AN ORBITAL PHOTOGEOLOGIC MAP OF THE JEZERO CRATER RIM: DIVERSE TARGETS FOR MARS 2020 FUTURE EXPLORATION. M. C. Deahn[1] (mdeahn@purdue.edu), B. Horgan[1], F. Calef III[2], J. Schroeder[2], K. M. Stack[2], N. R. Williams[2], S. Alwmark[3], C. C. Bedford[1], M. Bramble[2], L. Crumpler[4], D. Flannery[5], B. Garczynski[6], S. Gwizd[2], L. Ives[2], A. Klidaras[1], C. Lesh[7], H. Manelski[1], C. Miller[2], M. Nachon[8], C. Quantin-Nataf[9], N. Randazzo[10], E. Ravanis[11], P. Russell[7], T. Del Sesto[2], J. I. Simon[12], J. R. C. Voigt[2]; [1]Purdue U., [2]JPL/Caltech, [3]Lund U., [4]New Mexico Museum of Natural History, [5]Queensland U. of Technology, [6]Western Washington U., [7]U. of California, Los Angeles, [8]Texas A&M U., [9]U. Lyon, [10]U. of Alberta, [11]U. of Hawai‘i at Mānoa, [12]NASA JSC

Introduction: The Perseverance rover on the Mars 2020 mission is currently collecting samples in Jezero crater for potential future return to Earth by the Mars Sample Return (MSR) mission [1]. Jezero is a 45 km diameter mid- to late-Noachian-aged crater selected for its diverse geology and potential for preserving evidence of ancient life. The rover is approaching the crater rim, an area of interest for its potential to preserve diverse lithologies representative of a large period of geologic history [2]. It has significant astrobiological potential, as it may preserve evidence of uplifted deep crust and ancient hydrothermal environments [3]. Impact megabreccia in the crater rim may be exhumed pre-Noachian crust from the Isidis impact, which would likely be the oldest materials ever investigated by a rover on Mars [4]. Additionally, the rim hosts outcrops of the regionally extensive and potentially volcanic olivine/carbonate unit and mafic capping unit, which could have implications for the evolution of Mars volcanism [5]. Regional maps have delineated the lithologies present in and around Jezero as a whole [1,6,7]. The largest scale that the crater rim geology has been mapped is 1:5000 [3].

The goal of this study is to provide a more detailed 1:2500 photogeologic map of the ~ 14.5 x 3.5 km area around the Jezero crater rim to understand the potential for it to host key scientific evidence and MSR sampling targets for hydrothermal systems, impactites, uplifted basement rocks, and potentially volcanic regional units.

Methods: The primary dataset used is the High Resolution Imaging Experiment (HiRISE) basemap clipped to the Jezero crater region at ~ 25 cm/pixel resolution [8]. Also referenced are HiRISE color mosaics and elevation contours at ~ 1 m/pixel resolution. Combined, these datasets are used to discern surficial and morphologic units along the Jezero crater rim. All contact mapping is completed in CAMP (Campaign Analysis Mapping and Planning tool) [9], and later reconciled in ArcGIS Pro.

A subset of the Mars 2020 Science Team is collaborating to produce the photogeologic map (Figure 1). Following similar methodology to previous Jezero mapping efforts [3], the map is divided into 36 quadrants, each of which had a mapping lead responsible for drawing initial contacts for geologic units, and providing initial unit descriptions. Units are defined and named based on morphology, texture, relative brightness, and topography. Contacts are drawn between clear unit boundaries. Mission mapping specialists worked to reconcile the contacts between quadrants, and then a scientific reconciliation was performed to ensure that there was continuity in naming and interpretation across quadrants.

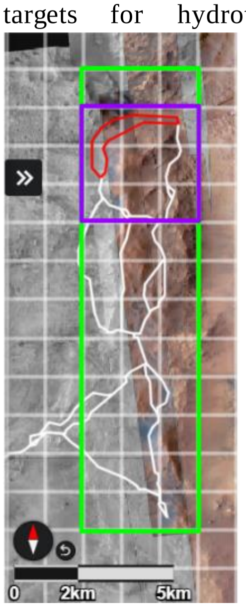

Figure 1 (left): Map area on Jezero crater rim with notional strategic traverse. Quads mapped so far are outlined in purple, still to be mapped in green.

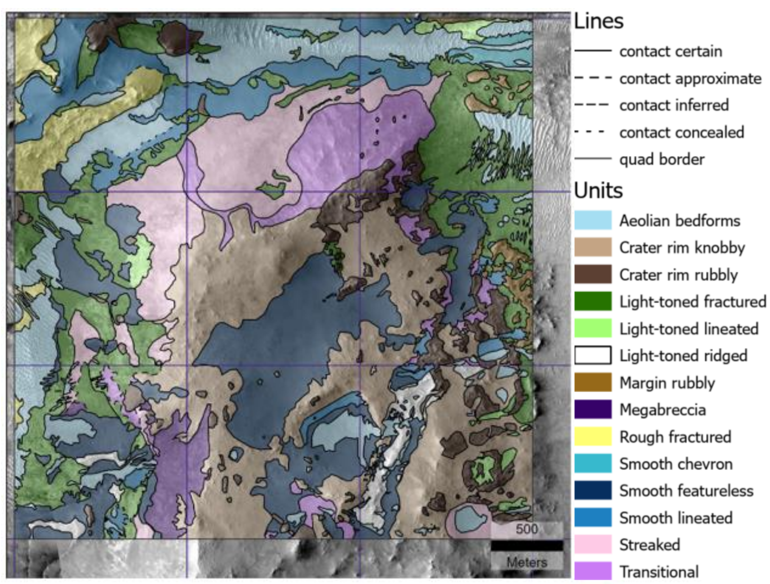

Figure 2 (right): The first nine mapped quads on the crater rim, color sets correspond to unit groups as described in text.

