SOURCE-TO-SINK ANALYSIS OF THE JEZERO CRATER WESTERN DELTA WATERSHED. B. V. Wogsland[1], L. C. Kah[2], F. J. Calef III[3], B. H. N. Horgan[4], [1]Department of Earth and Planetary Sciences, University of Tennessee (1621 Cumberland Avenue, 602 Strong Hall, Knoxville TN 37996, bwogsl1@vols.utk.edu), [2]Department of Earth and Planetary Sciences, University of Tennessee (lckah@utk.edu), [3]Jet Propulsion Laboratory (4800 Oak Grove Drive, Pasadena, CA 91109, fcalef@jpl.nasa.gov), [4]Department of Earth, Atmospheric, and Planetary Sciences, Purdue University (550 Stadium Mall Drive, West Lafayette, IN 47907, briony@purdue.edu)

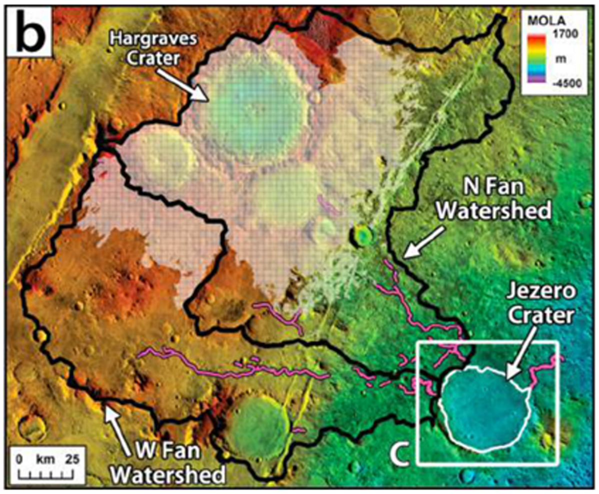

Figure 1. *Geographic delineation of the western and northern watersheds, Jezero Crater; Goudge et al. [4].*

Introduction: Both the northern and western deltas within Jezero crater have well-defined watersheds (Figure 1) that permit detailed evaluation of the potential provenance for deltaic sedimentary materials [4], [6]. Previous work by Goudge et al. [4] hypothesized that limited chemical weathering occurred during transport of sedimentary materials from the watershed to the delta, because data from the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) of both the northern fan and western deltas were similar to that found within their respective watersheds. CRISM spectra of the northern fan are dominated by olivine mixing with Mg-carbonate and potentially Fe/Mg smectite. By contrast, the western delta CRISM spectra is dominated by Fe/Mg smectite with a subtle feature attributed to Mg-carbonate [4]. Horgan et al. [5] later suggested that the deltaic source materials may have changed composition through time, from low calcium pyroxene and smectite dominated to olivine and carbonate dominated. Such transition between primary CRISM-identified lithologies may represent down cutting through different geologic units in the watershed. Recent data from the Perseverance Rover indicates that there are at least two discrete styles of sedimentation in the western delta: lacustrine-deltaic deposits recorded as delta fore sets and episodic floods recorded as boulder conglomerate deposits [6]. Here we present new mapping of the western watershed at a finer scale than that provided by Goudge et al. [4]. The discrete lithologic units exposed within the channels will facilitate a quantitative estimation of the eroded volumes of different lithological units to explore potential input to the western delta. Understanding of source-to-sink relationships will add robustness to the interpretation of Perseverance Rover data from the delta, and that data will in turn inform provenance interpretations made with orbital data.

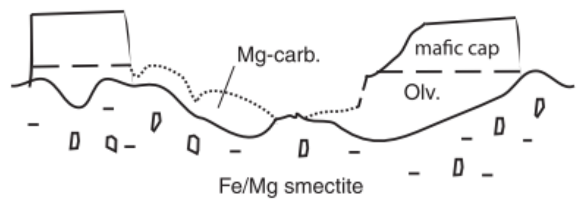

Figure 2. *Regional stratigraphy of mineralogically distinct rock units in the watershed for the Jezero crater western fan, consisting of smectite-bearing altered Noachian basement, a regional olivine unit (Olv.) with alteration providing a varying percentage of Mg-carbonate, and a mafic capping lithology that that is marked by spectral evidence for high calcium pyroxene, with little or no alteration signatures observable in CRISM [cf. 4, 5].*

Previous mapping efforts: Figure 2 provides a generalized regional stratigraphy of the lithologically distinct mineralogic units outside Jezero crater; the stratigraphy observed in this study is similar to that which has been proposed by previous authors [cf. 1, 2, 3, 4, 5, and 8].

