CHARACTERIZING THE NORTHERN FAN DEPOSITS IN JEZERO CRATER, MARS. Mohini J. Jodhpurkar[1], James F. Bell III[1], and Sanjeev Gupta[2] [1]Arizona State University, Tempe, AZ 85282 (mjodhpur@asu.edu) [2]Department of Earth Science and Engineering, Imperial College, London, UK

Introduction: Jezero Crater is a late Noachian to early Hesperian-aged ancient crater lake basin inside the western edge of the Isidis impact structure and is approximately 50 km in diameter [1]. It is also the landing site of the Mars 2020 Perseverance rover mission, which is now entering its first Extended Mission. One of the primary reasons for the selection of Jezero is the large, well-preserved fan delta that dominates its western half, originating from the western channel, Neretva Vallis. However, there are also sedimentary deposits located in the northern portion of crater. Since there is a northern channel that enters into the crater there (Sava Vallis), these fan deposits could either represent a second delta fan within the crater, or could be an outlying portion of the originally-larger western delta (Fig 1). To understand the fluvial and sedimentological history of Jezero, as well as to place the rover's *in situ* observations in proper geologic context, it is important to gain as thorough of an understanding of these deposits and their surrounding watersheds as possible.

Jezero's northern fan deposit is of particular interest because it remains unclear whether it is related to the western delta or is its own separate system connected with the northern watershed. Previous research has tended to group the deposits together as one unit [*e.g.,* 2], but there are many unanswered questions about the northern fan deposits [3]. Mineralogical characteristics as derived from the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) on the Mars Reconnaissance Orbiter (MRO) suggest that the relationship between the western delta and these northern fan deposits is not well-constrained [*e.g.,* 3]. In particular, there are some units that are similar between the western delta and these northern fan deposits, but there are also some stark compositional variations.

To that end, this ongoing study aims to characterize and interpret the morphology of the northern fan deposits through photogeological mapping. In addition, we seek to identify geological signatures that might help determine whether they are deltaic or alluvial deposits and to use crosscutting relationships to constrain age relations. Our study also involves comparing the contacts and units to data from CRISM and the Mars Odyssey orbiter Thermal Emission Imaging System (THEMIS), to see how mineralogic inferences supplement the photogeological mapping.

To date, there have been several observations of the northern fan deposits from the Mastcam-Z instrument onboard the Mars 2020 mission [4] and our work also incorporates ground-truthing and interpretations from those *in situ* images.

Methods: We rely heavily on orbital imagery from the MRO High Resolution Imaging Science Experiment (HiRISE). At an approximate resolution of 25 cm/pixel, these images provide the detail necessary for thorough photogeological mapping. The area identified for investigation spans several HiRSE images, so mosaics generated by Caltech's Murray Lab as a part of the Mars 2020 landing site effort are used as the basemaps [5]. The northern fan deposits are photo-geologically mapped using morphologic characteristics such as relative brightness, tone, and surface texture. THEMIS and CRISM datasets are also used to distinguish geological and/or mineralogical differences from the effects of illumination and dust cover variations. Mapping was done at a digitizing scale of 1:3000, in ESRI's ArcMap. Unit names for units that appear similar to those in the Mars 2020 team's map [6] are carried over to this map, while those that are different are named following a similar convention. In conjunction with mapping, Mastcam-Z stereo mosaics that include portions of the northern fan deposits are compared to one another and to the orbital-based map to use the three-dimensional surface perspective to help constrain the stratigraphy of some of these units.

Results/Discussion: While some of the units that are being photogeologically mapped as a part of this investigation seem to be in areas where there are variations in illumination or dust cover, the vast majority do appear to be distinct surficial geologic and bedrock units. Several of the contacts identified on the basemap also correlate with places where the THEMIS and/or CRISM signatures change. At the time of this writing, we have access to a Digital Elevation Model (DEM) of the northwestern fan that is sufficient to cover the transition zone shown in Figure 1. From the elevation change and the inferred flow direction, it appears that the western delta material overlaps the northwestern fan. Additionally, [3] showed that the northern fan deposits appear to be missing the uppermost LCP (low calcium pyroxene) and smectite bearing unit that is present in the western delta. The relative degradation of the northern fan deposits as observed from rover imaging, along with the absence of distinct lobes in orbital imaging, suggest that the northern fan deposits are either older than the western delta, or that they both deposited concurrently but ongoing fluvial activity in both deposits erased part of the record. More detailed study is necessary to identify any additional geologic evidence that may aid in constraining stratigraphy.

The Mastcam-Z images of the northern fan deposits (sol 395, sequence zcam08418) featured the best view possible towards the north during the rapid traverse. The rover was at an elevated position, so imaging was able to observe further into the deposits than was previously possible. Future work involves examining these Mastcam-Z in association with HiRISE images where it seems multiple units meet and looking for other signs that might help identify relative timing of deposition. This will allow for the creation of a basic stratigraphic column. The multi-faceted nature of this study can lead to a more comprehensive understanding of the northern fan deposits and where they fit within the broader Jezero system. This methodology can also be used on more recent discoveries of other candidate deltaic deposits, particularly ones referenced in recent global surveys of Martian deltas [*e.g.,* 7,8]. In this way, it may be possible to learn not just about Jezero and the processes that were active there at one point, but also the dynamics that have influenced and contributed to fluvio-deltaic deposition on Mars as a whole.

