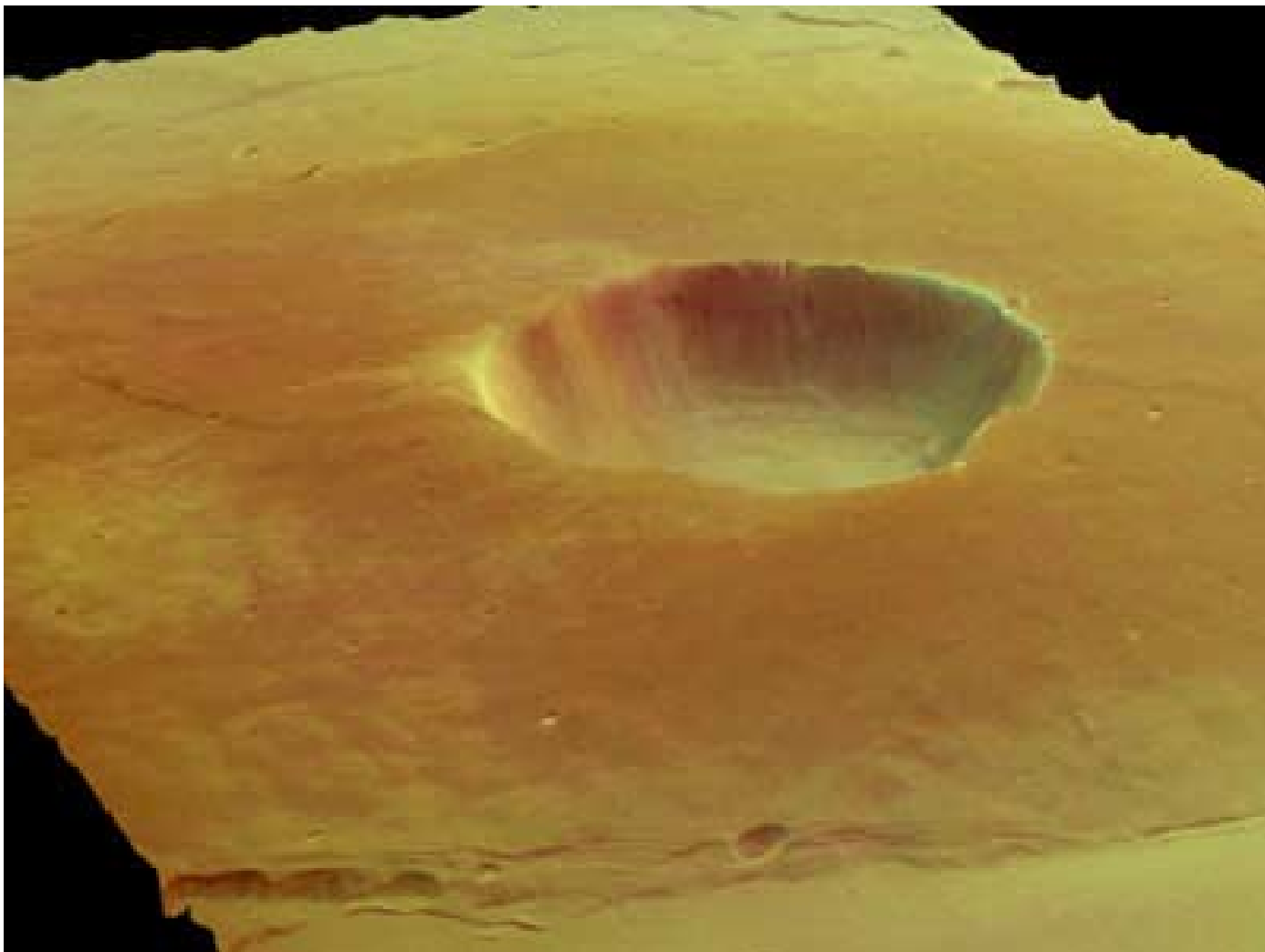


# **VOLCANOES**

# ALBOR THOLUS



Credits : ESA/DLR/FU Berlin (G. Neukum)

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Image taken: on 19<sup>th</sup> January 2004, during the 32<sup>nd</sup> Martian orbit.

This colour image shows a tri-dimensional oblique view of the summit of the caldera of « ALBOR THOLUS », Martian volcano, located in the region of ELYSIUM.

This caldera has a diameter of 30 km for a depth of 3 km. The volcano, as a whole, has a diameter of 160 km for a height of 4 km 500.

This is a very interesting geological case: the depth of the crater is nearly the same as the height of the volcano; this is very unusual on Earth.

On the left side of the crater, a fall of shining dust seem to flow from the mesa into the crater.

# OLYMPUS MONS Caldera

## Top view



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Image taken: on 21<sup>st</sup> January 2004, during the 37<sup>th</sup> Martian orbit.

Localisation: centre at 18°3 minute latitude North – 227° longitude East. South is at the top.

This is a view from overhead of the complex caldera at the summit of Olympus Mons, the highest volcano in our Solar System.

Olympus Mons has an average elevation of 22 km and the caldera has a depth of about 3 km. The image is about 102 km across (area 10 404 km<sup>2</sup>) with a resolution of 12 m per pixel.

## 3D View of Olympus Mons in its entirety



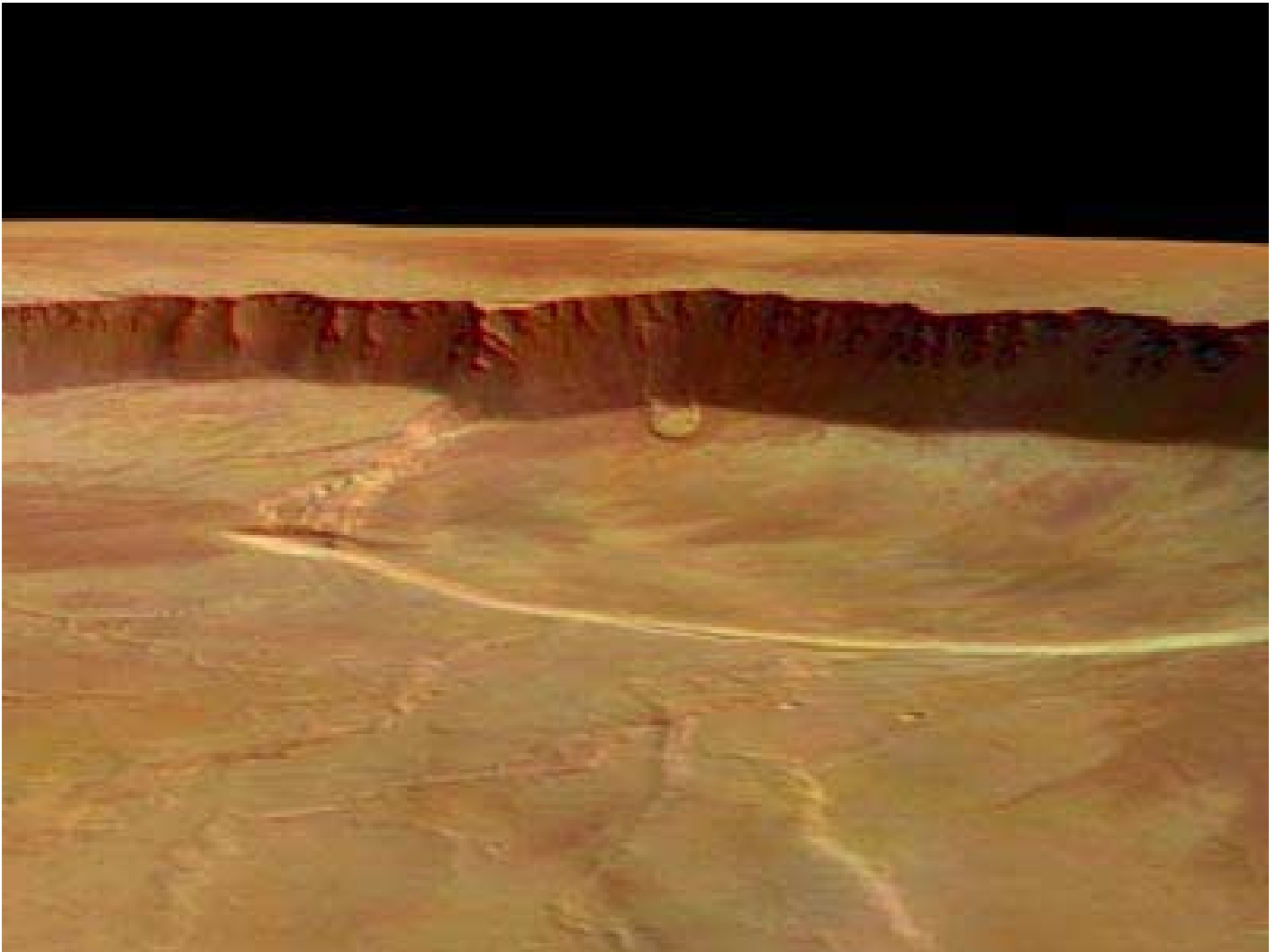
Credits : ESA / DLR / FU Berlin (G. Neukum)

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This complementary 3D view shows the “OLYMPUS MONS” volcano in its entirety, to put the caldera images in context.

