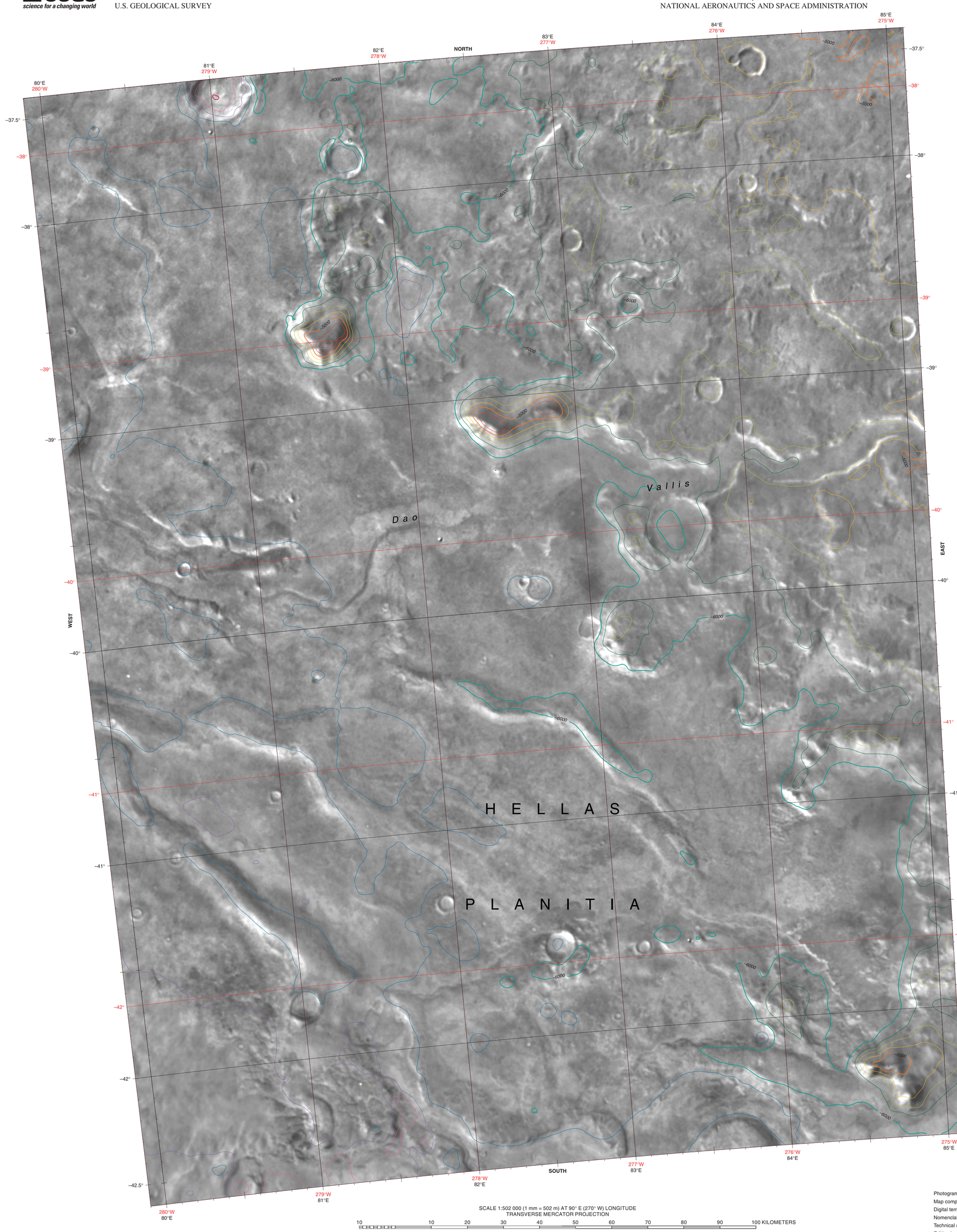
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared for the
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SCIENTIFIC INVESTIGATIONS MAP 2926



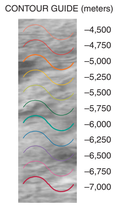
SCALE 1:502 000 (1 mm = 502 m) AT 90° E (270° W) LONGITUDE
TRANSVERSE MERCATOR PROJECTION

10 0 10 20 30 40 50 60 70 80 90 100 KILOMETERS

CONTOUR INTERVAL 250 METERS

Planetocentric latitude and east longitude coordinate system shown in black.
Planetographic latitude and west longitude coordinate system shown in red.

CONTOUR GUIDE (meters)



Prepared on behalf of the Planetary Geology and Geophysics Program, Solar System Exploration Division, Office of Space Science, National Aeronautics and Space Administration.

Topographic Map of the Western Region of Dao Vallis in Hellas Planitia, Mars

MTM 500k –40/082E OMKT

By

Mark R. Rosiek, Bonnie L. Redding, and Donna M. Galuszka

2006

NOTES ON BASE

This map, compiled photogrammetrically from Viking Orbiter stereo image pairs, is part of a series of topographic maps of areas of special scientific interest on Mars.

