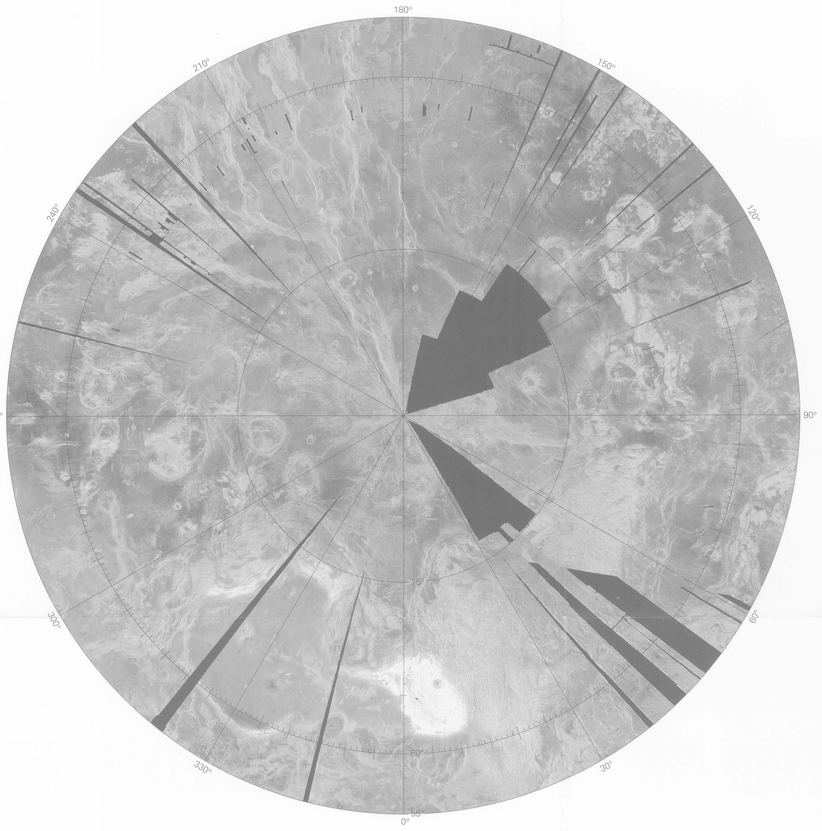
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

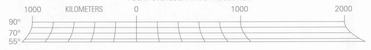
Prepared for the
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ATLAS OF VENUS
1:50,000,000 SERIES
V 50M 0/0 CM, 1997
I–2444 SHEET 1 OF 4



NORTH POLAR REGION

SCALE 1:30 573 561 (1 mm = 30.57 km) AT 90° LATITUDE
POLAR STEREOGRAPHIC PROJECTION



NOTES ON BASE

This sheet is one in a series of maps of Venus at nominal scales of 1:50,000,000 and 1:10,000,000 (Planetary Cartography Working Group, 1984 and 1993; Batson and others, 1994). It is based on data from the Magellan Synthetic Aperture Radar (SAR) instrument. The Magellan Mission was described by Saunders and Pettengill (1991). Magellan radar characteristics were described by Pettengill and others (1991).

ADOPTED FIGURE

The figure of Venus used for the computation of the map projection is a sphere with a mean radius of 6,051.0 km, consistent with the preliminary gravity figure reported by Phillips and others (1979) that was used for previous maps of Venus. Slightly larger values of the mean radius of Venus have subsequently been reported based of Pioneer Venus (Pettengill and others, 1980) and Magellan altimetry (Ford and Pettengill, 1992).

PROJECTION

The Mercator projection is used between the 57° parallels, and the polar stereographic projection is used for the polar regions north and south of the 55° parallels. The scale is 1:50,000,000 at lat 0° (Mercator) and 1:30,573,561 at ±90° (polar stereographic); both projections share a common scale of 1:27,959,645 at lat ±56°. Due to the retrograde rotation of Venus, longitude increases from west to east in accordance with usage of the International Astronomical Union (1971).

CONTROL

Planimetric control is derived from the radio-tracked position of the spacecraft. The first meridian passes through the central peak of the crater Ariadne, at lat 43.8° N., according to current International Astronomical Union convention. (Ariadne replaces the feature "Eve," which, at the same longitude, originally fixed the location of the prime meridian (Davies and others, 1986).) The Venusian cartographic coordinate system was described by Davies and others (1992).

