FRACTURES WITHIN THE DARK TONED FLOOR UNIT OF JEZERO CRATER AS POTENTIAL TARGETS OF ASTROBIOLOGICAL INTEREST. N.B. Miklusicak[1], M.D. Hudson[1], R.E. Kronyak[1], L.C. Kah[1], [1]Earth and Planetary Sciences, University of Tennessee, Knoxville, TN 37996; lckah@utk.edu.

Introduction: Jezero crater (18.8° N; 76.6° E) is a small diameter (~48 km) crater that lies northeast of the Syrtis Major volcanic region, near the margin of Isidus Planitia. As the landing site for the Mars2020 mission, Jezero crater will be increasingly examined in terms of potential astrobiological targets.

Three distinct types of targets (Fig. 1) within Jezero crater are of high astrobiological interest: (1) phyllosilicate-bearing strata of the western and northern fans that represent water-lain sedimentary materials [1, 2]; (2) fan-related deposits that show a spectral signal of Mg-carbonate that may represent mineral precipitation from circum-neutral fluids [3]; (3) potentially mineralized fracture systems that occur within the crater floor and may represent migration of subsurface fluids. Associated materials include a dark-toned floor unit that has been interpreted as volcanic in origin and highly fractured, light-toned crater floor material [4].

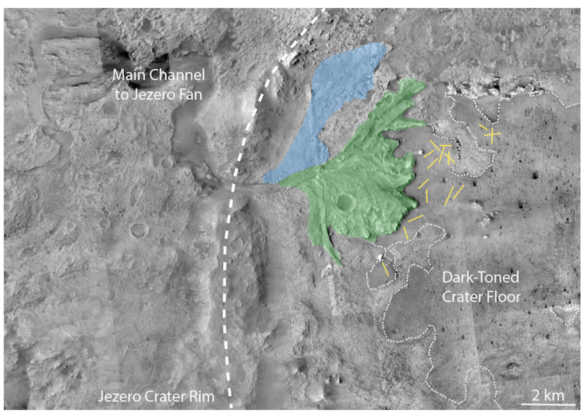

Figure 1. Targets of astrobiological interest within Jezero crater include (in green) phyllosilicate-rich fluvial-deltaic deposits, (in blue) deposits with a strong spectral signature of Mg-carbonate, and (in yellow) crater floor fractures.

Here we explore the distribution of the dark-toned floor unit, its relationship to associated crater floor materials, and the nature of fractures, and potentially mineralized fractures, within these units. Deciphering the relationship between crater floor materials and exposed fracture systems will place constraints on the origin of fractures, the timing of fracture formation, and on whether fractures served as conduits for potentially habitable, subsurface fluids.

Dark-Toned Floor Unit: Much of the floor of Jezero crater is mantled by a broadly smooth, heavily cratered surface that is characterized by a relatively low-albedo, relatively high thermal intertia, and a spectral signature that has been interpreted as a mixture of olivine and pyroxene. Combined, these features suggest an origin as a volcanic flow [5]. Although such characteristics are not unique to volcanic units [6], support for a volcanic origin includes the presence of levees in potential feeder channels northwest of Jezero crater, evidence for flow around topographically elevated regions of the crater floor, and potential vent features in southernmost Jezero crater (Fig. 2).

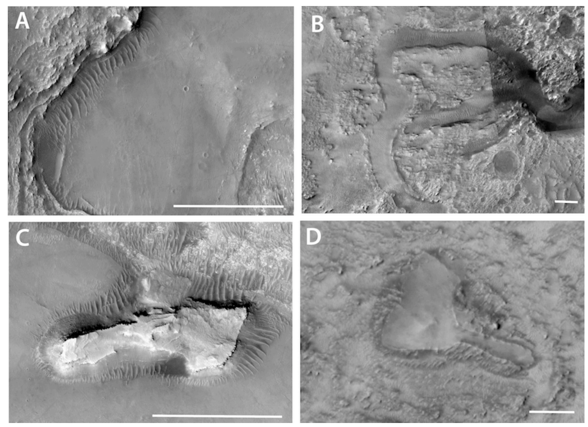

Figure 2. Evidence for volcanic origin of the dark-toned floor material include: (A) a regionally smooth, crater retaining surface, (B) leveed channels along potential flow paths into the crater, (C) lobate features around elevated regions of the crater floor, and (D) potential volcanic fissure. Scale bars are 250 m in all images.

Implications for Astrobiological targeting. If dark-toned crater floor material is interpreted as a volcanic flow, the Mars2020 science team must consider how such lithologies may have acted to compromise the preservation of potential astrobiological materials. Primary channels within the Jezero delta may have acted as conduits for high-temperature lava flows, which could potentially thermally degrade rock-hosted organic material accessible to the rover. Targets that were never exposed to thermal effects of lavas, or targets that represent post-depositional fluid flow may provide greater preservation potential.

