STREAM-LINED FORMS ON MARS: LATE AMAZONIAN CHANNEL AND ISLAND SYSTEMS IN THE CYANE–GORDII–OLYMPICA REGION, THARSIS RISE

H. Hargitai[1] and V. Gulick[2]

1 NASA Ames Research Center / NPP (MS 239-20 Moffett Field, CA 94035, hhargitai@gmail.com),
2 NASA Ames Research Center/ SETI Institute (MS 239-20 Moffett Field, CA 94035, virginia.c.gulick@nasa.gov)

Channel systems East of Olympus Mons

We have mapped the Northwest Tharsis Region East of Olympus Mons that includes the Cyane, Gordii, Pavonis and Olympica subregions and described three distinct channel-and-island systems.

The channel systems are:

1) the E-W trending, subparallel Olympica systems with lava and fissure-fed fluvial systems;

2) the S-N trending, discontinuous Pavonis–Cyane lava flow systems co-aligned downslope from each other; and

3) the short, Gordii fissure-fed systems scattered around the base of Olympus Mons.

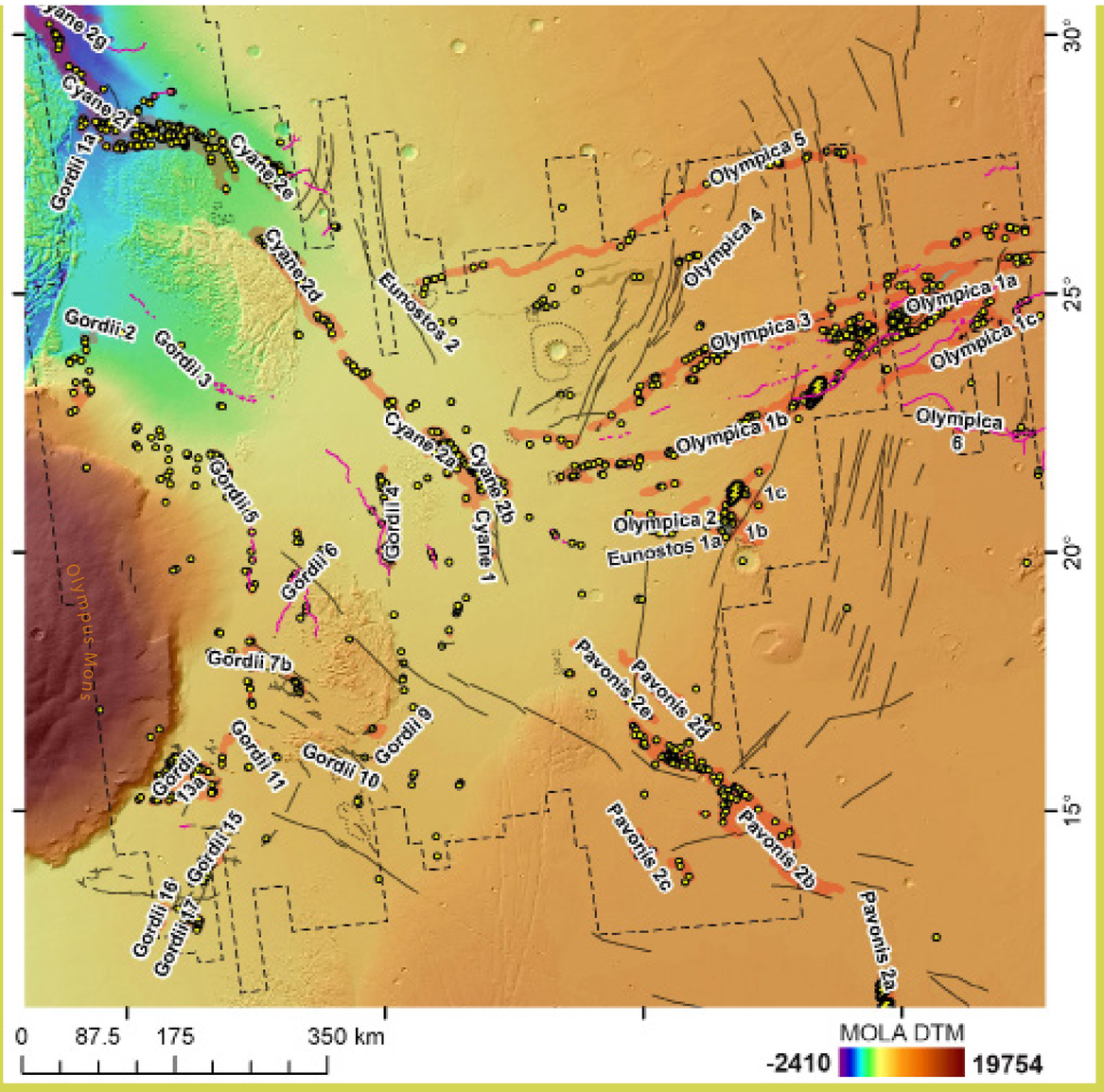
Different origin?

