GEOLOGY OF THE INTER-CORONA REGIONS OF MIRANDA; Philip J. Stooke, Department of Geography, University of Western Ontario, London, Ontario, Canada N6A 5C2.

INTRODUCTION. Apart from crater counts, most studies of Miranda's geology emphasize the coronae, which appear to consist of volcanic deposits occupying impact or tectonic depressions (1-4). In this study landforms between the coronae were mapped and interpreted. The inter-corona regions have a complex geological history involving two episodes of mantling, volcanism and faulting. The following units were identified (Figure 1):

CRATERED MATERIAL: This occurs mainly in Mantua Regio, long. 180. Published crater counts for Miranda differ widely (e.g. 5,6), perhaps because this unit and the rolling hills were not distinguished. The unit lacks large (>20 km diameter) overlapping craters, suggesting that signs of accretion have been obliterated. It has many 10-20 km craters, but most are subdued as if thinly mantled by ejecta or pyroclastics. Thus the unit may record two events, early resurfacing and more recent mantling, separated by sufficient time to accumulate the observed craters.

ROLLING HILLS MATERIAL: Most inter-corona areas lack the numerous craters of the previous unit. A few very subdued depressions up to about 80 km across are seen, together with numerous fresh craters 2 to 4 km across and a few up to 20 km. The impression is of a cratered surface thickly mantled in the last 2 billion years or so, best seen in Sicilia Regio where relief up to 8 km is retained (7) but features are rounded. Crater preservation suggests emplacement from above as ejecta or pyroclastics, but shapes of contacts (especially near long. 210, possibly a filled graben) suggest fluid deposition. Both mechanisms may have operated. Between lat. -30 and -60, and long. 150 and 200 a vague pattern of concentric ridges and depressions shows faintly through the mantle. The shape is irregular but roughly rectangular, and probably represents a buried corona or proto-coronal depression of tectonic origin similar to Inverness Corona rather than an impact basin (8). Dark material is exposed in crater walls, scarps and ejecta between Inverness and Arden and near the sub-solar point. It appears to underlie the rolling hills unit except where exposed by impact or faulting. Another dark streak, apparently ejecta, extends south-west from the crater Stephano. If the source is a buried dark layer in cratered terrain, other craters should expose it. It may derive from Elsinore Corona, which Stephano overlaps, but Elsinore has higher albedo than the other coronae. In image FDS 26816.43 (12.5 km/pixel resolution) this streak is dark, Elsinore almost invisible. If Elsinore is thinly mantled with bright ejecta other craters should have excavated dark material, and Stephano's north wall should be less bright. A small buried source such as an intrusion may be implied.

OLDER TECTONIC FEATURES: Several subdued linear scarps form a zigzag structure near lat. -50 between 250 and 330 long. The most prominent is Argier Rupes, up to 6 km high (7). They occur only in the rolling hills unit, perhaps smoothed by mantling rather than mass wasting and impact erosion. Seen in stereo, Argier and a sharper parallel scarp in Inverness Corona appear to form opposite sides of a deep graben. Argier itself forms a curious mirror image of the bright 'chevron' in Inverness, suggesting a possible relationship (the form this might take is unclear). Wide-angle image FDS 26846.30 shows an east-west scarp at -15, long. 0, which may belong to this system. Several valleys radial to Arden Corona near long. 130 were imaged at low resolution or high sun angle, and are tentatively assigned to this unit on the basis of their appearance in FDS 26846.26. Taken together, these features indicate that prior to the deposition of rolling hills material an episode of faulting produced scarps with several km of relief over much of the southern hemisphere.

