ORIGIN OF SINUOUS CHANNELS ON THE SW APRON OF ASCRAEUS MONS AND THE SURROUNDING PLAINS, MARS.
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Introduction: Ascraeus Mons is one of three large shield volcanoes located along a NE-SW trending lineament atop the Tharsis Bulge on Mars. Spacecraft images, beginning with Viking in the 1970's, revealed that the SW rift apron of Ascraeus Mons is cut by numerous sinuous channels, many of which originate from large, elongated, bowl shaped amphitheatres known as the Ascraeus Chasmata. A number of these channels can be traced onto the flatter plains to the east of the rift apron. These features have been interpreted as either fluvial [1] or volcanic [2] in origin. Most recently, it has been shown that one of the longest channels on the Ascraeus rift apron appears to transition into a roofed-over lava channel or lava tube at its distal end, and thus the entire feature is likely of a volcanic origin [2]. In addition, field observations of recent lava flows on Hawai'i have shown that lava is capable of producing features such as the complex braided and anastomosing channels and streamlined islands that are observed in the Ascraeus features [2].

Methodology: In order to make a more broad and definitive statement about the origin of the Ascraeus sinuous channels, we have mapped out all the channels on the SW apron of Ascraeus Mons as well as a number of channels on the surrounding plain in the vicinity of Tharsis Tholus. We use a combination of THEMIS, HRSC, CTX, and HiRISE images to identify and map the channels. Images are then stitched together in ArcGIS to create a complete map of the Ascraeus channel system. Elevation data from MOLA is used to produce topographical profiles along the channels and to create contour maps from which we infer the direction of flow.

We also observed features in the Pōhue Bay Flow and 1907 Mauna Loa flow on the island of Hawai'i that appear to be analogous to some of the channel and tube features observed on Ascraeus.

In addition to mapping out the sinuous channels, we also identify and map a variety of associated features on the Ascraeus apron based on geomorphologic characteristics. Raised vents, impact craters, collapse pits, elongated depressions, lava tubes, as well as individual lava flow channels and flow margins are mapped along with the sinuous channels in an attempt to identify significant spatial and temporal relationships between these features and the sinuous channels.

Results: We identify differences in the morphology of the sinuous channel features depending on their location relative to the rift apron. One set of channels is found on the proximal apron and originate from linear depressions similar to the gullies found in Ascraeus Chasmata. The proximal channels appear to be the youngest features in the study area, as they are not cross-cut by any of the other types of features we mapped. These channels are complex compared with the channels found on the distal apron and plains. They generally display an intricate network of nested, braided, and bifurcating channels. The proximal channels do not seem to be associated with discrete lava flows and are found on slopes ranging from 1-5°.

The channels found on the distal apron and the surrounding plains appear to be older in age as their source is generally not apparent but is instead buried under more recent flows. In several locations, they are

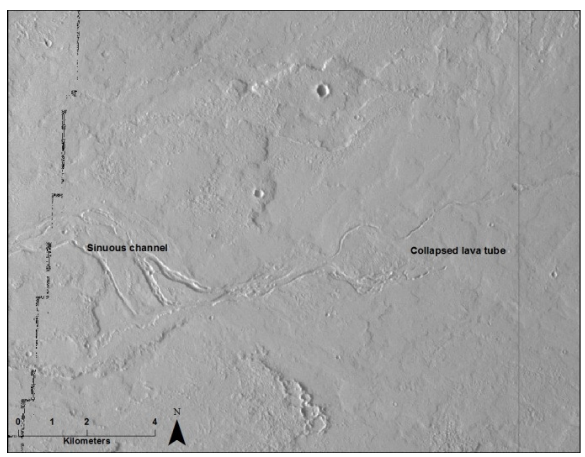

Figure 1. A sinuous channel with multiple branches transitions into a collapsed lava tube section near Tharsus Tholus. The collapse structures here are about 80-100m wide. Downhill direction is to the right. (THEMIS V063070181)

cross-cut or offset by linear scarp or fault-like features. These channels are found on shallower slopes (generally <1˚), and are usually straighter, less complex, and less commonly display braided channels or streamlined islands then the channels on the proximal apron. The distal channels can occasionally be visually associated with a discrete lava flow; some sections appear to be surrounded by lobes which likely formed as a result of lava overflowing the channel walls and building up levees on either side.

The proximal channels frequently transition into wide, shallow channels that clearly represent flow with a lobate lava flow. The distal channels similarly transition into what we interpret as roofed-over lava channels or lava tubes (Fig. 1). These lava tubes generally manifest themselves as a series of elongated collapse pits in an overall sinuous pattern found along the crest of an extended topographic high. A similar map pattern is observed with collapsed lava tubes in Hawaiian basalt flows, in particular the Pōhue Bay Flow on the southern coast of Hawai'i (Fig. 2) [4].

