GEOLOGIC MAPPING AND STRATIGRAPHIC ANALYSIS OF A CANDIDATE MARS 2020 LANDING SITE: JEZERO CRATER, MARS. S. Cofield,[1] K. M. Stack[2], [1]Old Dominion University, Norfolk, VA, 23529, scofi002@odu.edu, [2]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109.

Introduction: Jezero crater is one of three final candidate landing sites under consideration for NASA's Mars 2020 mission, the first step in a potential multi-mission effort to return samples from the surface of Mars to Earth. Jezero is an ~45 km diameter impact crater located in the Nili Fossae region of Mars that contains delta deposits interpreted to represent an ancient open-basin paleolake fed by two large inlet valleys connected to an extensive watershed and drained by an outlet valley [1-3].

Previous mapping efforts focused in Jezero crater used images from the Mars Reconnaissance Orbiter (MRO) Context Camera (CTX) to map at a scale of ~1:30,000 [4]. In this study, we construct a detailed orbital geologic map of the proposed Mars 2020 landing ellipse in Jezero using data from the MRO High Resolution Imaging Science Experiment (HiRISE). Maps and stratigraphic cross-sections are used to: (1) provide additional insight into the depositional origin of the geologic units in Jezero crater; (2) provide detailed geologic context for proposed Mars 2020 ROIs; and (3) re-examine the stratigraphic relationship between the crater floor units, delta remnants, and the western delta front. As with detailed geologic mapping efforts for the Mars Science Laboratory Curiosity rover field site in Gale crater [4-6], the orbital geologic map constructed here for Jezero could be used to plan and enhance surface science operations for a ground-based rover.

Methods: The study area covers the 87 km^2 Jezero crater candidate landing ellipse (Fig.1). Mapping of the entire ellipse was performed at a 1:5,000 scale using a 25 cm/pixel HiRISE orthophoto basemap and a 1m/pixel HiRISE digital terrain model (DTMs) constructed by [8]. A series of small mesas within the landing ellipse that have been interpreted as delta remnants by [3] and identified as a possible ROI for the M2020 rover, were mapped at 1:500 scale. Orbital geologic units were distinguished by differences in surface texture, relative tone, and topographic expression.

Units: Units are grouped by location within the study area:

Delta Front Units. The delta front units include those units mapped within the southeastern portion of the delta front contained within the landing ellipse. The top surface of the delta was divided into four dark, smooth units (D-Gs, D-Ge, D-Gp, D-Gp) and three light-toned, erosionally resistant units (D-LTp, D-LTr, D-LTf). The smooth dark units are interpreted to be predominantly mantling material, rather than *in situ* bedrock. Distinct bright white layers (DL-LT and dark gray layers (DL-G) are present along the west-facing slope of the delta front, but these outcrops are intermittently exposed amongst the smooth, dark units.

Crater Floor Units. The present-day floor of Jezero was divided into three groups: smooth dark to intermediate-toned units (F-DGs, F-DGf), light-toned units (F-LT, F-LTp, F-LTc), and units transitional between the two endmember groups (F-T1-3). Some smooth unit exposures appear extremely homogenous and featureless (F-DGs); other occurrences contain rare impact craters and fractures ranging in length from meters to kilometers (F-DGf). Smooth units are found throughout the ellipse, but are rarely in sharp contact with adjacent light-toned units, instead exhibiting diffuse boundaries and gradual transitions between the smooth and the light toned units. Those units defined as transitional either exhibit tones and textures intermediate between the two endmember groups (F-T1), or form continuous regions composed of small exposures of each endmember that are below the map scale (F-T2-3).

The light-toned units (F-LT) were identified by their bright tone, high crater retention, abundance of km-scale fractures, and rough, mottled surface texture. Some exposures exhibit distinct meter-scale polygonal fractures (F-LTf), though the stratigraphic relationship between these exposures and surrounding light-toned fractured units is unclear. The light-toned units in the eastern portion of the ellipse (F-LTc) have a distinctly brighter tone and are very heavily cratered.

Delta Remnant Units. The delta remnants are a group of four mesas located ~3 km east of the delta front. The mesas are topped by light-toned peaks (R-LTp) with light-toned, smooth slopes (R-LTS), and light-toned linear ridges (R-LGr) sitting atop a massive smooth intermediate-toned unit (R-Gs). Some slopes appear to be covered by unconsolidated mantling material (R-MSe) or modern sand dunes (R-DS).

Layered outcrops are mapped within the delta remnants and distinguished by tone: light-toned, polygonally fractured layers (RL-Lp), intermediate-toned, polygonally fractures layers (RL-Mp), and dark, polygonally fractures layers (RL-DGp). The fourth layered unit was identified by thick smooth, dark layers (RL-DGs).

Discussion: The Jezero crater landing ellipse map constructed in this study has revealed several important unit subdivisions within the previously undivided Jezero crater floor. Our mapping shows that the "volcanic floor unit" of [5] is composed of starkly distinct smooth, dark-to-intermediate-toned units and light-toned units, as well as a series of transitional units that appear gradational in tone and expression of surface textures including fractures and small impact craters. These gradational characteristics suggest the possibility that the transitional units are the result of the non-uniform distribution of the material—whether unconsolidated or not is unknown—that comprises the smooth unit(s) across the light-toned units, resulting in variable "muting" of the texture and tone of the underlying light-toned bedrock. This interpretation suggests that caution should be applied when interpreting crater age dates for the "crater floor unit" as a whole, as crater expression may be non-uniformly affected throughout the exposure.

