IAF SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 3 (2C)

Author: Mr. Menelaos Konstantinidis
York University, Canada, menelaos@my.yorku.ca

Dr. Emmanuel Lalla
York University, Canada, elalla@yorku.ca
Mrs. Elizabeth Lymer
York University, Canada, beth.lymer@gmail.com
Dr. Peter Dietrich
MDA, Canada, peter.dietrich@mdacorporation.com
Prof. Michael Daly
York University, Canada, dalym@yorku.ca

EVALUATING THE CAPABILITIES OF THE LIBS RAMAN SENSOR: IMPLICATIONS FOR MARTIAN AND LUNAR EXPLORATION

Abstract

Several technologies have been proposed over the years for conducting relevant analyses from which geochemical and biochemical inferences may be made. Of particular interest here is the general field of spectroscopy, which has, without a doubt, found its place in planetary exploration. Notable examples include i) Laser-Induced Breakdown Spectroscopy (LIBS) featured on NASA'S Curiosity Rover as the ChemCam and on the upcoming Mars2020 mission as the SuperCam, and ii) Raman Spectroscopy to be featured aboard Mars2020 as SHERLOC in addition to the RLS aboard the ESA's ExoMars rover.In this work, we present the re-evaluation of the LIBS Raman Sensor (Lirs)- a breadboard concept instrument featuring two lasers- a 1064 excitation laser for LIBS, and a 266nm excitation laser for Raman spectroscopy, Laser-induced Fluorescence (LIF) spectroscopy, and Time-resolved LIF (TR-LIF). The system is a prototype for a future planetary mission of the Canadian Space Agency. It has been recalibrated with a suite of samples ranging from Certified Mars and Lunar relevant geological standards, Lunar and Martian analogues, and other applicable samples. A set of samples was also synthesized to detect organic material with varying concentrations and mixtures of well-known organic materials. This instrument has been developed with particular emphasis to Lunar exploration in mind; thus, to maximize the applicability to the moon, the samples were measured under vacuum and low-temperature conditions comparable to the lunar environment. LIBS was used for the identification and quantification of elements. The remaining modes were used for complimentary mineral identification/quantification and organic identification. Results of the analyses in each of the modes suggest that the multifaceted instrument, coupled with robust statistical techniques, is capable of yielding an accurate characterization of relevant samples. The corresponding characterizations, in addition to our ongoing research in Isotopic spectroscopy for planetary exploration, will allow insights into planetary biochemistry and geochemistry, thus establishing Lirs and related instruments as promising candidates for the future of planetary science.