PIXL Investigation on the Mars 2020 Rover: Spatially-Resolved Fine Scale Elemental Chemistry and the Challenging Search for Ancient Biosignatures. A. C. Allwood[1], L.A. Wade[1], J.A. Hurowitz[2]. [1]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr, Pasadena, CA, USA. Stony Brook University, Stony Brook, NY, USA.

Introduction: The Mars 2020 Rover mission will search for potential clues to past life on Mars, and select samples for future return to Earth. The rover's science instruments will be the prime tools for achieving these objectives. 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, 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 to investigate abundances and distribution of elements at sub-millimeter scales, accurately tying chemical measurements to 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.

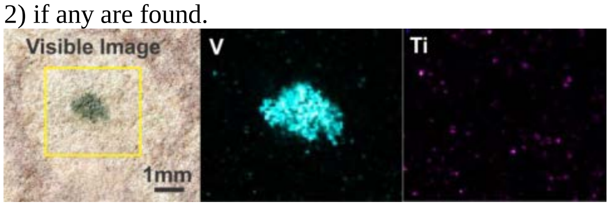

Figure 1 PIXL element maps of a potential chemical biosignature: a vanadium-enriched microbial reduction spot in sandstone. Sample courtesy S. Spinks.

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.

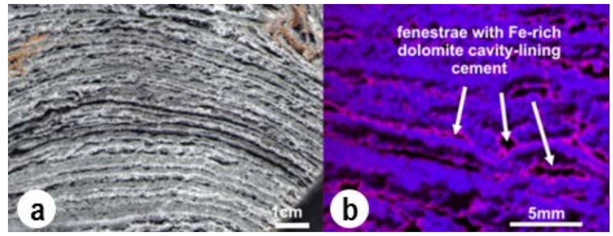

Figure 2: Element map of Early Archean stromatolite: (a) visible image. (b) PIXL element map (Blue = Ca, Pink = Fe) of stromatolite texture shows Fe-rich dolomite cements in fenestrae (voids - black areas, now chert-filled), indicating sedimentary origin of carbonate and microbial influence on texture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