AN ALTERNATIVE (AEOLIAN) HYPOTHESIS FOR THE PROPOSED RECENT CERBERUS FOSSAE PYROCLASTIC DEPOSIT. L. P. Keszthelyi[1], [1]U.S. Geological Survey, Astrogeology Science Center, 2255 N. Gemini Dr., Flagstaff, AZ 86001 (laz@usgs.gov).

Introduction: Horvath et al. [1] report the exciting possibility that an extremely recent pyroclastic deposit has been discovered at the Cerberus Fossae on Mars. This abstract provides new and additional observations that suggest that aeolian processes are more likely to have produced this feature.

It is important to emphasize that the seemingly extraordinary suggestion by [1], that there may be a modest (~0.01 km^3) pyroclastic deposit on Mars that formed within the past 1 Ma, is entirely plausible. There is evidence for a variety of volcanic eruptions at and near the Cerberus Fossae within the Late Amazonian, and there is little doubt that this region contains the most recent lavas on Mars [2-3]. It has been suggested that a voluminous (~5000 km^3) flood of lava took place nearby within the last ~10 Ma [3-5] and the Cerberus Fossae are a locus of current seismic activity [6]. This part of Mars does indeed appear capable of volcanic eruptions to this day.

Basic Characteristics: The diffuse deposit in question is located at 7.9° N, 165.8° E, near the Zunil impact crater in north-central Elysium Planitia. It has a ~15x30 km ovate planform with its long axis centered on a strand of the Cerberus Fossae fissure system (Fig. 1). The dearth of superimposed impact craters indicates that the deposit is very young. Crater age dating of very young (and thin) deposits is challenging but is reported as 53±7 to 210±12 ka [1].

The deposit has distinct zones, with a lighter toned outer "halo" to a darker core (Fig. 1a). In the thermal infrared, the daytime temperature of the outer light-toned zone is cold, but the rest of the deposit is hot (Fig. 1b). Nighttime temperatures for the inner zones are anomalously high, but the outer (light-toned) zone is indistinguishable from the surrounding plains (Fig. 1c). VNIR imaging and infrared spectral measurements suggest the darkest material contains mafic minerals and glass, but much of the deposit is not distinct from the surrounding dust-covered plains [1].

Unusual Characteristics: Other diffuse deposits in the region share many of the basic visible, infrared, and thermophysical characteristics of the deposit in question. These dark streaks with bright halos extend downwind from topographic features such as impact craters, fissure segments, and knobs. What is unusual is that the deposit in question extends a much larger distance *against* the regional trend than other deposits across the region. It is more symmetric about the topographic feature than is typical of aeolian streaks in the region (which predominantly extend as narrow streaks to the southwest). This is a significant statistical anomaly and has been suggested to rule out an aeolian origin for this deposit [1].

New Observations: Continued observations by the instruments on the NASA *Mars Reconnaissance Orbiter* (*MRO*) and the ESA ExoMars *Trace Gas Orbiter* (*TGO*) provide some important additional information about the rapidly changing nature of the diffuse deposits in this area. For example, in MRO CTX image K13_058439_1880_XN_08N194W acquired on 2019-01-14 and TGO CaSSIS image MY35_009574_175 acquired on 2020-01-15, the inner zone of the proposed pyroclastic deposit has faded and is no longer distinct from the outer zone (Fig. 2a,b). Comparing to the streaks surrounding nearby impact craters, it is evident that this behavior is seen across the entire region northwest of Zunil crater; many other NW-SE trending dark streaks have also faded in the last few years (Fig. 2a,b).

Examination of the diffuse deposits associated with craters NW of Zunil show that, in this area, broad dark streaks with bright halos extend to the north as well as to the southwest of many features (Fig. 2a,b,c). In other words, the "anomalous" shape of the suggested pyroclastic deposit is actually typical of the aeolian deposits in this specific part of Elysium Planitia, given an extended linear source area.

Conclusions: The purported recent pyroclastic deposit near Zunil crater exhibits no characteristics that are significantly different than other deposits generally interpreted as aeolian in this particular part of Mars. Given that other features typically associated with a mafic pyroclastic eruption (spatter ramparts or cones, rheomorphic lava flows, lithic blocks, etc.) are absent, the aeolian hypothesis for the origin of this diffuse deposit is arguably epistemologically preferred.

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References: [1] Horvath, D. G. et al. (2021) *Icarus, 365*, 114499. [2] Jaeger, W. L. et al. (2007) *Science, 317*, 1709-1711. [3] Keszthelyi, L. P. et al. (2021) *USGS SIM 3477*. [4] Vaucher, J. et al. (2009) *Icarus, 204*, 418-442. [5] Golder, K. B. et al. (2020) *Icarus, 335*, 113388. [6] Kedar, S. et al. (2020) *JGR, 126*, e2020JE006518.

