

Raman-LIBS combination: A synergy to analyze Mars's surface

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LIBS, is a versatile technique able to detect, any element of the periodic table. This technique has played an important role in the latest discoveries by NASA's rover Curiosity ChemCam instrument [1]. Nevertheless the process to induce the plasma prevents from observing the structure of the analyzed material. Thus, the most important area of application of this technique is to analyse the elemental composition of the sample, making it not possible to distinguish between polymorphs as calcite or aragonite, or the structural order in carbonaceous materials. On the other hand, Raman Laser Spectroscopy provides information about the structure of the sample and it is a very useful technique in the detection of biomarkers. For this reason Raman spectrometers will be present in several future missions to Mars [2] [3]. As a drawback, in some situations, for example in cationic substitutions, it can be hard to distinguish between two different samples, i.e. Jarosite and Natrojarosite.

Supercam, the instrument that will be part of NASA's next mission to Mars, Mars2020, will be able to perform combined Raman and LIBS analyses at the same spot.

In this work we study some mixtures of different compounds, with both techniques, evaluating different cases in which a cross-study of the data from both spectra makes a significative improvement in identification and cuantification, as candidates for Supercam calibration target for chemometric purposes.

We present preliminary results obtained in several samples including silicates, sulfates, carbonates and carbon with a combined Raman + LIBS remote instrument. We also present basic chemometric / data fusion studies on different mixtures taking into account several factors such as thermolability or Raman - LIBS emission efficiency. This work is relevant in the framework of the exploration of Mars, and will also be used for the definition of the candidate compounds for Supercam's calibration targets.

[1] Blaney, D. L. et al., 2015, *LPSC Science Conference*. [2] Rull, F. et al. 2013, *LPSC Science Conference*. [3] Manrique, J.A. et al. 2014 *Georaman Conference*