YOUNGER TECTONIC FEATURES: Massive scarps are visible near the terminator at long. 345 (Verona Rupes) and on the limb at long. 115 (edge of Arden, FDS 26846.26). They connect to form a graben bisecting the southern hemisphere, rivalling Ithaca Chasma on Tethys relative to the size of the satellite. Depths up to 10 km are reported (7,9). These sharply defined features must postdate the rolling hills material and the dark filling of Arden. Smaller faults strike northwest from Verona Rupes to the terminator. Similar parallel faults run from -60, 75 to -70, 210, forming a horst/graben complex, several extending to the terminator just west of Elsinore. Most faults in the 'core' of Elsinore are parallel to these minor structures, and may be related. The flows of Elsinore's outer parts appear to originate beyond the terminator at long. 220 and to flow through a hollow in rolling hills, running south, east and north to surround the 'core'. The geometry of Verona Rupes has been analyzed in detail. The scarp's slope relative to the dark limb beyond the terminator (Fig. 2) is 25 to 30 degrees. The visible slope is a talus apron striated downslope. Similar streaks are visible throughout this massive graben, revealing steep slopes even at high sun angles. The topography is mis-represented on USGS map I-1920. Rectified FDS 26846.17 is distorted by oblique viewing of high relief, but was airbrushed without modification. Fig. 3 is part of map I-1920: the zigzag shape of the top of the scarp is echoed by the shape of the bottom, but in Fig. 3 the bottom is displaced to the south (right) by parallax. Fig. 4 illustrates the geometry, and from it the true depth is estimated to be 5 to 15 km, shallower towards the terminator. Fig. 5 is a corrected map view of Verona Rupes.

DISCUSSION: The oldest material seen is the cratered unit, but evidence of earlier resurfacing is present. This is overlain or intruded in places by dark material which is now exposed in crater walls, ejecta and scarps. Many craters, notably Alonso, do not expose this material so it cannot be ubiquitous under the rolling hills unit. This and the possible buried corona at -45,170 suggest an early period of corona formation. That surface was disrupted by large-scale faulting. Then higher albedo material covered much of Miranda. Later, dark volcanic deposits flooded depressions to form the present coronas, and further faulting produced Verona and other young graben. Elsinore appears younger than small faults in its vicinity, but Arden is cut by the largest graben. Two cycles of mantling, volcanism and faulting are postulated. The energy source required is uncertain, but a consistent scenario is proposed: each mantling deposit consists of ejecta from a very large impact. One of these might have formed the Arden depression (8), the other may have been in the northern hemisphere. Each impact may have initiated chaotic rotation, causing heating (10) which triggered short-lived volcanism and faulting. Elsinore's flows postdate darker Arden-type deposits (11), and bright flows may have formed part of the rolling hills unit overlying buried dark material, suggesting two dark-to-bright extrusive sequences which may reflect methane abundance. Relaxation of large basins may also have contributed to faulting, as suggested for Tethys (12).

