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SURFACE EXPRESSION AND GEOMETRIES OF DELTAIC DEPOSITS OF JEZERO WESTERN FAN TOP (MARS).

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Introduction: Between February-September 2023, the Mars 2020 *Perseverance* rover explored the upper exposed surface of the western Jezero sedimentary fan. The rover's exploration focused primarily on the so-called "curvilinear unit." This unit was initially defined in orbiter images [1, 2] by the presence of repetitive, arcuate decameter-scale bedsets (Fig. 1). These morphologies were first interpreted to be fluvial in origin (likely meanders [2]). However, ground-based inspection from the rover's perspective tends to show us that they more than likely originate from deltaic depositional processes, in line with other observations made by *Perseverance* on the fan front [e.g., 3; 4].

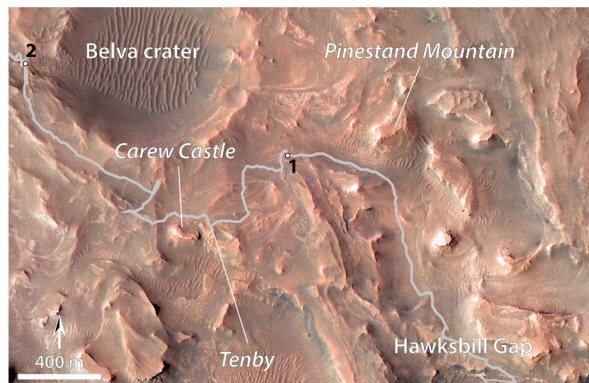


Fig. 1 Orbital view of the "curvilinear unit" in the vicinity of the traverse of the *Perseverance* rover (grey line), with location of the main outcrops (color HiRISE basemap) and imaging locations 1 and 2 for Fig. 2.

Observations and interpretation of the outcrops:

During *Perseverance*'s traverse across the western fan from Hawksbill Gap towards Belva crater (Fig. 1), the rover acquired long distance image mosaics of several well-preserved outcrops in and around the curvilinear unit (e.g., Pinestand Mountain and Carew Castle), and stopped to characterize the unit up-close at areas such as Tenby (Fig. 1). Image and 3D data from Mastcam-Z and SuperCam's RMI were used to characterize the surface expression and the geometries of the bedsets at these places.

Pinestand Mountain. Pinestand Mountain is a ~25 m high butte exposed east of the rover's traverse (Fig.

1). It displays two tall (~14 and ~22 m, respectively) sets of steeply dipping (up to ~40°) sigmoid strata (Fig. 2a), inferred to be composed of sandstone. These strata do not display any conspicuous cross-stratification or evidence of scour. When viewed from the northwest (loc. 2 in Fig. 1), the 3D shape of the butte is visible. We can observe that the sigmoidal strata from the left set pass laterally into sub-horizontal bedsets without any obvious discontinuity (Fig. 2b). The Pinestand Mountain butte is lobate shaped, with sub-horizontal strata observed along its central axis (Figs. 1 and 2b). The strata at Pinestand are interpreted as foreset beds formed by gravity-induced avalanche of sediments deposited onto the slope of a deltaic edifice. Additionally, the Pinestand Mountain butte could represent a single deltaic lobe.

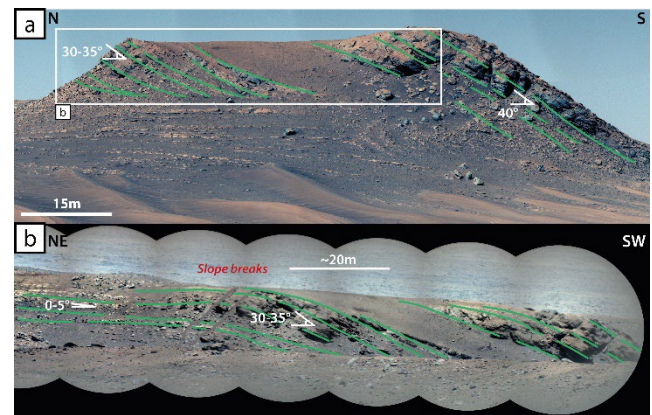


Fig. 2 a) General view of the Pinestand Mountain butte from imaging location 1 (zcam08726), highlighting the two ensembles of steeply dipping sigmoidal foreset strata (green lines). b) Detailed view (scam03777) of the NW faces of Pinestand taken from imaging location 2, with highlights (green lines) of the 3D configuration of the foresets, laterally passing from sub-horizontal, non-cross-stratified strata (left) to steeply dipping sigmoidal beds (right).

Tenby. The Tenby outcrop (Figs. 1 and 3) was thoroughly studied by *Perseverance* as it was a sampling location [5]. The close observation of the outcropping bedrock showed that it was mainly composed of medium- to coarse-sandstone, arranged in parallel, non-cross-stratified beds. 3D modeling of the area and analysis using Pro3D software helped

determine that the alternating resistant/non-resistant beds are dipping at angles up to $\sim 40^\circ$ (Fig. 3). This outcrop serves as the type locality for the Skrinkle Haven member of the Tenby formation [5]. We interpret these deposits as similar to those of Pinestand but observed in plan-view. Similarly, we consider them to represent deltaic foresets.

