

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

Prepared for the  
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

**NOTES ON BASE**  
This map is one in a series covering the entire surface of Mars at a nominal scale of 1:5,000,000. The series was originally compiled from Mariner 9 data (Batson and others, 1979). The original shaded relief base was revised and augmented with image data from Viking Orbiter, but feature positions were not shifted to fit contours derived from Viking.

**ADOPTED FIGURE**  
The figure of Mars used for the computation of the map projection is an oblate spheroid (flattening of 1/192) with an equatorial radius of 3,393.4 km and a polar radius of 3,375.7 km.

**PROJECTION**  
The Mercator, Lambert Conformal Conic, and Polar Stereographic projections are used for this map series. The scale of the series is 1:5,000,000 at the equator. The projections have common scales of 1:4,336,000 at lat ±30° and 1:4,306,000 at lat ±65°. Standard parallels for the Lambert Conformal Conic projection are at lat ±35.8° and ±59.2°. Longitude increases to the west in accordance with astronomical convention for Mars. Latitude is planetographic.

**CONTROL**  
Planimetric control of the shaded relief is provided by photogrammetric triangulation using Mariner 9 images (Davies, 1973; Davies and Arthur, 1973) and the radio-tracked position of the Mariner 9 spacecraft. The first meridian passes through the center of a small crater, Airy-O (lat 5.19° S., long 0°), within the crater Airy.

Primary controls used in the network include the Viking Orbiter Secondary Experiment Data Record, radio-occultation measurements from both Mariner 9 and Viking Missions (Lorell and others, 1972; Klore and others, 1973; Lindal and others, 1979). Earth-based radar observations (Pettengill and others, 1971; Downs and others, 1975), and the Mars primary control network of the Rand Corporation (Davies and others, 1978).

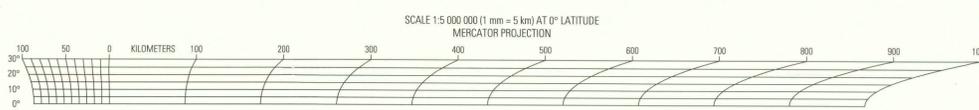
**MAPPING TECHNIQUE**  
Shaded relief was portrayed by photointerpretive methods described by Inge and Bridges (1976). Uniform sun illumination from the west was used throughout. The original definition of feature positions, sizes, and shapes was taken from a controlled base mosaic of Mariner 9 images. Various computer enhancements of many Mariner 9 and Viking Orbiter images besides those in the base mosaic were examined in an attempt to portray the surface as accurately as possible.

Initial shaded relief analysis and representation were made by Susan L. Davis; revisions were made by Barbara J. Hall.

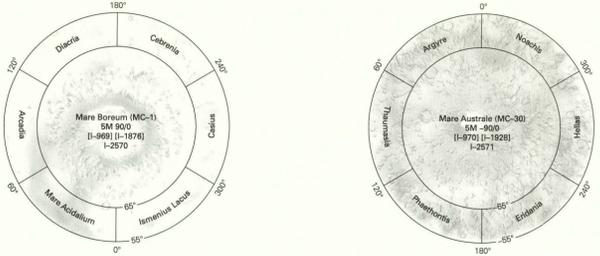
**COLOR**  
No attempt was made on the map to duplicate precisely the color of the martian surface, although the color used may approximate it.

**NOMENCLATURE**  
Names on this sheet are approved by the International Astronomical Union (1974, 1977, 1980, 1986, 1998).  
MC-11: Abbreviation for Mars Chart 11.  
M 5M 15/22 RN: Abbreviation for Mars, 1:5,000,000 series; center of sheet, lat 15° N., long 22°; shaded relief map (R) with nomenclature (N).