Compositional units within the watershed are primarily identified with CRISM by their aqueous alteration products. These include evidence for aqueous alteration containing Fe/Mg smectite and isolated regions containing kaolin-group minerals within the Noachian basement [cf. 1, 3, and 4]. Additional aqueous alteration, whose timing is uncertain, also produced varying amounts of Mg carbonate within a regional olivine carbonate unit [2] which is preserved stratigraphically beneath a regional mafic capping unit [cf. 1, 4, 5]. This mafic capping unit, also called the pitted capping unit, has no distinct alteration signature observable in CRISM spectra [4].

At present, it is hypothesized that fluvial and lacustrine activity in Jezero may have lasted as long as 10 million years, or as little as a few hundred years, ending around 3.8 Ga [7]. Regardless of the time span of fluvial activity, we posit this new work on the understanding that fluvial downcutting in the western watershed must have successively passed through multiple compositional units.

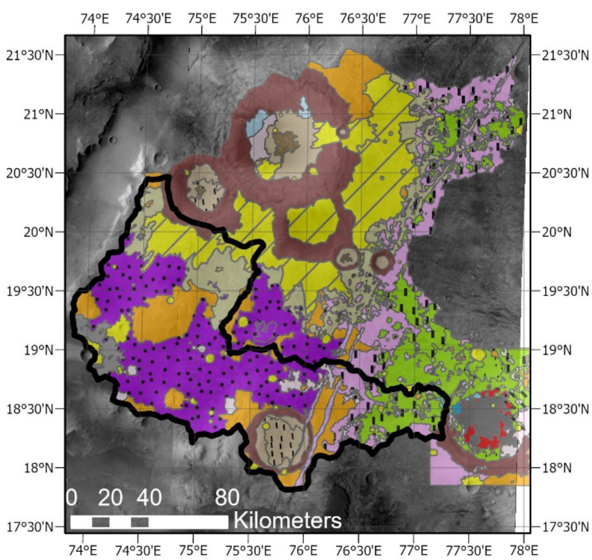

Figure 3. *Geomorphic map of Jezero crater and its respective watershed (modified from [4]). The watershed outlined in black feeds the western delta that the Perseverance rover is currently exploring.*

New mapping efforts: Multiple studies have suggested that the regional stratigraphy of the Nili Fossae and Nili Planum outside Jezero region includes altered Fe/Mg smectite-bearing Noachian basement, overlain by a regional olivine carbonate unit that contains various amounts of Mg-carbonate alteration products, and an unaltered mafic capping unit marked by a high-Ca pyroxene component. The fluvial system that fed the western delta in Jezero crater cuts through all three of these compositional units, with apparently minimal aqueous alteration before deposition [cf. 4, 5].

Previous CRISM-identified mineral compositions and geomorphic delineations [Figure 3; cf. 4, 5, and 8] were synthesized to approximate the boundaries and initial units for this project. The units comprising the western delta watershed were then mapped at 1:10,000 (CTX ~6m/pixel), a scale substantially finer than the 1:30,000 scale that was used by Goudge et al. [4]. Fluvial channels within the watershed were then mapped at even higher resolutions, based on HiRISE imaging. We then used a digital terrain model to (1) define both regional and local thicknesses of the primary mineralogical units within the watershed; (2) to define the units through which local watershed channels eroded, assuming only minimal post-fluvial erosion; (3) to delineate the local width and depth of the channels throughout the watershed, beginning with primary, then secondary, then higher-order channels; and (4). calculate the volumes of the distinct mineralogical units eroded during channel formation.

Efforts at higher-resolution mapping of the western delta watershed permits analysis of sedimentary input from the distinct mineralogical units that occur within the western watershed. This data is critical to construct a three-dimensional model of watershed erosion, and to provide critical constraints on potential changes of sediment composition flowing into Jezero through time.

Implications for Mars2020: The stratigraphy and rock units exposed within Jezero crater is being actively investigated by the Perseverance Rover team. New mapping efforts will provide (1) an estimate of the maximum and minimum delta volume, which will help with understanding the original extent of the western Jezero delta and the depositional and erosional history of Jezero crater; and (2) an evaluation of potential changes in provenance and composition during deposition of the western Jezero delta, which will provide a critical framework within which the Mars 2020 team will work during the upcoming delta campaign.

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