TERRESTRIAL ANALOG STUDIES OF VOLCANIC EMBAYMENT RELATIONSHIPS: IMPLICATIONS FOR INTERPRETATIONS OF VOLCANIC CONTACTS ON MARS.

D. A. Crown[1], S. P. Scheidt[1,2,3], S. W. Ruff[4], J. W. Rice[1], and F. C. Chuang[1], [1]Planetary Science Institute, 1700 E. Ft. Lowell Rd., Suite 106, Tucson, AZ 85719, [2]NASA Goddard Space Flight Center, Greenbelt, MD 20771, [3]University of Maryland, College Park, MD 20742, [4]Arizona Sate University, Tempe, AZ 85287.

Introduction: In order to facilitate geologic studies of Martian landscapes and to improve interpretations of local stratigraphy and volcanic history, we are conducting investigations of contact relationships in volcanic settings at a series of terrestrial analog sites in the western U.S. These studies utilize topographic, morphologic, textural, and compositional characteristics to provide ground truth for orbital observations, examine the scale-dependencies of embayment signatures, and document the effects of degradation on geologic interpretation. This work is being done in conjunction with and to inform 1:250K-scale, CTX-based (~5 m/pixel) geologic mapping of Gusev crater, the floor of which preserves numerous localities at which volcanic units contact features of the pre-existing terrain [1-3].

Basaltic Lava Flow Fields in New Mexico: Our research to-date has focused on the Aden and Carrizozo lava flows in southern New Mexico. The 75 km^2 lava flow field associated with Aden crater (22 Ka; alkaline olivine basalts and basanite [4-8]) is located in the Potrillo Volcanic Field, which includes cinder cones and maar craters in addition to the Aden vent, near-vent shield, and surrounding inflated pahoehoe flow field [9-10]. The 75 km long Carrizozo lava flow field (~5 Ka; intermediate composition between alkalic and tholeiitic basalt [11-14]) is located in the Tularosa Basin north of White Sands National Park. It is composed of compound, tube-fed pahoehoe, interpreted to have been emplaced in a steady, long duration eruption with low effusion rate [14-15].

Both of these flow fields exhibit the effects of flow inflation, from minor, small-scale inflation in the form of digitate networks with inflated elements (toes, sheets, small ropy-surfaced channels) to more significant and larger-scale inflation affecting multiple emplacement units and forming tumuli, lava-rise pits, and pressure ridges/plateaus [16-19].

Research Results. Our studies have included analyses of existing remote sensing datasets, ground-based reconnaissance of lava flow margins with different degrees and styles of flow inflation, and collection of rock samples for laboratory spectroscopy. Our analog research is centered around operation of uncrewed aerial systems (UAS or drones) to conduct low-altitude (80-120 m) surveys at high priority sites along flow margins. Key data products are high-resolution orthomosaics (≤ 5 cm/pixel) and DTMs (2 x ground sampling distance) produced from Structure from Motion stereophotogrammetry that are being used to characterize both the large-scale flow morphology and the fine-scale textures of flow surfaces, as well as to assess relationships to topographic obstacles of various sizes. The ability to make high precision measurements is ensured by surveying a network of ground control points with a real time kinetic (RTK) GPS system.

Representative datasets for the Aden and Carrizozo flow fields are shown in Figures 1 and 2. To-date, we have completed multiple UAS surveys that cover ~1.5 km^2 at Aden and ~3.2 km^2 at Carrizozo. These datasets allow systematic, detailed characterizations of flow surfaces and margins, document the effects and magnitudes of flow inflation, and facilitate informed interpretations of volcanic contacts. Fracture patterns due to both cooling of flow surfaces (i.e., polygonal) and large-scale inflation (margin parallel inflation clefts) can be identified. Accumulations of fine-grained sediments accentuate fracture patterns and also provide constraints on aeolian deposition. This research will be extended to additional sites in the coming year.

Acknowledgments: This research is supported by NASA SSW grant 80NSSC20K0862. We thank Alexis Rodriguez for assistance with field studies and Aleksandr Knapowski and the BLM Roswell Field Office for logistical support.

