The dark dunes of Mars: Moreux crater

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The Moreux crater is roughly three kilometres deep, and spans 135 kilometres from edge to edge. While the surrounding material is visible in hues of butterscotch and caramel, the crater's walls are dark, resembling a smudged ring of charcoal, and dark brown-black dunes cover the crater floor. This darkness is thought to be a result of the dunes comprising sandy material rich in pyroxene and olivine, minerals with a typically dark appearance. The dunes and flow features in Moreux crater are intriguing. Many of the features surrounding the central peak and southern region of the crater (to the left of the image) appear to have been formed by substantial and episodic glacial activity over the past few million years. Many other features, most notably the sickle-shaped dunes covering the crater floor, show signs of being eroded or formed by wind-related processes. This image comprises data gathered on 30 October 2019 during orbit 20014. The ground resolution is approximately 16 m/pixel and the images are centred at about 44°E/42°N. This image was created using data from the nadir and colour channels of the High Resolution Stereo Camera (HRSC). The nadir channel is aligned perpendicular to the surface of Mars, as if looking straight down at the surface. North is to the right. Credit: ESA/DLR/FU Berlin, CC BY-

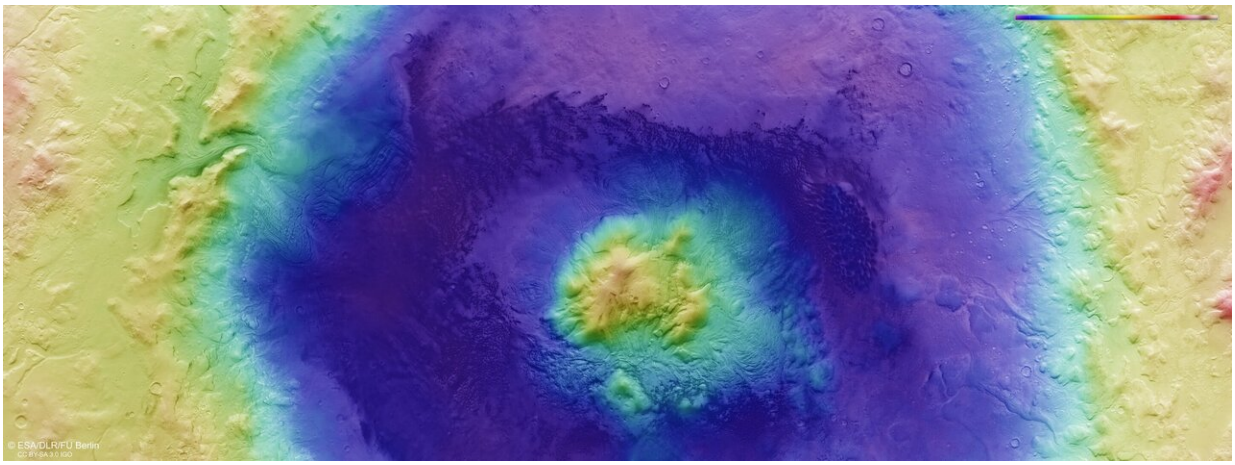
Known for its wide swathes of rippling, textured, gently sloping dunes, the Terra Sabaea region on Mars is home to many fascinating geological features—including the prominent Moreux crater, the star of a new image from ESA's Mars Express.

The Moreux crater on Mars showcases numerous intriguing geological processes and features. It sits at the northern edge of Terra Sabaea, a large area of the Red Planet that is speckled with impact craters and covered in glacial flows, dunes, fretted terrain and intricate ridge networks.

When compared to other impact craters on both Mars and Earth, Moreux crater appears a little misshapen and messy—the result of ongoing erosion over martian history. Its egg-shaped rim is broken up, its dark walls are ridged, rippled and mottled, and its center features a prominent clustered 'peak," created as material from the crater floor rebounded and rose upwards following the initial impact.

It is difficult to get a sense of scale when viewing this peak from orbit, but Moreux crater's central peak is sizable, reaching around two kilometers in height. The crater itself is roughly three kilometers deep, and spans 135 kilometers from edge to edge.

The range of colors featured in images like this one, taken by the High Resolution Stereo Camera on Mars Express, reveals much about the composition of a particular region, material or feature.