References: [1] Tanaka K.L. *et al.* (2014) *Planet. & Space Sci. 95*, 11-24. [2] Goudge T.A. *et al.* (2015) *JGR*, *120*(4), 775-808. [3] Horgan B. H. N. *et al.* (2020) *Icarus, 339*, 1-34. [4] Bell J.F. *et al.* (2020) *Space Sci. Rev., 217*, doi:10.1007/s11214-020-00755-x. [5] Dickson, J. Mars2020 Landing Site Working Group 2.0 URL http://murray-lab.caltech.edu/Mars2020/index.html [6] Stack *et al.* (2020) *Space Sci. Revl,* 216, 1-47. [7] De Toffoli *et al.* (2021) *Geophys. Res. Letters*, 48(17), 1-10. [8] Wilson *et al.* (2021) *Geophys. Res. Letters,* 48(4), 1-10.

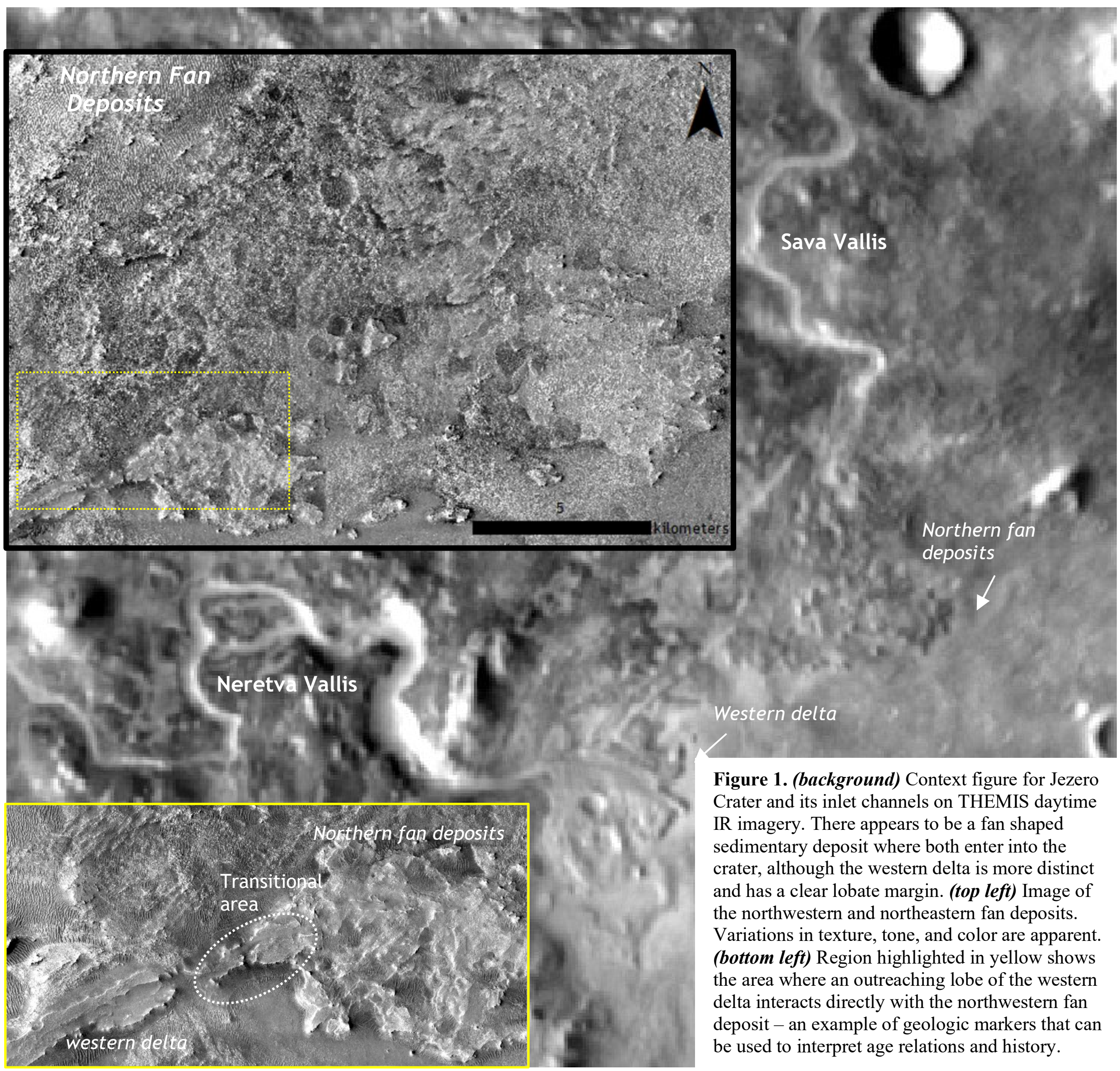

Figure 1. ***(background)*** Context figure for Jezero Crater and its inlet channels on THEMIS daytime IR imagery. There appears to be a fan shaped sedimentary deposit where both enter into the crater, although the western delta is more distinct and has a clear lobate margin. ***(top left)*** Image of the northwestern and northeastern fan deposits. Variations in texture, tone, and color are apparent. ***(bottom left)*** Region highlighted in yellow shows the area where an outreaching lobe of the western delta interacts directly with the northwestern fan deposit – an example of geologic markers that can be used to interpret age relations and history.