Conclusions and further study: The fact that a large number of the sinuous channels, both on the apron and on the surrounding plain, transition into lava tubes or channels that are clearly associated with a discrete lava flow makes a strong case that the entirety of the sinuous channel features experienced volcanic processes. However, this interpretation does not exclude the possibility of subsequent fluvial alteration of the channels. Another possibility is that magma was erupted onto a surface that had been previous dissected

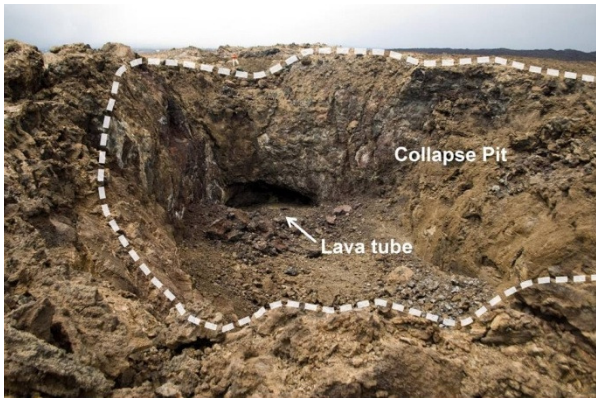

Figure 2. Field photo of a collapse structure and associated lava tube in the Pōhue Bay lava flow, Hawai'i. The collapse pit measures approximately 50x20m and is roughly 25m deep.

by fluvial processes in which case we would expect lava to preferentially flow along any pre-existing channels. However, without information about subsurface geology, this is a very difficult theory to test. The difference in geomorphology between the proximal and distal channels and the preponderance of lava tube features on the distal apron are likely both connected to differences in slope.

Further study will look more closely at the quantitative differences between the proximal and distal channels and possibly look at similar features on other Tharsis volcanoes or perhaps elsewhere on Mars.

References: [1] Murray et al. (2010) *E & P Sci. Letters.* [2] Bleacher et al. (2010) *LPSC*, #1612. [3] Bleacher et al. (2011) *LPSC*, #1805. [4] Jurado-Chichay & Rowland (1995) *Bull. Vol.*, 57, 117-126.

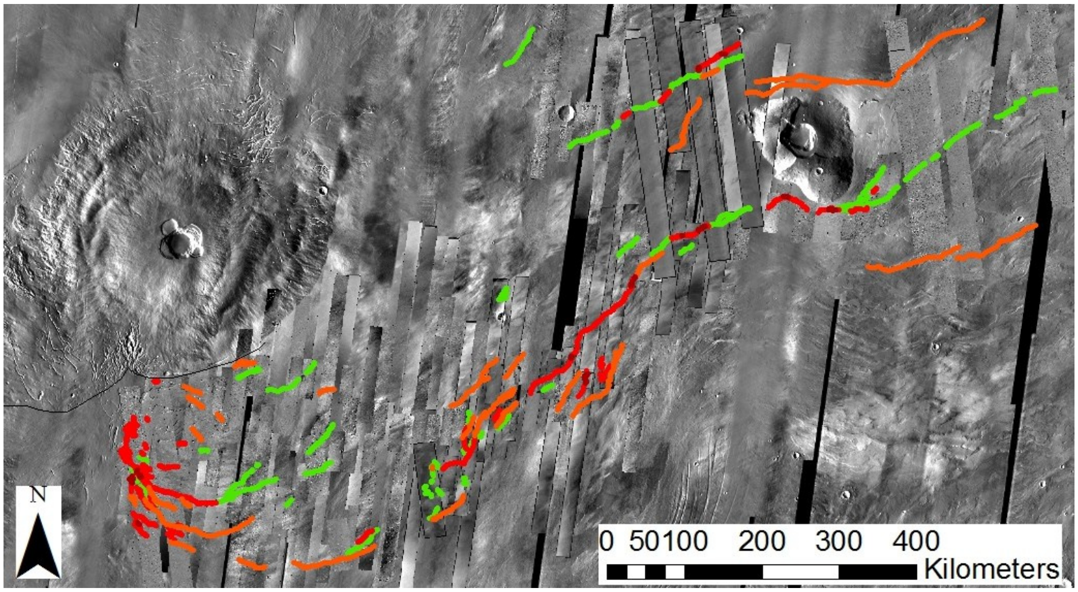

Figure 3-Distribution of sinuous channels (red), collapsed lava tubes (green), and lava flow channels (orange) on the Ascraeus Mons (left) rift apron (lower left) and surrounding plains extending east to Tharsis Tholus (shield at upper right).