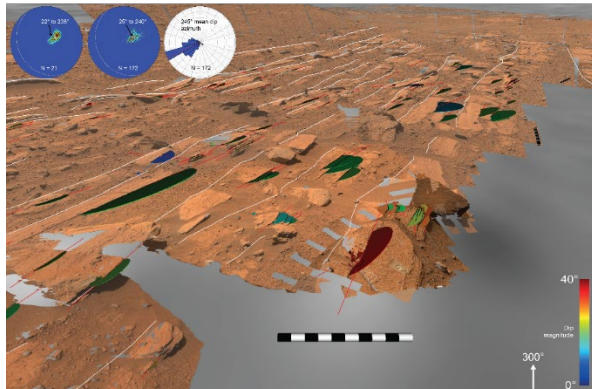


Fig. 3 Perspective view in Pro3D on the 3D Digital Outcrop Model of the Tenby outcrop with characterization of steep dip angles up to $\sim 40^\circ$ for bedsets interpreted to be cropping out leveled foresets in plan-view.

Carew Castle. The Carew Castle outcrop is a ~ 10 m high butte, situated just west of the Tenby outcrop (Figs. 1 and 4). While mostly covered by scree and regolith, the base of the outcrop is comprised of dipping medium to coarse sandstone beds of the Skrinkle Haven member. Above an irregularly-shaped erosive unconformity (white dashed line in Fig. 4a), we observe several amalgamated cross-stratified beds of conglomerate and coarse sandstone (Figs. 4a and 4b). Several of these beds exhibit evidence of a conspicuous concave base hinting at channelized bodies (Fig. 4b). The upper part of this outcrop serves as the type locality for the Carew Castle member of the Tenby formation [5]. These coarse-grained and heavily cross-stratified beds are likely to have been deposited within a relatively energetic setting, compatible with a braided river system. The unconformable transition from Skrinkle Haven member foresets at the base of Carew Castle to braided river deposits in the upper part of the butte is interpreted to represent a transition to topsets deposited onto the deltaic plain.

Discussion and Conclusion: The different features identified on the outcrops belonging to the curvilinear unit (e.g., facies, 2D/3D architecture, steep dips, large size of the clinoforms) are not compatible with a fully fluvial system. In turn, they are more in line with deltaic slope processes, and the deposition of foresets belonging to laterally successive lobes (or mouth bars). Preserved topsets at several places are evidence of

fluvial deposition (braided to possibly meandering rivers) as part of the deltaic plain. No bottomsets have been observed in this area. Still, we presume they are buried under the foresets and not observable on top of the delta fan.

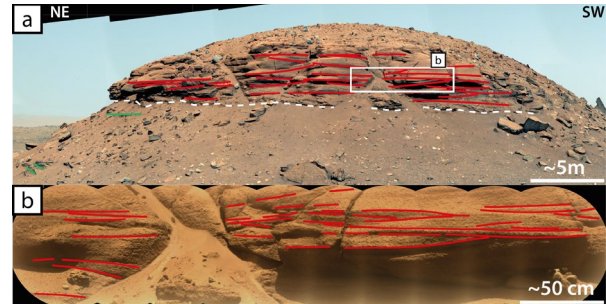


Fig. 4 a) General view of the Carew Castle outcrop (zcam08758), highlighting the coarse-grained, cross-stratified bedsets (red lines) unconformably overlying (white dashed line) the finer-grained material correlated to Tenby (cf. fig. 3). b) Detailed view (scam03754) of the cross-stratified sandstone to conglomerate of the topsets at Carew Castle.

The observations made in Jezero are in line with field observations of barely buried terrestrial deltaic analogs such as [6; 7]. The typical curvilinear surface expression conspicuously observed here results from a horizontal truncation of the deltaic lobes (or mouth bars), with the arcuate dipping beds corresponding to individual foresets. We hypothesize that truncation could either be a product of long-term erosion, or could be older and contemporaneous with deltaic build-up. In the latter case, truncation of the foresets could correspond to former terraces carved by the paleo-lake Jezero. These levels could therefore be used in addition to the foresets/topsets transition to map the 4D fluctuations of the lake-level, as we notably observe a forced regression pattern linked to lake-level dropping in Jezero [cf. 8].

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References: [1] Schon *et al.* (2012) *PSS* **61**(7), 28-45. [2] Goudge *et al.* (2018) *Icarus* **301**, 58-75. [3] Mangold *et al.* (2023) *ESS Open Archive*. [4] Caravaca *et al.* (2024) *JGRp*. [5] Ives *et al.* (2023) *AGU Fall Meeting '23* P43A-04. [6] Clauzon *et al.* (2015) *Mar. Pet. Geol.* **66**, 18-40. [7] Sztanó *et al.* (2010) *Földtani Közlöny* **104**(2), 167-182. [8] Mangold *et al.* (2024) *LPSC LV* (this conf.)