It has been derived from the Mars Orbiter Laser Altimeter (MOLA) topographic data superimposed with the Mars Orbiter Camera (MOC) wide-angle image mosaic.

## Detail of the southern part of the caldera in perspective



Credits : ESA / DLR / FU Berlin (G. Neukum)

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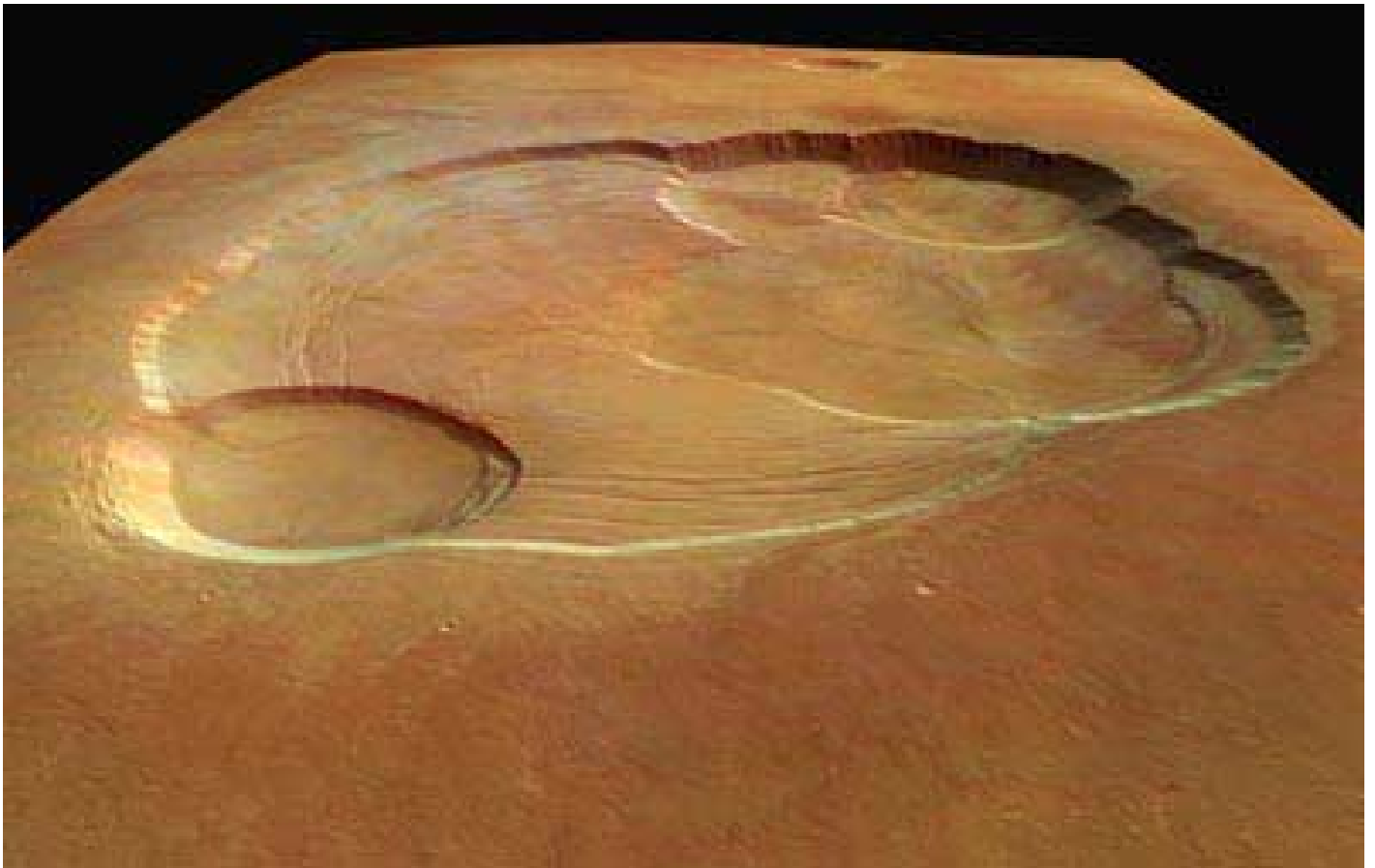
Image taken: on 21<sup>st</sup> January 2004, during the 37<sup>th</sup> orbit.

Localisation: Centre at latitude : 18,3° North – longitude : 227° East.

Area: 40 x 40 km (1 600 km<sup>2</sup>) - The vertical exaggeration is 1.8. South is up to allow the mass-movement features to be seen.

The scene reveals tongue-shaped mass-movement features in 3D on the southern wall. The striations are tectonic faults. After lava production has ceased the caldera collapsed over the emptied magma chamber. Through the collapse the surface suffers from extension and so extensional fractures are formed. The elevation level on which these fractures can be observed represents the event of the oldest caldera collapse. Later lava production has produced new caldera collapses at different locations (the other circular depressions), they partly destroyed the circular fracture pattern of the oldest one.

## Olympus Mons: Perspective view of the caldera



Credits : ESA / DLR / FU Berlin (G. Neukum)

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The image is 102 km across. The vertical exaggeration is 1.8. South is up.

# OLYMPUS MONS Western Flank

## Colour Image



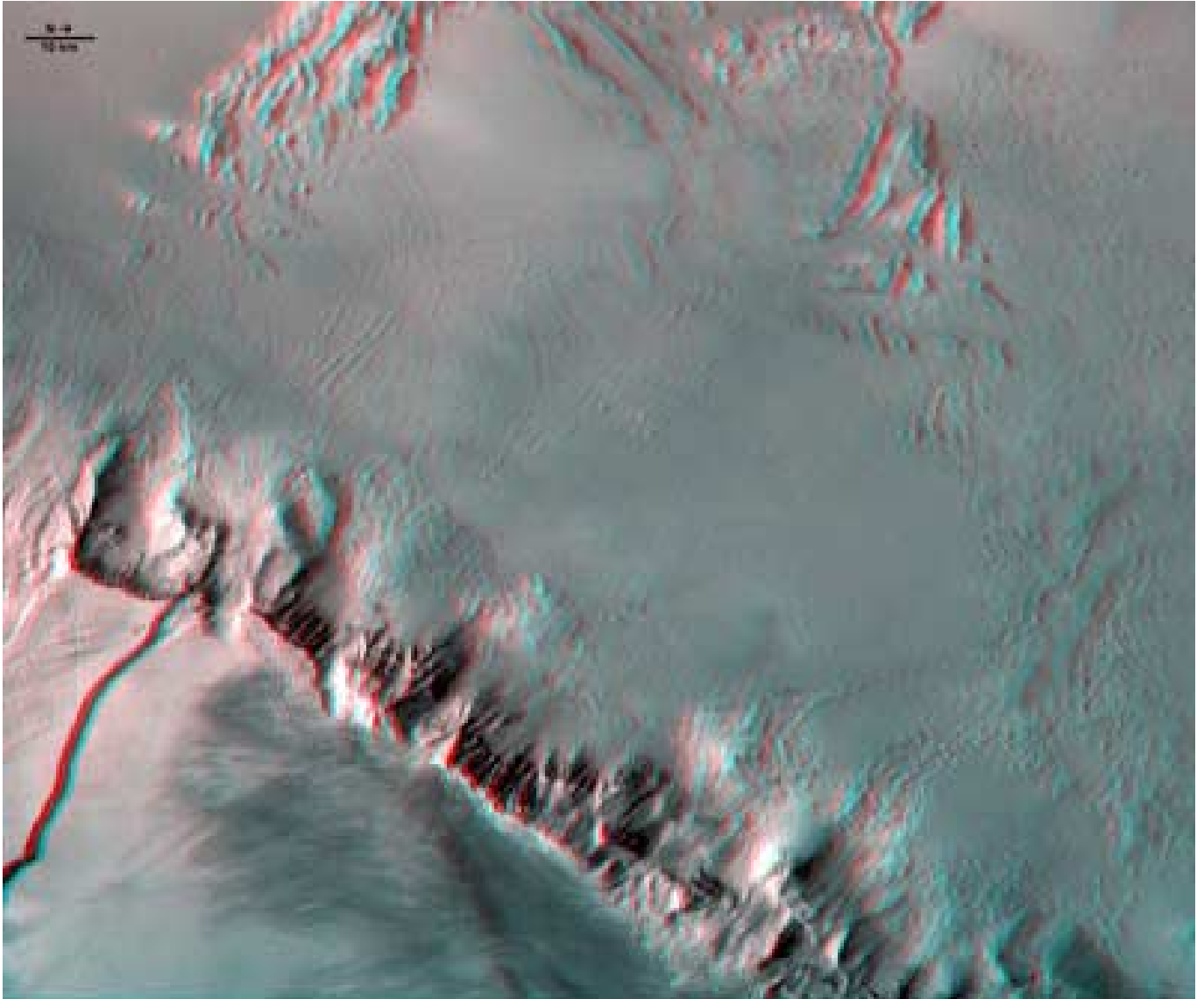
**Credits: ESA/DLR/FU Copyright 2000 - 2004 © European Space Agency. All rights reserved**

