MORPHOLOGY AND GEOLOGY OF ASTEROID IDA: PRELIMINARY GALILEO IMAGING OBSERVATIONS; R. Greeley, R. Sullivan, R. Pappalardo, *Dept. of Geology, Arizona State University, Tempe, AZ 85287-1404,* J. Head, *Brown University*, J. Veverka,, P. Thomas, P. Lee, *Cornell University*, M. Belton, *National Optical Astronomical Observatory*, C. Chapman, *Planetary Science Institute*

Summary. The Galileo spacecraft flew by asteroid 243 Ida on 28 August 1993 [1]. Five of the highest resolution (31-38 m/pixel) Solid State Imaging clear filter frames of Ida were returned for preliminary analysis (Fig. 1a); the remainder will be returned in 1994. Ida is classified as an S-type asteroid, inferred to be of pyroxene and olivine composition, and measures ~55 km in its longest dimension. At least seven categories of morphological features are mapped on Ida (Fig. 1b) which provide clues to the properties and geological evolution of the surface.

We have confidently identified 16 isolated positive relief features ("*rocks*"), none larger than 150 m in longest dimension. They are more concentrated in the upper part of the image mosaic, but it should be noted that their detection is strongly influenced by local slope and illumination. The four most prominent features are located within the rim of a large, partially illuminated impact crater in the upper part of the mosaic. Resolution is generally inadequate to determine confidently whether a given feature is "perched" on the surface or partly buried. These features may be blocks of impact ejecta. Less likely, they may be remnants of resistant "bedrock" (implying local heterogeneity of material strength) or fragments of impactor (implying very low energy impacts).

At least three shallow concavities (informally termed "*chutes*") are recognized on a steep slope near the top of the mosaic. The chutes are oriented with their long axes roughly parallel to local slope, and each ends downslope in a sub-circular crater. The largest chute is 1 km long and 400 m wide. Chutes could be scars produced by mass wasting of weakly cohesive material, possibly triggered by an impact. This interpretation suggests the presence of a regolith mantle, at least in the location where chutes occur. Alternatively, these features may represent extremely low-angle impacts, although their non-random distribution argues against this idea.

Lineations are recognized on the basis of albedo ("stripes") and topography ("grooves"). Stripes are 50 to 100 m wide, and 400 m to 2.5 km in length. Grooves are resolved as linear depressions of uniform width that in some places have subtle indications of raised and/or crenulated edges. Grooves are less than 100 m wide, and 400 m to 4 km in length. Some grooves and stripes cross craters, although they rarely intersect each other or bifurcate. Stripes are generally brighter than surrounding terrain, are more apparent in areas viewed at locally high sun, and are commonly oriented locally downslope; some "stripes" illuminated by high sun may be grooves. Grooves and stripes may have diverse origins. One group of bright stripes within a large bowl-shaped depression in the top third of the mosaic could represent tracks of mass-wasted debis; alternatively, they could be rays of ejecta from an impact crater which may be hidden from view. One groove terminates downslope adjacent to a "rock," and the groove might represent the track of this feature. Grooves could be fractures or joints resulting from stresses from large impacts, although a source crater(s) cannot be determined from the present mosaic.

Dark-floored craters, distinguished by low albedo floors, are seen in areas illuminated by high sun; most dark-floor craters occur in a cluster (lower left of the mosaic). Typically, dark material constitutes most of the crater interior. In a few cases, dark-floor material is surrounded by a halo of bright material lying at or just within the crater rim. Dark-floored craters could represent impacts through a thin, weak regolith to expose underlying low albedo material. Identification of this feature class is tentative, as their appearance could be an artifact of local illumination.

Three *albedo features* are tentatively identified; additional views of Ida available in Spring 1994 will show some of these features under different illumination and viewing geometries, allowing a more confident evaluation. (1) A triangular bright feature 2.5 km by 500 m wide is recognized in the top left of the mosaic; it is bounded on one side by the base of a local slope and on the other by a groove. The origin of this feature is unknown but it may represent mass wasting of debris from the adjacent slope. (2) A triangular dark patch nearly 2 km by 500 m wide is located near the terminator in the middle of the mosaic. A 200 m crater is located at the apex. The feature suggests either a thin, dark mantling deposit, possibly derived from the small crater at the apex, or a laterally extensive underlying darker material locally swept clear of a thin layer of brighter material, or an extensive exposure of anomalously dark material (no horizontal layering/mantling implied). (3) An irregular dark patch 200 m by 500 m is located among the cluster of dark-floored craters in the lower left of the mosaic (Fig. 1b). This feature may be a cluster of small dark-floored craters that do not display rim topography.

Craters are generally bowl-shaped, but some have flat floors; others appear to have small central mounds, and some have straight rim segments. There is a continuous range of degradation states. Craters lack distinct ejecta blankets, although deposits may be too thin to be recognized. A few of the freshest impact craters visible are bright and have one or two short rays. Many other craters with crisp rims do not have rays, although they do have narrow, raised rims. Under high sun, many craters are surrounded by a narrow bright ring immediately outside the rim (in contrast to the bright halo of some dark-floored craters, located mostly within the rim). The extremely low gravity on Ida probably precludes formation of distinct ejecta blankets and extensive fresh crater rays.

