Fire and ice in the red valley

14 February 2013

On 13 January 2013 the High Resolution Stereo Camera (HRSC), operated by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) on board ESA's Mars Express spacecraft, imaged the mouth of the Tinto Vallis region of Mars, southwest of Palos Crater.

Tinto Vallis, named after the famous river located in the Andalucía region of Spain, is 190 kilometres long and believed to have formed around 3.7 billion years ago, during Mars' early history.

Volcanic activity melted subsurface ice

Its formation is thought to be the result of volcanic activity, which melted subsurface ice. As a consequence, groundwater was liberated to the surface of Mars and what are known as 'sapping valleys' formed. Groundwater sapping is believed to be responsible for the erosion seen in many of the valley networks on the red planet and is the process whereby water comes out of the ground laterally as seeps and springs. This results in slopes being undermined, undergoing mass wasting, forming steep 'U' shaped valley structures. Sapping valleys developed all over this region due to soil erosion, with a clear example being the mouth of Tinto Vallis, seen in the lower centre of the two-dimensional colour, topographic and anaglyph images.

Formations like those in arid regions on Earth

Also of note in the aforementioned two-dimensional images and the striking second perspective image (3/6), is a 100-kilometre-wide crater that dominates the southern (left) half of the two-dimensional images. A smaller 35-kilometre-wide crater is superimposed onto it. The floor of the 100-kilometre crater is chaotic, littered with mesas and their smaller siblings, buttes. These are probably the result of the removal of subsurface water ice, which lead to the collapse of the surrounding surface, leaving these high-sided features behind. Buttes and mesas owe their sheer sides to thicker layers of more resistant rock within them. On Earth, we can find many examples of these types of formations in the desert regions of Utah. Within the 35-kilometre crater, and most notably seen in the second perspective image, are spectacular landslides towards the northwestern and northeastern sides.

Toward the north (right) side of the two-dimensional images, several smaller craters display very smooth and flat floors, which are due to infilling by sediments. The darker regions to the far north and south are low-lying areas, covered in wind-transported basaltic sands.

With these recent images, Mars Express continues to show the similarities between regions on Earth and those on Mars, and how the two worlds' early geological history is subtly intertwined.

Image processing and the HRSC experiment on Mars Express

The colour plan view (1/6) was acquired using the nadir channel, which is directed vertically down onto the surface of Mars, and the colour channels of the HRSC; the perspective oblique views (2/6 and 3/6) were computed from data acquired by the HRSC stereo channels. The anaglyph image (4/6), which creates a three-dimensional impression of the landscape when viewed with red/blue or red/green glasses, was derived from the nadir channel and one stereo channel. The colour-coded view (6/6) is based on a digital terrain model of the region, from which the topography of the landscape can be derived.

The HRSC camera experiment on board the European Space Agency's Mars Express mission is headed by Principal Investigator (PI) Professor Gerhard Neukum (Freie Universität Berlin), who was also responsible for the technical design of the camera. The science team consists of 45 co-investigators from 32 institutions in 10 nations. The camera was developed at DLR under the leadership of the PI and it was built in cooperation with industrial partners EADS Astrium, Lewicki Microelectronic GmbH and Jena-Optronik GmbH. The instrument is operated by the DLR Institute of Planetary Research in Berlin-Adlershof. The systematic processing of the HRSC image data is carried out at DLR. The images shown here were created by the Institute of Geological Sciences at Freie Universität Berlin in cooperation with the DLR Institute of Planetary Research, Berlin.

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Colour plan view of Tinto Vallis

High Resolution Stereo Camera (HRSC) nadir and colour channel data acquired during orbit 11,497 on 13 January 2013 by ESA's Mars Express spacecraft has been combined to form a natural-colour view of the Tinto Vallis region. The region imaged, which lies southwest of Amenthes Rupes and Palos Crater, is centred at around three degrees south and 109 degrees east, and has a ground resolution of about 22 metres per pixel. The mouth of Tinto Vallis, seen clearly in the lower centre of this image, is believed to have formed 3.7 billion years ago after volcanic activity warmed and melted subsurface ice, which then escaped to the surface to form 'sapping valleys'. Copyright note: As a joint undertaking by DLR, ESA and FU Berlin, the Mars Express HRSC images are published under a Creative Commons licence since December

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Perspective view of Tinto Vallis

This computer-generated perspective view of Tinto Vallis was created using data acquired by the High Resolution Stereo Camera (HRSC) on board ESA's Mars Express spacecraft. Acquired during orbit 11,497 and centred at around three degrees south and 109 degrees north, the image has a ground resolution of about 22 metres per pixel. This perspective view shows the mouth of Tinto Vallis, with its U-shaped cross section, indicative of sapping. The top left of the image is the periphery of a 100-kilometre-wide crater, the floor of which is littered with mesas and buttes. Copyright note: As a joint undertaking by DLR, ESA and FU Berlin, the Mars Express HRSC images are published under a Creative Commons licence since December 2014: ESA/DLR/FU Berlin, CC BY-SA 3.0 IGO. This licence will also apply to all HRSC images released to date.