Image taken on 21<sup>st</sup> April 2004, during the 143th orbit of Mars Express – resolution of 25 metres per pixel  
Localisation: Latitude 22° North – Longitude 222° East. North is to the right.

These images show the western flank of the shield volcano OLYMPUS MONS in the Tharsis region of the western Martian hemisphere.

The escarpment at lower left rises from the surface level to over 7000 metres. At the top of the image, part of the extensive plains west of the escarpment are shown, known as the 'aureole' (from the Latin for 'circle of light').

## « 3 D » Anaglyph Image (stereoscopic 2 colours)

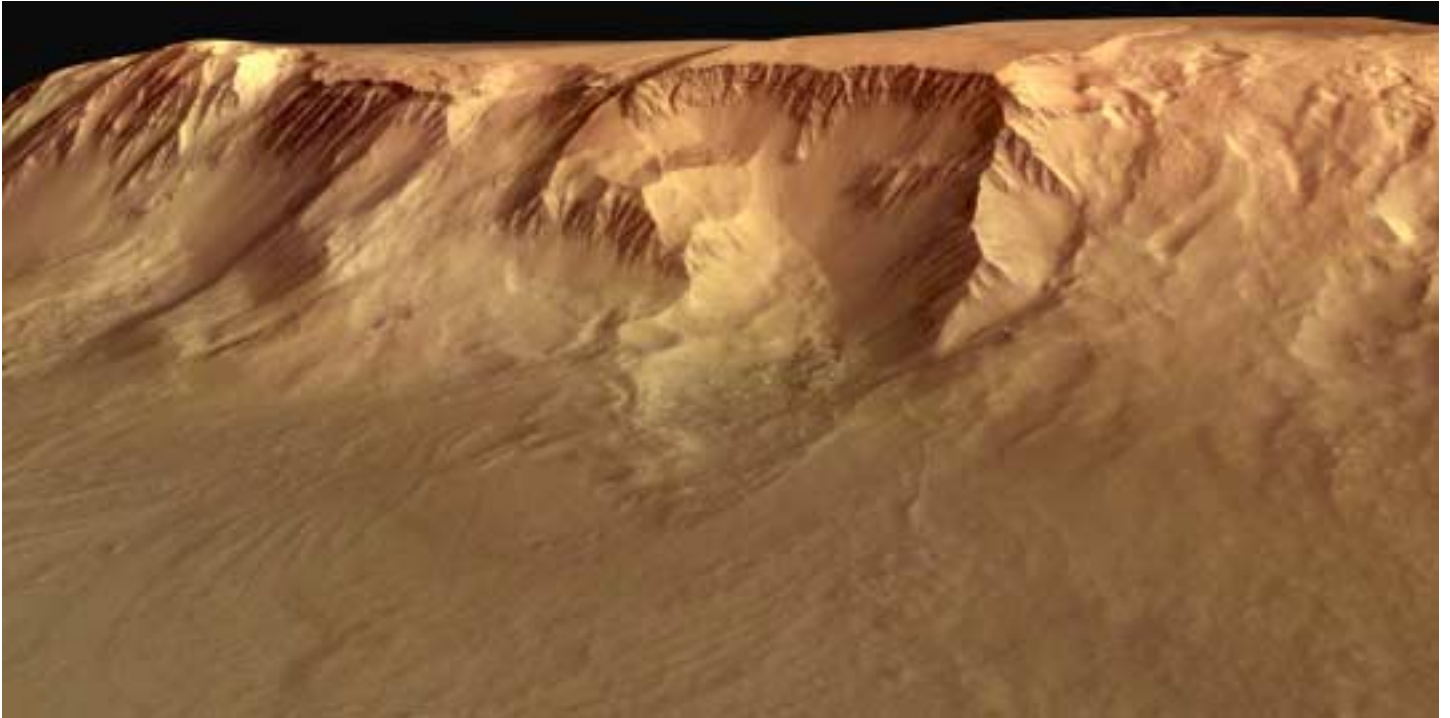


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To the north and west of the volcano, these 'aureole' deposits are regions of gigantic ridges and blocks extending some 1000 kilometres from the summit like petals of a flower. The origin of the deposits has challenged planetary scientists for an explanation for decades.

The most persistent explanation, however, has been landslides. Large masses of shield material can be found in the aureole area. Several indications also suggest a development and resurfacing connected to glacial activity.

## Perspective View Of Western Flank



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## Close-Up Perspective View Of Western Flank



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# OLYMPUS MONS – Escarpments And Landslides

## Perspective View of Scarp



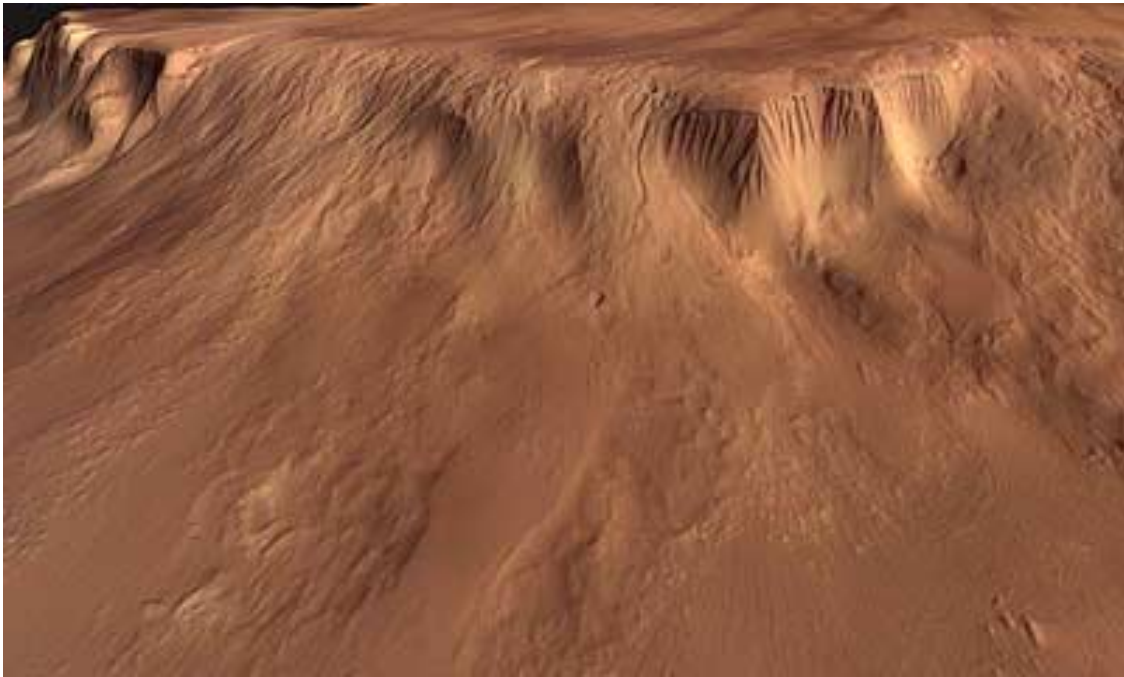
Credits: ESA/DLR/FU Copyright 2000 – 2004 © European Space Agency. All rights reserved

These images were taken during the orbit 143, showing the western flank of OLYMPUS MONS, from an altitude of 266 kilometres. Here, North is to the left.