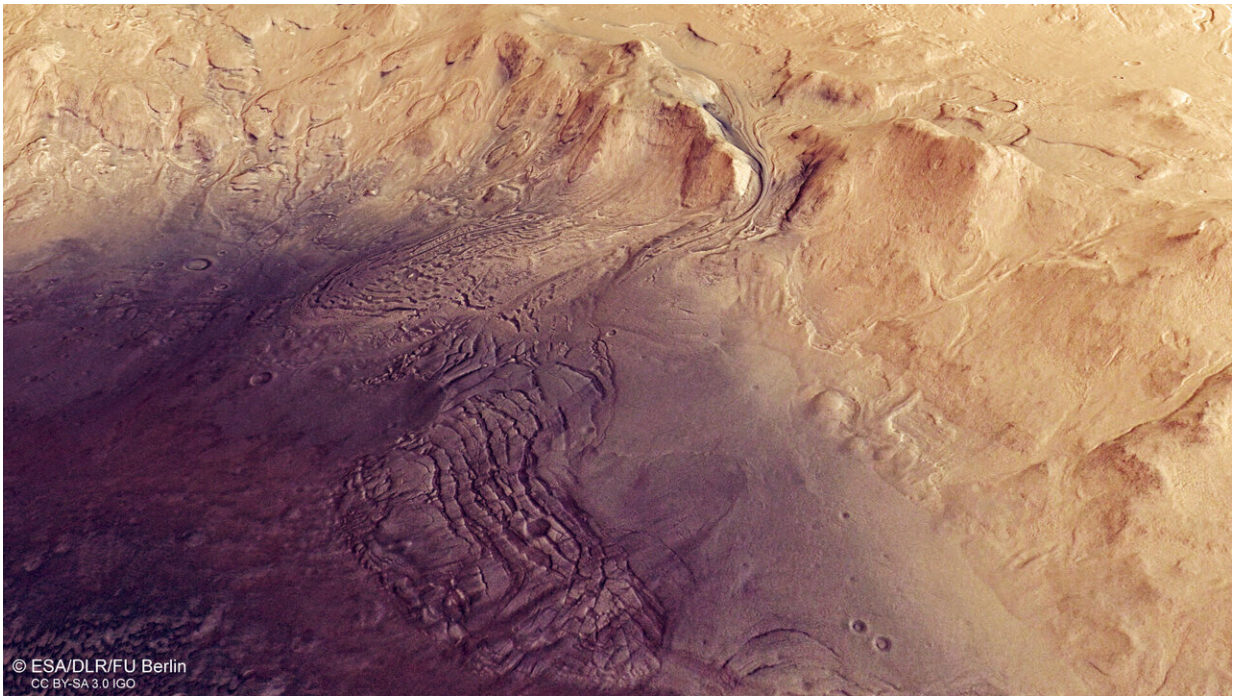
This colour-coded topographic image shows a feature on Mars' surface named Moreux crater, based on data gathered by the Mars Express High Resolution Stereo Camera on 30 October 2019 during orbit 20014. This view is based on a digital terrain model (DTM) of the region, from which the topography of the landscape can be derived; lower parts of the surface are shown in blues and purples, while higher altitude regions show up in whites, yellows and reds, as indicated on the scale to the bottom left. North is to the right. Credit: ESA/DLR/FU Berlin, CC BY-SA 3.0 IGO

In the case of Moreux crater, the color differences are stark: while the surrounding material is visible in hues of butterscotch and caramel, the crater's walls are dark, resembling a smudged ring of ash or charcoal. Dark brown and black dunes cover the crater floor, while the peak remains a pale yellow-orange. Dark, prominent ejecta, comprising material flung outwards during the crater-forming collision, spread outwards from the crater rim, discoloring and encroaching upon the lighter surrounding terrain.