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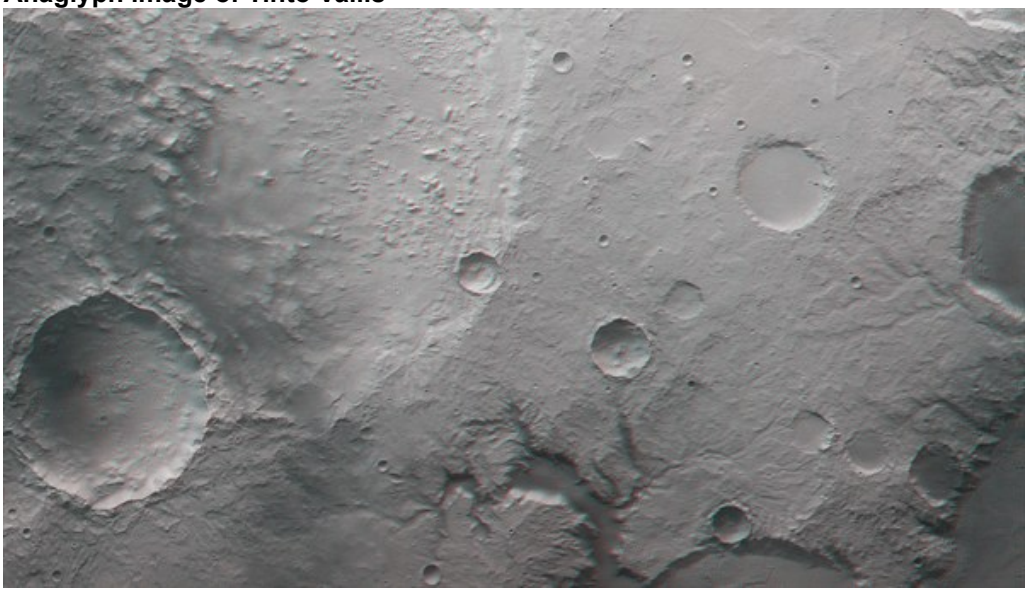
Perspective view of Tinto Vallis

This computer-generated perspective view of part of the Tinto Vallis region was created using data acquired by the High Resolution Stereo Camera (HRSC) on ESA's Mars Express spacecraft. Imaged during orbit 11,497 on 13 January 2013 and centred at around three degree south and 109 degrees east, the image has a ground resolution of about 22 metres per pixel. A 35-kilometre-wide steep sided crater dominates the image, with evidence of two large landslides on its northeastern and northwestern sides. These landslides may have been induced by small direct impactors or simply be due to gravitational force acting on unstable slopes. Shaking caused by earthquakes or distant impacts may also have been sufficient to cause slope collapse.

Credit: ESA/DLR/FU Berlin, CC BY-SA 3.0 IGO.