Potential astrobiological targets. Abundant targets on the floor of Jezero crater may have remained uncompromised by interaction with high-temperature volcanic materials, including exposures of the underlying crater floor material and a series of extensive fractures that may have served as conduits for fluid flow.

Light-Toned Crater Floor Unit: Differences in surface texture and albedo within the Jezero floor reflects partial exposure of the underlying fractured, light-toned material. In some cases, these regions are interpreted as embayments that were topographically elevated at the time of deposition of dark-toned materials, and were likely never buried by dark-toned materials. These regions commonly show evidence of lamination, suggesting that they may represent distal sedimentary accumulations within the Jezero lake. Other regions occur as intermittent exposures within the dark-toned unit, and may represent regions that were topographically high and experienced little interaction with light toned materials, or regions that had only thin coverage by now-eroded dark-toned materials.

Crater Floor Fracture Systems: The astrobiological importance of fracture systems as conduits of fluid flow are well-documented within elsewhere on Mars, such as in Gale crater, which preserved erosionally resistant, fracture systems interpreted to represent mineralization by both surficial fluids [7] and subsurface brines [8]. Here we highlight three fracture systems that occur within crater floor materials (Fig. 3).

Fractures within light-toned materials. The first of these fracture systems is observed within the light-toned crater floor material. Fractures within light-toned crater floor material show a hierarchy in scale that results in a series of polygonal blocks of different sizes. Distinct sedimentary layers can show discrete sizes of polygons. Occasionally, larger oriented fractures reflect a secondary process, such as fracture related to impact events. The surface expression of these fractures is typically flush with the exposed surface, suggesting no preferential mineralization attributable to fluid flow. Fractures are filled with material identical in tone to local wind-blown material. These fractures are interpreted to reflect ongoing thermal expansion and contraction of surface materials.

Fractures within dark-toned materials. A second fracture system occurs exclusively within the smooth, dark-toned floor unit. These fractures also occur as hierarchical polygons. Polygons appear unoriented in much of the dark-toned material, but can show distinct differences in behavior near flow edges, where distinctly longer fractures mimic the orientation of the flow edge. This fracture system is often more difficult to see in orbital images. Fractures are indented within the smooth surface of the dark-toned unit, and do not show any indication of mineralization. Fractures are interpreted to reflect contraction upon cooling of lavas.

Potential mineralized fractures. A third fracture system is represented by a series of unoriented, but often straight fractures that are exposed in erosional relief within dark-toned crater floor materials. These fractures postdate the emplacement of dark-toned materials, but can be cross-cut by (and thus predate) craters within this material. This fracture system provides the most convincing evidence of fluid flow; erosional relief at edges of fractures suggests preferential lithification (or alteration) of fracture edges, or precipitation of secondary materials along fracture edges. Although these fractures occur in both dark-toned materials and light-toned patches within dark-toned regions, fractures do not extent beyond the edges of the dark-toned materials, suggesting that their formation may have been tied directly to emplacement of crater floor lavas. These fractures are therefore interpreted as hydrofracture and associated expulsion of basin fluids upon flow emplacement. Targeting of such fractures should thus be of high interest for astrobiological investigation.

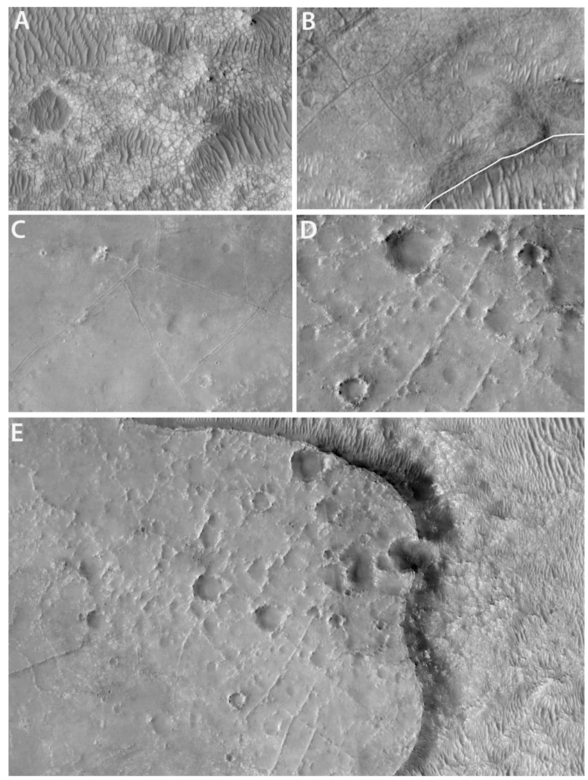

Figure 3. Fracture styles in Jezero crater. (A) Hierarchical polygons within light-toned crater floor material. (B) Oriented fractures within the dark-toned crater floor unit. (C, D) Potential mineralized fractures within the dark-toned unit. (E) Erosionally resistant fractures w-thin dark-toned unit.

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