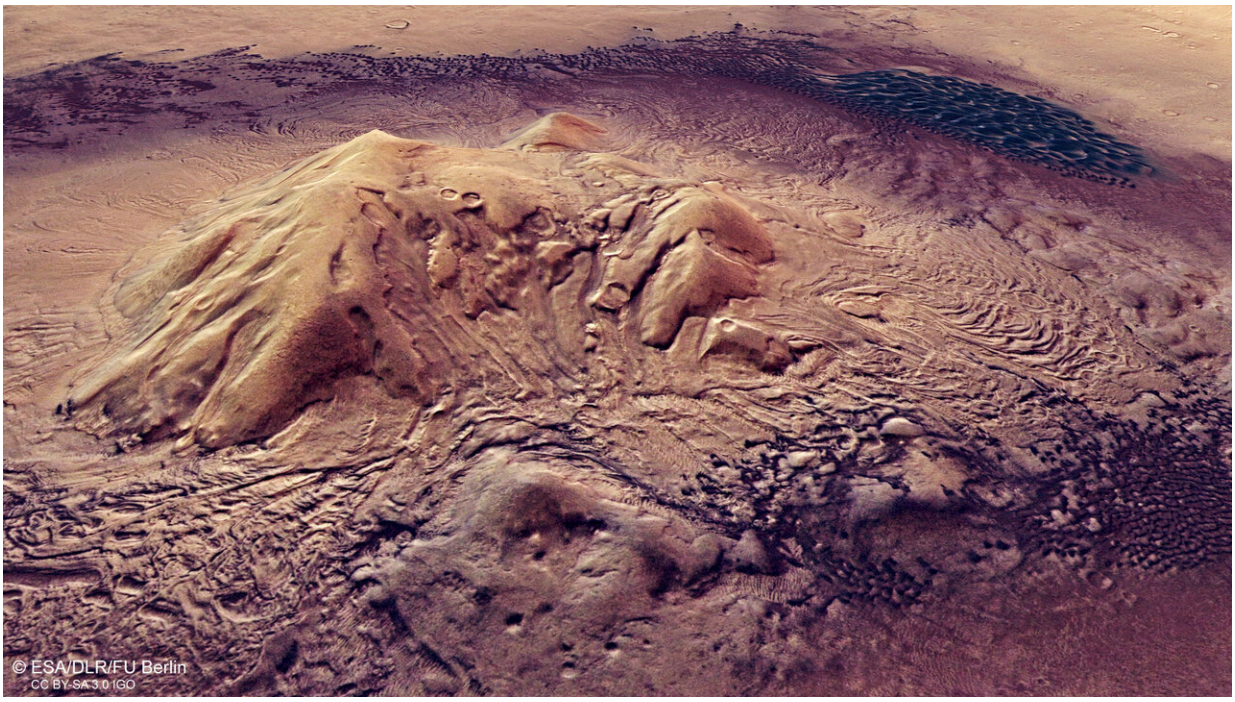
This varied color palette reflects an equally varied geological composition. The dunes within and around the crater are thought to contain sandy material rich in pyroxene and olivine: rock-forming

minerals that are mafic (containing magnesium and iron) and characterized by their typically dark appearance.

Martian winds are also thought to have swept and gathered fine, basaltic, volcanic sand and ash into and around the crater. Basaltic rock is commonplace on both Mars and other celestial bodies. It is a key component of the maria, or seas, on the Moon, for instance, and causes them to appear visibly and notably darker than the lunar highlands.



The image was created using data from the nadir and colour channels of the High Resolution Stereo Camera (HRSC). The nadir channel is aligned perpendicular to the surface of Mars, as if looking straight down at the surface. Credit: ESA/DLR/FU Berlin, CC BY-SA 3.0 IGO



