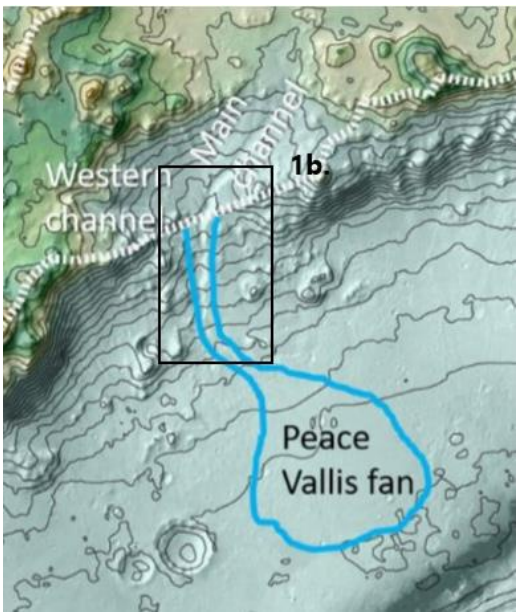
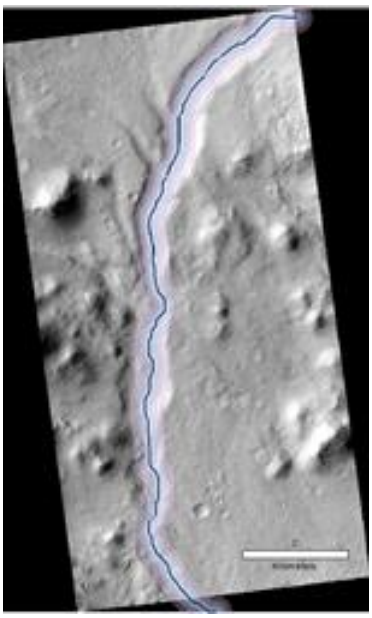
EVIDENCE FOR RESURFACING AND SUBSQUENT GROUNDWATER SEEPAGE PEACE VALLIS CHANNEL, GALE CRATER, MARS: L. A. Scuderi[1], T. Nagle-McNaughton[1], H. E. Newsom[1], J. Williams[1], Z. E. Gallegos[1], [1]U. New Mexico, Albuquerque, NM 87131, USA (tree@unm.edu)



a.



b.

Fig. 1. a. Peace Vallis Fan and lower portion of the Main channel drainage (see Newsom et al. this meeting). Original image courtesy F. C. Calef III. **b.** HiRISE image (PSP_010283_1755); main channel with centerline (blue) shown.

Introduction: The Peace Vallis (PV) alluvial fan is characterized by two distinct surface morphologies: specifically an older and coarser bedded fractured (BF) unit that is overlain in part by a younger alluvial fan (AF) unit [1,2]. The smoother AF surface, dated to <2.0Ga [3] represents a resurfacing event with source material derived from the PV drainage. Here we examine the main channel above the PV fan (Fig. 1) and identify features associated with sediment flow and runoff from this resurfacing event

Observations: Analysis of the main drainage with CTX Digital Elevation Models (~6m resolution) and HiRISE images (0.25m resolution) suggests:

1. Terraces with smooth and relatively uncratered surfaces bordering the main channel at elevations ~5 to 8m above the channel centerline (Fig. 2).

2. Erosional features at the edges of these terraces formed under receding flow (Fig. 3a) similar to those formed on Earth during recessional flow (Fig. 3b).

3. Groundwater sapping locations representing the latest period of flow following this resurfacing event (Fig. 4).

Discussion: The Peace Vallis fan in Gale crater is one of only a small number of crater alluvial fans on Mars, with a substantial drainage area above the crater rim [4,5]. This large drainage area may generate significant runoff and as such is likely to be exceptionally sensitive to putative Amazonian precipitation/runoff events. Terraced surfaces (Fig. 2), likely composed of the same material found in the AF unit of the PV fan, are consistently found within 250m of the main channel at elevations 5–8 m above the main channel. These surfaces grade smoothly to the PV fan apex.

