

X-Ray Spectromicroscopy on Rocks Relevant to Mars Return Samples

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A main objective of an ambitious, multi-mission campaign by NASA is to determine whether or not Mars was ever host to ancient microbial life [1]. Finding evidence for extinct (or extant) life on Mars has the potential to fundamentally alter our view of the origin and evolution of life. It would provide proof for Earth being just one amongst others regarding the question of biological activity in the solar system. Furthermore, returned Martian samples would provide a rich repository of information on the history of planetary accretion and differentiation, geochronology, atmospheric evolution, and the paleo-environmental history of Mars. This would add tremendous value to such a mission beyond the issue of extraterrestrial life [1].

Considering the timeline for creating procedures to work with Martian samples [2] and expecting samples returned from Mars in the early 2030's, it is now time to provide proof-of-concept measurement data to establish the feasibility of sample handling and safe sample triage. The high X-ray brightness of the National Synchrotron Light Source-II (NSLS-II) at the Brookhaven National Laboratory provides a unique and critical capability to perform assessments of the elemental composition and the chemical state of Mars Return Samples using synchrotron radiation X-ray fluorescence imaging and X-ray absorption spectroscopy.

Samples of rock types relevant to Martian returned samples [3] were examined at NSLS-II. The elemental composition and the chemical state of these sample were investigated using X-ray fluorescence mapping and XANES spectroscopy with μm spatial resolution. A detailed description of the measurements and the results will be given.

[1] McLennan, S.M. et al. (2011) Final report of the MSR E2E-iSAG, MEPAG. [2] Smith, C., et al. (2016) iMARS Phase II: Findings and Recommendations, MEPAG Meeting, Silver Springs. [3] Panossian, L.T. et al. (2016) 47th LPSC (2016).

Figure 1: RGB map of Fe (red), Mn (green), and As (blue) in a Stromatolite (Gunflint Formation).
Size: 1.5 x 2.1 mm,
500 x 700 pixels

