CONSTRAINING THE ORIGIN OF HYDRATED SILICA IN JEZERO CRATER AND ITS ACCESSIBILITY BY NASA'S MARS 2020 ROVER J.D. Tarnas[1], J.F. Mustard[1], M. Parente[2], F.P. Seelos[3], Y. Itoh[2], A.M. Saranathan[2] [1]Dept. of Earth, Environmental and Planetary Sciences, Brown University (jesse_tarnas@brown.edu), [2]Dept. of Electrical and Computer Engineering, University of Massachusetts Amherst, [4]3ohns Hopkins University Applied Physics Lab.

Introduction: A series of validated mineral maps and hyperspectral images are being generated via the MRO CRISM [1] Science Team's "Fandango" [2], which seeks to find consensus in CRISM data interpretation. One major goal of the "Fandango" is to deliver mineral maps and hyperspectral images to NASA's Mars 2020 Rover Project to assist in rover path planning and orbit-to-ground scientific analysis. This abstract focuses on constraining the origin and rover-accessibility of hydrated silica in Jezero crater, where hydrated silica was detected by Tarnas et al. [3]. Two outcrops of hydrated silica were found. They share similar geomorphological characteristics. Both are associated with smooth dark-toned material that lies between delta remnants and directly overlies the olivine-rich unit [olivine-rich unit described in 4], which protrudes through it and is exposed beneath it at multiple contacts apparent in HiRISE images. It is unclear whether this hydrated silica-bearing unit is the stratigraphically lowest component of the deltaic unit, or another unit entirely. Hydrated silica was also found in the rock units of Jezero's watershed [3]. Here we assess the capability of the Mars 2020 rover to access this hydrated silica-bearing material. We also attempt to further constrain its origin via detection of additional possible hydrated silica outcrops.

Methods: We applied Dynamic Aperture Factor Analysis/Target Transformation (DAFA/TT) [5] to CRISM data over Jezero crater to detect the hydrated silica outcrops reported in [3]. After initial discovery via DAFA/TT, we worked with the CRISM "Fandango" to validate these detections. The 2.2 um features that are reported in this abstract were found via band parameter mapping and extraction of ratioed spectra.

Results: Unfortunately, the locations of the hydrated silica outcrops reported by [3] render them inaccessible during the primary mission of NASA's Mars 2020 rover. Here, we generate a fine-scale geomorphologic map of smooth dark-toned material directly overlying the olivine-rich unit near the tentative Mars 2020 rover traverse path. Near-traverse outcrops of this smooth-dark toned material are significantly smaller in areal distribution than the two outcrops that bear a strong hydrated silica signature, precluding a definitive hydrated silica detection via CRISM. However, they are both geomorphologically and stratigraphically consistent with the hydrated silica-bearing smooth dark-toned unit, as the olivine-rich unit is exposed directly beneath this material.

We also report three 2.2 um absorptions that are consistent with Al-OH or Si-OH bonds, one on the western delta remnant and 2 on the northern delta remnant. These detections are also reported by Horgan et al. [6]. By overlaying the mineral detections on HiRISE images, we determine that all of these 2.2 um detections are associated primarily with dark-toned material either within or overlying the deltaic unit.

Discussion: If these reported 2.2 um spectral features are due to Si-OH bonds, then hydrated silica is detected topographically beneath (or low within) the deltaic unit *and* atop (or high within) the deltaic unit. This is consistent with either (1) hydrated silica presence within multiple layers of the deltaic unit or (2) presence of a smooth dark-toned mantling material that drapes both the deltaic unit and olivine-rich unit. In scenario (1), the hydrated silica presents an excellent target for biosignature investigation. In scenario (2), the material is younger than all its underlying units, and is relatively unlikely to host biosignatures.

Based on our geomorphic mapping, the smooth dark-toned material that overlies the olivine-rich unit could be the same unit in which [3] discovered hydrated silica in Jezero crater. If this is the case, then hydrated silica-bearing material is indeed accessible by the Mars 2020 rover during its primary mission based on tentative traverse paths [e.g. 7]. The likelihood of this silica to host biosignatures is dependent on whether it is part of the deltaic unit or is a younger material that mantles the deltaic unit and the olivine-rich unit. NASA's Mars 2020 rover will be able to differentiate between these two hypotheses via in-situ investigation.