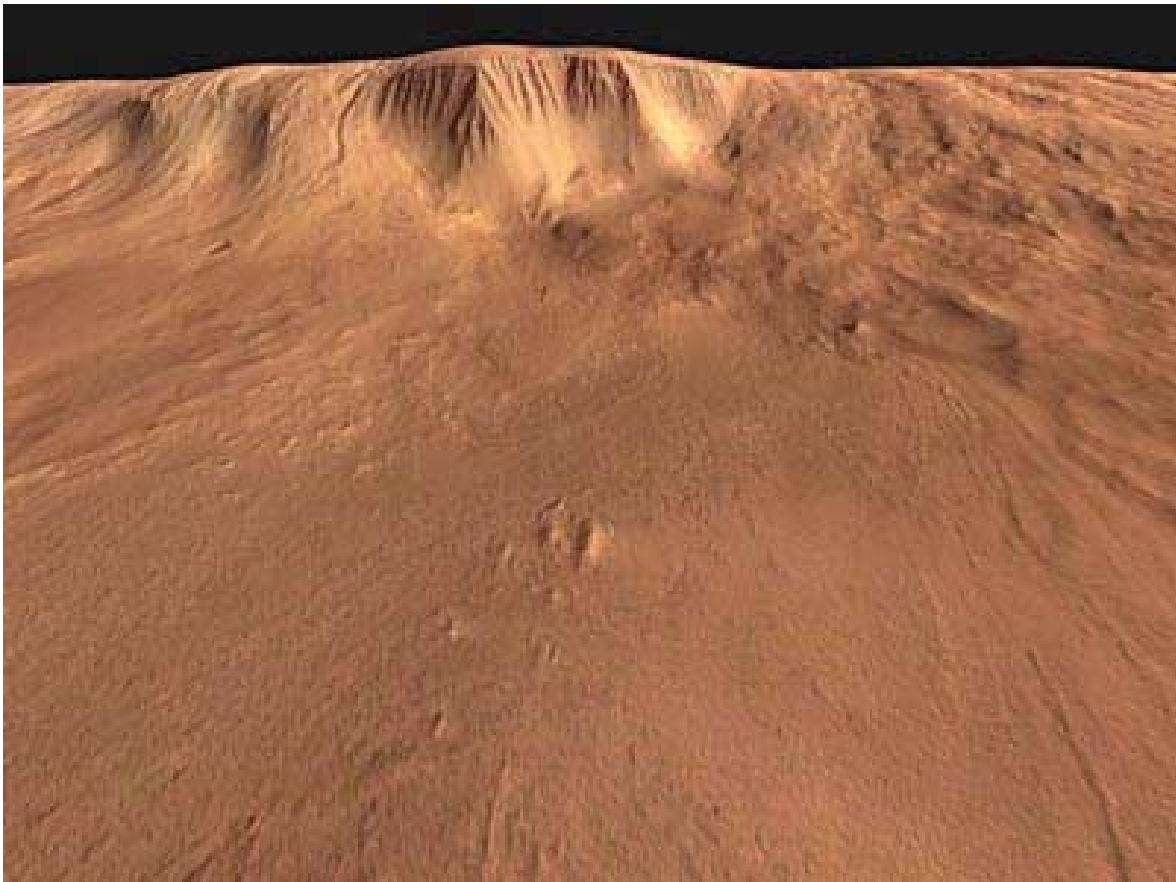
The images show the western part of the escarpment, rising from the surface level to over 7000 metres.

In the foreground, part of the extensive plains west of the escarpment are shown, known as an 'aureole' (from the Latin for 'circle of light'). See the black and white MOLA extensive view of the full Mons for the full extent of this aureole.

## Close-up Perspective View

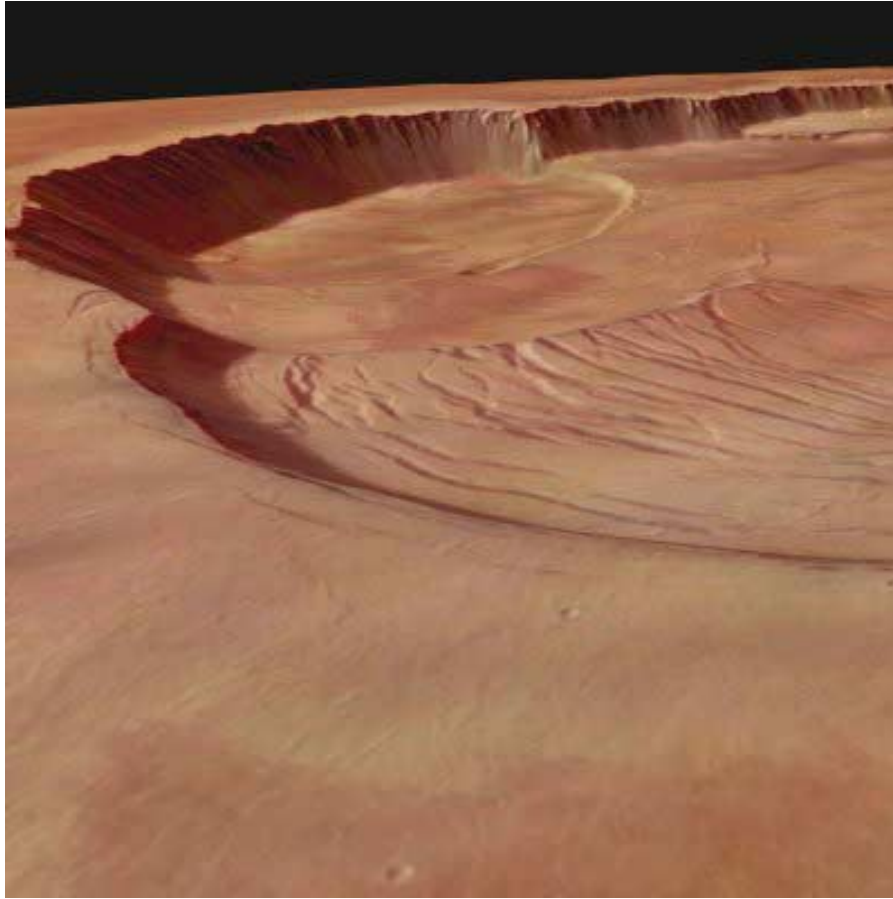


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## Perspective View Of The Caldera



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The data was retrieved during the orbit 143 of Mars Express. The view is looking north.

The curved striations on the left and foreground, in the southern part of the caldera, are tectonic faults.

