EGU21-13939
https://doi.org/10.5194/egusphere-egu21-13939
EGU General Assembly 2021
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Mineral and Trace Element Identification in Jezero Crater, Mars, with SuperCam's Time-Resolved Raman (TRR) and Luminescence (TRL) Techniques

Ann Ollila[1], Olivier Beyssac[2], Gorka Arana[3], Stanley Mike Angel[4], Karim Benzerara[2], Sylvain Bernard[2], Pernelle Bernardi[5], Bruno Bousquet[6], Kepa Castro[3], Elise Clave[6], Sam Clegg[1], Shiv Sharma[7], Agnes Cousin[8], Olivier Forni[8], Olivier Gasnault[8], Peter Willis[9], Guillermo Lopez-Reyes[10], Juan Manuel Madariaga[3], Jose Manrique[10], Jesus Martinez-Frias[11], and the SuperCam Raman Working Group[*]

[1]Los Alamos National Laboratory, United States of America (amo@lanl.gov)
[2]IMPMC, Sorbonne Univ., Paris, France
[3]Univ. of Basque Country, Bilbao, Spain
[4]Univ. of South Carolina, Columbia, SC, USA
[5]LESIA, Meudon, France
[6]Univ Bordeaux, France
[7]Univ. of Hawaii, Honolulu, HI, USA
[8]IRAP, Toulouse, France
[9]JPL, Pasadena, CA, USA
[10]Univ. of Valladolid, Spain
[11]IGEO, Madrid, Spain
[*]A full list of authors appears at the end of the abstract

In February 2021, NASA's Perseverance rover will begin its exploration of Jezero crater near a putative ancient delta. Orbital mineralogy indicates the presence of carbonates and clay minerals in the landing site, which will be key targets for study. The SuperCam instrument provides an important tool for remotely surveying for these and other minerals using multiple techniques: Laser-Induced Breakdown Spectroscopy (LIBS), Time-Resolved Raman (TRR) and Luminescence (TRL) spectroscopies, Visible-Near Infrared (VisIR) spectroscopy, micro-imaging, and acoustics. TRR and TRL use a pulsed 532 nm laser with an adjustable gate width, from 100 ns to several ms. The time at which the gate opens is also adjustable, from coincident with the laser pulse to obtain Raman and fast luminescence out to 10 ms or more to capture the lifetimes of luminescence signals. These techniques will operate at distances up to 7 m from the rover mast and will be most effective if LIBS first removes dust from the targets and chemistry is subsequently obtained at the same location. Early lab results show that TRR is effective for detecting certain carbonates (magnesite, hydromagnesite, siderite, ankerite, calcite, and dolomite), sulfates (gypsum, anhydrite, barite, epsomite, and coquimbite), phosphates (apatite), and silicates (e.g., quartz, feldspar, forsteritic olivine, topaz, and diopside). Many of these minerals are high-priority targets for astrobiology studies because they represent habitable environments and have high biosignature

preservation potential in terrestrial rocks. Raman signal strength is significantly decreased in fine-grained materials, however, and clay minerals will be a challenge to detect, as will opaque minerals such as Fe-oxides. TRL will be useful for identifying rare earth elements in phosphates and zircon, Fe^{3+} in silicates such as feldspar, Mn^{2+} in carbonates, and Cr^{3+} in Al-oxides and some silicates. TRL may also be able to identify fast (<100 ns) fluorescence that may indicate the presence of organic materials, which could then be analyzed more closely with the rover's other instruments. Early results from the Jezero crater will be presented, if available.

SuperCam Raman Working Group: S. Maurice (IRAP, Toulouse, France), P. Y. Meslin (IRAP, Toulouse, France), G. Montagnac (ENS Lyon, France), T. Nelson (LANL, Los Alamos, USA), R. Newell (LANL, Los Alamos, USA), P. Pilleri (IRAP, Toulouse, France), S. Robinson (LANL, Los Alamos, USA), F. Rull (Univ. of Valladolid, Spain), I. Torre-Fdez (Univ. of Basque Country, Bilbao, Spain), R. C. Wiens (LANL, Los Alamos, USA), S. Schroeder (DLR, Germany), S. Shkolyar (USRA, NASA GSFC, Blue Marble Space Institute of Science)