A somewhat surprising observation was the textural and morphological similarity of light-toned units mapped within the crater floor that had previously been identified by [3] to have very distinct mineralogies and relative ages. Although we identified a slight topographic distinction between [3]'s carbonate-bearing "light-toned floor unit" (this study's F-LTp) and mafic "volcanic crater floor unit" (all other crater floor units mapped here), textural differences between these units were observed in HiRISE to be unexpectedly subtle, particularly at the contact between the units.

This study has also highlighted the locations of the best-exposed layered outcrops within the delta front and delta remnants that would be of particular interest for *in situ* rover exploration. The layering within the west slope of the delta front is similar in style and expression to the layering exposed at the base of the delta remnant slopes. However, layers within the delta front tend to follow elevation contour lines, while the layering within the delta remnants appears to exhibit a more complex geometry and potentially steeper dips. Our mapping reveals that well-exposed layered outcrops do occur within the delta front slope and distal delta remnants (Fig.1), but these exposures are somewhere limited in lateral extent. Should Jezero be selected as the site for the M2020 rover mission, traverse planning should consider prioritizing these exposures to provide the best context for the rover in situ investigation and sample collection activities.

-References: [1] Fassett and Head, 2008a. *Icarus*, 195, 61–89. [2] Schon et al., 2012. *Planet. Space Sci.,* 67, 28–45. [3] Goudge et al., 2015. *JGR-Planets*, *120*(4), 775-808. [4] Calef et al., 2013. LPSC [5] Grotzinger et al., 2014. *Science*. 343(6169), 1242777 [6] Stack et al., 2017. LPSC. [7] N. R. Williams et al. (2018), LPSC.

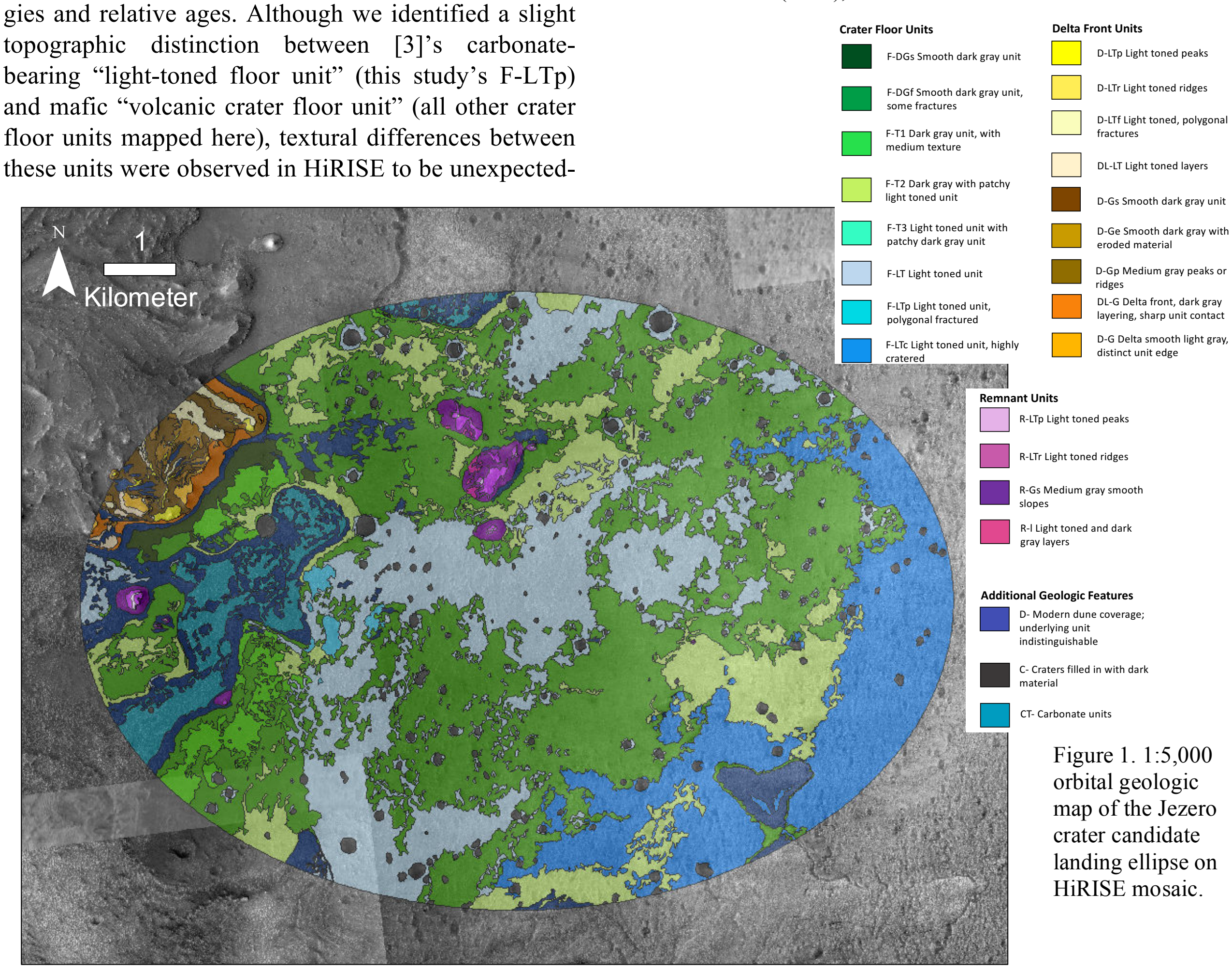

Figure 1. 1:5,000 orbital geologic map of the Jezero crater candidate landing ellipse on HiRISE mosaic.