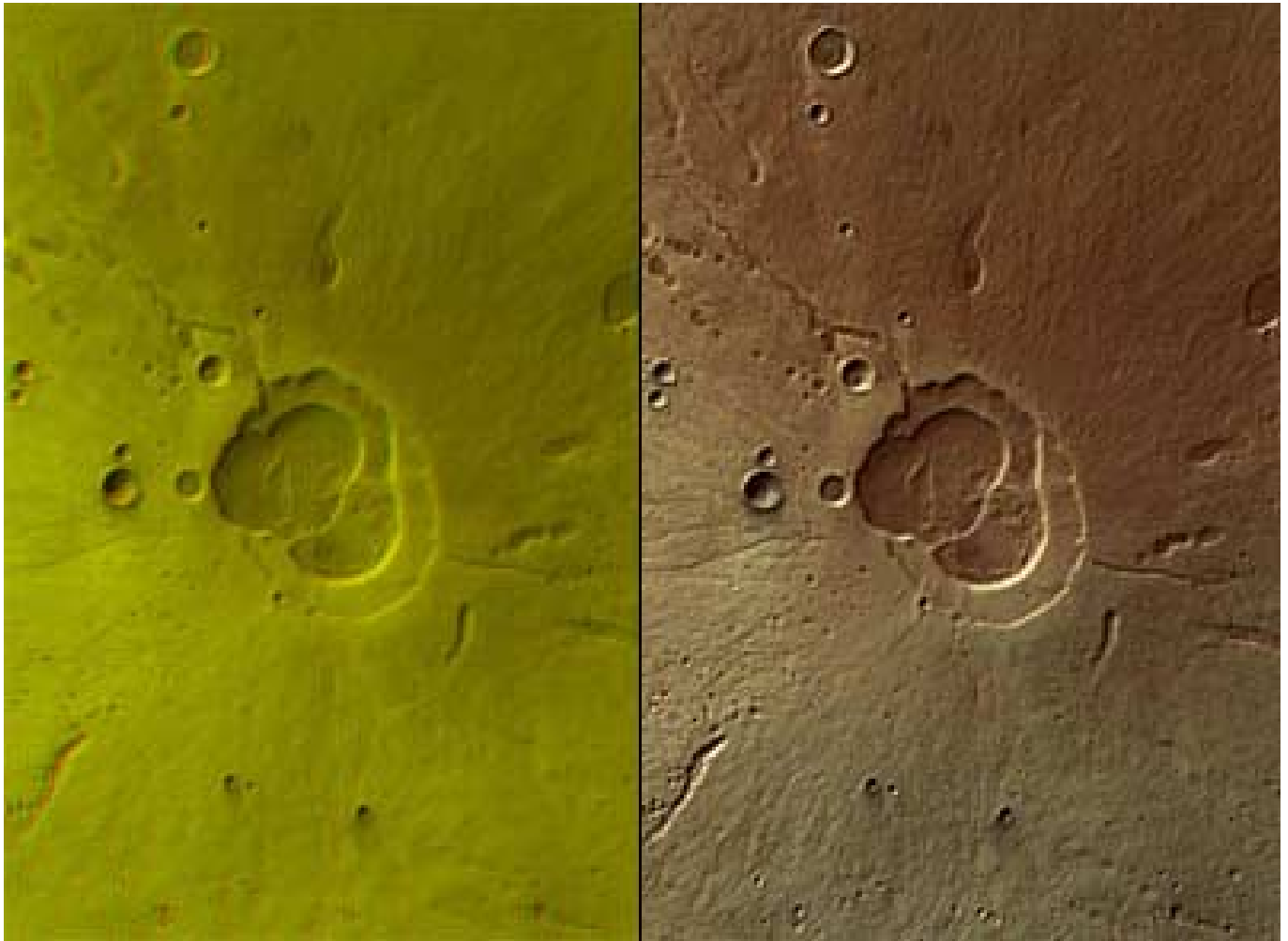
After lava production has ceased the caldera collapsed over the emptied magma chamber. Through the collapse the surface suffers from extension and so extensional fractures are formed.

The level plain inside the crater on which these fractures can be observed represents the oldest caldera collapse.

Later lava production caused new caldera collapses at different locations (the other circular depressions). They have partly destroyed the circular fracture pattern of the oldest one.

# HECATES THOLUS Volcano

## “3D” and Colour View



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Image taken: on 1<sup>st</sup> March 2004, during the 32<sup>nd</sup> Martian orbit..

## Colour View



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Image taken: on 1<sup>st</sup> March 2004, during the 32<sup>nd</sup> Martian orbit.

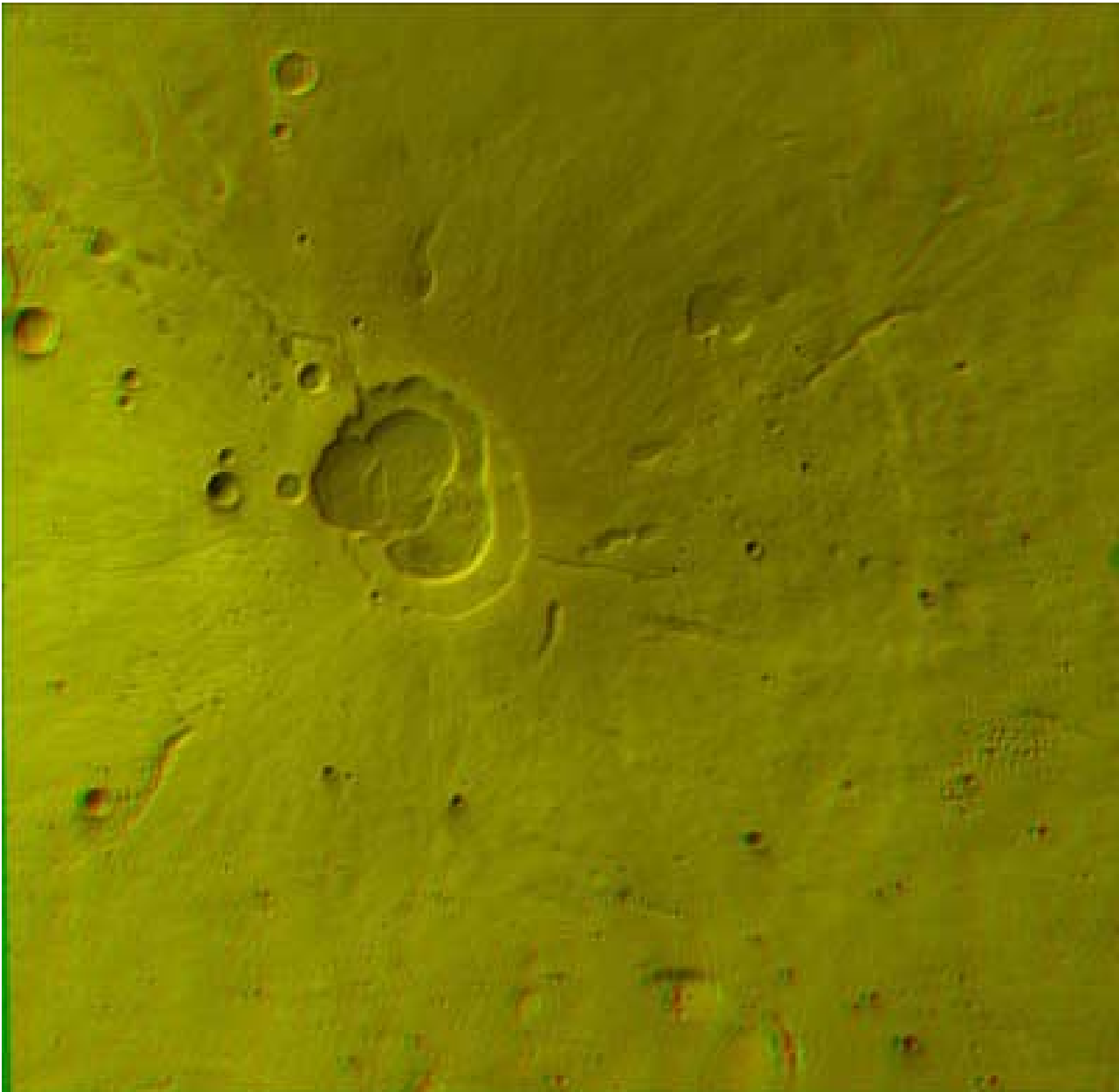
Localisation : The image centre is located at 150° East and 31.7° North.

The colour image (with north at the top) shows the summit caldera of « HECATES THOLUS », the northernmost volcano of the Elysium volcano group.

The volcano reveals multiple caldera collapses. On the flanks of HECATES THOLUS, several flow features related to water (lines radiating outwards) and pit chains related to lava can be observed.

The volcano has an elevation of 5300 metres, the caldera has a diameter of maximum 10 km and a depth of 600 metres.