References: [1] Crown DA et al. (2021) *Ann Meet Planet Geol Mappers*, Abstract 7020. [2] Crown DA et al. (2022) *LPSC LIII,* Abstract 1123. [3] Scheidt SP et al. (2021) *Terrest Analogs for Planet Expl,* Abstract 8028. [4] Hoffer JM (1976) *NM Geol Soc Spec Pub 5,* 89-92. [5] Kahn PA (1987) *MS Thesis,* UTEP, 89 p. [6] Williams WJW and J Poths (1994) *NM Geol 14,* p 16. [7] Hoffer JM (2001) *NM Mus Nat Hist & Sci Bull 18,* 137-140. [8] Dunbar NW (2005) *NM Mus Nat Hist & Sci Bull 28,* 95-106. [9] De Hon RE and RA Earl (2018) *NM Geol Soc Guidebook 69,* 197-202. [10] De Hon RE and RA Earl (2018) *NM Geol 40,* 17-26. [11] Theilig E (1986) *PhD Thesis,* ASU, 214 p. [12] Anthony EY et al. (1998) *NM Geol Soc Guidebook 49,* 117-122. [13] Dunbar NW (1999) *NM Geol 21,* 25-28. [14] Keszthelyi LP and DC Pieri (1993) *JVGR 59,* 59-75. [15] Zimbelman JR and AK Johnston (2001) *NM Mus Nat Hist & Sci Bull 18,* 131-136. [16] Walker GPL (1991), *Bull Volc 53,* 546-558. [17] Hon K et al. (1994) *GSA Bull. 106,* 351-370. [18] Walker GPL (2009) *Spec Pub IAVCEI, 2,* 17-32. [19] Hamilton CW et al. (2020) *JGR 125,* e2019JE005975.