We distinguished between characteristically different channel-and-island system producing mechanisms by the morphologies of islands and channels. Islands include accretional lava islands, erosional islands in lava channels and fluvial systems and residual islands in collapse systems.

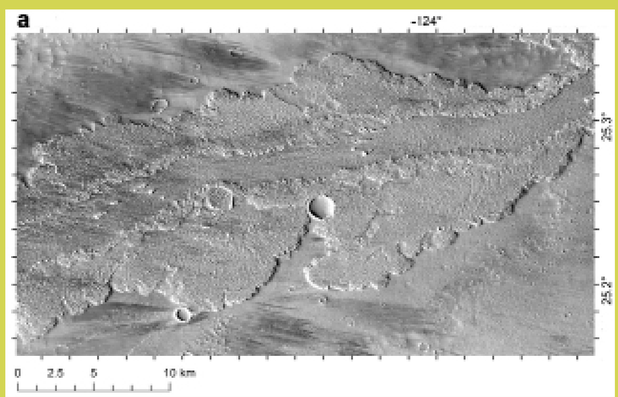
While the origin of the anastomosing channels and the channels with dominantly rounded streamlined forms can be traced back to straight troughs, the origin of perched lava channels and rille-and-pit systems is typically unresolved, which might be due to postdating, overlapping lava flows.

Interpretation

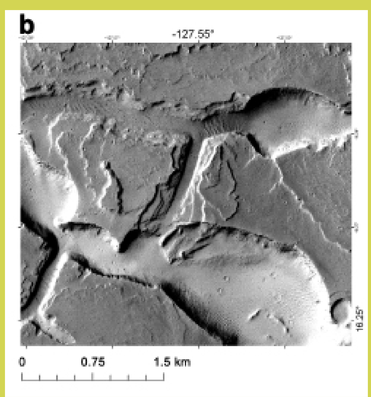
We interpret these channels to have formed by a combination of tectonic, mass wasting (collapse), volcanic and fluvial processes that formed fissures, pits, lava flows and channels with streamlined islands, respectively. This formation model is consistent with other Martian fossa-fed channel-and-island systems where both lava and water was transported along the same channels, in some cases alternating and repeatedly (Keske et al. 2015, Burr 2005). Collapse channels and pits along subsurface conduits exhibit irregular islands; lava channels typically display a pattern of pressure ridges and knobby (rocky) margins; and fluvial channels are generally smooth surfaced.



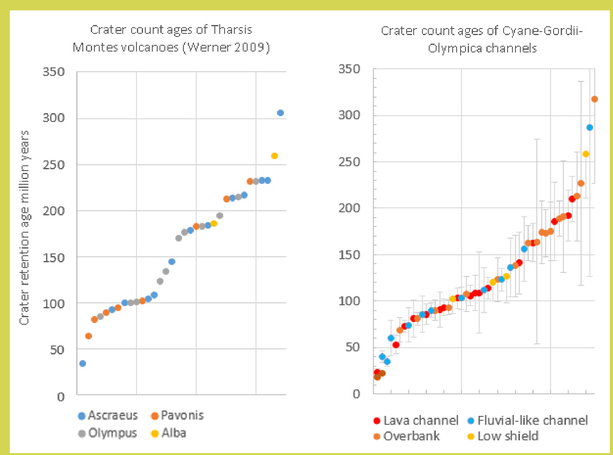
Individual channel-and-island systems East of Olympus Mons with informal nomenclature. Red areas are channels, yellow dots are islands, yellow flash symbols represent cross-channel island rows, black lines are tectonic troughs, purple lines are rilles (narrow channels). Dashed line shows boundary of CTX resolution survey. Dotted areas are regions where we conducted crater counting.



Portion of the Olympica 5 system. Lobate lava flow with perched channel, levee, and oriented islands within the channel. Rough-knobby channel wall suggest rocky margin. The channel also exhibits ridges, likely pressure features. Small islands may be accreted blocks of lava.



Layered substrate associated with a short fossa and channels, likely formed in a violent outflow event. Gordii 11 system. Sutton et al. (2016) interpreted similar systems here as fissure-fed lava channels, where dikes generated fractures and heat transfer mobilized ground water or ice.



