MAPPING AND INTERPRETING PUTATIVE DELTAIC DEPOSITS ACROSS THE MARTIAN SURFACE. Mohini J. Jodhpurkar[1] and James F. Bell III[1], [1]Arizona State University, Tempe, AZ 85282 (mjodhpur@asu.edu)

Introduction: Putative deltaic deposits are located across the surface of Mars and are of interest to scientists because in addition to indicating the presence of long-standing water, they have the potential to preserve biosignatures and contain a record of Mars's geologic history. For these reasons, they have been studied extensively – both through studies relying on orbital data and through the course of rover missions. Studies about Gale Crater [1], the Hypanis fan [2], and even Jezero Crater, landing site for NASA's Perseverance mission, are just a few examples of such efforts [3-4]. In the recent years, several surveys of fan-shaped deposits across Mars have also been conducted, focusing on those interpreted to be deltaic [5-8]. Investigating such sites, particularly ones that are in and around impact craters, is useful because it can allow for more detailed comparisons between them.

With all this in mind, in this study we select several sites across Mars where recent surveys have identified putative deltaic deposits within craters. The most prominent of these to date is the northern fan deposit within Jezero crater, a ~50 km diameter Noachian-aged ancient crater lake basin inside the western edge of the Isidis impact structure [9,10]. While the western fan delta along the crater's western edge is the primary focus of the Perseverance mission, the northern fan deposits are of interest because it remains unclear whether their depositional history is related to the western inlet channel or the northern one [4]. Though previous mapping efforts support the former interpretation [3,11], data from MRO's Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) show that the northern fan deposit lacks the low-calcium pyroxene and smectite signatures observed on the surface of the western fan [4].

In addition to Jezero Crater's northern fan, this study maps other sites – including two located in Lunae Planum and Arabia Terra [6], though both are much smaller than Jezero and only have one inlet and outlet channel. Studying such deposits, along with looking at their surrounding inlet and outlet valleys and infill deposits provides context that can help constrain stratigraphy in these areas. Synthesizing various datasets and comparing across locations can build a more comprehensive understanding of the deltaic processes that lead to their deposition and allow for paleoenvironmental interpretations.

Methods: All locations selected for this study are photo-geologically mapped at a 1:3000 digitizing scale in ESRI's ArcMap. Since HiRISE has an approximate resolution of 25 cm/pixel, these images provide the detail necessary for thorough photogeological mapping. Units are mapped based on morphologic characteristics, such as relative brightness, tone, and surface texture in HiRISE imagery. In addition, we use CRISM and THEMIS data to distinguish geological and/or mineralogical differences from the effects of illumination and dust cover variations. We also incorporate "ground-truth" for mapped units using images obtained from the Perseverance rover to correlate geologic units identified through ground-based mapping with those in the Jezero landing site map, for Jezero's northern fan [12]. Where possible, crater counting is conducted using the ArcMap CraterTools extension on the unit that the mapping effort identified as putatively deltaic [13]. The creation of these crater density plots allows for age interpretations using model ages.

Results/Discussion: So far, three photogeological maps at the 1:3000 scale have been created at the locations shown in Figure 1. Though these are primarily surficial geologic maps, as this work continues comparisons to orbital datasets such as CRISM and THEMIS can help with interpreting composition and refining map units.

Northern Fan Deposits According to the geologic map created through this effort, the northeastern portion of the northern fan exhibits more differentiated units than the northwestern portion. Additionally, it exhibits different CRISM signatures from the northwestern portion and the western fan delta, potentially indicating an influence from Sava Vallis. Similarly, the presence of a transitional area in the western portion of the northern fan may also support the idea that Sava Vallis played a role in the formation of the northern fan deposits. However, the timing of the deposition of these two deposits remains uncertain. Since the northern fan deposits are significantly degraded, it is also challenging to identify craters to count for the purpose of deriving a model age.

Lunae Planum The crater here is dominated by the putative deltaic deposit (shown in light blue). Along the northern part of the crater, the floor unit is covered almost entirely by a dune field. The unit called "fragmented" seems morphologically distinct from the dunes and deltaic material surrounding it, which is why it is interpreted as a separate unit. Crater counting was much easier here than in the Arabia Terra site, and yielded a model age of 3.4 Ga.

