OLYMPICA FOSSAE VALLES - NEWLY RECOGNIZED FLUVIAL-VOLCANIC SYSTEM. J. B. Plescia, The Johns Hopkins University, Applied Physics Laboratory, 11100 Johns Hopkins Road, Laurel MD (jeffrey.plescia@jhuapl.edu).

Introduction: A fluvial-volcanic system extending from Ceraunius Fossae through Olympica Fossae and southward toward Jovis Tholus and onto the plains east of Olympus Mons has been recognized. Fluvial sources occur south of Ceraunius Fossae and along a north-northeast trending fracture north of Jovis Tholus (Fig. 1). Subsequent to fluvial erosion, volcanic flows were erupted at both source regions flowing down Olympica Fossae and out across the plains east of Olympus Mons. The fluvial erosion is similar to outflow channels elsewhere on Mars [1-4].

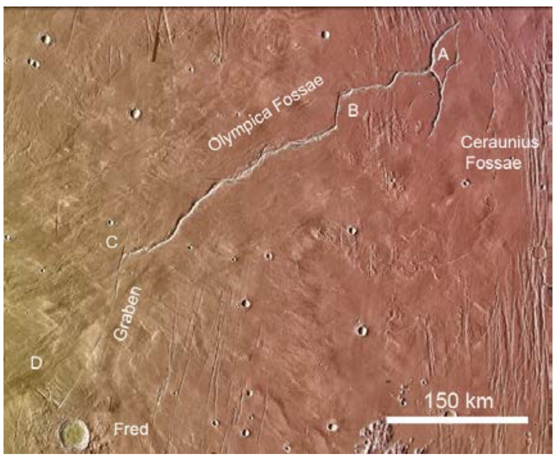

Figure 1. Olympica Fossae region. A: source area, B and C: NNE trending structural control, D: channel system (Daytime THEMIS and MOLA).

Source Areas: Two source areas for water and lava have been identified. The first lies in the curvilinear depressions south of Ceraunius Fossae (A in Fig. 1) at +0.5-0.5 km; the second (D) is immediately north of an unnamed crater (31 km dia., "Fred") north of Jovis Tholus along a NNE (N30°E) fracture at 0 km. Two source areas along the fracture are 20 km apart.

Morphology: Olympica Fossae is characterized by a narrow gorge ~1.5-2.0 km wide, the floor characterized by material with an undulatory surface (e.g. folded) and a central channel 100-400 m wide (Fig. 2). Along the fossae's length, exterior to the gorge, the surface has parallel, shallow (10-50 m), meandering channels that merge and separate, and broad areas of scour with teardrop shaped islands. The overall width of eroded area can be up to ~10 km. The depth to the floor of the inner gorge is 200-1000 m. The distance to the intersection with the NNE graben is 360 km straight line and 390 km with the bends. The elevation changes from +500 to -200 m (regional slope of 0.1°).

At the point where the fosse intersect the NNE graben, the gorge abruptly ends, although the interior morphology turns south into the graben (C in Fig. 1) and the shallow channels and scour continue beyond the graben. The graben clearly post-dates the channels and scour but predates the folded material on the gorge floor and the central channel. South of the intersection, the graben floor is hidden by an aeolian mantle.

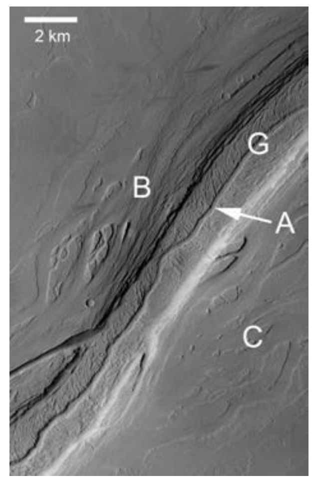

Figure 2. Section of Olympica Fossae. G: gorge, A: inner channel, B: scoured surface, C: channels.

A second channel system occurs 170 km to the SSW (D in Fig. 1 and Fig. 3). The observed length of the canyons is short (30 km) as they are buried to the northwest by lava flows. Two primary sources (Fig 3. A, B) and a possible third source (C) occur along the NNE graben. Teardrop islands occur in the main canyons. Paralleling the canyons on the adjacent plains, are scour features and meandering channels.

Aeolian material obscures the morphology of the graben source area. Terraces characterize the canyon margins and canyon floors exhibit a rough to folded morphology. Floors of the parallel channels are either striated or covered by aeolian deposits.