Our crater counting shows that in this region Late Hesperian to Early Amazonian terrain is flooded by multiple generations of lobate lava flows that we dated as Late Amazonian with a peak activity approximately 175 and 100 Ma which is contemporaneous with other the volcanic activities in the Tharsis Montes area.

REFERENCES

Burr, D., 2005. Clustered streamlined forms in Athabasca Valles, Mars: evidence for sediment deposition during floodwater ponding. Geomorphology 69, 242–252.

Keske, A.L., Hamilton, C.W., McEwen, A.S. and Daubar, I.J., 2015. Episodes of fluvial and volcanic activity in Mangala Valles, Mars. Icarus, 245, 333-347.

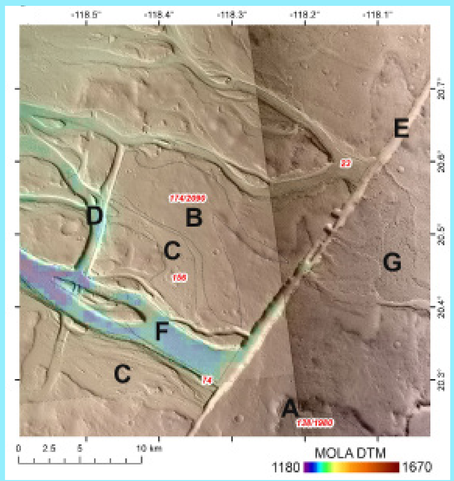
Mouginis-Mark, P.J., 1990,. Recent Water Release in the Tharsis Region of Mars. Icarus 84, 362-373.

Plescia, J.B., 2013. Olympica Fossae Valles – newly recognized fluvial-volcanic system. 44th Lunar and Planetary Science Conference abstract #2478.

Sutton, S.S., Hamilton, C.W., Bleacher, J.E., 2016. Investigating Channel Morphologies In The Eastern Olympus Mons Region Of Mars: Implications For Volcanic And Fluvial Processes. 47th Lunar and Planetary Science Conference, abstract # 2759

Werner, S. C., 2009. The global martian volcanic evolutionary history. Icarus 201, 44–68.

GEOLOGIC HISTORIES



Eunostos 1a (B-D) and 1b (G).

This system in the Olympica Plains* is a complex channel belt that is cut across by a tectonic graben. Its eastern side has volcanic channels while in the western side it has a 32 km long and 28 km wide multilevel channel belt where the youngest channels are covered with lava.

A: lobate ejecta. A, B: The top level with no fluvial features. C: The middle level with sinuous channels and islands. D: tectonic graben crosscuts the channels in the middle level and the island in the bottom level. Crater-cored islands suggest that the terrain was old (and thus, contained large craters) when the flow occurred on it. E: tectonic graben, the source of water that carved the channels in level F and C. G: lava flows.

Red numbers are crater retention ages (Ma) from crater counting within the dotted lines. The latest episode was likely fluvial, and it produced a common floor level across E, F, D features. This system is directly connected to the terminus of the Olympica 1a system by graben E. The edges of the lava flows have been eroded by subsequent fluvial flow that originated from west of this region.

The most complex system in the Olympus–Alba Region is Olympica 1a. The major, most complex Olympica channel system was first described in detail by Mouginis-Mark (1990) who interpreted it to be fluvial in origin. Plescia (2013) interpreted this system as fluvial-volcanic-tectonic.

A: braided-anastomosing channels with rounded, layered islands commonly split to smaller forms by island-crossing channels. These are the oldest features on the "top" level, likely fluvial. These channel belts are cross-cut by B, a deep trough, central Olympica Fossa. This fossa is likely tectonic, but it contains an ogive (pressure ridge) pattern that is characteristic of lava flows and this pattern is cross-cut by a sinuous interior channel, which may be fluvial. The banks of central Olympica Fossa are lineated, suggesting layered substrate and/or scouring, which in turn suggest that the tectonic graben was first eroded in a fluvial episode that also eroded the overbank areas already channels, and later the graben was flooded by lava. D is a straight channel, which suggests tectonic origin.

This research was supported by a senior postdoctoral research fellowship awarded to H. Hargitai by the NASA Postdoctoral Program (NPP) at Ames Research Center, administered initially by ORAU and later by Universities Space Research Association through a contract with NASA. V. Gulick is supported by MRO HiRISE Col funds and also by SETI Institute's NASA Astrobiology Institute grant # NNX15BB01A.