References: [1] Murchie et al. (2006), *JGR* 114: E2. [2] Parente et al. (2019) *50th LPSC* 3112. [3] Tarnas et al. (2019), *GRL* 46: 22. [4] Ehlmann & Mustard (2012) *GRL* 39: 11. [5] Lin et al. (2018), *49th LPSC* 1835. [6] Horgan et al. (2020), *Icarus* 339: 113526. [7] Gupta & Horgan (2018) *4th Mars 2020 Rover Landing Site Workshop* https://marsnext.jpl.nasa.gov/workshops/2018-10/PRESENTATIONS/m2020_lsw_day2_19_Jezero_Final.pdf

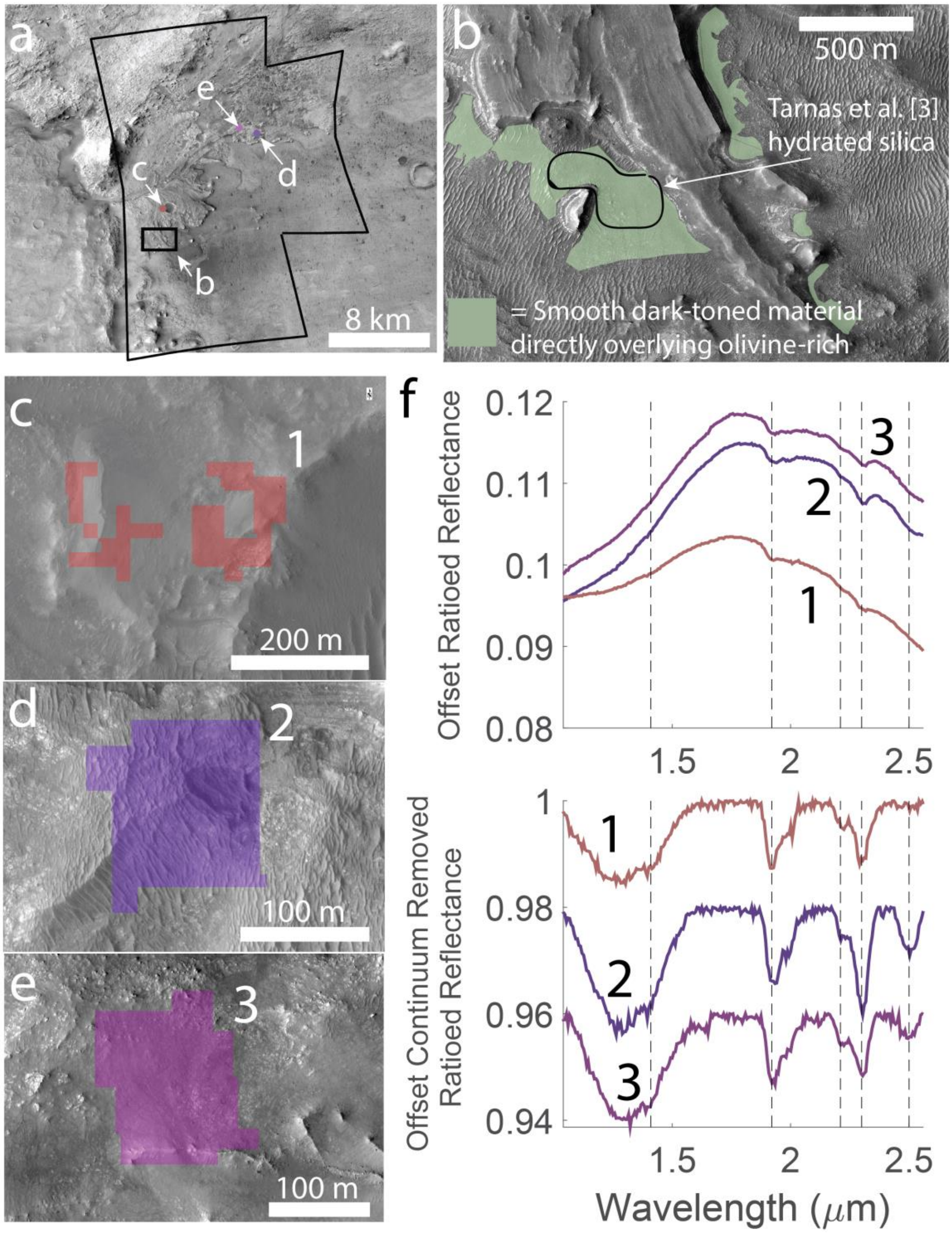

Figure 1 | Smooth dark-toned unit geomorphic mapping and additional possible hydrated silica detections. (a) Overview figure of west Jezero crater. The larger black outline shows the combined image footprint for CRISM images HRL40FF and FRT47A3. (b) Geomorphic map of smooth dark-toned material that directly overlies the olivine-rich unit, similar to the hydrated silica-bearing material described in [3]. (c) Possible hydrated silica detection on western Jezero delta remnant, also reported in [6]. The detection is associated with dark-toned material. (d & e) Possible hydrated silica detections on northern Jezero delta remnant, also reported in [6]. The detections are associated with dark-toned material. (f) Spectra from pixels colored in c-e, both non-continuum removed (top) and continuum removed (bottom). The spectra exhibit 2.2 μm features consistent with Al-OH or Si-OH bonds. Because of the chemically non-unique nature of this 2.2 μm spectral feature, we call these detections “possible hydrated silica”.