GEOLOGY OF MIMAS, Philip J Stooke, Dept. of Geography, University of Western Ontario, London, Ontario, Canada N6A 5C2

INTRODUCTION. Reinspection of Voyager images of Mimas suggests a more complex geologic history than has been described previously (1,2,3). Three distinct fault sets, with different ages and distributions, are mapped in Fig. 1. The question of volcanic resurfacing is not fully resolved, but an argument for early global resurfacing is offered. A possible volcanic construct is identified.

LINEAMENTS. Many lineaments are visible in the imaged portion of Mimas (c 80 percent of the surface) despite drastic variations in resolution. They can be assigned to three categories scarps and ridges, grooves and cratered grooves. Each has a distinct distribution. SCARPS AND RIDGES occur near the anti-Saturn point and trend generally N-S with a subset trending NE-SW. They are best seen in 34936 15 and 34938.02, and in profile on the limb in 34930.40. They are not covered by the published limb profiles of (4), but may be further characterized in that manner. They appear to bound a broad rift system 100 km wide, extending from -30, 180 to +40, 170 (and an unknown distance further north). The ridges may be degraded horsts, tilted fault blocks or relaxed graben walls (cf ref 5). They have many superposed small craters. CRATERED GROOVES extend from -20, 40 through high southern latitudes to -40, 190, including Pangea, Camelot and Tintagil Chasmata and unnamed valleys near the south pole. It is unclear whether these features are crater chains (lunar analog: Catena Davy), rows of collapse pits (lunar analog: Rima Hyginus) or old graben with superposed craters. CASSINI imaging should resolve this issue. For the time being the latter possibility is preferred. GROOVES extend from the sub-Saturn region through -30, 270 to -10, 180, including Ossa and Pelion Chasmata Another set of grooves imaged at low resolution (34930.40, 34932.04) extends from -50, 130 to +10, 50. Oeta Chasma and possible lineations on the floor of Herschel in 34932.04 may be part of this group. Although the resolution is low no superposed craters are apparent. Note that Avalon Chasma appears from ref. 6 to belong to this group, but its existence is far from obvious in images, and the name should probably be reassigned.

ANOMALOUS HIGH RELIEF REGION. At roughly 0, 0 is an area with unusually high (2-3 km) limb topography (4) and a unique 'blocky' appearance. Landforms in this region in images 34944.21 and 34944.33 are indistinct but resemble isolated mountain masses 20 to 40 km across. Intervening areas are smooth No obvious pattern of superposed craters seems to reproduce this appearance. Typical cratered terrain at 0, 280 (identical viewing and lighting geometry) looks very different. This area may be dominated by faults, like the scarp and ridge topography at its antipode. Alternatively, this may be the site of a large impact structure. If so it is probably more degraded or relaxed than Herschel. Very low resolution imaging (not available for this study) may provide further details. Faint lineaments near the resolution limit radiate from this region in image 34944.33.

POSSIBLE VOLCANIC CONSTRUCT. At -25, 355 in image 34944.33 is an isolated mound 30 km across and roughly circular. Its surface appears very smooth and uncratered, though caution is required in assessing the significance of this observation for such a small area. The landform does not appear to be crater-related and does not resemble a horst. In the absence of other likely interpretations this is very tentatively suggested to be of endogenic origin, a small viscous flow or volcanic construct. Nearby faults may have given a viscous magma access to the surface.

RESURFACING. Conflicting claims for resurfacing in the south polar region have been made (7,8). Southern latitudes near long. 0 seem deficient in large craters relative to the Herschel-Arthur region (long. 90-180), but Lissauer et al. (ref 8) conclude that this is not significant (in other words, random global cratering is sufficiently likely to create the observed clustering that local resurfacing is not mandated) Nevertheless, the absence of large degraded craters near long. 0 suggests that the region is not an unmodified accretional surface. Note that the significant point is not the distribution of large craters but the fact that ancient, degraded craters with many superposed impacts are not observed anywhere on Mimas. Images of Rhea and Callisto at similar resolution clearly show very degraded large craters. A compromise is proposed: Mimas experienced brief global resurfacing during the final stages of accretion. The subsequent impactor population contained few large objects, so large craters are rare. A randomly generated cluster near long. 180 makes that area appear older than the long. 0 region. Resurfacing probably accompanied the brief thermal episode postulated by (4). Nothing can be deduced from the observations reported here regarding early fragmentation and reassembly of Mimas.

