2 atmosphere using LIBS

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Integration of LIBS instruments in the rover used for planetary exploration in an attempt to get multi-elemental information from rocks, minerals, and soils is a reality. Its great effectiveness has been demonstrated in many works from the research teams participating in the mission Mars Science Laboratory (MSL). However, the detection and discrimination by LIBS of organic compounds can be complex since, among other aspects; this technique is very sensitive to environmental conditions, such as the atmosphere composition and pressure [1-3].
The objective of this investigation is to assess the effect of the surrounding atmosphere (CO2) on the formation of emitting species in laser-induced plasmas of C-containing compounds in order to identify the possible both inorganic and organic sources. Moreover, the influence of molecular structures on the intensity of C, C2, CN, H, N and O emissions has been analyzed (Fig. 1). Four organic compounds (adenine, glycine, pyrene, and urea) were selected for their interest as possible indicators or precursors of life. A laboratory LIBS system coupled to a pressure chamber for simulating Martian environment was used for the analysis of pellet-shaped samples. Formation pathways of species coexisting in the plasma plume (C, C2 and CN, mainly) generated in air and in CO2 atmosphere have been considered. The ablation thresholds and the limits of detection of the organic molecules on inorganic matrices (CaCO3 and CaSO4 2H2O) have been established.

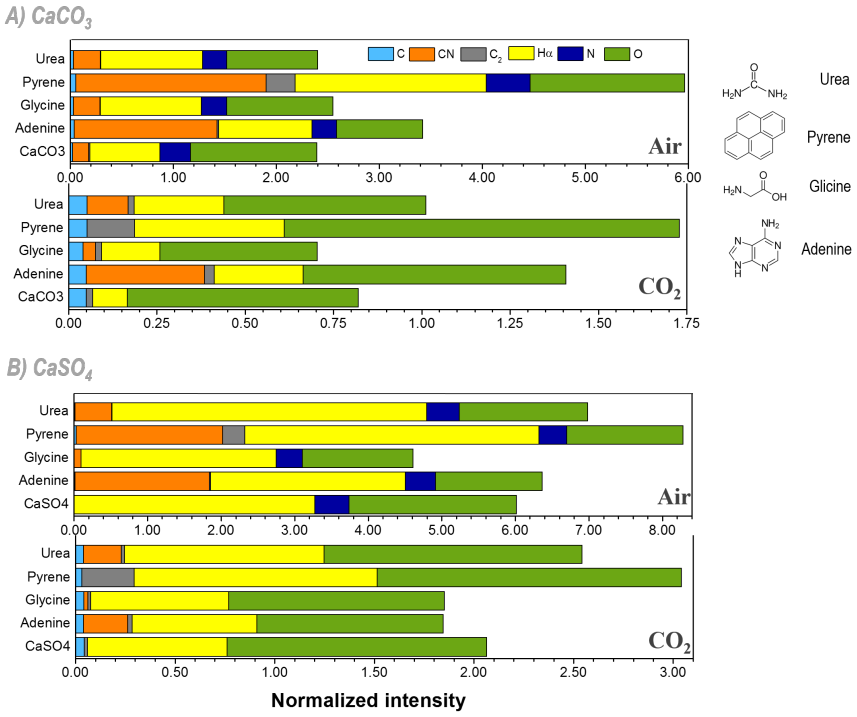

Fig1.: Comparison of the optical emission C-containing and non-C-containing species expressed as normalized intensity. The results were determined in pure inorganic matrixes mixed with a 10 % (w/w) of organic dopant, both in air and in CO2 atmosphere conditions.

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