## “3D” View

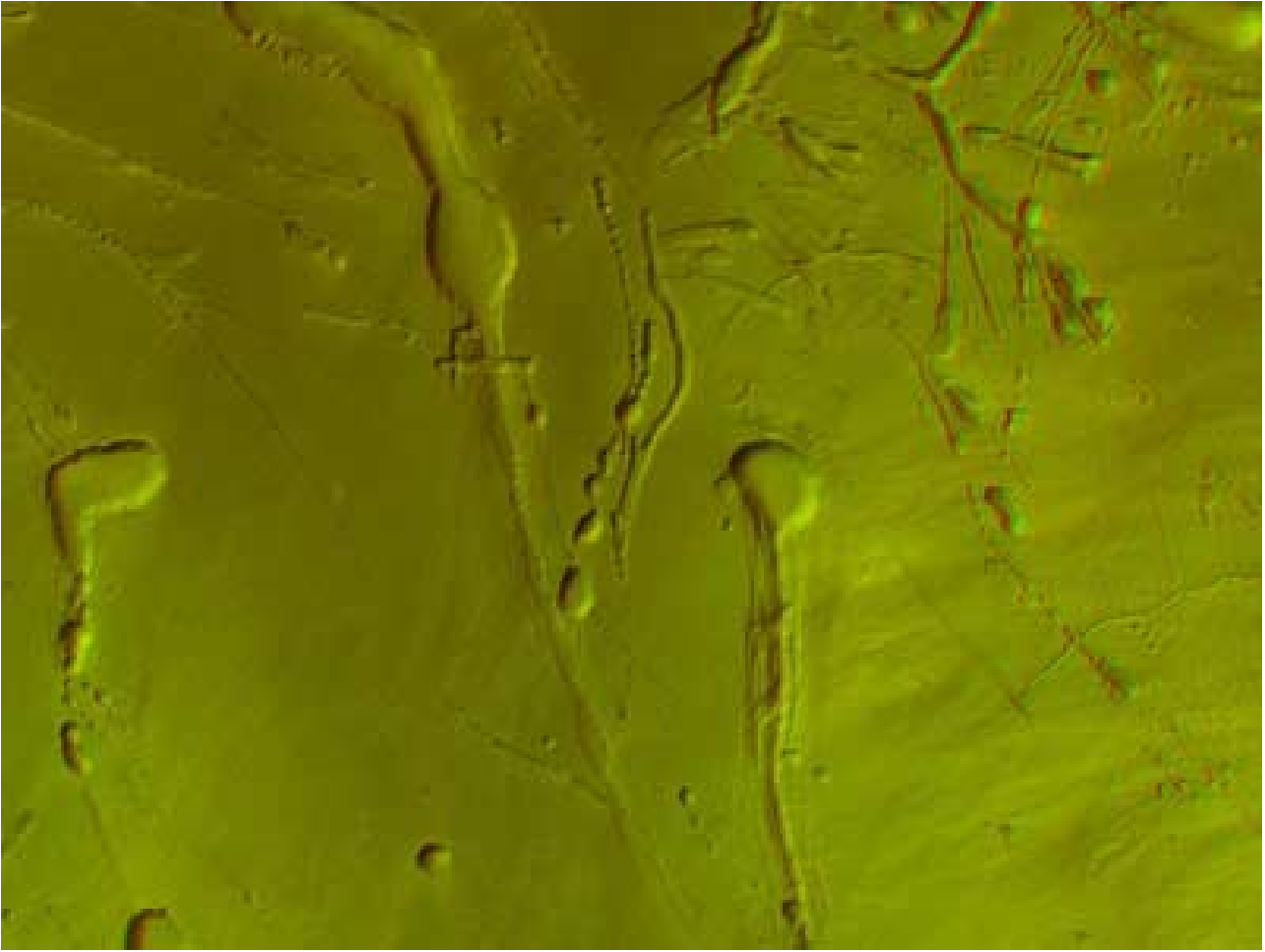


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In this anaglyph version (stereoscopic view in 2 complementary colours, showing the relief) the image has been rotated by 90 degrees to obtain the true 3D effect.

# ASCRAEUS MONS

## “3D” View



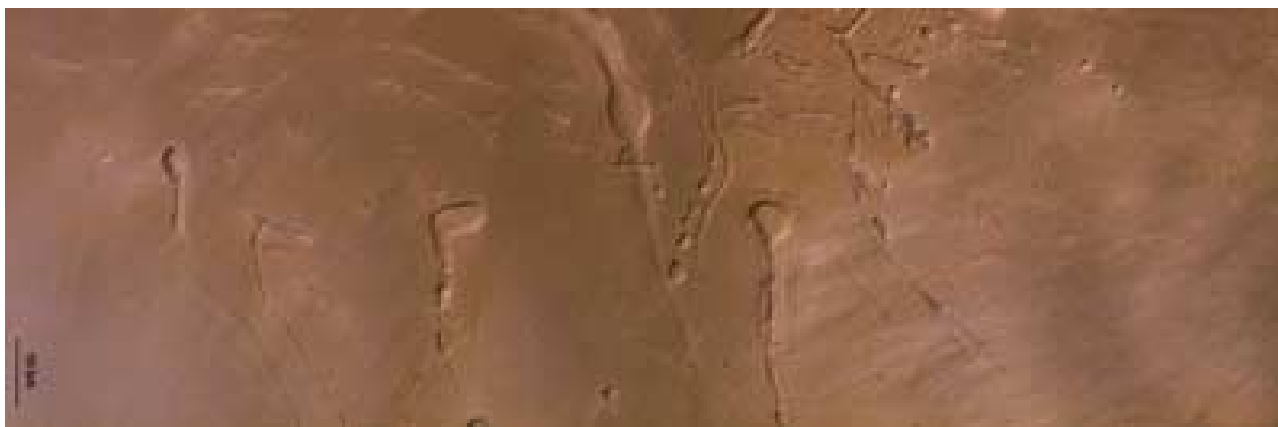
Credits : ESA / DLR / FU Berlin (G. Neukum) Copyright 2000 – 2004 © European Space Agency. All rights reserved

Localisation: Latitude: 7°9 North - Longitude: 255°5 East. North is at the right.

This 3D image shows a portion of the southern flank of « ASCRAEUS MONS », the northernmost volcano of the Tharsis volcano group.

The peculiar depressions which can be observed here, and on several Martian volcanoes, are so-called 'lava tubes'.

## Colour View



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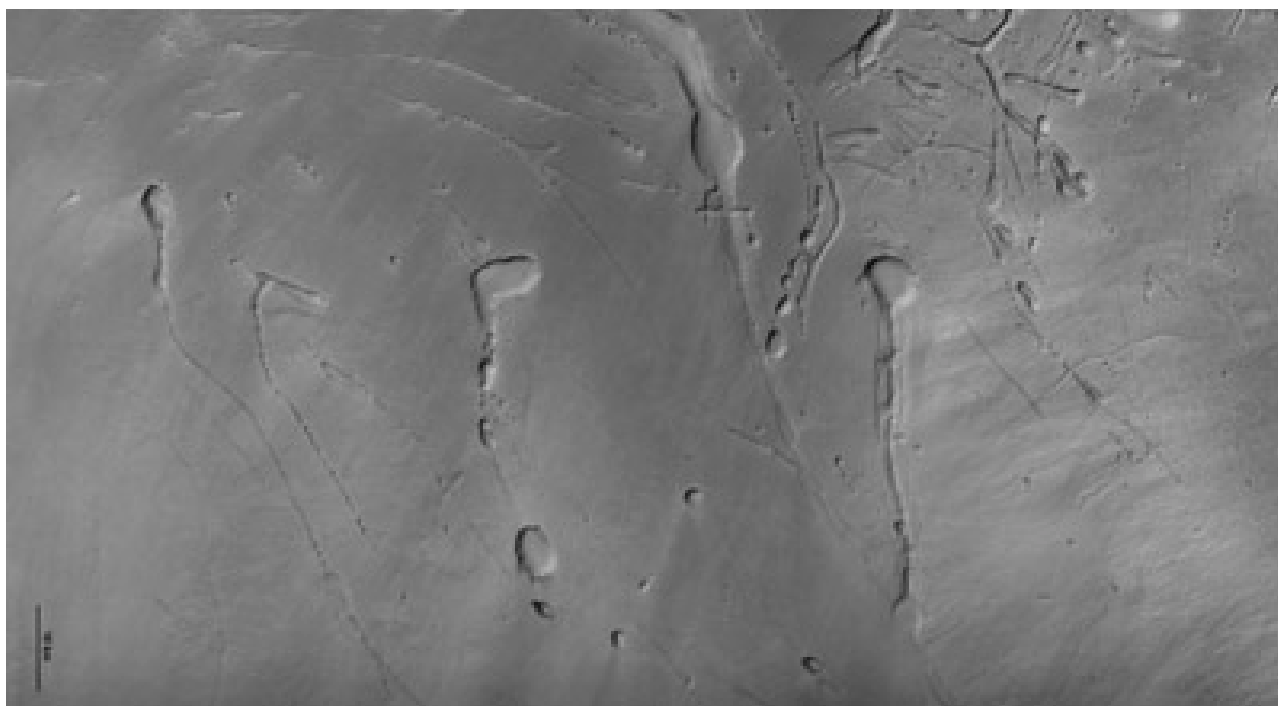
This colour image shows a larger portion of the southern flank of Ascraeus Mons. The lighter, 'pink' areas on the colour image are clouds.

The visible lava tubes are caused by the crusting (or cooled lava) which occurs over a lava channel, a covering making the channel into a tunnel. When lava production ceases, the tunnel empties and the roof of the tunnel falls in, making an elongated depression.

Occasionally, the depression forms a chain of small pits over an emptied lava tunnel. Pit chains and lava tunnels are common on the Martian surface and are also seen on other terrestrial planets and the Moon.