MTM 500k –40/082E OMKT

The map code identifies the Mars topographic maps:

MTM 500k –40/082E OMKT: Mars transverse Mercator projection (MTM); 1:500,000 series; center of sheet lat 40° S., long 82.5° E. in planetocentric coordinate system (this corresponds to –40/277; lat 40° S., long 277.5° W. in planetographic coordinate system); orthophotomosaic (OM) with color-coded (K) topographic contours and nomenclature (T) (Greeley and Batson, 1990)

ADOPTED FIGURE

The figure of Mars used for the computation of the map projection is an oblate spheroid (flattening of 1/176.875) with an equatorial radius of 3,396.19 km and a polar radius of 3,376.2 km (Seidelmann and others, 2002). The datum (the 0-km contour line) for elevations is defined as the equipotential surface (gravitational plus rotational) whose average value at the equator is equal to the mean radius as determined by Mars Orbiter Laser Altimeter (MOLA; Smith and others, 2002).

PROJECTION

The projection is part of a Mars transverse Mercator (MTM) system with 20°-wide zones. For the area covered by this map, the central meridian is at 90° E. (270° W.). The scale factor at the central meridian of the zone containing this quadrangle is 0.9960 relative to a nominal scale of 1:500,000.

COORDINATE SYSTEM

Longitude increases to the east and latitude is planetocentric (black) as allowed by International Astronomical Union/International Association of Geodesy (IAU/IAG) standards (Seidelmann and others, 2002) and in accordance with current National Aeronautics and Space Administration (NASA) and U.S. Geological Survey (USGS) standards (Duxbury and others, 2002). A secondary grid (red) has been added to the map as a reference to the west longitude/planetographic latitude system that is also allowed by IAU/IAG standards (Seidelmann and others, 2002) and has been used for previous Mars maps.

CONTROL

Horizontal and vertical control was established using the Mosaicked Digital Image Model 2.0 (MDIM 2.0; Kirk and others, 2000) and MOLA data. A portion of MDIM 2.0 covering the map area was extracted in simple cylindrical projection. This MDIM image was georeferenced to the MOLA data with an affine transformation. The MDIM image and georeferencing information were imported into a digital photogrammetric workstation (Miller and Walker, 1993) and used as an orthophoto to provide horizontal control to stereopairs of Viking imagery. The horizontal information was used to extract vertical control from the MOLA data. Note that the distribution of Viking Orbiter images suitable for mapping at a scale of 1:500,000 is uneven. Areas mapped in this series are chosen, often in blocks of two or more adjacent quadrangles, based on scientific interest as well as on the availability of suitable data for accurate mapping.

CONTOURS

Contours were derived from a digital terrain model (DTM) compiled on a digital photogrammetric workstation using Viking Orbiter stereo image pairs with orientation parameters derived from an analytic aerotriangulation. Contours were drawn automatically using a commercial geographic information system (GIS) software package (Environmental Systems Research Institute, 1994). For stereomodels based on orbit 406, the local expected vertical precision based on image resolutions, parallax-to-height ratio (that is, convergence angle), and a matching accuracy of 0.2 pixel ranges from 85 m to 105 m with a mean of 95 m. For stereomodels based on orbits 329 and 363, the local expected vertical precision ranges from 115 m to 130 m with a mean of 122 m. Elevation (in meters) is given with respect to the adopted Mars topographic datum (see section named "Adopted Figure"). A comparison of the DTM with the MOLA grid shows that the DTM is on average 6.2 m lower than the MOLA points (n=202,078; μ=–6.2 m; σ=45.5 m). Contour lines were generated automatically using GIS software and were not edited. Because the contour lines were not edited, small closed contour lines, contour lines that intersect, and contour lines that do not match features are present. The post spacing for most of the DTM is 600 m; features that are less than 600 m in diameter will not be resolved, and features that are smaller than 1,800 m in diameter may only have four elevation measurements associated with them. This lack of elevation measurements may result in contour lines that do not adequately represent some features. The purpose of this mapping project is to produce the digital orthophoto and DTM. This map provides a graphical representation of the digital products that are available.

IMAGE BASE

The image base for this map employs Viking Orbiter images from orbits 406 and 363. An orthophotomosaic was created on the digital photogrammetric workstation using the DTM compiled from stereo models. Integrated Software for Imagers and Spectrometers (ISIS; Torson and Becker, 1997) provided the software to project the orthophotomosaic into the transverse Mercator projection.

NOMENCLATURE

Names on this map are approved by the IAU. For a complete list of IAU-approved names, see the Gazetteer of Planetary Nomenclature at http://planetarynames.wr.usgs.gov.

REFERENCES

Duxbury, T.C., Kirk, R.L., Archinal, B.A., and Neumann, G.A., 2002, Mars Geodesy/Cartography Working Group Recommendations on Mars Cartographic Constants and Coordinate Systems, *in* Joint International Symposium on Geospatial Theory, Processing and Applications, Commission IV, Working Group 9—Extraterrestrial Mapping, Ottawa, Canada, 2002, Proceedings: Ottawa, Canada, International Society for Photogrammetry and Remote Sensing [http://www.isprs.org/commission4/proceedings/paper.html].

