MAPPING REGOLITH AND BLOCKS ON ASTEROID 243 IDA: THE EFFECTS OF PHOTOMETRIC VIEWING GEOMETRY. Pascal Lee[1], Joseph Veverka[1], Michael J. S. Belton[2], Peter C. Thomas[1], Brian T. Carcich[1], Ronald Greeley[3], Robert Sullivan[3], Robert Pappalardo[3], and the Galileo SSI Team. [1]Department of Astronomy, Cornell University, Ithaca, N.Y. 14853. [2]Kitt Peak National Observatory, NOAO, Tucson, AZ 85719. [3]Department of Geology, Arizona State University, Tempe, AZ 85287.

We mapped the distribution of ejecta blocks on asteroid 243 Ida both "conservatively" and "liberally", and find that it may be significantly biased by photometric viewing geometry. Most observed blocks occur under relatively small emission angles where block visibility is understandably enhanced. Most blocks also appear to be associated with large (Ø > 2 km) or fresh-looking craters. While few blocks are seen where the viewing geometry is unfavorable, there are at least two broad areas on Ida where blocks are rare *in spite of* favorable viewing conditions. The subdued topography in these areas suggests that they might possess a thicker regolith cover than elsewhere. We find no clear indication that the distribution of blocks on Ida presents any systematic asteroid-wide asymmetry.

With the recent flybys of 951 Gaspra and 243 Ida by the Galileo spacecraft, disk-resolved images of the surfaces of main-belt asteroids have become available. As suspected from earlier (indirect) evidence, impact cratering appears to be the principal geological process currently at work on these objects. While *direct* evidence for the existence of the finer-grained fraction of a regolith is generally lacking for small bodies, high-resolution spacecraft imaging data provide such evidence for the coarser fraction of their regolith: several discrete and localized positive relief features (PRFs), meters to tens of meters in size, have been identified on the surfaces of Phobos and Deimos [1], and now possibly many are seen on 243 Ida, most of which likely represent individual ejecta blocks. The size of the largest blocks observed on Ida, about 150 m, is consistent with the relationship between maximum ejecta block size and crater diameter found for the Moon, Phobos and Deimos [1].

In light of these observations, attempts are currently underway to map the distribution of ejecta blocks on Ida. The maps will hopefully provide clues to the mechanisms by which ejecta is produced and emplaced on small bodies, and lead to a better understanding of their evolution and of the impact cratering process. In constructing the maps however, several shortcomings become apparent. These may be observational (limited spatial resolution, varying photometric viewing geometry, albedo contrasts or lack thereof, etc.), or intrinsic (partial to complete burial of ejecta blocks, block fragmentation in response to varying material strengths, etc.). On Ida, block identification is indeed first challenged by the spatial resolution limit (31 to 38 m/px for the mosaic currently available) ; then, because regolith depths of order several tens of meters or more are conceivable on Ida, partial or even complete burial of all but the largest ejecta blocks is possible. While interesting in themselves, such caveats clearly would affect the observed distribution of blocks and must be taken into account.

In an attempt to measure more specifically the possible effects of varying photometric viewing geometry on the observed distribution of blocks on Ida, we determined the angles of incidence i and emission e under which each PRF is observed, using the latest numerical shape model available for the asteroid. Two approaches were adopted: a "conservative" one, in which only the PRFs that were deemed most likely to be individual blocks were included in the count - 29 were found ; and a more "liberal" one, in which virtually all discrete PRFs were taken into account, so long as there was reasonable doubt as to what the features might actually be (an ejecta block indeed, or merely a raised crater rim or protruding bedrock) - 185 were found. In both approaches, the locations of the PRFs were mapped against Ida's shape model (Figures 1 and 2). We find that the observed blocks have a tendency to occur in greater numbers very near, and often within, large (Ø > 2 km) craters or in the close vicinity of fresh-looking, smaller craters. While larger craters might constitute efficient traps for blocks ejected ballistically from other areas on Ida and fresher craters have better-exposed ejecta, the rougher topography found in the immediate vicinity of all craters probably also enhances block visibility and might thus bias their mapping. We note also that there are two distinct areas on Ida (R_A and R_B in Fig.2) where very few blocks are visible in spite of favorable viewing circumstances.