This nadir (vertical view) image is centred at 7.9 degrees North and 255.5 degrees East.

## Before processing and colour addition



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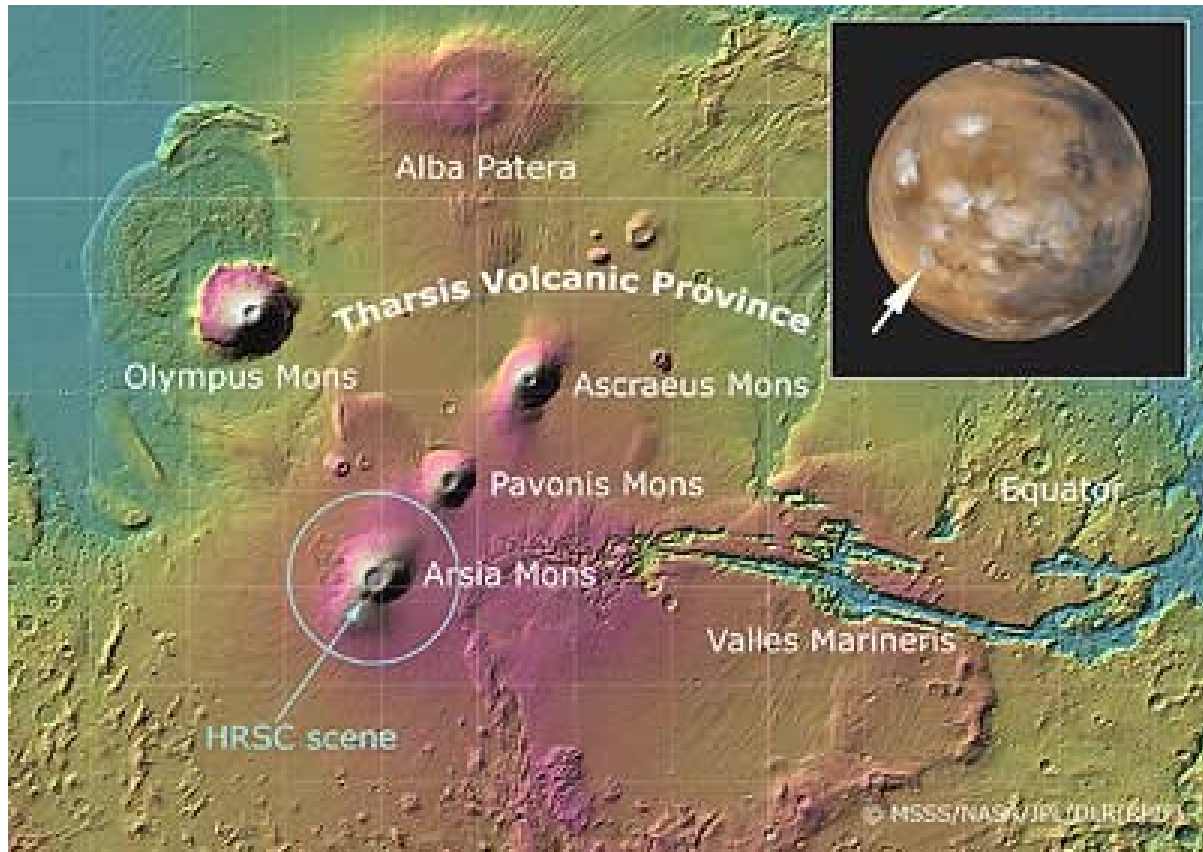
This is how the same image looks like before final processing and colour channel addition.

# ARSIA MONS Volcano

Image taken on 24<sup>th</sup> May 2004 from an altitude of about 400 kilometres during orbit 263.

Localisation: Latitude: 10° South - Longitude: 239° East

## Localisation

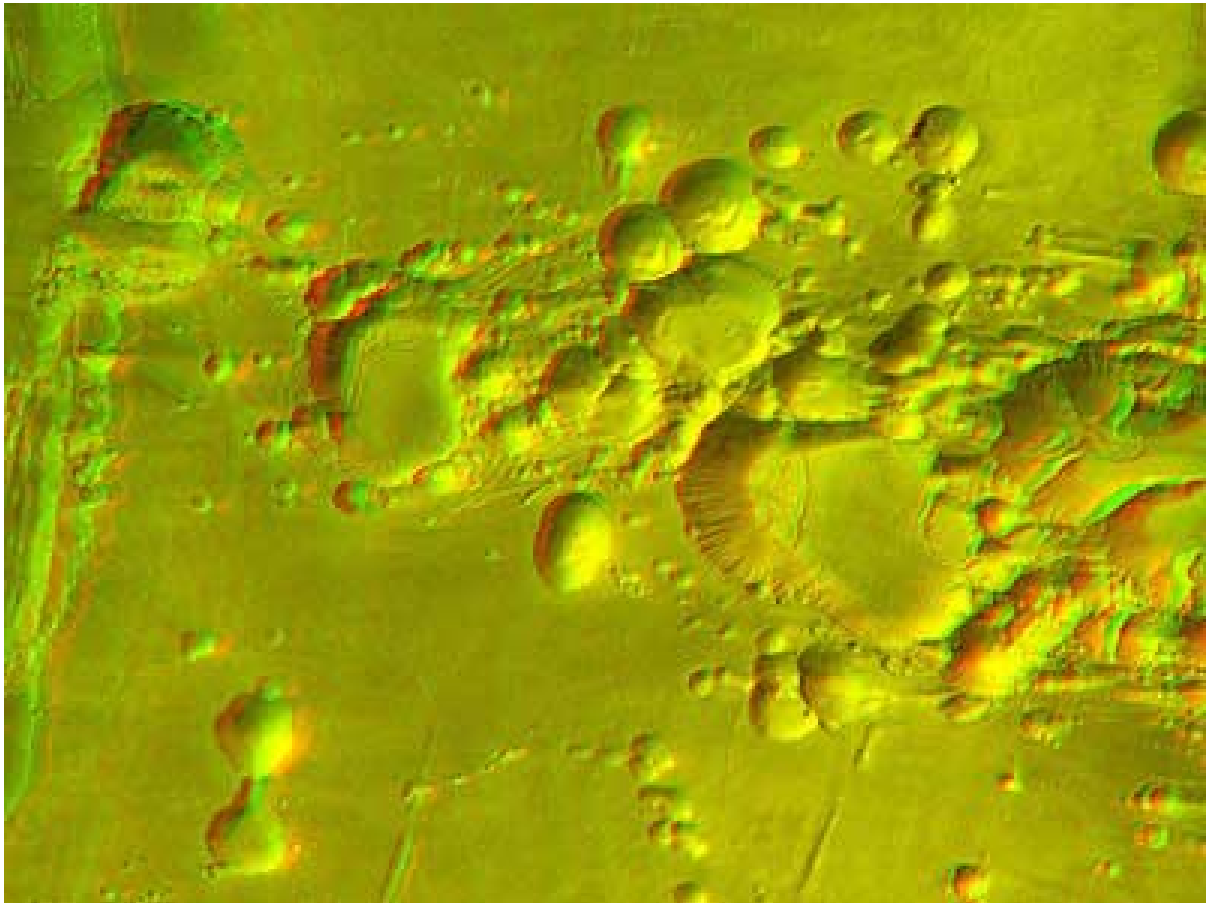


The 2 images you will see (circle, with an arrow indicating « HRSC scene », at the lower left) show a spectacular zone of collapse features on the southern flank of the giant shield volcano ARSIA MONS. We are in the « THARSIS region » where you can find, among other features, the 3 large volcanoes named: ARSIA MONS – PAVONIS MONS- ASCRAEUS MONS that are perfectly aligned.

The original image resolution was 20 metres per pixel, but the versions shown here have been reprocessed to reduce the volume of data for use on the internet.

The main red-green anaglyph image, covering an area of 38 kilometres by 53 kilometres (2014 km<sup>2</sup>), is a detail section of the top left of the black and white image below, which covers an area of 80 kilometres by 105 kilometres.

