This image from ESA’s Mars Express shows part of a large fault system on Mars known as Tantalus Fossae. This image comprises data gathered by Mars Express’ High Resolution Stereo Camera (HRSC) on 19 July 2021. It was created using data from the nadir channel, the field of view aligned perpendicular to the surface of Mars, and the colour channels of the HRSC. It is a ‘true colour’ image, reflecting what would be seen by the human eye if looking at this region of Mars. The ground resolution is approximately 18 m/pixel and the images are centred at about 43°N/257°E. North is to the right. Credit: ESA/DLR/FU Berlin, CC BY-SA 3.0 IGO

This network of long grooves and scratches forms part of a giant fault system on Mars known as Tantalus Fossae, and is shown here as seen by ESA’s Mars Express. At first glance, these features look as if someone has raked their fingernails across the surface of the Red Planet, gouging out lengthy trenches as they did so.

While not quite so dramatic in its formation, Tantalus Fossae (“fossae” meaning a hollow or depression) is a noticeable feature on Mars. This system of troughs flanks a sprawling, low-relief martian volcano named Alba Mons, running along the volcano's eastern side.

The fossae were created as the summit of Alba Mons rose in elevation, causing the surrounding surface to become warped, extended and broken. The Tantalus Fossae faults are a great example of a surface feature known as grabens; each trench formed as two parallel faults opened up, causing the rock between to drop down into the resulting void.

The same features can be found on the western side of Alba Mons, forming an incomplete ring around the volcano. Overall, this volcano's associated grabens stretch out for up to 1,000 km in length, up to 10 km in width, and are up to 350 m deep.

This oblique perspective view of Tantalus Fossae on Mars was generated from the digital terrain model and the nadir and colour channels of the High Resolution Stereo Camera on ESA's Mars Express. Credit: ESA/DLR/FU Berlin, CC BY-SA 3.0 IGO

A complex history

Throughout this Mars Express image, numerous grabens can be seen running roughly northeast (bottom-right) to southwest (top-left).

These structures are thought to have formed not at the same time but one after the other, providing scientists the opportunity to reconstruct a past timeline and picture of what created this dramatic landscape.

The large impact crater at the center of the image, for example, is crosscut by grabens, indicating that it was already present before the volcano was uplifted to create the Tantalus Fossae faults. The
second-largest impact crater (far smaller and to the bottom-left of the central crater) appears to superpose the faults, and is therefore likely to be younger.

This oblique perspective view of Tantalus Fossae on Mars was generated from the digital terrain model and the nadir and colour channels of the High Resolution Stereo Camera on ESA's Mars Express. Credit: ESA/DLR/FU Berlin, CC BY-SA 3.0 IGO

Upon closer look, many small, branching valleys can be seen across this region. These valleys appear to cut directly through the grabens, and so are assumed to be older.

As shown most clearly in the associated topographic view, the northern (right) part contains far lower terrain than the southern (left) part—in places, as much as three kilometers lower in altitude. We would expect any small, branching valleys to run along the slopes of Alba Mons and merge where the ground is lowest, but this is not seen here, implying that the valleys must originate from more ancient times—before Alba Mons rose to sculpt this terrain into what we see today.

This color-coded topographic image of Tantalus Fossae was created from data collected by ESA's Mars Express on 19 July 2021 during orbit 22173. It is based on a digital terrain model of the region, from which the topography of the landscape can be derived. Lower parts of the surface are shown in blues and purples, while higher altitude regions show up in whites and reds, as indicated on the scale to the top right. North is to the right. The ground resolution is approximately 18 m/pixel and the images are centered at about 43°N/257°E. Credit: ESA/DLR/FU Berlin, CC BY-SA 3.0 IGO

This area is named after Tantalus, a son of Zeus and Pluto who, according to Greek legend, betrayed the gods and was forced by Hades to stand in water beneath a fruit tree. When he tried to drink the water retreated, and when he tried to eat the branches moved beyond his reach—a punishment known as the torments of Tantalus.

Exploring Mars

Mars Express has been orbiting the Red Planet since 2003, imaging Mars' surface, mapping its minerals, identifying the composition and circulation of its tenuous atmosphere, probing beneath its crust, and exploring how various phenomena interact in the Martian environment.

The mission's High Resolution Stereo Camera (HRSC), responsible for these new images, has revealed much about Mars' diverse surface features, with recent images showing everything from wind-sculpted ridges and grooves to volcanoes, impact craters, tectonic faults, river channels and ancient lava pools.

Provided by European Space Agency