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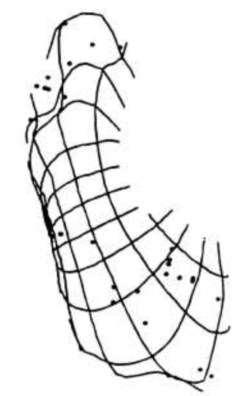
While the distribution of blocks on Ida may not be uniform, the subdued topography in these areas suggests that the regolith cover could be thicker there than elsewhere and have buried even the largest blocks. The thickness of the regolith might thus vary regionally on Ida. The observed distribution of blocks shows otherwise no clear indication of an asteroid-wide asymmetry, such as a rotational leading side/trailing side dichotomy as might be expected from a non-uniform "sweep-up" of ejected blocks by the rotating asteroid [2].

The photometric viewing geometry under which our two populations of blocks were observed (in the conservative and liberal approaches) is presented in Figures 3 and 4, where $\mu_0 = \cos i$ is plotted against $\mu = \cos e$. Because the current shape model is still coarse and the shape of the asteroid itself is such that not all photometric geometries occur with equal frequency, the observed distributions must be interpreted with caution. (Note also that some combinations of μ and μ_0 are not represented in the original mosaic. The excluded domain, however, is very limited.) Figures 3 and 4 show how the observed block distribution may be affected significantly by differences in photometric viewing geometry. Most PRFs appear to be clustered in the large μ region, likely because foreshortening is minimal at small emission angles, optimizing viewing. Very few PRFs are visible near the limb (the "y" axis) where e becomes large. Meanwhile, several PRFs also occur at intermediate incidence and emission angles where shadows are reasonably well-developped and open to view. More surprizing, however, is the apparent lack of blocks at large incidence angles (small μ_0) and intermediate emission angles ($\mu \sim 0.6$). Blocks viewed under this geometry would be conspicuous. Perhaps they are absent or lie hidden from view.

REFERENCES: [1] Lee S.W. et al. (1986) *Icarus* 68, 77-86. [2] Geissler, P., personal communication.

Fig.1



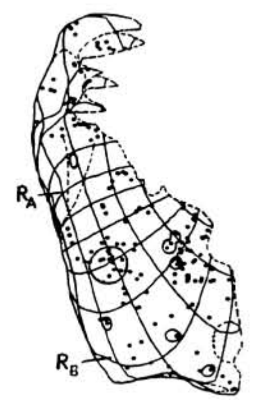
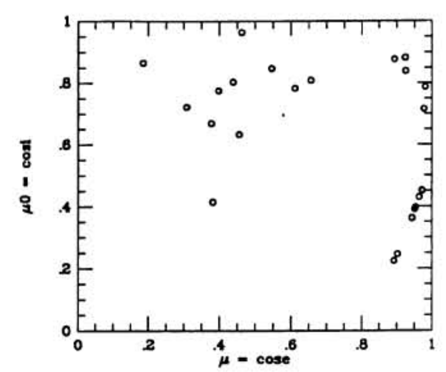


Fig. 2

Fig. 3



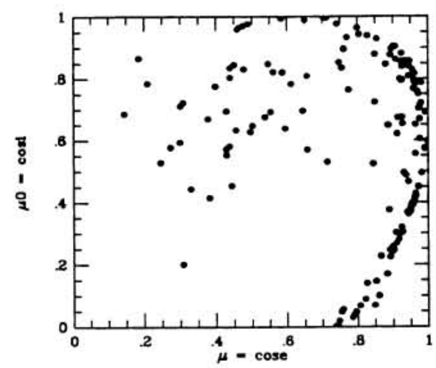


Fig 4

Fig.1: Distribution of PRFs on asteroid 243 Ida mapped on best available shape model drawn with an 18° grid spacing: "conservative" approach (see text), yielding 29 possible ejecta blocks.
Fig.2: Distribution of PRFs on asteroid 243 Ida mapped on the same shape model as in Fig.1: "liberal" approach (see text), yielding ~185 possible ejecta blocks. Major geological features are outlined, along with areas R_A and R_B.
Fig.3 and Fig.4: Photometric viewing geometry of the blocks shown in Figures 1 and 2, respectively.

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