**REFERENCES**  
Batson, R.M., Bridges, P.M., and Inge, J.L., 1979. Atlas of Mars—The 1:5,000,000 map series. National Aeronautics and Space Administration Special Publication 438, 146 p.  
Davies, M.E., 1973. Mariner 9—Primary control net: Photogrammetric Engineering, v. 39, no. 12, p. 1297-1302.  
Davies, M.E., and Arthur, D.W.G., 1973. Martian surface coordinates: Journal of Geophysical Research, v. 78, no. 20, p. 4355-4394.  
Davies, M.E., Katsuya, F.Y., and Roth, J.A., 1978. Control net of Mars: February 1987: The Rand Corporation, R-2309-NASA, 91 p.  
Downs, G.S., Reichley, P.E., and Green, R.R., 1975. Radar measurements of martian topography and surface properties: Icarus, v. 26, no. 3, p. 273-312.  
Inge, J.L., and Bridges, P.M., 1976. Applied photointerpretation for airbrush cartography: Photogrammetric Engineering and Remote Sensing, v. 42, no. 6, p. 749-760.  
International Astronomical Union, 1974. Commission 16: Physical study of planets and satellites and Lunar and martian nomenclature, in Proceedings of the 15th General Assembly, Sydney, 1973. Transactions of the International Astronomical Union, v. 15B, p. 105-108, 207-221.  
—1977. Working Group for Planetary System Nomenclature, in Proceedings of the 16th General Assembly, Grenoble, 1976; Transactions of the International Astronomical Union, v. 16B, p. 321-325, 331-336, 355-362.  
—1980. Working Group for Planetary System Nomenclature, in Proceedings of the 17th General Assembly, Montreal, 1979; Transactions of the International Astronomical Union, v. 17B, p. 285-304.  
—1986. Working Group for Planetary System Nomenclature, in Proceedings of the 19th General Assembly, New Delhi, 1985; Transactions of the International Astronomical Union, v. 19B, p. 339-353.  
—1998. Working Group for Planetary System Nomenclature, in Proceedings of the 23rd General Assembly, Kyoto, 1997; Transactions of the International Astronomical Union, v. 23B, [in press].  
Klore, A.J., Feldho, Gunnar, Seidel, B.L., Sykes, M.J., and Woloshyn, P.M., 1973. S-band radio occultation measurements of the atmosphere and topography of Mars with Mariner 9: Extended mission coverage of polar and intermediate latitudes: Journal of Geophysical Research, v. 78, no. 20, p. 4331-4351.  
Lindal, G.F., Hotz, H.B., Sweetnam, D.N., Shippory, Z.V., Brenkle, J.P., Hartsell, G.V., and Spear, R.T., 1979. Viking radio occultation measurements of the atmosphere and topography of Mars: Journal of Geophysical Research, v. 84, no. B14, p. 8443-8456.  
Lorell, Jack, Born, G.H., Jordan, J.F., Laing, P.A., Martin, W.L., Sjogren, W.J., Shapiro, I.I., Reassenberg, R.D., and Slater, G.L., 1972. Mariner 9 celestial mechanics experiment: Gravity field and pole direction of Mars: Science, v. 175, no. 4019, p. 317-320.  
Pettengill, G.H., Rogers, A.E.E., and Shapiro, I.I., 1971. Martian craters and a scarp as seen by radar: Science, v. 174, no. 4016, p. 1321-1324.



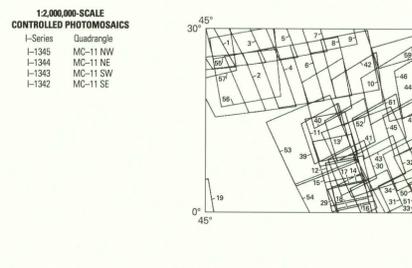
Shaded relief revised in January 1987 on behalf of the Planetary Geology Program, Solar System Exploration Division, Office of Space Science, National Aeronautics and Space Administration  
This map supersedes map I-1551  
Edited by Doris Weir and Derrick D. Hirsch; cartography by Darlene A. Casabier  
Manuscript approved for publication April 18, 1994



