

PIXL Investigation on the Mars 2020 Rover. A. C. Allwood¹, L.A. Wade¹, J.A. Hurowitz². ¹Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr, Pasadena, CA, USA. Stony Brook University, Stony Brook, NY, USA.

Introduction: PIXL (Planetary Instrument for X-ray Lithochemistry) is a micro-focus X-ray fluorescence instrument that is part of the selected science payload for the 2020 rover. From its position on the end of the rover's robotic arm, PIXL will be able to scan a tiny 0.12mm-diameter x-ray beam across a 25x25mm target area on rock or soil, measuring the abundance and distribution of a wide range of elements with high spatial resolution, sensitivity and accuracy. The elemental measurements will be correlated to visible textures and microstructures through an optical fiducial system, consisting of a micro-context camera and a structured light array.

With these capabilities, PIXL will be able correlate chemical measurements with individual grains, crystals, veins, cements, concretions and laminae. These measurements will provide detailed information about past conditions affecting habitability, biosignature formation and biosignature preservation – information that is needed to guide the search for biosignatures. PIXL can also directly detect potential chemical biosignatures such as reduction spots [1] (Fig. 1), and provide critical geochemical characterization of other kinds of potential biosignatures (e.g. stromatolites, organic deposits: Fig. 2) if any are found.

To maximize access to science targets, PIXL will use a hexapod motion system, novel optical fiducial system and a range of algorithms for autonomous positioning and position documentation. Together, these capabilities will allow scientists to investigate targets with uneven surfaces, target specific areas of interest at millimeter scales and to acquire high resolution maps overnight.

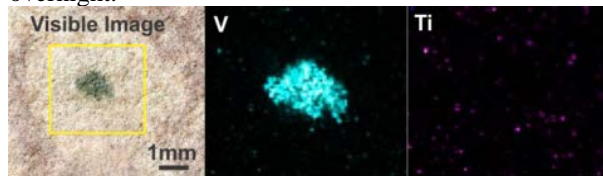


Figure 1 PIXL element maps of a potential chemical biosignature: a vanadium-enriched microbial reduction spot in sandstone. Sample courtesy S. Spinks.

PIXL will have flexible operations enabling the science team to adjust experiment parameters to suit a specific target or operational constraints such as time, power and data volume.

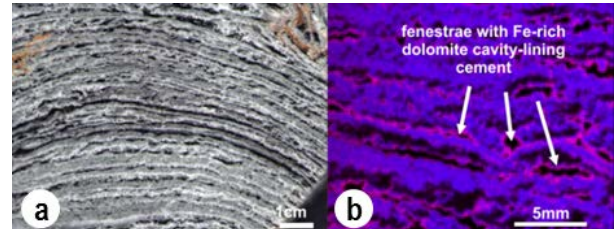


Figure 2: Element map of Early Archean stromatolite: (a) visible image. (b) PIXL element map (Blue = Ca, Pink = Fe) of stromatolite texture shows Fe-rich dolomite cements in fenestrae (voids - black areas, now chert-filled), indicating sedimentary origin of carbonate and microbial influence on texture [2].

In situ science with PIXL: With data produced by PIXL, the science team will be able to:

1. Determine the elemental composition of individual rock components. This includes relative and absolute abundances (point, bulk rock, and bulk of rock sub-components such as cement vs. grains),
2. Measure spatial variations in element abundance and correlate chemistry with visible features at sub-mm resolution
3. Constrain mineralogy from element abundances and correlations
4. Determine the relative timing of formation of chemically distinct components from small scale cross-cutting relationships

PIXL data will be correlated with organic and mineral mapping by the SHERLOC instrument on the rover arm. Together with other instruments on the 2020 rover—including powerful new remote imaging (Mastcam-Z) and spectroscopy (Supercam) instruments—it will be possible to carry out astrobiological field investigations with sufficient detail and quality to credibly address the search for signs of ancient life on Mars.

References:

- [1] Spinks, S.C. et al. (2010), *International Journal of Astrobiology*, doi:10.1017/S1473550410000273.
- [2] Allwood, A.C. et al. 2009. *Proceedings of the National Academy of Sciences*, 106, 9548-9555