Interpretation: The morphology and morphometry of Olympica Fossae, the NNE graben and the channel system at the south end of that graben suggest a complicated tectonic, fluvial and volcanic history.

Evidence for fluvial erosion at Olympica Fossae is the morphology of the channel, canyon and gorge floors including teardrop shaped erosional features, scour marks and meanders. The braided morphology of on the adjacent plains also indicates fluvial erosion (although these features are not braided streams *sensu strico*). Water released from the source flowed southwest. The flow could initially have been broad, forming the scour and channel systems and then localized along what would be the fossae, eroding it significantly deeper. Alternatively, the flow could have filled a pre-exiting fossae depression and periodically overtopped the edge and eroded the adjacent plains, although this would require an enormous volume of water.

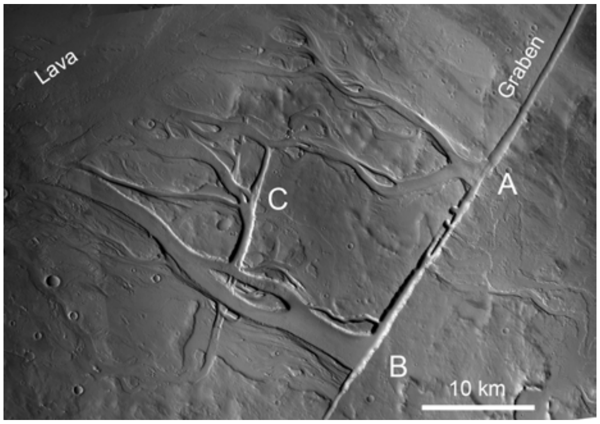

Figure 3. Channels near Jovis Fossae. A and B denote source areas; C may be also be a source.

A similar interpretation is made for the southern canyon system. Water was released from a graben flowing NW downslope. The morphology at source areas suggests an initially broad flow later localized to the positions of the canyon. The scoured surface immediately adjacent to "B" could only have been formed if water were released along the total length of the graben at the head of system. Later, the canyon systems were carved abandoning the shallow channels. The flow was not only to the NW, but also to the southeast (upslope) onto the northern ejecta of Fred.

The evidence for volcanic activity includes the morphology of channel floors, on the surrounding plains, and the presence of features interpreted to be low shields. Well-defined lava flows occur with lobate margins, pressure ridges, levees and breakouts. On the plains adjacent to Olympica Fossae are several low shields (50 m high) with elongate central vents and radial lava flows.

Geologic History: The original surface is volcanic, associated with Tharsis volcanism and locally faulted at the surface (and at depth). The first event was fluvial with water released near Cerberus Fossae and at the southern source. Water flowed broadly across the surface southeast and then localized into more narrow canyons. Subsequently, lava was erupted from same source areas. Lavas filled the canyons and flowed downstream. Only the lowest floors are lava covered. Lavas were also erupted from other areas on the adjacent plains partly covering the margins of the higher altitude scoured areas. At the southern source, lava had sufficient head to flow upslope onto the Fred ejecta.

Discussion: While fluvial sources along tectonic features have been recognized in several places on Mars, some of which are relatively young (e.g., Athabasca), this system represents the most clearly-defined within Tharsis. The geologic history is similar to that at Athabasca in which an initial fluvial episode was localized by a fracture, in turn followed by a volcanic event controlled by the same fracture [5-11].

It is interesting to note the southern channel's proximity to a crater with lobate ejecta (deposits argued to indicate shallow water or ground ice). Presumably, rising magma intruding the NNE-trending dike creating tension that may have been sufficient to allow the water to escape because the aquifer was overpressurized or it may have melted ground ice (Carr 1979; Head et al. 2003; Hanna and Phillips 2006; McKenzie and Nimmo 1999). Subsequently, lava continued to erupt and flowed down the channel.

Crater counts were made on the uneroded surrounding plains, scoured surfaces and the lava flows. The surrounding plains are heavily mantled significantly reducing the number of small craters. Nominal model ages are of the order 10-100 My (within the statistical scatter) [16].

Summary: A young fluvial and volcanic system is associated with Olympica Fossae and a NNE trending graben. Fluvial activity was followed by eruption of lavas from the same fractures. Lavas covered the channel floor for hundreds of km. Crater counts indicate the activity occurred in the latest Amazonian.

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