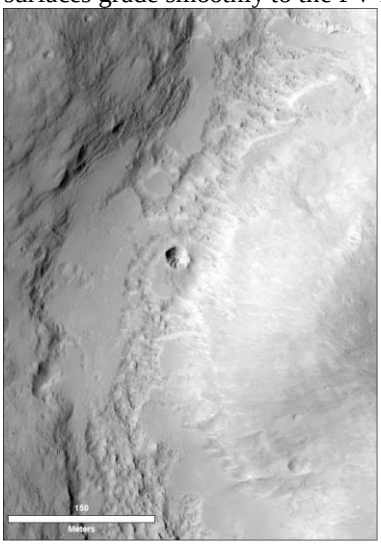
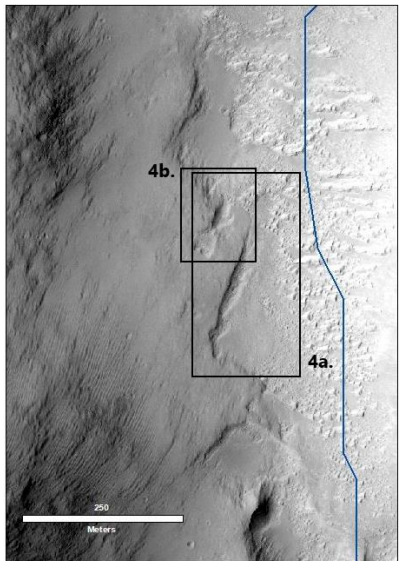


Fig. 2. Smooth terrace surfaces slope towards the main channel. Terraces found both east and west of the main channel. These terraces are relatively uncratered suggesting an Amazonian age.

Terrace edges along the primary drainage line contain scalloped features indicative of runoff after the primary event (Fig. 3a). These features are similar to those found along recessional drainages in the Hunshandake Sandy Lands of northern China (Fig. 3b) that formed after a significant middle Holocene lake draining and groundwater runoff event that dewatered the surface and subsurface [6].



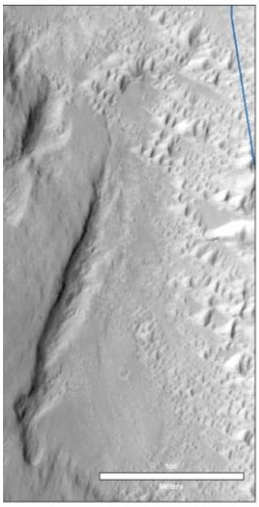
a.

b.

Fig. 3. Erosional features at terrace edge. **a.** PV drainage. **b.** Hunshandake Sandy Lands, China.

Features both on the terraces and associated with terrace edges (Fig. 4a) are similar to groundwater sapping features found on Earth in poorly cohesive sediment environments [6,7]. In the Peace Vallis drainage, these internal features appear as depressions in the otherwise smooth terrace surfaces (Fig. 4b).

The combination of evidence for resurfacing of the PV fan, related terrace deposits in the main channel, and groundwater seepage features on these terraces suggests a period of runoff from the PV drainage <2.0Ga that is analogous to similar resurfacing evidence from equatorial latitude sites [8]. A cluster of events at these sites dating to ~1.5Ga $\pm$0.2G [9] and similar evidence from sites closer to Gale Crater [10,11] suggests that this Amazonian resurfacing event was minimally regional in extent and possibly extended across the equatorial latitudes of Mars.



a.

b.

Fig. 4. Groundwater sapping features within the terrace deposits of the PV drainage. **a.** Elongated seepage feature draining into the main channel. **b.** Steeped groundwater seepage feature

Conclusions: The recognition of both terraced surfaces and groundwater sapping features in the main drainage of the Peace Vallis fan system provides additional evidence of an Amazonian resurfacing event.

References: [1] Palucis et al., (2014) J. Geophys. Res.: Planets 119:705–728. [2] Grant et al., (2014) Geophys. Res. Lett. 41:1142–1148. [3] Scuderi et al. (2019), LPSC. [4] Moore & Howard (2005) J. Geophys. Res. 110:E04005. [5] Kraal et al., (2008) Icarus 194:101–110. [6] Yang et al. (2015) Proc. Nat. Acad. Sci. 112(3):702–706. [7] Marra, et al. (2015). Earth Surf. Dyns. 3(3):389–408. [8] Tanaka et al. (2014) Planet. Space Sci. 95:11–24. [9] Neukum et al. (2010) Earth Planet. Sci. Letts. 294:204-222. [10] Ehlmann and Buz (2015) Geophys. Res. Letters 42(2):264-273. [11] Buzz et al., (2014) Geophys Res: Planets 122(5):1090-1118.