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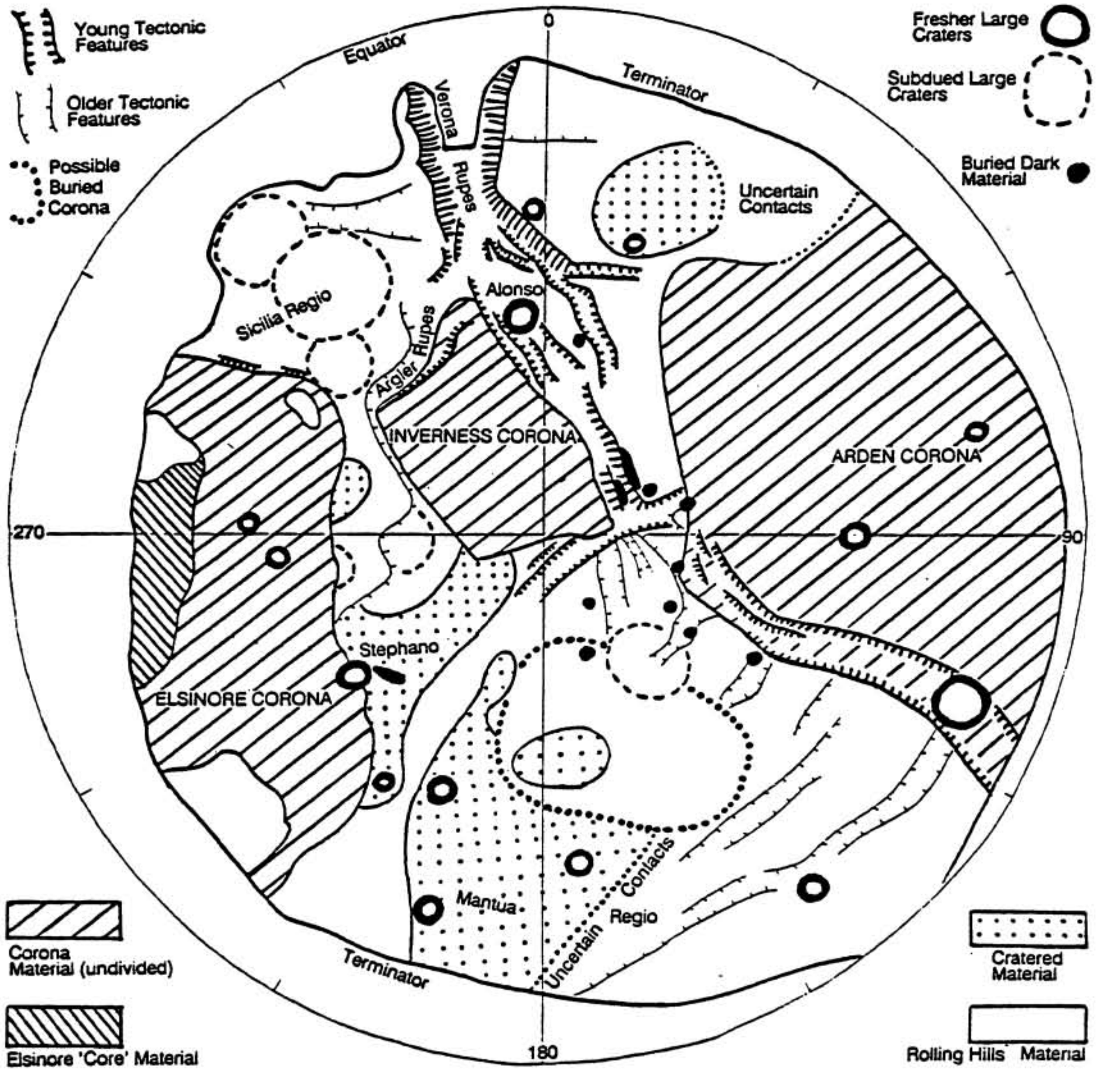

FIGURE 1. Geological map of the southern hemisphere of Miranda, polar stereographic projection.

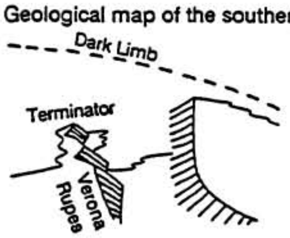

FIGURE 2. Position of Verona Rupes relative to the dark limb (FDS 26846.17 and 26846.30).

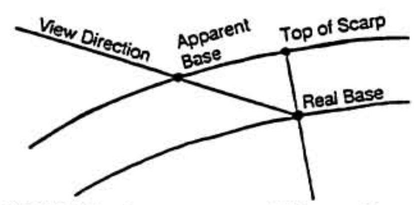

FIGURE 4. Viewing geometry of Verona Rupes in FDS 26846.17.

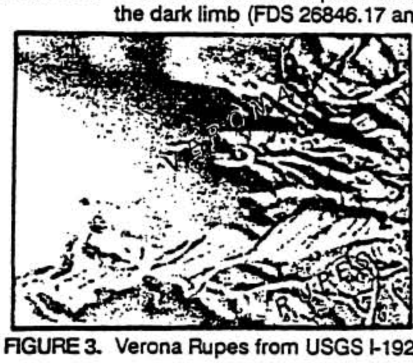

FIGURE 3. Verona Rupes from USGS I-1920.

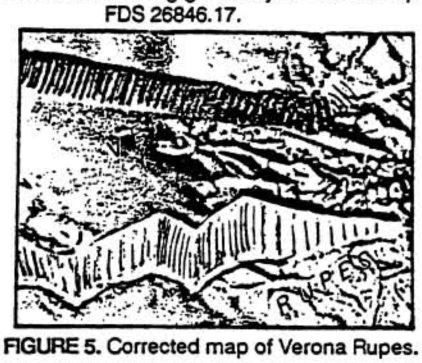

FIGURE 5. Corrected map of Verona Rupes.

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