## « 3D » anaglyph View



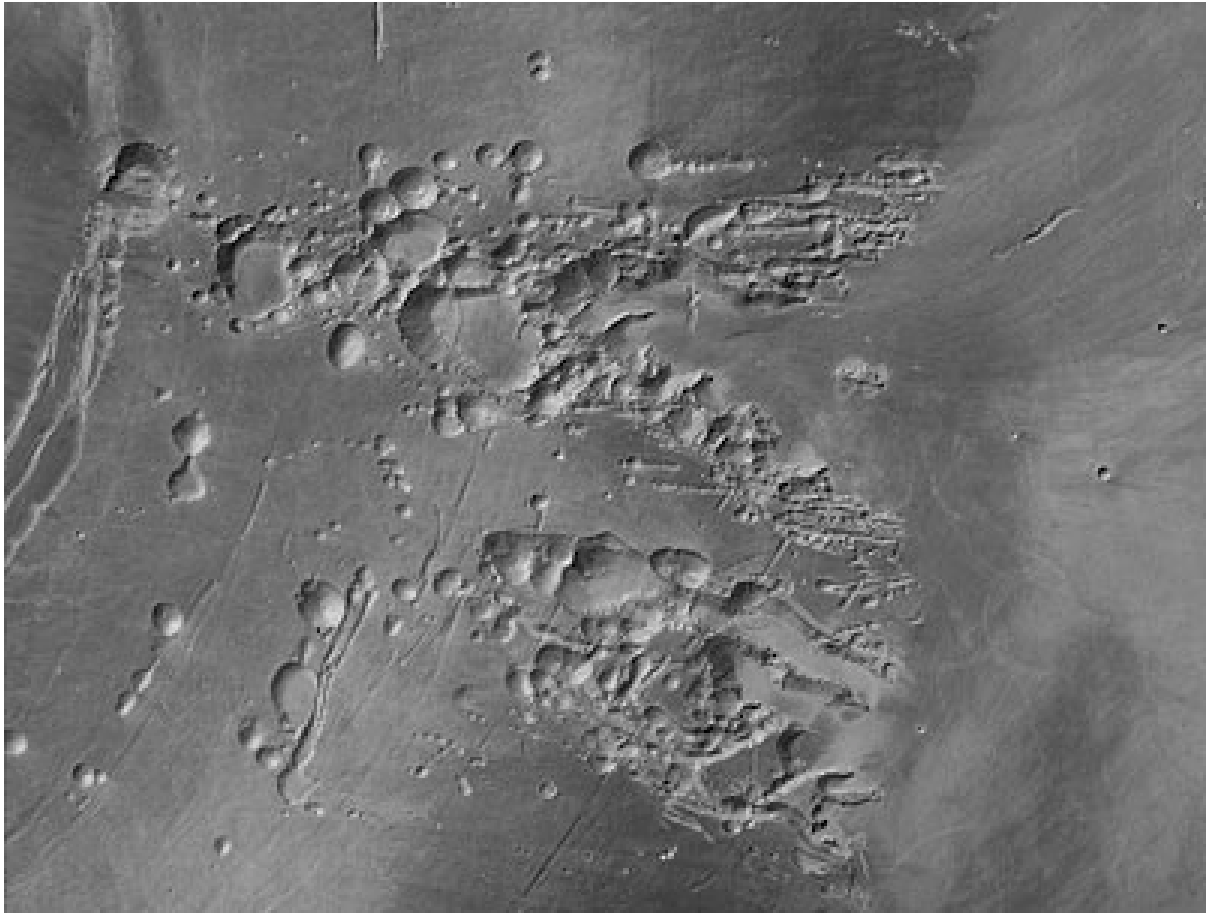
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The total height difference in the land surfaces in these scenes is about 7 kilometres, and some individual collapse pits have a depth of 2 kilometres.

The pits probably formed when lava erupted from the side of Arsia Mons. When lava, or molten rock, finds its way to the surface, it produces several veins and chambers. These slowly empty as the lava erupts and runs down the volcano flanks.

Some of the lava reaching the surface cools down and becomes solid, often building a roof over the emptied chamber. The resulting voids collapse due to the weight of the overlying material. At several places, the walls of the pits have been modified by later landslides.

## Black & White image

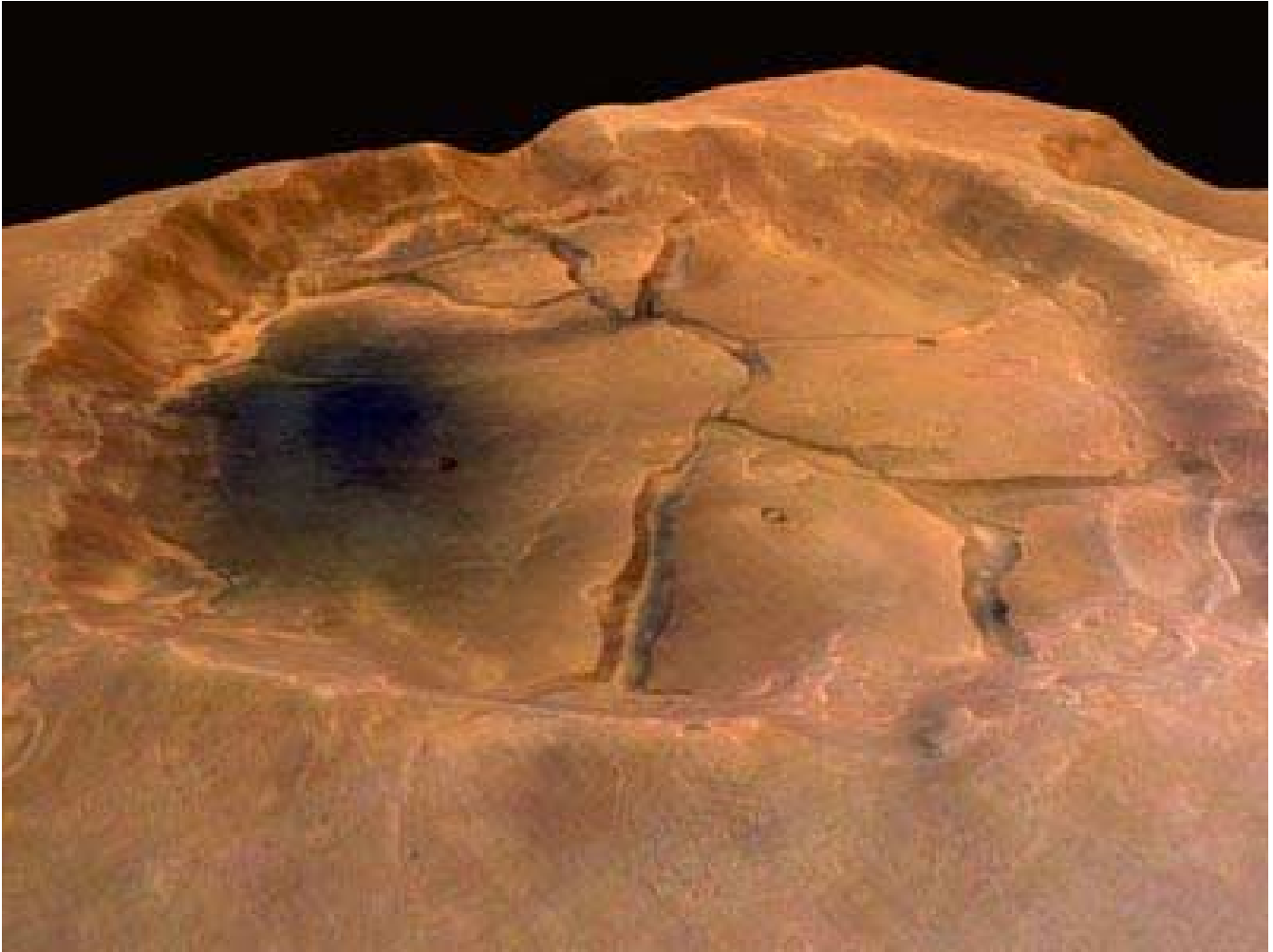


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This image covers an area of 80 X 105 km, that is 8 400 km<sup>2</sup>.

The overall trend of the collapse zone runs from the south-west to the north-east, following exactly a giant zone of crustal weakness in the Tharsis region, along which the three large volcanoes Arsia, Pavonis and Ascraeus Montes are aligned.

# **FRACTURED CRATER Near VALLES MARINERIS**



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This perspective image of a fractured crater near VALLES MARINERIS on Mars was obtained during orbit 61 in January 2004 with a resolution of 12.5 metres per pixel.

It shows part of a cratered landscape to the north of the VALLES MARINERIS, at 0.6° S latitude and 309° E longitude, with this crater having a fractured base.

This crater has a rim diameter of 27.5 kilometres and is about 800 metres deep.

It is not known yet how these fractures are generated. On Earth, polygonal fractures may occur in contracting material, which breaks at weak zones. For example, we may see this appearing in cooled lava, dried clay or frozen ground.