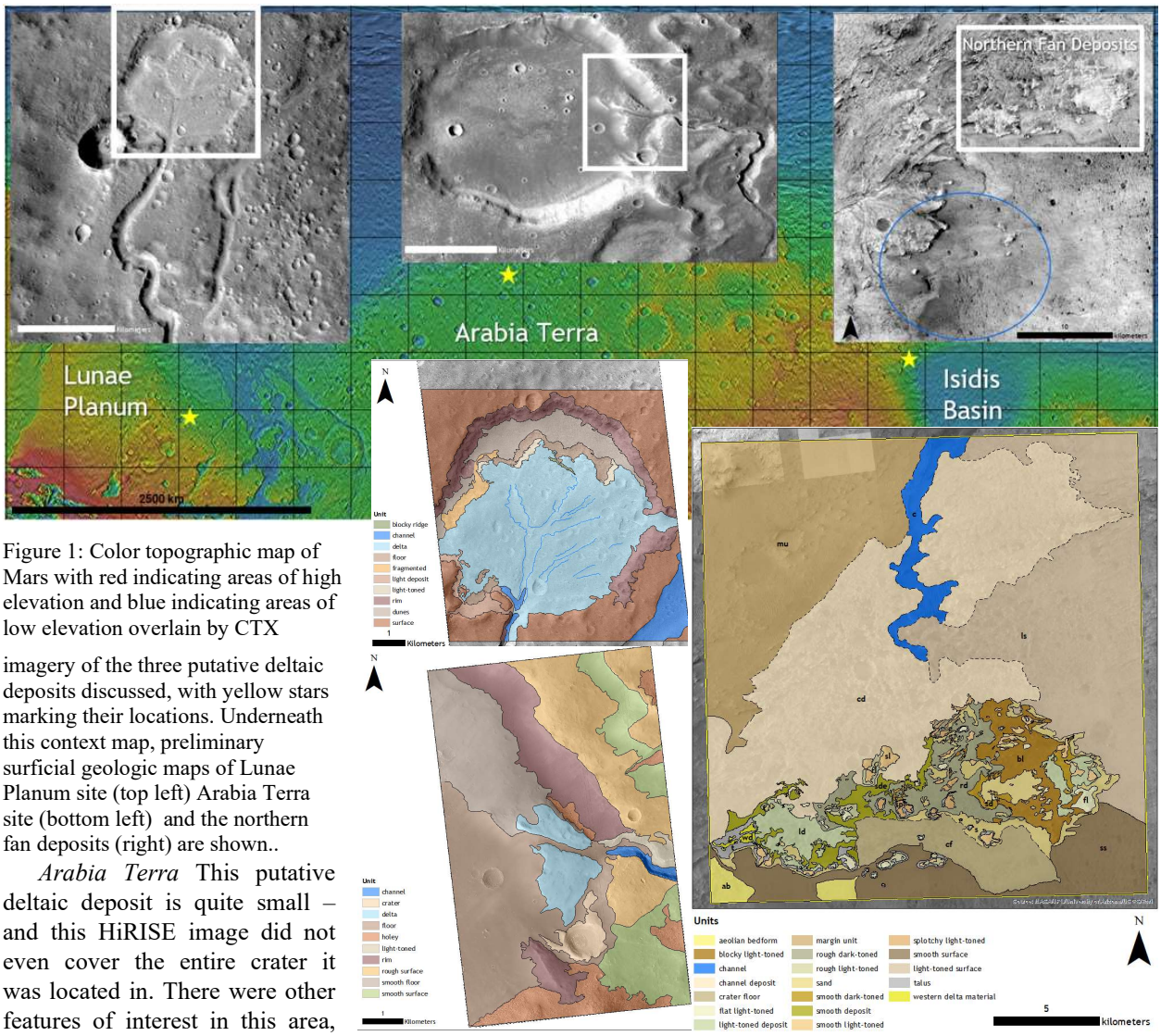

Figure 1: Color topographic map of Mars with red indicating areas of high elevation and blue indicating areas of low elevation overlain by CTX imagery of the three putative deltaic deposits discussed, with yellow stars marking their locations. Underneath this context map, preliminary surficial geologic maps of Lunae Planum site (top left) Arabia Terra site (bottom left) and the northern fan deposits (right) are shown..

Arabia Terra This putative deltaic deposit is quite small – and this HiRISE image did not even cover the entire crater it was located in. There were other features of interest in this area, however – in particular, the unit called "holey" was named this because the surface had a unique, pockmarked texture compared to the rest of what was observed across these two sites. Further, the channel unit here was quite obviously layered, unlike that of the one in the Lunae Planum site. Crater counting here yielded a model age of 3 Ga. This younger age is consistent with the morphologic indicators that the latter site might be younger than the former, as the deltaic shape seems to be less degraded and stands higher relative to the floor unit.

Future Work: As the Perseverance rover's mission continues, it is possible we will receive new imagery towards the northern fan deposits that may help determine their place within the context of Jezero as a whole. The preliminary surficial geologic maps created by this work so far will be refined as comparisons to CRISM and THEMIS data continue. By consolidating that with DTMs, it may also be possible to begin to interpret stratigraphic relations and create cross sections that illustrate these relationships. Additionally, we will continue to search Martian deltaic surveys to identify new sites of interest to include in this mapping effort and compare them to fan deltas on Mars that have already been studied.

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