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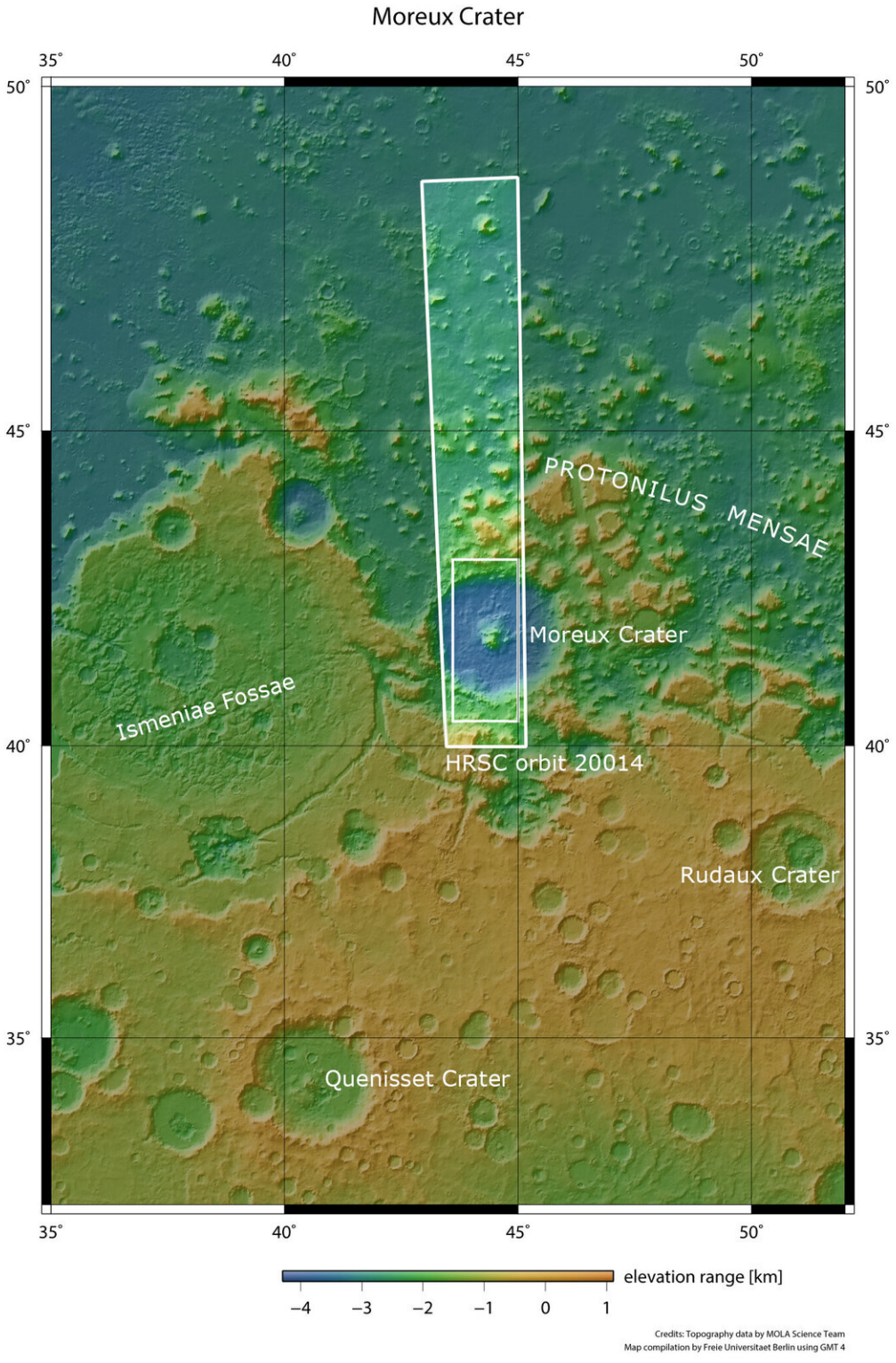

The area outlined by the bold white box indicates the area imaged by the Mars

Express High Resolution Stereo Camera on 30 October 2019 during orbit 20014. Credit: NASA MGS MOLA Science Team

Many of the features, such as dunes and flows, surrounding the central peak and southern region of Moreux crater (to the left of the image) appear to have been formed by ice. This is thought to have occurred in the form of substantial episodes of glacial activity over the past few million years.

Many other features show signs of wind erosion, or having been formed via wind-related processes—most notably, the dunes covering the crater floor. These dunes are largely sickle-shaped (barchanoid), and reveal much about wind direction within and across the crater.

From the orientation of the dunes, scientists have inferred a complex system of prevailing winds, likely influenced by the topography of the crater itself. Dunes to the north and east of the central peak are largely influenced by winds coming from the northeast, while dunes sitting west of the park are controlled by winds from the northwest.

These cross-cutting winds create an interesting and unique dune morphology within Moreux crater, adding to the feature's intrigue.

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