Environmental Systems Research Institute, 1994, Arc commands: Redlands, Calif., Environmental Systems Research Institute, Inc.

Greeley, Ronald, and Batson, R.M., 1990, Planetary mapping: New York, Cambridge University Press, p. 261–276.

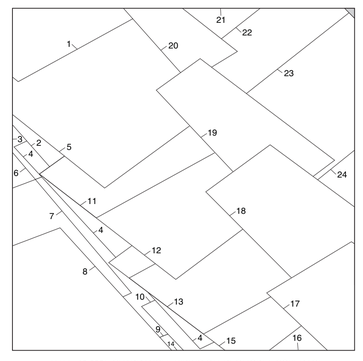
Kirk, R.L., Lee, E.M., Sucharski, R.M., Richie, J.O., Grecu, A.E., and Castro, S.K., 2000, MDIM 2.0—A revised global digital image mosaic of Mars *in* Lunar and Planetary Science XXXI: Houston, Texas, Lunar and Planetary Institute, abstract 2011 [CD-ROM].

Miller, S.B., and Walker, A.S., 1993, Further developments of Leica Digital Photogrammetric Systems by Helava: ACSM/ASPRS Annual Convention and Exposition, Technical Papers, American Society for Photogrammetry and Remote Sensing, v. 3, p. 256–263.

Seidelmann, P.K. (chair), Abalakin, V.K., Bursa, M., Davies, M.E., de Bergh, C., Lieske, J.H., Oberst, J., Simon, J.L., Standish, E.M., Stooke, P.J., and Thomas, P.C., 2002, Report of the IAU/IAG Working Group on Cartographic Coordinates and Rotational Elements of the Planets and Satellites—2000: Celestial Mechanics and Dynamical Astronomy, v. 82, p. 83–110.

Smith, D.E., Zuber, M.T., Frey, H.V., Garvin, J.B., Head, J.W., Muhleman, D.O., Pettengill, G.H., Phillips, R.J., Solomon, S.C., Zwally, H.J., Banerdt, W.B., Duxbury, T.C., Golombek, M.P., Lemoine, F.G., Neumann, G.A., Rowlands, D.D., Aharonson, O., Ford, P.G., Ivanov, A.B., McGovern, P.J., Abshire, J.B., Afzal, R.S., and Sun, X., 2001, Mars Orbiter Laser Altimeter (MOLA)—Experiment summary after the first year of global mapping of Mars: Journal of Geophysical Research, v. 106, p. 23,689–23,722.

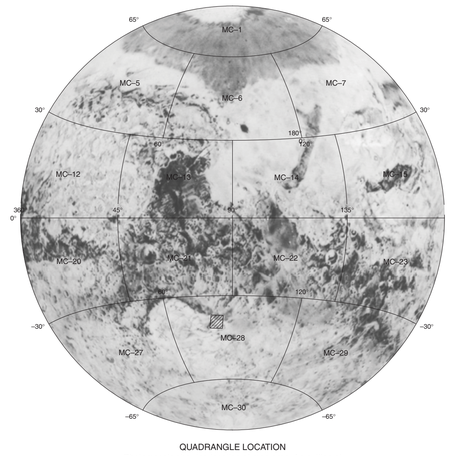
Torson, J.M., and Becker, K.J., 1997, ISIS—A software architecture for processing planetary images [abs.], *in* Lunar and Planetary Science Conference XXVIII: Houston, Texas, Lunar and Planetary Institute, p. 1443.



MTM –40/082E QUADRANGLE VIKING STEREOMODEL COVERAGE

Diagram of map area showing locations of stereo-image pairs used to produce the topographic information. Numbers on the diagram correspond to numbered stereo-image pairs listed below. Shaded area indicates MOLA data.

No.	IMAGE PAIR	No.	IMAGE PAIR	No.	IMAGE PAIR
1	406S40/406S18	9	363S46/329S10	17	406S48/406S25
2	363S48/329S11	10	363S44/329S07	18	406S46/406S23
3	363S48/329S12	11	406S44/406S20	19	406S44/406S21
4	363S46/329S09	12	406S44/406S22	20	406S42/406S19
5	406S42/406S20	13	406S46/406S22	21	406S43/406S21
6	363S27/329S12	14	363S44/329S08	22	406S41/406S19
7	363S27/329S10	15	406S46/406S24	23	406S45/406S21
8	363S25/329S08	16	406S48/406S24	24	406S47/406S23



QUADRANGLE LOCATION

Photomosaic showing location of map area. An outline of 1:5,000,000-scale quadrangles is provided for reference.

Photogrammetry by M.R. Rosiek
Map compilation by M.R. Rosiek and B.L. Redding
Digital terrain model review by B.L. Redding and D.M. Galuszka
Nomenclature by J.S. Blue
Technical review by D. Crown and E. Howington-Kraus
Editing by J.L. Zigler
Cartography by D.A. Ryan
Manuscript approved for publication May 31, 2006

Available at http://pubs.usgs.gov/sim/2006/2926