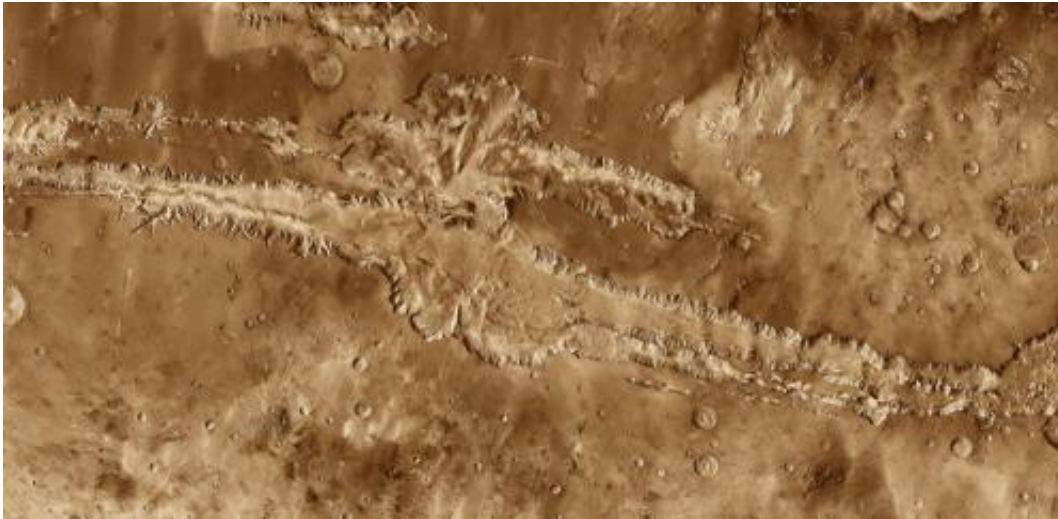


Lava, not water, formed canyons on Mars

June 3 2014, by Robin Wylie



The Grand Canyon of Mars – Valles Marineris. Credit: NASA, Viking Project, USGS, CC BY

The canyon-like scars which line Mars' crust are seen by many as evidence for liquid water. But a study now suggests that a different kind of fluid – one much less hospitable to life – may actually have carved these features.

On Mars, the most striking topography occurs around the equator. The planet's low latitudes are dominated by the Tharsis plateau, which hosts several towering volcanoes. Not far off sits the solar system's largest – Olympus Mons. Near the Eastern fringe, however, things start to get deep.

There the land dives into a winding maze of [valleys](#) and river-like "outflow channels", the former including the 4000km-long [Valles Marineris](#) – the "Grand Canyon" of Mars – which exceeds its terrestrial namesake in every dimension. These great gouges are widely thought to have been formed, at least in part, by flowing water. But according to recently published research, they could have had a very different genesis, linked to the volcanoes to the West.

Explosive erosion

A paper by Giovanni Leone of the Swiss Federal Institute of Technology, published in the [Journal of Volcanology and Geothermal Research](#), suggests that the martian valleys and outflow channels were in fact formed mostly by [lava flows](#), which erupted from the Tharsis plateau in the planet's distant past.

To draw this conclusion, Leone scrutinised thousands of images from NASA's Mars Reconnaissance Orbiter (MRO) spacecraft, which has been orbiting the planet since 2006. This allowed him to map the floors of the equatorial valleys and outflow channels at an extremely high resolution of up to 25cm per pixel. These images appear to show extensive lava flows draping the floors of many of the valleys and channels. Around 90% of the floors look to be covered either by lava or by lava-related landslides.



Valles Marineris Credit: G. Neukum/ESA/Mars Express/DLR, CC BY

The morphology of the lava flows Leone encountered suggest that the lava actually incised the valleys and channels in the first place. The MRO images seem to show that channels formed by the freshly erupted lava were later deepened and widened by the passage of liquid rock. This type of erosion, Leone argues, can explain the existence of the valleys and outflow channels without the need to invoke significant amounts of liquid water.

The valleys and outflow channels are believed to be many billion years old. Leone believes the lava would have been emitted by now-vanished volcanoes somewhere on the Tharsis plateau, forerunners of the region's (relatively juvenile) modern volcanoes.

Leone believes that every stage of this volcanic erosion process is visible in the MRO images. The first stage, he concludes, can be seen in the locations closest to today's Tharsis volcanoes, at the western end of Valles Marineris. Here lava tunnels seem to have collapsed, forming "pit chains" – long curvilinear depressions in the crust. Further east, where the terrain deepens, the pit chains seem to have been further eroded, by the injection of yet more lava, into more extensive channels – first into "fossae" and later into larger "chasmata".

The MRO images showed relatively little evidence for the past presence of liquid water in the valleys and outflow channels, which can be inferred by the presence of "light toned deposits" in the images. This, Leone believes, adds further weight to the theory that these features are igneous in origin.

Against the current

These are radical conclusions. While a volcanic origin for Mars' valleys and outflow channels had been proposed before (in the wake of NASA's Viking mission in the 1970s, this was actually the prevailing theory), for the past 25 years, scientific opinion has drifted towards an explanation involving a mixture of tectonic uplift and sedimentary erosion caused by water.

The distinction between sedimentary and igneous rocks reaches far beyond geology. If, as the majority of scientists still believe, the valleys and [outflow channels](#) once contained significant volumes of water, then they are naturally prime candidates for future missions on the hunt for life. For instance, the European Space Agency's [ExoMars](#) rover, due to touch down in 2019, is considering landing sites around Valles Marineris.

If Leone's conclusion is accurate, however, and these features are instead

mostly volcanogenic, this implies that much less water was present during their formation. If this turns out to be true, their suitability as landing sites could be called into question.

This would not spell doom for the chances of finding life on Mars. If Leone is right, it simply means that less liquid water existed in this particular corner of the planet. It would say little about Mars' total water inventory.

In any case, this study is unlikely to change the ESA's travel plans. Leone's research, while intriguing, is far from conclusive. It is notoriously tough to tell between igneous and sedimentary rocks using orbital images, even at the resolution offered by the MRO. A definitive answer, then, will have to wait. But let's hope not at the cost of another expensive mission which comes up dry.

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Citation: Lava, not water, formed canyons on Mars (2014, June 3) retrieved 20 March 2024 from <https://phys.org/news/2014-06-lava-canyons-mars.html>

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