Geology: From initial mapping, we identify 14 units in 4 groups: surficial, light-toned, blocky, and textured.

Surficial units: Four units are categorized as surficial, *aeolian bedforms* as well as three variations of *smooth* units: *featureless, lineated, and chevron*. These are intermediate-to-dark in tone, found in low topography regions, and are named for their individual variations in prevailing surface patterns. These are interpreted to be the youngest units, as they conceal all underlying bedrock and are mainly preserved in topographic lows, where sediments are likely to collect.

Light-Toned units: Three units are identified based on their characteristic light-tone. *Light-toned lineated* occurs in bright patches with alternating light and dark-toned lineaments. They are often curvilinear and dissected by faults that offset the lineaments. *Light-toned fractured* is characterized by meter-to-decameter-sized polygonal fractures, occurs in heavily eroded patches along the crater rim margins, and often retain dark circular crater-like features with darker infill. Lastly, *light-toned ridged* are landforms found in the southern edge of the current mapped area. It forms an elongated network of ridges surrounded by surficial regolith.

The *light-toned fractured/lineated* units could correspond to a variety of lithologies including uplifted ancient crust, pre-impact sedimentary rocks, hydrothermally altered materials, and/or impactites. Some of the light-toned outcrops on the western edge of the crater rim may be similar to the adjacent carbonate-bearing bedrock found in the margin unit [10]. The *light-toned ridged* unit is likely a resistant filled fracture network, that is either hydrothermal or magmatic in origin.

Blocky units: Three blocky units are identified, all of which are found in higher topography regions and on slopes. *Margin rubbly* is light to intermediate-toned accumulations of meter-scale boulders. It is found on the eastern side of the rim transitioning from the margin unit. *Crater rim rubbly* exhibits similar blockiness but tends to be intermediate-to-dark in tone and is exposed at topographic highs along the crater rim. The *crater rim knobby* unit is intermediate-toned, has irregularly scattered knobs separated by smooth surfaces, and lacks the meter-scale boulders of the *rubbly* units.

The blocky units are interpreted to be disaggregated and highly eroded competent bedrock that has been partially covered by regolith. The *margin rubbly* unit is lighter in tone and may be part of or related to the margin unit. The *crater rim knobby* materials may be a more buried version of the *crater rim rubbly* unit, as it is often found in clusters around the *rubbly* unit at lower topography.

Textured units: The four remaining units are named for their textures. *Rough fractured* appears to be the most heavily fractured/jointed unit in the study area. It contains disaggregated bedrock with meter to decameter polygonal fractures, high-standing ridges, and a rubbly surface texture. It is dominantly found on the western side of the crater rim. The *megabreccia* unit is characterized by irregular to patchy light and dark-toned fractured bedrock. Next is the *streaked* unit, which appears to be moderately dust-covered bedrock with light and dark lineations that overlie and/or dissect the terrain. Lastly, the *transitional* unit appears as a "transition" between the surficial and geologic units, where generally smooth and uniformly-toned units have occasional small to large elongate higher-relief mounds of blocky/rubbly outcrop poking up from beneath the mantle.

The *rough fractured* unit is primarily found along the lower portions of the western rim, and has characteristics similar to the previously identified regional olivine/carbonate-bearing unit [6,11]. The *megabreccia* unit is interpreted to be exposures of Isidis megabreccia along the rim [2]. These morphologies have previously been suggested to contain blocks of crust excavated by the Isidis and/or Jezero impact events [11]. The *streaked* and *transitional* units are both partially concealed by surficial units such as regolith. The "streaked" morphology is likely due to aeolian processes, and the peaks of outcrops in the *transitional* unit is likely similar to the morphologies present in the *crater rim knobby* unit, but with a greater regolith cover due to its lower elevation.

Conclusions: Preliminary mapping of the Jezero crater rim reveals at least ten unique bedrock units and four surficial units. The diverse morphologies present in the crater rim have the potential to address scientific questions about some of the most ancient terrains on Mars, including potential Noachian volcanic units (*rough fractured* unit), megabreccia (*megabreccia* unit), impact-induced hydrothermal alteration (*light-toned ridged*), and potential impactites (*light-toned fractured/lineated*). The large-scale crater rim geologic map will also serve as a resource for strategic planning and selecting potential sampling sites for Mars Sample Return.

References: [1] Farley et al. (2020) *Space Sci. Rev., 216*, 142. [2] Mayhew et al. (2024) *this volume*. [3] Stack et al. (2020) *Space Sci. Rev. 216,* 127. [4] Scheller & Ehlmann (2020) *JGRP, 125,* e2019JE006190. [5] Hundal et al (2022) *Geophys. Res. Lett., 49,* e2021GL096920. [6] Goudge et al. (2015) *JGRP, 120,* 775–808. [7] Sun & Stack (2020) *Sci. Invest. Map*. 3464. [8] McEwen et al. (2007) *JGRP, 112,* E05S02. [9] Calef et al. (2023) 54th LPSC, abs. 2914 [10] Tarnas et al. (2021) *JGRP, 126,* e2021JE006898. [11] Mustard et al. (2009) *JGRP, 114,* E00D12.