MAPPING TECHNIQUES

Magellan SAR datasets were originally produced by the Jet Propulsion Laboratory. Full-resolution (75 m/pixel) image strips were compressed and mosaicked to produce C1-MIDR's (Compressed-Once Mosaicked Image Data Record; 225 m/pixel) (Pettengill and others, 1991). C1-MIDR's were assembled and reprojected to produce this map. Cycles 1 and 2 left (east)-looking, Cycle 2 and 3 right (west)-looking, and Cycle 3 left (east)-looking with reduced (stereo) incidence angle data records were used in the image mosaic. (Cycle 1 radar operations commenced September 15, 1990, and ended May 16, 1991; Cycle 2 began May 16, 1991, and ended January 17, 1992; Cycle 3 began January 17, 1992, and ended September 13, 1992).

Cartographic processing was done by Robert M. Sucharski.

SYNTHETIC APERTURE RADAR (SAR) IMAGE INTERPRETATION

Because side-looking radar uses long-wave radiation and an imaging geometry distinct from that of framing cameras radar images differ from conventional photographs (Ford and others, 1993, p. 45–56, and Young, 1990, p. 71). These differences should be kept in mind when interpreting radar images. Brightness in radar images is dependent on three factors: topography, surface texture, and surface electrical properties.

Topography affects radar images as it affects photographs. Surfaces sloping toward the source of illumination appear brighter and surfaces sloping away appear darker. However, note that the source of illumination for SAR radar images, the radar transmitter, is the same as the site of the observation, the receiving antenna (fig. 2). This geometry gives SAR images a different perspective from most photographs, where the illumination source (usually the sun) is independent of the observing position. Relief properties are most effectively seen in SAR images when they are relatively abrupt. Shallow slopes are not shown well on SAR images.

Surface texture strongly affects radar brightness yet may have little effect in photographic images. Surfaces whose roughness is comparable with the radar wavelength (12 cm for Magellan; Pettengill and others, 1991) scatter more energy back to the radar receiver (they appear brighter) than do smooth, mirror-like surfaces, or surfaces composed of very small particles such as sand or silt, which will be transparent to or, if of sufficient depth, absorb radar waves (appear dark). Thus, areas that appear dark in a photograph may be bright in a radar image, and vice versa.

The third major influence on radar brightness is due to the electrical properties of the surface: materials having higher dielectric constants reflect radio waves more strongly, and hence appear brighter, than materials having low dielectric constants. Variations in dielectric constants over most of Venus are subtle, and their influence on image brightness is generally overwhelmed by that of relief or roughness variations. However, brightness is significantly enhanced planet-wide for materials at elevations above a radius of about 6,055 km (Tyler and others, 1991). The electric properties are dependent on frequency; high reflectivity in the radar images does not necessarily correlate with high reflectivity in the optical part of the spectrum.

The side-looking geometry of imaging radar leads to geometric distortion ("layover") of features with significant relief. Slopes facing the radar appear foreshortened. (In extreme cases, where the slope angle exceeds the incidence angle (fig. 2) the radar echo from the base of the slope is received before the echo from the top so that the surface may even appear to be folded back upon itself.) Correspondingly, slopes facing away from the radar appear elongated. The amount of layover increases with decreasing incidence angle: the incidence angle used by Magellan as a function of latitude is shown in figure 3. Greatly expanded explanations of these effects, as well as summaries of Magellan operations and venusian geology, can be found in the Magellan Venus Explorer's Guide (Young and others, 1990) and in the Guide to Magellan Image Interpretation (Ford and others, 1993). The latter is substantially more technical.

NOMENCLATURE

V 50M 0/0 CM: Abbreviation for Venus; 1:50,000,000 series; center of map, lat 0°, long 0° ; controlled mosaic (CM).