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SUMMARY. Mimas may have been resurfaced globally near the end of accretion. Old scarps and ridges near 0, 180 and cratered grooves of possibly similar age may define a global great-circle fracture set tilted roughly 60 degrees to the present equator. Following the comments of (9) regarding Tethys, they may have been initiated by a postulated large impact at +10, 0. Relatively uncratered grooves near Herschel and extending between 0, 0 and 0, 180 via -20, 270 may form another great-circle fracture set initiated by the Herschel impact. A possible small volcanic construct at -25, 355 may be relatively young (comparable with Herschel) and may be located where fracture sets intersect. CASSINI should be directed to image the possible large impact structure, volcanic construct and fracture sets at high resolution. Mimas may have more in common with Miranda than previously thought.

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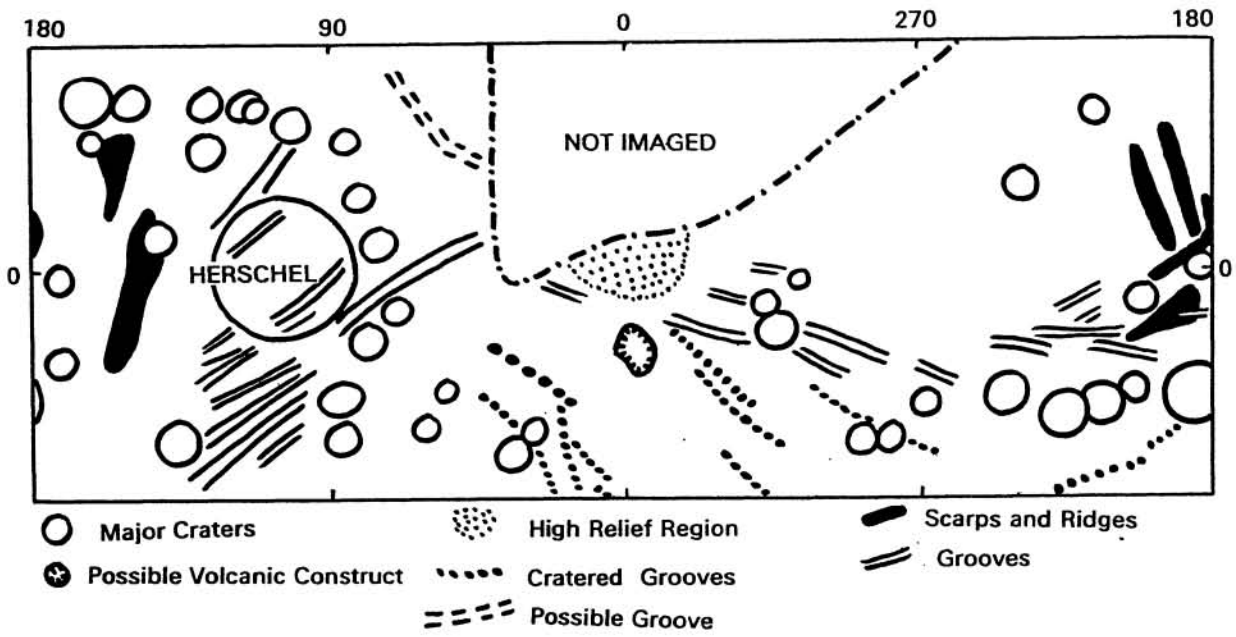

Figure 1. Features of Mimas (latitude +57 to -57) described in text (based on ref. 6).