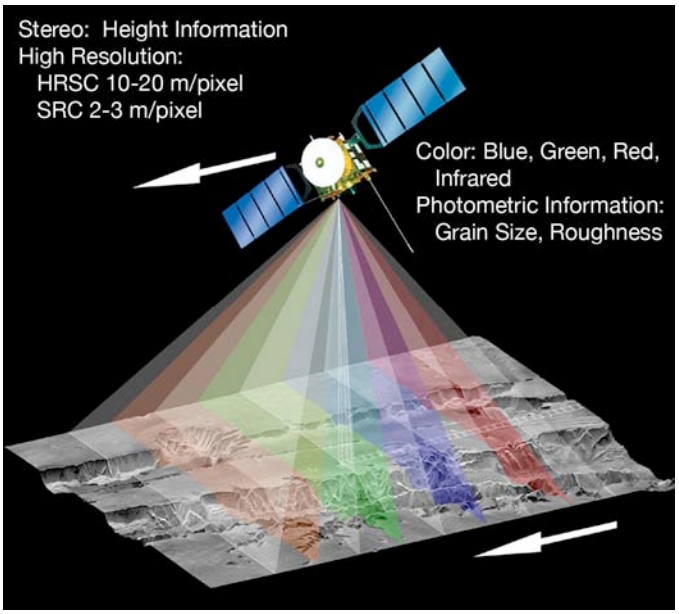
HRSC on *Mars Express* Fact Sheet

The *High Resolution Stereo Camera* (HRSC; Gerhard Neukum, *PI*, *Free University Berlin* through the German Aerospace Center *DLR*) began operation in early 2004 and thus far (August 2009) has returned > 3 terabytes of processed images covering > 50% of Mars at better than 20 m/pixel, and > 71% of the surface at better than 40 m/pixel.

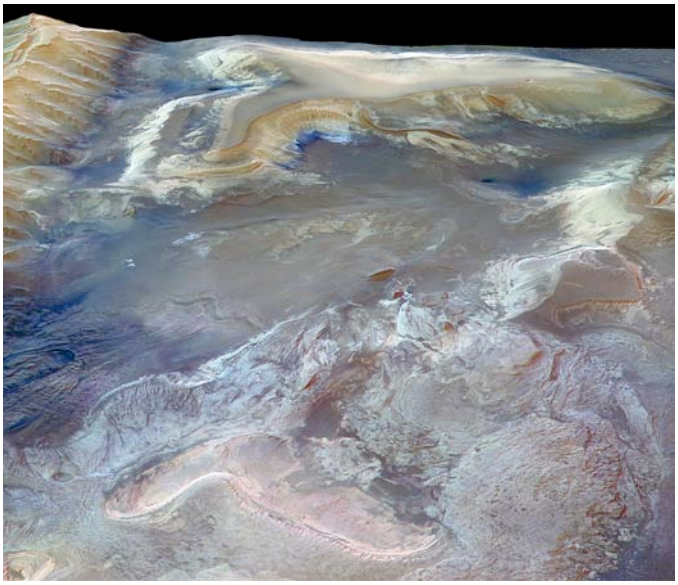


HRSC is a multi-line pushbroom scanner with nine CCD-lines of 5,184 pixels/line in the focal plane of a 175 mm optics system. *Mars Express* is in a polar elliptical orbit, flying from south to north, with a periapsis altitude of ~250 km, resulting in a spatial resolution of 10-12 m/pixel. Standard imaging simultaneously covers the surface with **one nadir channel**, **two stereo channels** (forward- and back-looking), **two photometry channels** (all at 675±90 nm), and **four color channels** (blue, 440±45 nm; green, 530±45 nm; red, 750±20 nm; near-infrared, 970±45 nm). HRSC images:

- cover 52-km wide swaths at **high resolution** (12.5 m/pixel in the nadir channel, 25 m/pixel in stereo, and ~50 m/pixel in color), filling **the resolution gap** between *Viking Orbiter* and THEMIS daytime-IR images (~50-100 m/pixel) and the higher-resolution HiRISE, CTX, and MOC images (30 cm/pixel – 6 m/pixel).

- provide **high-resolution color coverage** at four wavelengths, enabling the production of true and false color products to assess **surface compositions**.

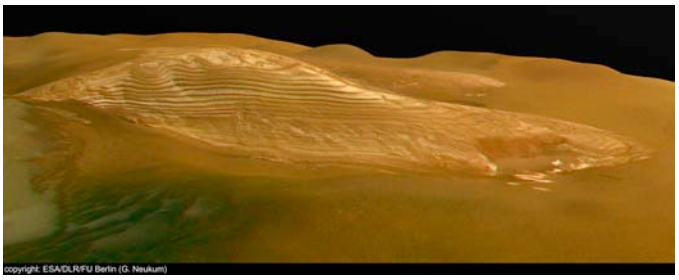
- photogrammetric processing yields **digital terrain models (DTMs)** at higher spatial resolution than the *Mars Orbiter Laser Altimeter* (MOLA) DTM, and are orthorectified to the nadir and color images, enabling production of **perspective views** of the surface.



False color HRSC perspective view of central Valles Marineris. Whitish materials are sulfates discovered by the OMEGA spectrometer, and bluish materials are composed of basaltic ash weathered from canyon walls.