Crater chains are defined as consisting of three or more aligned craters of similar size separated by less than one crater diameter. Crater chains range from 500 m to 2.5 km in length, and component crater diameters range from 200 to 400 m. Orientations and locations are random across the mosaic. Crater chains may result from low-velocity impact of ejecta from a primary crater (although no crater chain can yet be linked to a larger primary) or from a string of original impactors.

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Preliminary analysis of the types, morphologies, and distributions of surface features on the five-frame mosaic of Ida suggest the following:

1. Ida is geologically more complex than Gaspra, an asteroid imaged by Galileo in 1991. This may reflect its larger size or a different history.
2. Many of the morphological features suggest the presence of regolith, as evidenced by downslope movement of debris. Asymmetric distribution of these features may mean that the regolith is not present everywhere or is of variable thickness.
3. Preferred orientation of many of the lineations may be related to a stress field or as yet unseen craters.

We note that these observations are tentative and may be strongly influenced by local illumination and viewing geometry. Dimensions reported here are apparent and have not been corrected for foreshortening or local slope. When completed coverage from subsequent images is received, the distribution of morphological features and interpretation of surface geology will be improved.

REFERENCE: [1] C.R. Chapman et al., this volume.

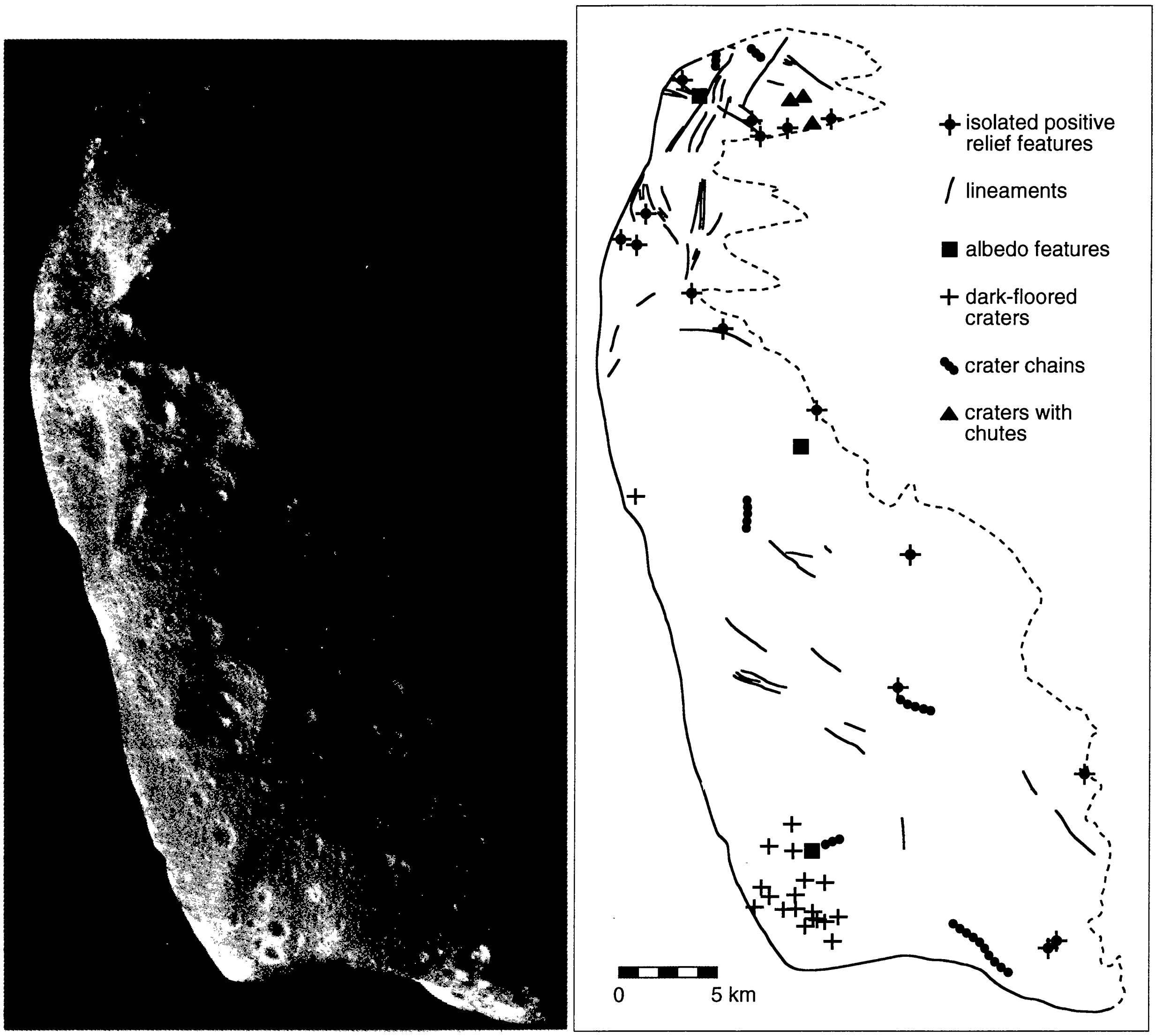

Fig. 1. a) Galileo photomosaic of Ida, b) sketch map corresponding to Figure 1a showing various surface features.