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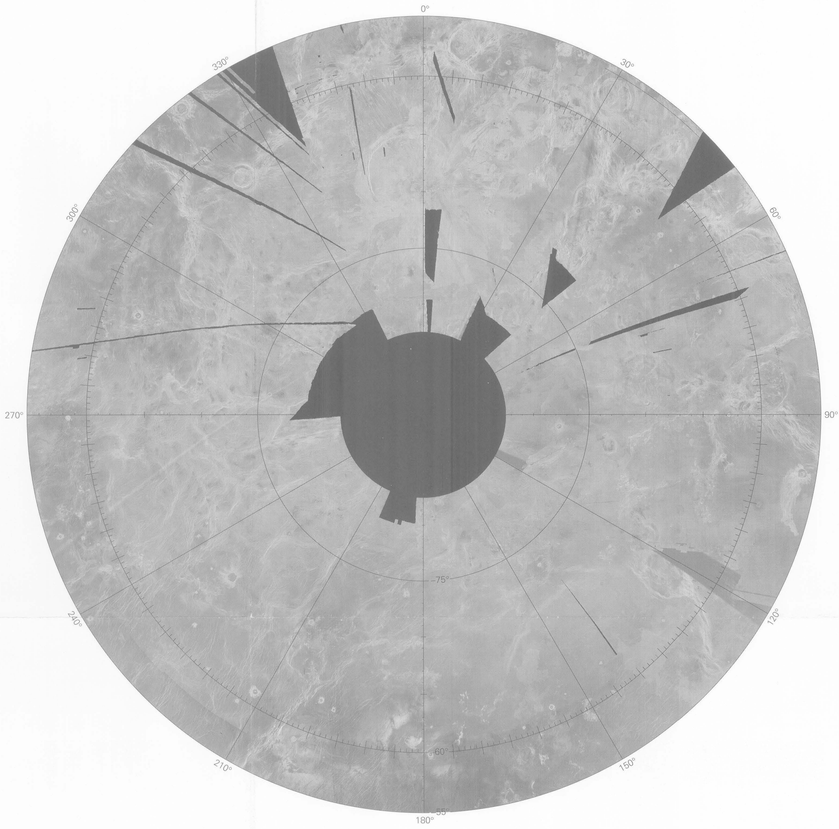
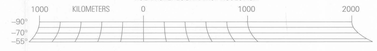
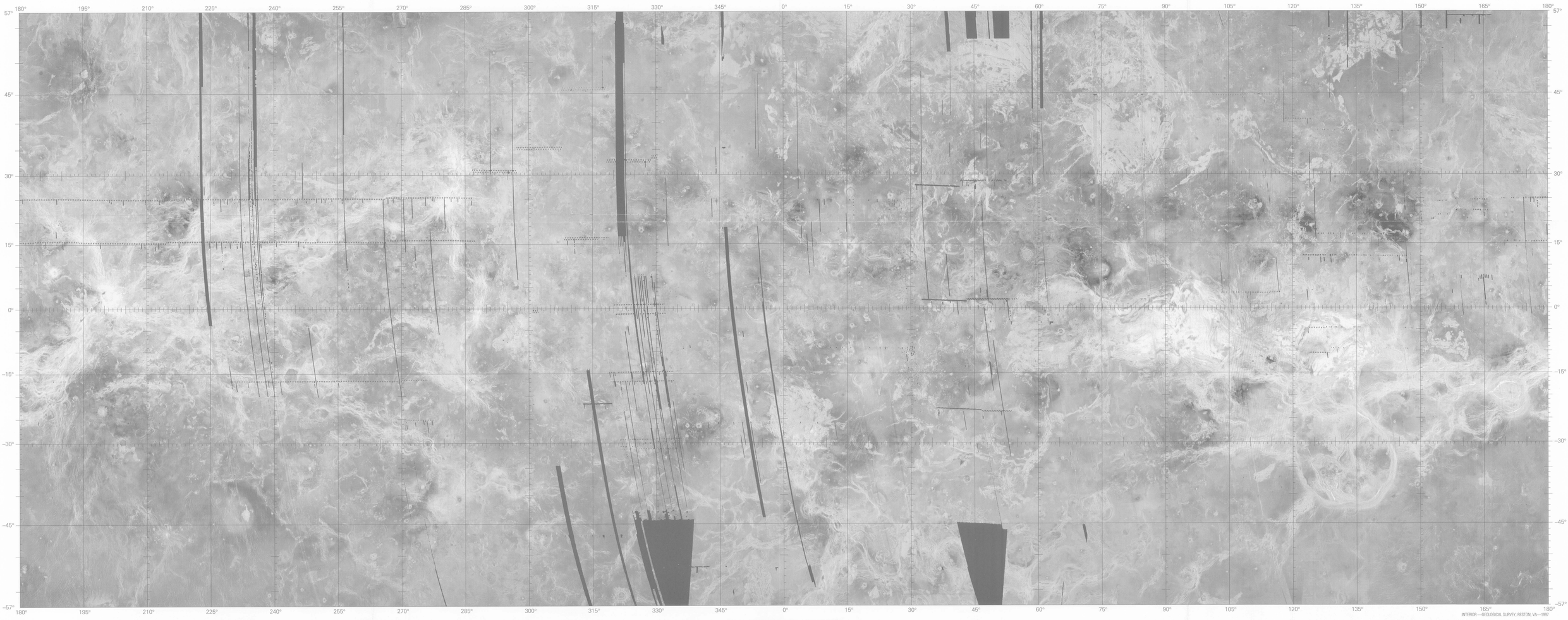


