MERCURY RADAR ALTIMETRY: A PRELIMINARY ANALYSIS. J. K. Harmon[1], D. B. Campbell[1], J. W. Head[2], D. L. Bindschadler[2], and I. I. Shapiro[3]. (1) Nat'l Astronomy and Ionosphere Center, Arecibo, PR 00612; (2) Dept. of Geological Sciences, Brown Univ., Providence, RI 02912; (3) Harvard-Smithsonian Center for Astrophysics, Cambridge, MA 02138.

Range-Doppler radar observations have been made of the planet Mercury over the six-year period 1978-1983. Approximately 30 continuous altitude profiles were obtained, each spanning between 20 and 90 degrees of longitude. The profiles are located in the equatorial zone of Mercury between 5°S and 12°N latitude (Figure 1). Approximately 40% of the total coverage is in the unimaged hemisphere.

Data were taken on approximately 130 separate days, with between one and three observations being made each day. Profiles were generated by analyzing the averaged range-Doppler array taken for each run using a technique in which delay templates are fit to each frequency in the array to determine the time delay to the leading edge of each Doppler annulus (1). Subtraction of time delays corresponding to the mean planetary sphere and assignment of latitude and longitude location based on the location of the leading edge of each Doppler annulus results in a single altitude profile. Each profile typically extends 7° from the subradar point in a roughly east-west direction. Because of the rotation of the planet, the Doppler technique yields a much better longitudinal than latitudinal resolution; a typical radar "footprint" is 0.15° in longitude and 2.5° in latitude (corresponding to an area about 6 km by 100 km at the equator). It is important to note that this technique does not yield any kind of average altitude for a given footprint but rather picks out the strongest returned signal with certain Doppler characteristics. For example, a large quasispecular return from a crater floor more than 1.3° to the north or south of the radar ground track could appear as a point in a given profile. However, examination of the profiles has shown this to occur only rarely.

Analysis of altitude profiles is directed toward characterizing the topographic signal of various geologic features in the imaged hemisphere of Mercury and using these models to understand profiles located in the unimaged hemisphere. Using USGS 1:5,000,000 airbrush topo maps and the Atlas of Mercury (2) as references we have attempted to develop criteria that allow for separation of three major surface units based solely on the topographic profiles. Of these units, the smooth plains, intercrater plains, and cratered terrain (as identified by Trask and Guest, 1975) (3) only the smooth plains unit is clearly separable. Tir Planitia, located to the south-southeast of Caloris Basin, is a good example of a smooth plains region that appears to be as much as a kilometer below the surrounding terrain. A similar area appears in profiles taken to the west of Mozart crater, in the unimaged hemisphere of the planet. These observations lend support to the idea that an annular plains region surrounds the Caloris Basin.

In addition, attempts have been made to characterize specific topographic features. Craters and ridges show up distinctly in the profiles, whereas valleys and scarps are less distinctive. Mare-like ridges, such as those identified in Tir Planitia, appear as small disturbances in profile and are typically no more than 300 m high. Ridges as high as 700 m to 1 km are often seen in profiles covering intercrater plains regions. Ridge-like features often occur in intercrater plains and cratered terrain but do not correlate well with any mapped features, particularly in areas that were imaged at high sun-elevation angles. Tir Planitia, which is populated by ridges analogous to lunar mare ridges, is characterized by a broad topographic depression which suggests that the topography and ridges may be a result of lithospheric loading and flexure, analogous to the emplacement and deformation of the lunar mare deposits (4). These similarities in the nature and tectonic deformation of mercurian plains and lunar maria provide additional evidence that the circum-Caloris plains may be of volcanic origin.

We are presently compiling depth-diameter relationships for fresh and degraded craters and extending our analyses to the unimaged part of Mercury.

References: 1) R. Ingalls and L. Rainville (1972) Astron. J., 77, 185. 2) M. Davies et al. (1978) NASA SP-423. 3) N. Trask and J. Guest (1975) JGR, 80, 2461. 4) S. Solomon and J. Head (1980) RGSP, 18, 107.

Figure 1: Map of total Arecibo altimetry coverage of Mercury from 1978-1983. The subradar tracks are denoted by solid lines.