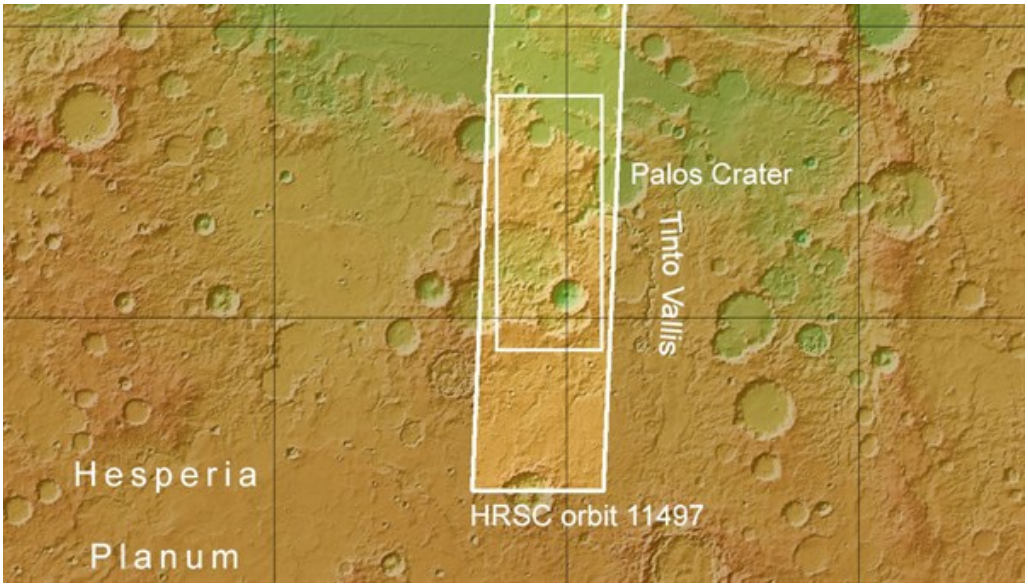
Anaglyph image of Tinto Vallis



Tinto Vallis imaged on 13 January 2013 during orbit 11,497 of ESA's Mars Express spacecraft using the High Resolution Stereo Camera (HRSC). Data from HRSC's nadir channel and one stereo channel have been combined to produce this anaglyph image, which can be viewed using stereoscopic glasses with red–green or red–blue filters to give a three-dimensional impression of the landscape. Centred at around three degrees south and 109 degrees east, the image has a ground resolution of about 22 metres per pixel.

Credit: ESA/DLR/FU Berlin, CC BY-SA 3.0 IGO.

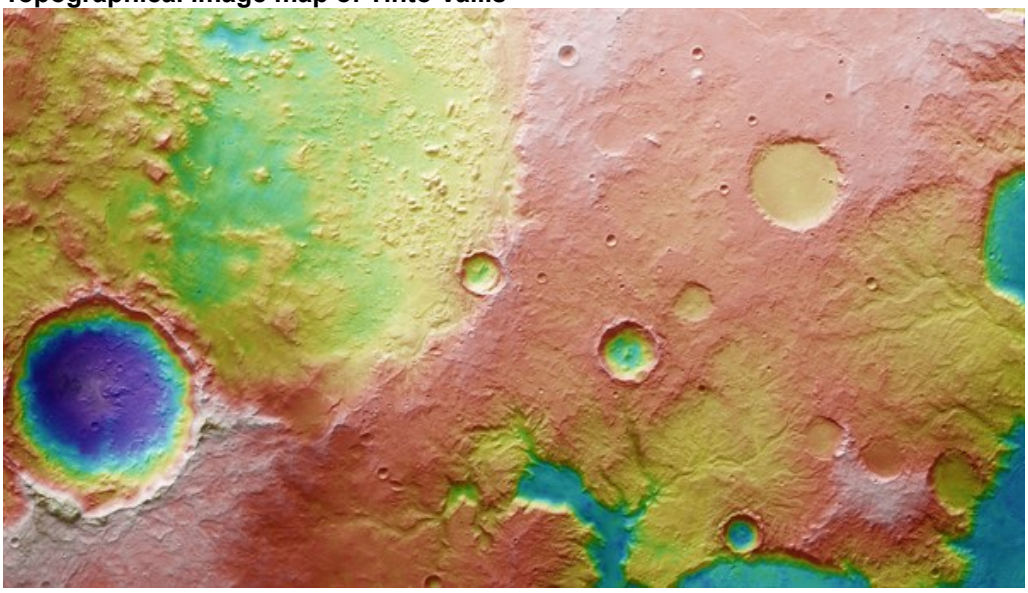
Tinto Vallis in context



Tinto Vallis seen in a broader context. The smaller rectangle shows the region covered by this Mars Express image release. The High Resolution Stereo Camera (HRSC) on board ESA's Mars Express spacecraft imaged the Tinto Vallis region during orbit 11,497 on 13 January 2013.

Credit: NASA/JPL (MOLA); FU Berlin.

Topographical image map of Tinto Vallis



Using the HRSC stereo camera, digital terrain models can be derived that illustrate the topography of the region using false colours. The altitude can be read from the colour scale at lower right. This colour-coded view is based on a Mars Express HRSC digital terrain model of the Tinto Vallis region. Centred at around three degrees south and 109 degrees east, the image has a ground resolution of about 22 metres per pixel. The image data was acquired during orbit 11,497 on 13 January 2013. The colour coding emphasises the superimposed craters on to the large 100-kilometre-wide crater to the left (south) of the image. Also more clearly seen are the various mesas and buttes within the 100-kilometre crater. At the bottom of the image, just to the right of the mouth of Tinto Vallis, the edge of Palos Crater can be seen. Palos Crater was at one stage considered as a possible landing site for the NASA Mars Exploration Rovers. Copyright note: As a joint undertaking by DLR, ESA and FU Berlin, the Mars Express HRSC images are published under a Creative Commons licence since December 2014: ESA/DLR/FU Berlin, CC BY-SA 3.0 IGO. This licence will also apply to all HRSC images released to date.

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