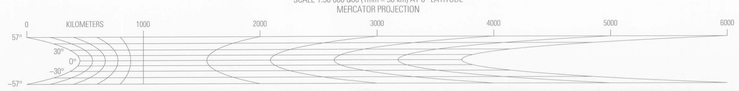
SOUTH POLAR REGION

SCALE 1:30 573 561 (1 mm = 30.57 km) AT –90° LATITUDE
POLAR STEREOGRAPHIC PROJECTION





SCALE 1:50 000 000 (1mm = 50 km) AT 0° LATITUDE
MERCATOR PROJECTION



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Edited by Derrick Hirsch; cartography by Roger D. Carroll
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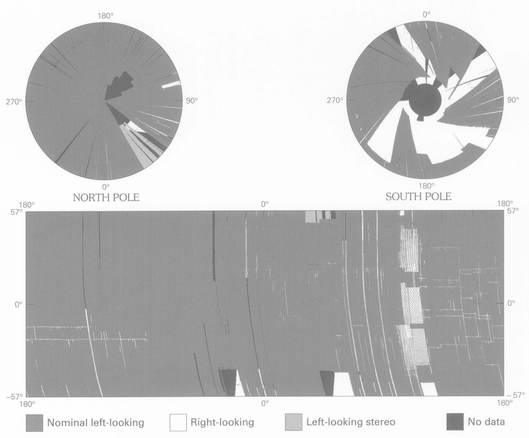


Figure 1. Magellan left (east)–looking, right (west)–looking, and left (east)–looking stereo radar images used in the mosaic.

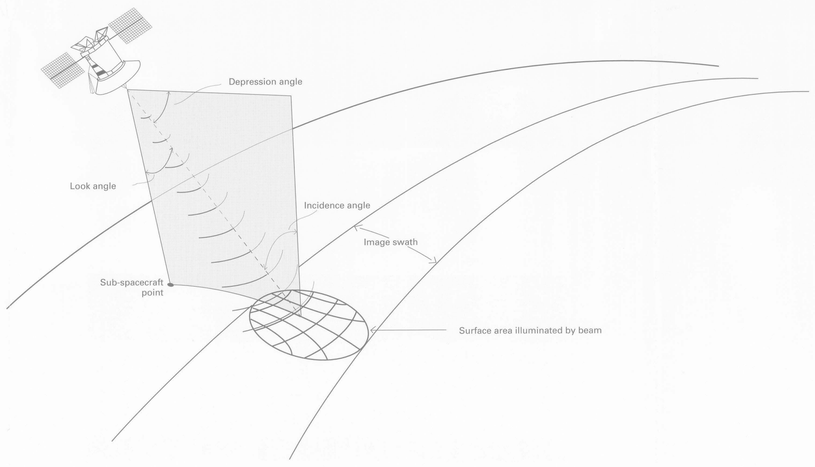


Figure 2. Geometry of the Magellan Synthetic Aperture Radar (SAR) footprint and terminology.

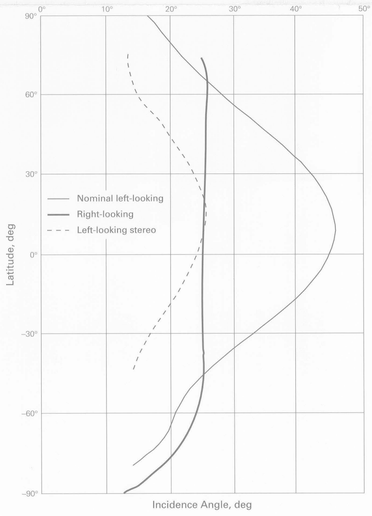
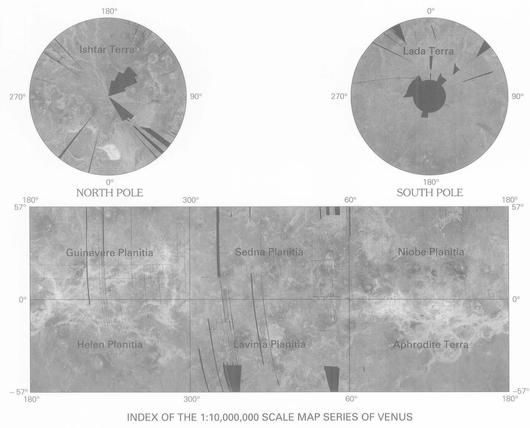


Figure 3. Magellan radar incidence angles as a function of latitude. Spacecraft look angle was varied during right-looking operations to keep the nominal incidence angle at about 25°. Nominal incidence angle was reduced during part of left-looking operations to produce optimal stereo viewing geometry in combination with normal left-looking images.



INDEX OF THE 1:10,000,000 SCALE MAP SERIES OF VENUS

RADAR IMAGE MAP OF VENUS

V 50M 0/0 CM

1997

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, 2255 N. Gemini Drive, Flagstaff, AZ 86001. A replacement copy will be returned.

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