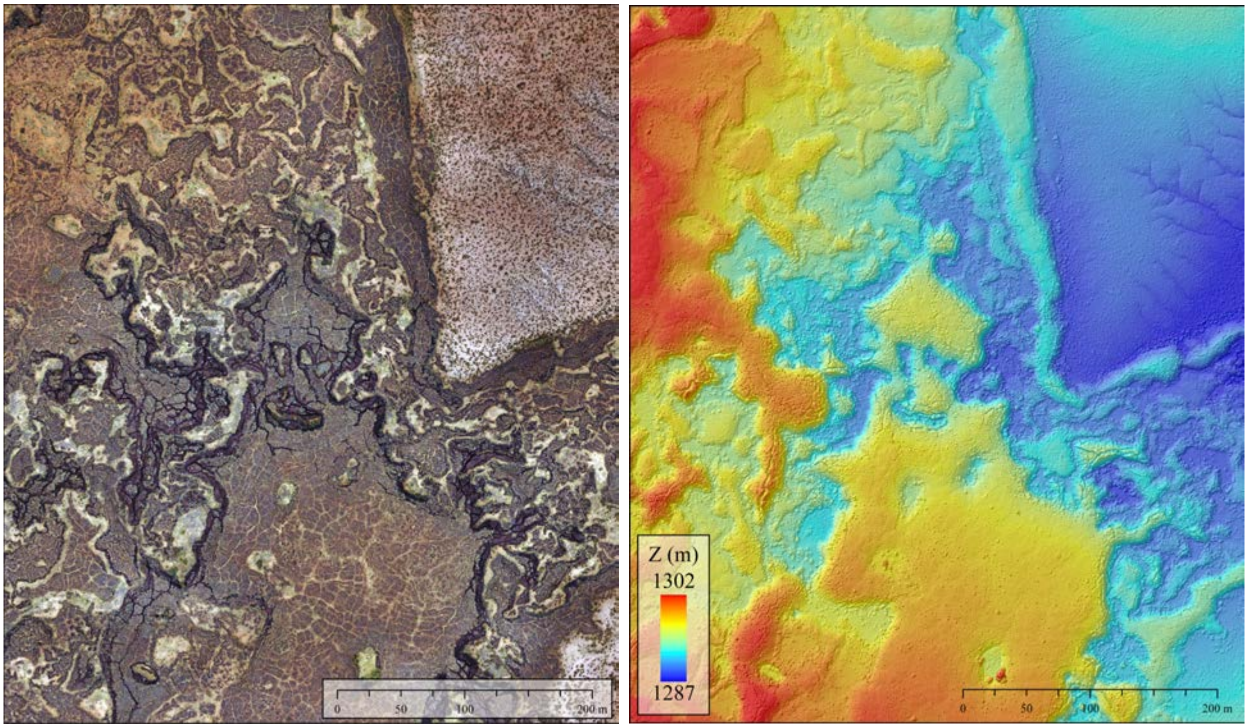

Figure 1. UAS datasets from part of Aden lava flow margin, Potrillo Volcanic Field. Basaltic pahoehoe lava flows show different magnitudes and scales of inflation. *Left)* color orthoimage (5 cm/pixel). *Right)* corresponding DTM (12 cm/pixel). The irregular lava flow surface exhibits numerous lava-rise pits and inflation fractures. A large inflation plateau with cooling fractures (center bottom) is generally smooth and flat. The outer flow margin to the NE is defined by an elongate inflated ridge that bends sharply around a subtle topographic high in the pre-existing terrain (that also includes a series of small drainage networks).

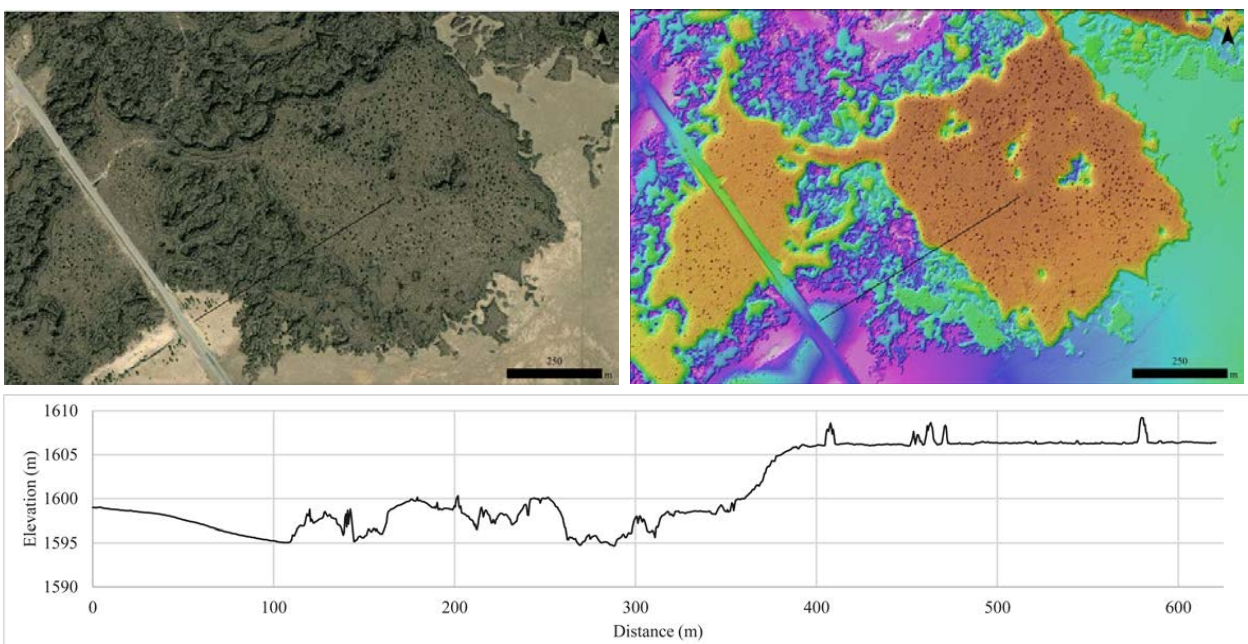

Figure 2. Remote sensing datasets for part of Carrizozo flow margin showing digitate lobes extending from large rectangular inflation plateau with lava-rise pits. *Left)* ESRI World Imagery (0.5 m/pixel). Black line is profile location. *Right)* USGS DEP airborne LiDAR (gridded to 0.5 m; scene relief ~15 m). *Bottom)* Topographic profile. The flow margin is defined by steep, 10+ m high plateau edges to the NE and SE and by digitate lobes with small to medium scale inflation (including tumuli) to the SW.