Quadrangle Name	SM Number	MC Number	Latitude Range	Longitude Range
Diacra (MC-2)	SM 48150	MC-2	1-2570	180-120
Aracida (MC-3)	SM 48300	MC-3	1-2470	180-120
Mars Aidium (MC-4)	SM 48330	MC-4	1-2574	180-120
Iamnius Lacus (MC-5)	SM 48330	MC-5	1-1052 [I-1495]	180-120
Caelia (MC-6)	SM 48270	MC-6	1-1121 [I-1466]	180-120
Caelenia (MC-7)	SM 48270	MC-7	1-2577	180-120
Amazonia (MC-8)	SM 48150	MC-8	1-2567	180-120
Tharsis (MC-9)	SM 15112	MC-9	1-2468	180-120
Lunae Palus (MC-10)	SM 15158	MC-10	1-2468	180-120
Oxia Palus (MC-11)	SM 15222	MC-11	1-2482	180-120
Arabia (MC-12)	SM 15238	MC-12	1-2483	180-120
Syrtis Major (MC-13)	SM 15292	MC-13	1-2484	180-120
Amenthes (MC-14)	SM 15248	MC-14	1-2485	180-120
Elyetum (MC-15)	SM 15202	MC-15	1-2488	180-120
Memnonia (MC-16)	SM 15158	MC-16	1-2487	180-120
Phoenicia Lacus (MC-17)	SM 15112	MC-17	1-2488	180-120
Copernicus (MC-18)	SM 15158	MC-18	1-2488	180-120
Margarifer Sinus (MC-19)	SM 15222	MC-19	1-2488	180-120
Sinus Sabaeus (MC-20)	SM 15238	MC-20	1-2488	180-120
Tapuya (MC-21)	SM 15292	MC-21	1-2488	180-120
Mare Tynnum (MC-22)	SM 15248	MC-22	1-2488	180-120
Arcadia (MC-23)	SM 15202	MC-23	1-2488	180-120
Phaethon (MC-24)	SM 48150	MC-24	1-2488	180-120
Thaumasia (MC-25)	SM 48300	MC-25	1-2488	180-120
Argyre (MC-26)	SM 48330	MC-26	1-2488	180-120
Noxia (MC-27)	SM 48270	MC-27	1-2488	180-120
Helia (MC-28)	SM 48270	MC-28	1-2488	180-120
Eridania (MC-29)	SM 48270	MC-29	1-2488	180-120

**QUADRANGLE LOCATION**  
Number preceded by I refers to published shaded relief map.  
(Number in brackets refers to earlier map superseded by revised version.)

**NOTE TO USERS**  
Users noting errors or omissions are urged to indicate them on the map and to forward it to U.S. Geological Survey, Building 4, Room 450, 2555 North Gemini Drive, Flagstaff, Arizona 86001. A replacement copy will be returned.



**INDEX OF VIKING SOURCES**  
This shaded relief map has been revised by utilizing 1:2,000,000-scale controlled photomosaics and supplementary Viking pictures outlined above. Copies of various enhancements of these pictures are available from National Space Science Data Center, Code 601, Goddard Space Flight Center, Greenbelt, MD 20771.

Picture No.	Index No.	Picture No.	Index No.
1 450A01	22 488A10	43 689A25	81 735A10
2 450A02	23 488A11	44 689A26	
3 450A03	24 488A12	45 689A27	
4 450A04	25 488A13	46 689A28	
5 450A05	26 488A14	47 689A29	
6 450A06	27 488A15	48 689A30	
7 450A07	28 488A16	49 730A01	
8 450A08	29 689A01	50 728A22	
9 450A09	30 689A02	51 728A24	
10 450A10	31 689A03	52 728A31	
11 450A11	32 689A04	53 728A32	
12 451A01	33 689A05	54 728A34	
13 451A02	34 689A06	55 730A17	
14 451A03	35 689A07	56 730A19	
15 451A04	36 689A08	57 730A20	
16 451A05	37 689A09	58 730A07	
17 451A06	38 689A10	59 733A08	
18 451A07	39 689A21	60 733A09	
19 452A01	40 689A22	61 733A10	
20 488A08	41 689A23		
21 488A09	42 689A24		

Picture No.	Index No.	Picture No.	Index No.
1 7815478	24 7798238	21 7758988	45 6571358
2 7815479	25 9182344		
3 4615123	26 7831148		
4 9088619	27 7830796		
5 7814983	28 7830728		
6 7814913	29 7830658		
7 9016584	30 7759118		
8 7887368	31 7780358		
9 1048314	32 7830518		
10 7815480	33 9234234		
11 7887018	34 7830338		
12 7886943	35 7830288		
13 7886819	36 7830218		
14 7815338	37 7830248		
15 7815333	38 7830278		
16 9283446	39 7831038		
17 7792579	40 7830248		
18 7738188	41 9336124		
19 7538983	42 7830283		
20 7798933	43 7830288		
21 7738788	44 6571423		
22 7837228	45 6571423		
23 7758988	46 6571358		

**INDEX OF MARINER 9 PICTURES**  
The mosaic used to control the positioning of features on this map was made with the Mariner 9 A-camera pictures outlined above. Useful coverage is not available in the crosshatched areas. The DAS number may vary slightly (usually by 5) among different versions of the same picture.

ISBN 0-607-88652-0  
9 780607 886522

REVISED SHADED RELIEF MAP OF THE OXIA PALUS QUADRANGLE (MC-11) OF MARS