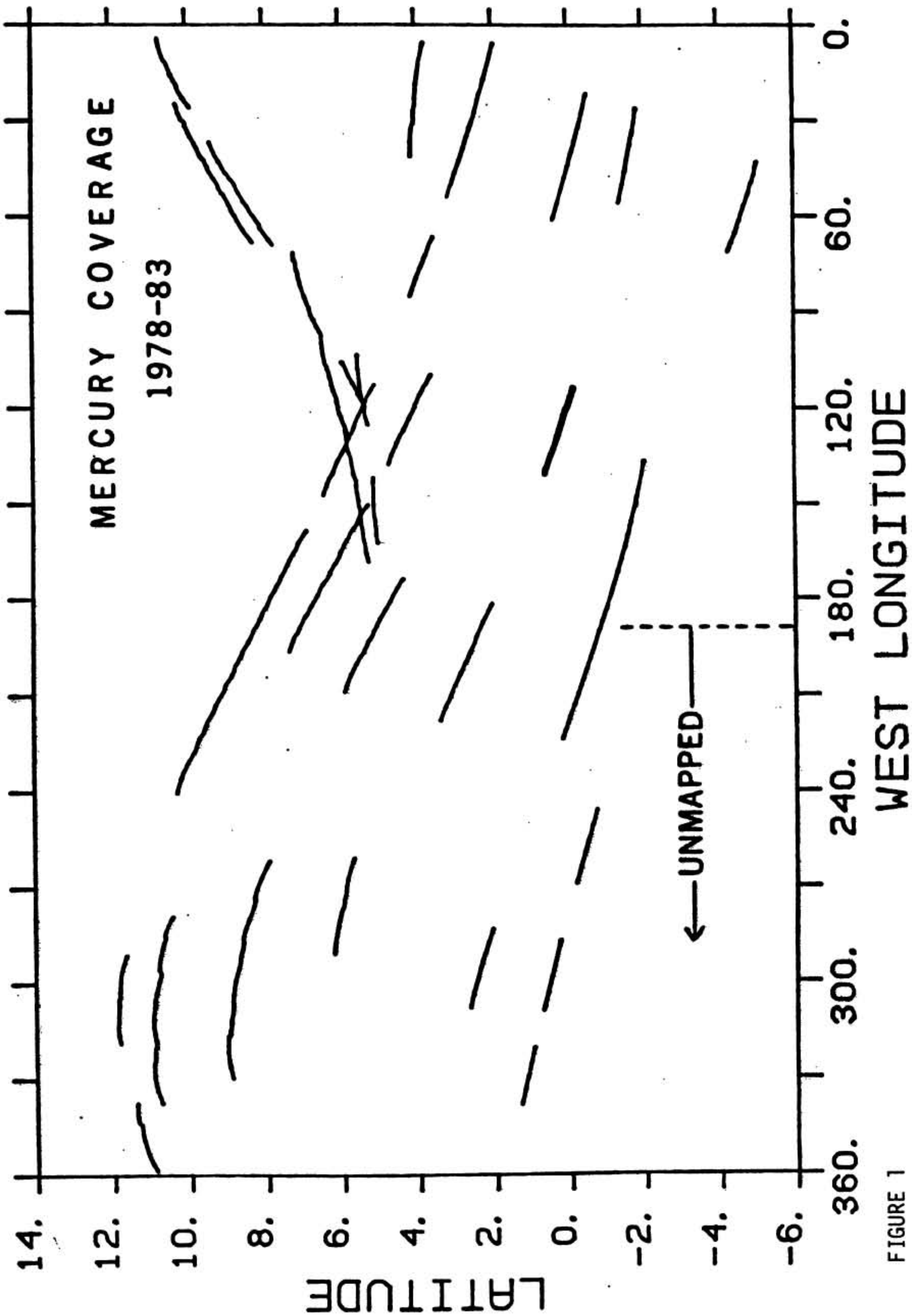
MERCURY COVERAGE
1978-83
UNMAPPED
WEST LONGITUDE
LATITUDE
0.
60.
120.
180.
240.
300.
360.
14.
12.
10.
8.
6.
4.
2.
0.
-2.
-4.
-6.

FIGURE 1