

MOLA TOPOGRAPHY AND THE ISIDIS BASIN: CONSTRAINTS ON BASIN CENTER AND RING DIAMETERS.

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Summary: A MOLA pass through the Isidis Basin provides an opportunity to map the detailed topography of the slightly tilted, relatively smooth (but with fine scale structure) basin floor and the rugged rim material on the high relief southern and lower relief northern side. The basin center is estimated by fitting concentric circles to matching slope breaks in the rising elevations from the rim/floor contact on the northern and southern sides. We find a center and inner ring diameter essentially identical to that previously reported based on imagery alone. This suggests MOLA topography can be used to help constrain the structure of major impact basins, perhaps even including highly degraded structures not easily mapped from imagery.

MOLA pass 34 [1] runs through the western third of the Isidis Basin, one of the most obvious large impact basins of Mars. Isidis is a two [2, 3] or perhaps four [4] ring basin with a main ring marked by an incomplete annulus of rugged terrain and massifs (*Nplh*, isolated *Nm*) to the south and southeast. The western continuation of this annulus is buried by Syrtis Major volcanic plains (*Hs*), and the NE rim is likewise buried under *Aps*, *Hr* and *Apk* units (some of the knobs of which may be portions of the rim). The NW portion of the rim consists of a mix of *Npl*₂, *Nple*, *Hnu* and *Apk* units.

Figure 1 shows passes 25, 34 and 27. The scale of the basin is impressive, even compared to the crustal dichotomy boundary zone [5, 6, this volume] on which it is

superimposed. Relief across the basin's southern margin is

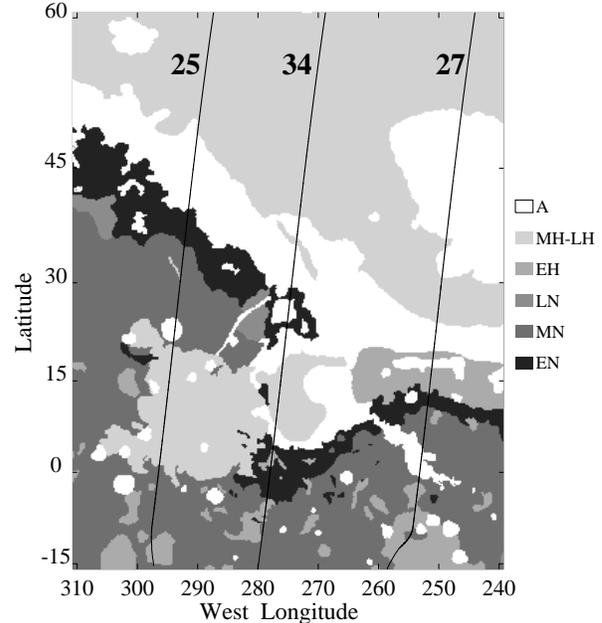


Figure 1a. Simplified terrain age map of Isidis Basin, showing the locations of MOLA passes 25, 34, and 27.

~6 km, consistent with the maximum found for the western margin from radar data [7], and significantly greater than that typically found across the dichotomy boundary zone [5, 6].

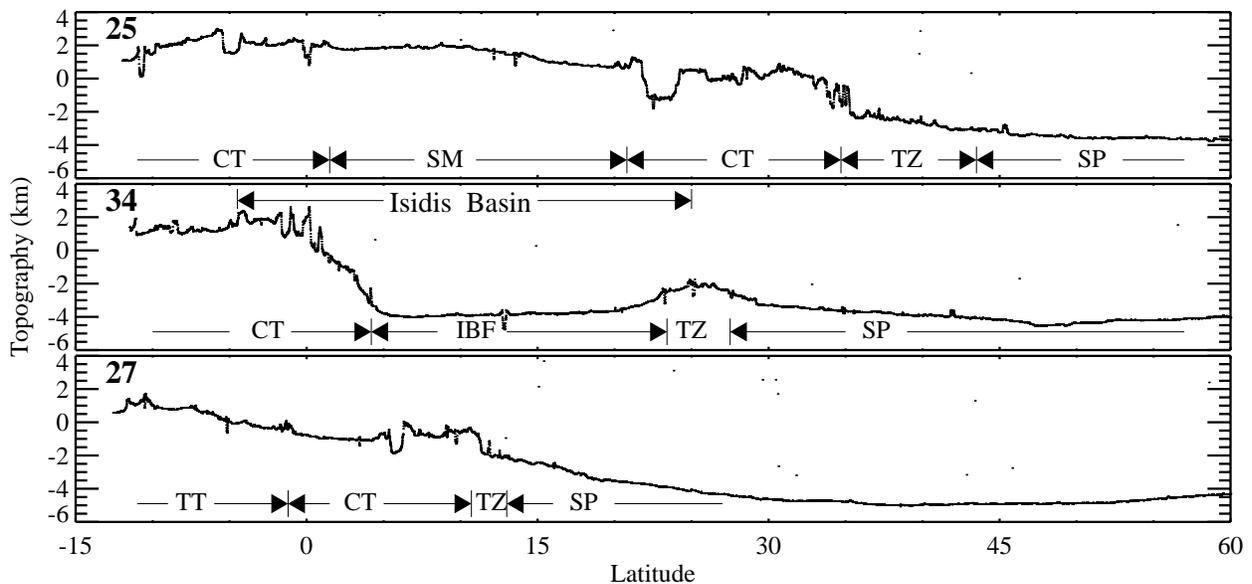


Figure 1b. MOLA data for passes 25, 34, and 27. The extent of Isidis basin is labeled in pass 34, as are the geomorphic regions of Cratered Terrain (CT), Syrtis Major (SM), the Transition Zone (TZ), Smooth Plains (SP), the Vastitas Borealis Formation (VBF), and Terra Tyrrhena (TT).