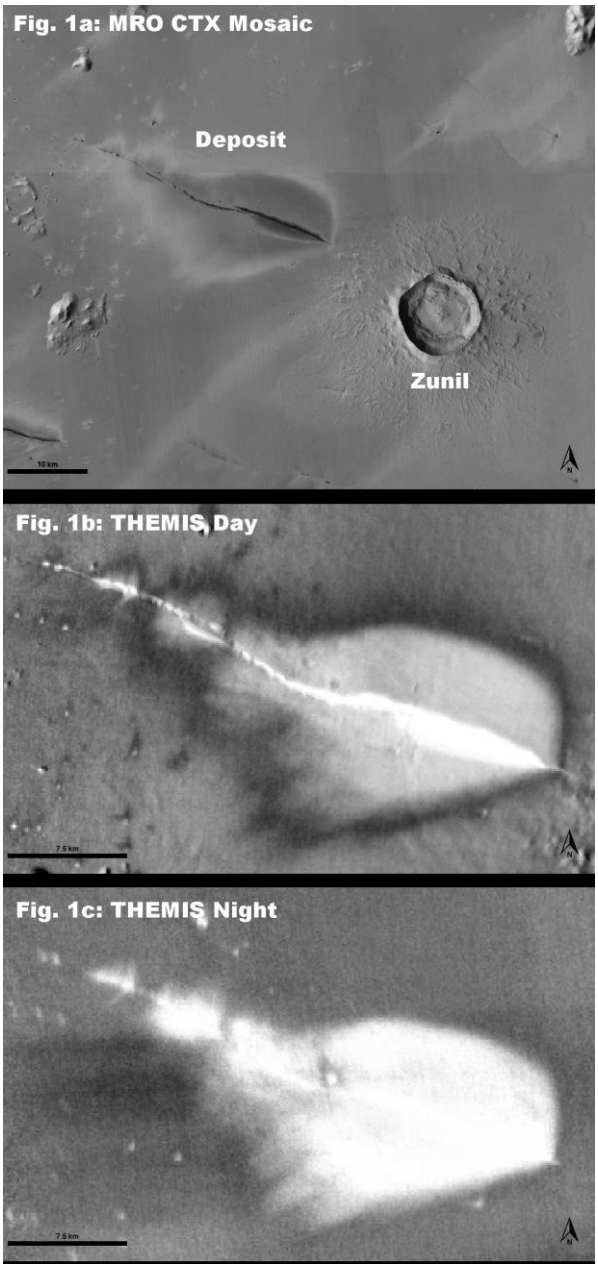

Figure 1. Portions of global mosaics of CTX and THEMIS IR data illustrating some of the basic characteristics of the diffuse deposit along the Cerberus Fossae near Zunil crater.

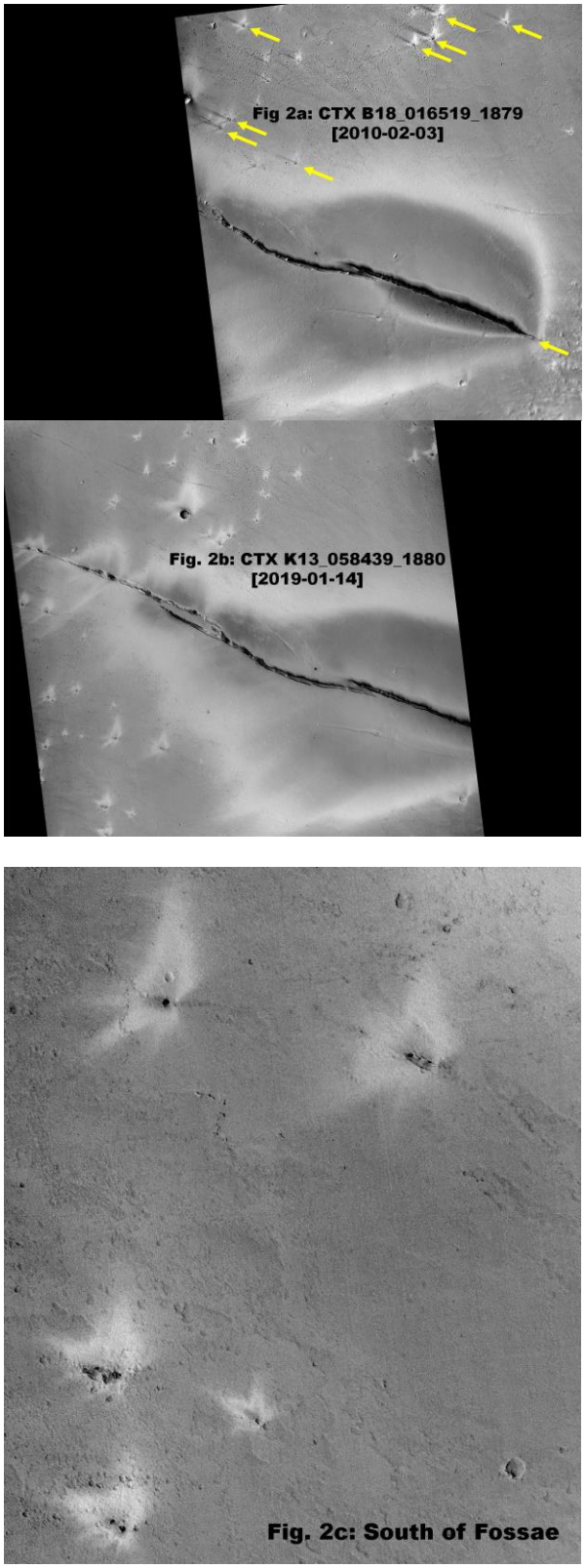

Figure 2. Some new observations of the deposit. (a) and (b) show that, by 2019 the inner deposit had faded, along with other WNW trending dark streaks in the area that are pointed out with the yellow arrows. (c) highlights a few of the many craters in this locality with broad deposits trending to the north which is against the regional trend. The northward extent of the larger diffuse deposit is not anomalous.