HRSC Data Format

HRSC ***Level-2 images*** are radiometrically-calibrated (but not map-projected), and are raster form, signed 16-bit data; each image also has extori, header, and histogram files. ***Level-3 images*** are radiometrically-calibrated, geometrically-corrected, and map-projected to sinusoidal (<±85˚ latitude) or polar stereographic (>±85˚) projections, rectified to the MOLA DTM. ***Level-4 images*** include an HRSC-based DTM, in which the images have been orthorectified to the DTM. ***Archival Level-4 products*** (highest quality) are now available in the NASA *Planetary Data System* (PDS) and the ESA *Planetary Science Archive* (PSA).



HRSC true color perspective view of the "Sulfate Hill" in Juventae Chasma.

Accessing HRSC Data in NASA PDS

Level 2-4 HRSC data can be accessed from the Geosciences Node of the NASA PDS at: http://pds-geosciences.wustl.edu/missions/mars_express/hrsc.htm HRSC Images are provided at **full resolution in PDS format**, but also are provided at **lower resolution in JPEG format** in the "Browse" folders. A search of HRSC images can also be done using the "Mars Orbital Data Explorer" from the NASA PDS Geoscience node: http://ode.rsl.wustl.edu/mars/

HRSC File Naming Convention

HRSC image filenames have the form:

hoooo_mmmm_ddl.img

in which oooo = orbit number, mmmm = image number, dd = detector id, l = level (2,3,4), and vv = version number. The detector ids are: nd = nadir channel, s1 = stereo 1 channel, s2 = stereo 2 channel, p1 = photometry 1 channel, p2 = photometry 2 channel, re = red channel, ir = infrared channel, gr = green channel, bl = blue channel, and sr = super resolution channel (framing camera).

Free Software for Viewing HRSC Data

Along with the Level-2 data in the PDS there is **freely-available software for viewing, reprojecting, and converting HRSC images**. MINIVICAR is a DLR-modified version of NASA-JPL's VICAR software, and contains software to display the HRSC images, convert the images to other image formats (PNG, TIFF, JPEG), and generate Level-3 data at various projections. The software runs under Linux (RedHat Enterprise) and Solaris (Solaris 9) operating systems, and can run under other UNIX operating systems, but without support.

Using MiniVICAR with HRSC Images

Use of MiniVICAR for HRSC images is outlined step-by-step through:

http://src.la.asu.edu/pdf/MiniVICAR.pdf

Other HRSC Resources

HRSCview is a web interface to the *Mars Express* HRSC image archive by the Free University, Berlin and the *German Aerospace Center* (DLR). It carries out on-the-fly image subsetting, stretching, compositing, and perspective views of map-projected data. Access to the images is through footprint maps, geographic coordinates, or image identifier at:

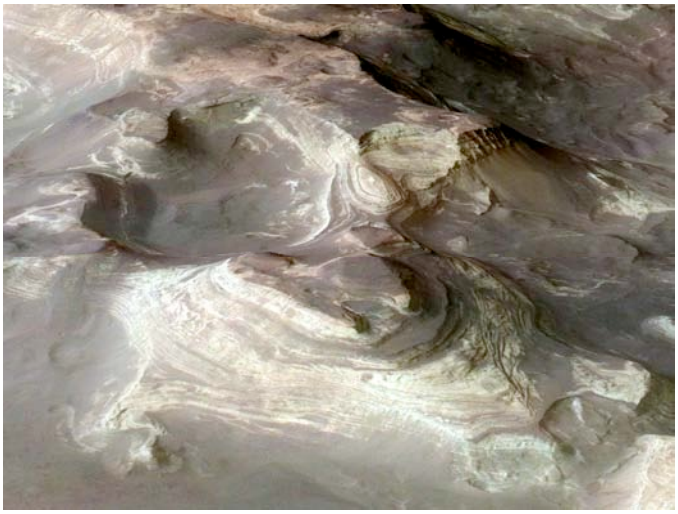
http://hrscview.fu-berlin.de/cgi-bin/ion-p?page=entry.ion

Full-resolution press release products, including true- and false-color nadir and perspective views, red-blue stereo anaglyphs, and altimetry maps are available at the ESA *Mars Express* website:

http://www.esa.int/SPECIALS/Mars_Express/index.html

Files from an **HRSC Data Workshop** with information on using HRSC data can be found at this website:

http://pds-geosciences.wustl.edu/workshops/MEX_WORKSHOP_MAY08.htm


False color HRSC perspective view of layered sedimentary deposits within Terby Crater.

SRC Mosaics

The Super Resolution Channel (SRC) is a separate framing camera that is part of the HRSC experiment. It produces images through a clear filter (400-900 nm) with an ideal pixel size on ground of 2.3 meters/pixel at periapsis altitude of 250 km. However, an astigmatic deformation of the primary mirror results in an effective spatial resolution to ~8-10 m/pixel. Mosaics of all SRC images acquired on each orbit can be downloaded at:

http://src.la.asu.edu/

References

Jaumann, R. and 26 coauthors (2007) The High Resolution Stereo Camera (HRSC) experiment on *Mars Express*: Instrument Aspects and Experiment Conduct from Interplanetary Cruise through the Nominal Mission, *Planet. Space Sci., 55*, 928-952.

Gwinner, K., F. Scholten, M. Spiegel, R. Schmidt, B. Giese, J. Oberst, R. Jaumann, C. Heipke, G. Neukum (2009) Derivation and Validation of High-Resolution Digital Terrain Models from Mars Express HRSC-Data. *Photogrammetric Engineering and Remote Sensing, 75(9)*, 1127-1141.