BIOSIGNATURES PRESERVED IN QUENCHED IMPACT GLASS AT MARS LANDING SITES: A CASE STUDY FROM THE NILI FOSSAE TROUGH. J. F. Mustard[1] and K. M. Cannon[1], [1]Brown University, Department of Earth, Environmental and Planetary Sciences, Providence RI, USA, john_mustard@brown.edu

Introduction: While sedimentary environments have been a major exploration focus for biosignature preservation on Mars, terrestrial quenched impact melt breccias can encapsulate organics and complex cellular structures [1,2], demonstrating a widespread biosignature preservation mechanism for Mars with a fidelity superior to sedimentary rocks. We have identified preserved glass-rich impactites in dozens of craters on Mars [e.g., 3], showing that these deposits are accessible on the martian surface today. Using the Nili Fossae trough as an example, we show how impactite deposits can be mapped from orbit over a potential landing site, then identified on the ground with the instrument suites onboard the ExoMars and Mars 2020 rovers.

Nili Fossae Trough: The Nili trough is a NE-SW trending graben that opened radially to the Isidis basin and was later infilled with clay-rich sediments [e.g., 4] and buried by Hesperian lava. Ejecta from Hargraves Crater (D = 60 km) spill into the trough and underlie a landing ellipse proposed for MSL, and now the Mars 2020 rover (Fig. 1). The ejecta is exceptionally well preserved and exposed by erosion and thus is a significant exploration target given the recent recognition of glass-rich impactites as a biosignature preservation mechanism.

Orbital Observations: HiRISE imagery reveal the textural signatures of impactites as shown in images of Hargraves ejecta throughout the proposed landing ellipse (e.g Fig. 2). We have developed techniques to detect glass-bearing materials using the CRISM dataset [3], and these methods are applicable to suspected impactites at other proposed landing sites. In the Nili trough ellipse impact melt is difficult to distinguish from the ubiquitous mafic cap material that coats the surface.

Rover Observations: Cameras on the Phoenix lander and MSL have imaged probable impact glass spherules [5,6], so mast imagers can be used to remotely detect impact glass from a distance of meters to tens of meters. On Mars 2020, the SuperCam [7] instrument will be ideal for more rigorously characterizing impact glass at distance: it will measure visible/near-infrared spectra, Raman spectra and laser-induced breakdown spectral chemistry as a coordinated set of measurements. For *in situ* rover arm measurements, the PIXL lithochemistry instrument [8] and SHERLOC Raman spectrometer [9] would provide spatially resolved chemical analyses of any impact glasses, and possibly detect organics embedded within impact glass.

References: [1] Schultz P. H. et al. (2014) *Geology*, *42*, 515. [2] Howard K. T. et al. (2013) *Nature Geosci.*, *6*, 1018. [3] Cannon K. M. and Mustard J. F., *under review*. [4] Ehlmann B. L. et al. (2009) *JGR*, *114*, E00D08. [5] Goetz W. et al. (2010) *JGR*, *115*, E00E22. [6] Minitti M. E. et al. (2013) *JGR*, *118*, 1. [7] Maurice S. et al. (2015) *LPSC XLVI*, Abstract #2818. [8] Allwood A. et al. (2014) *IEEE Aerospace Conf.* [9] Beegle L. W. et al. (2014) *LPSC XLV*, Abstract #2835.

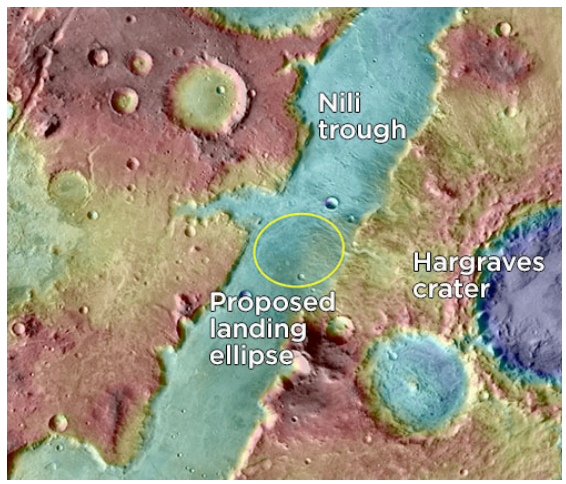

Figure 1. Topography of the Nili trough, showing the proposed landing ellipse under Hargraves ejecta.

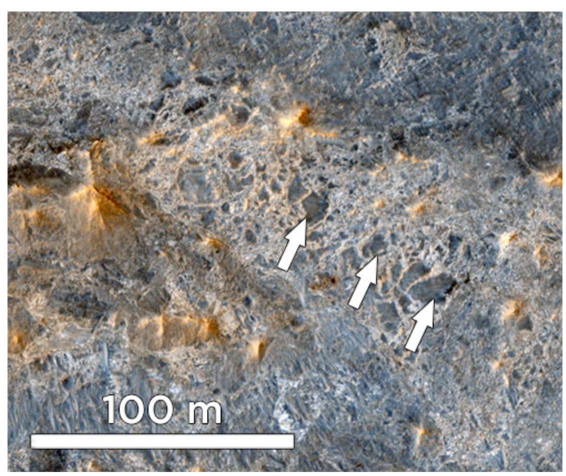

Figure 2. HiRISE image showing details of Hargraves impactite with white arrows pointing to breccia blocks.