The floor of Isidis shows a noticeable tilt upward to the south, but the slope is very low ($<0.02^\circ$). This is of comparable magnitude but in the opposite sense to that in the northern lowlands, which generally slope very gently downward northward from the dichotomy boundary zone. Pass 34 shows this same sloping lowland behavior north of Isidis.

On a side note, the high resolution topography of the floor of Isidis reveals a wealth of detailed structure. Undulations at a variety of scales and at a variety of wavelengths occur. The floor shows a series of tilted surfaces with relatively abrupt rises of 50-100 m separated by 100-250 km. Superimposed on these tilted surfaces are smaller scale features a few to 10 m high, with spacing of a few to 10 km. At even finer scale there are topographic features < 5 m high with < 5 km separation. This detailed structure may be the topographic expression of small scale features recognized in images which perhaps reflect a complicated deposition and degradation history for the basin interior [8].

The northern rim has distinctly less relief (~ 2 km) than the southern, and less rugged topography, consistent with the geomorphology of the region through which the profile passes (Figure 2). But like the southern rim, significant slope breaks are found in the topography as it rises from the basin floor. We fit concentric circles to the obvious matching slope breaks on the southern and northern sides, beginning with the floor/rugged terrain and working upward, in an effort to define a center for the basin (Figure 2). The approximate circular plan of the Isidis Basin suggests such an approach is valid, and may help to delineate separate rings for this basin, which have previously been suggested through analysis of imaging data [2, 3, 4] without benefit of detailed topography.

The center implied by the three concentric fits is at 12.7°N , 272.6°W . The innermost circle, which follows the break between rugged rim material and the plains-filled floor, has a diameter of 1090 km. The uncertainty on both the center location and circular diameter is 20-30 km. Following Wilhelms [2], Schultz and Frey [3] adopted an inner ring for Isidis at this same rim/floor contact. Their inferred diameter is 1100 km, with a basin center at 13°N , 272.5°W . The two determinations are identical within the expected uncertainty of either approach. The main ring diameter from [3] is ~ 1900 km, this is shown in figure 3 passing through the highest topography in profile 34.

These results suggest MOLA topography can be used to help delineate the large scale as well as small scale structure of large impact basins, perhaps even those highly degraded basins whose erims are difficult to recognize in imagery alone.

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References. [1] MOLA Science Team, this volume. [2] Wilhelms, J. Geophys. Res. 78, 4048-4095, 1973. [3] Schultz, R. and H. Frey, J. Geophys. Res. 95, 14,175-14,189,

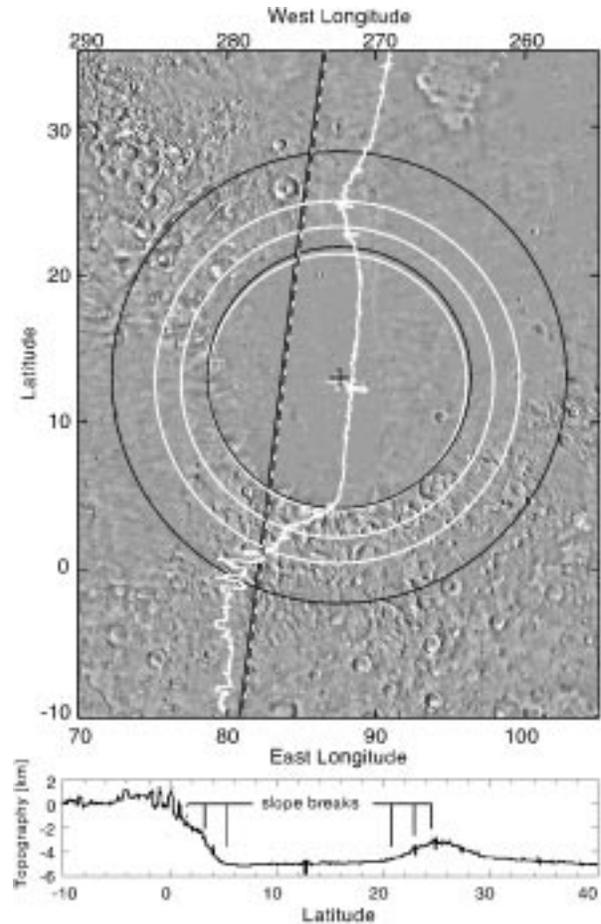


Figure 2. Comparison of Isidis Basin center and concentric features determined from MOLA data with those predicted from geologic mapping of Viking images. The straight solid black line is the predicted MOLA ground track on the Viking digital image mosaic, the dashed black and white line is the estimated MOLA ground track. The MOLA topography along the estimated ground track is shown in the lower plot, and is also plotted for reference in white in the upper plot. The white circles and cross are a concentric fit to the MOLA topography slope breaks indicated in the lower plot. The black circles and cross are predicted basin rings and center from prior geologic mapping [3]. The two basin centers are less than 20 km apart, well within the measurement error of either technique.

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