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FIRST *GALILEO* IMAGE OF ASTEROID 243 IDA; C. R. Chapman (Planetary Science Inst., Tucson AZ), M. J. S. Belton (NOAO, Tucson AZ), J. Veverka (Cornell Univ., Ithaca NY), G. Neukum (DLR Inst. for Planetary Exploration, Berlin, Germany), J. Head (Brown Univ., Providence, RI), R. Greeley (Ariz. St. Univ., Tempe AZ), K. Klaasen (JPL, Pasadena CA), D. Morrison (NASA Ames Res. Ctr.), and the Galileo Imaging Team.

The second spacecraft encounter with an asteroid has yielded an unprecedentedly high resolution portrait of 243 Ida. On 28 August 1993, Galileo obtained an extensive data set on this small member of the Koronis family. Most of the data recorded on the tape recorder will be returned to Earth in spring 1994. A five-frame mosaic of Ida was acquired with good illumination geometry (phase angles about 50 to 60 degrees) a few minutes before closest approach; it has a resolution of 31 to 38 m/pixel and was played back during September 1993. Preliminary analyses of this single view of Ida are summarized here. When the data are returned, our color images of Ida will provide data on its compositional homogeneity and heterogeneity and may provide additional information relevant to the presence and geometry of a regolith. Also, we emphasize that much more definitive conclusions will be possible when we have images with somewhat different angles of illumination and perspective, and of the other sides of Ida.

Ida is at least 55 km long, perhaps slightly bigger than expected from groundbased data. Its general shape and orientation are consistent with pre-encounter predictions [1] for pole solution #2 of the two inherently ambiguous solutions from photometric lightcurves. Ida is clearly not a contact binary, contrary to some pre-encounter suggestions. It is not clear whether Ida is a monolithic body or a rubble pile, although views from other sides may clarify this issue. Ida appears to be more irregular in shape than does Gaspra, the first asteroid imaged by Galileo, or well-imaged small planetary satellites.

Unlike Gaspra, Ida is one of the most densely cratered objects yet observed in the solar system. Some of our preliminary crater frequency statistics are shown in Fig. 1 and comparisons with other bodies in Fig. 2; the preliminary conclusions that follow are based on these and other crater data. Ida's crater density (R-values of about 0.3) is similar to that attained on surfaces that are in equilibrium with a "saturation" cratering process. The slope of its differential size-frequency relation on a log-log plot is similar to, or perhaps a little steeper than, -3 for diameters smaller than 1 to 2 km.

For cratering production functions appreciably steeper than -3, studies of lunar cratering [2, 3] demonstrated that below the size where equilibrium sets in, the size-distribution should bend over to a -3 slope and there should be a full spectrum of crater morphologies from fresh to highly degraded. This is just what is seen on Ida for craters from 1 km down to at least 0.2 km diameter (Fig. 1). At larger diameters, preliminary counts show a steeper slope in the 2 - 4 km size range, possibly flattening at still larger sizes, consistent with the lunar crater production function [4]. Therefore, a consistent (though not unique) interpretation of the cratering histories of Gaspra and Ida is that the very steep production function recognized on Gaspra [5, 6] has cratered Ida 8 - 10 times more than Gaspra. It is expected, from orbital distributions of large main belt asteroids, that the inherent cratering rate by smaller asteroidal fragments should differ by much less than a factor of 2 between Gaspra and Ida. Accordingly, Ida's cratering age is 5 to 10 times older than Gaspra's age, which we estimated to be about 200 m.y. [6], or 1 to 2 b.y. old. If Ida is stronger than the rocky strengths assumed, its surface could date to the Late Heavy Bombardment (older than 3.5 b.y.). It *may* be inconsistent with Binzel's work [7] on the Koronis family that Ida is so old.

Ida seems to show more evidence for a regolith than Gaspra [8]. Downslope features (including "chutes"), small-scale albedo variations (e.g. dark floored craters), and the range of crater morphologies are all suggestive of regolith. There are some very large craters on Ida, which could be sources for the apparently more abundant regolith, particularly given Ida's stronger gravity and resulting greater retention of ejecta than is true for Gaspra. The spectral uniformity of Ida compared with Gaspra [9] could be due to ejecta from the latest big cratering event blanketing the entire surface with material from a single source region, or it could reflect underlying compositional homogeneity. Imaging

IMAGE OF ASTEROID 243 IDA; C.R. Chapman *et al.*

data in different spectral bands to be returned in 1994 will clarify if the compositional homogeniety extends to smaller spatial scales.

Various members of the Imaging Team [e.g. 8, 10] have described boulders visible on Ida, which may be ejecta blocks. Other geological features that have been recognized include grooves, crater chains, and various albedo features. Already, this single view of Ida shows more geological diversity than was found for Gaspra; although that partly reflects the better spatial resolution, Ida's larger size may facilitate processes not effective on smaller bodies or there may be other more fundamental differences between these two complementary members of the S-type.

Further clues that Ida may hold in store for us about the nature of S-type asteroids and about how the Koronis family parent body was disrupted await return of the bulk of the Ida encounter data, which is still stored on the Galileo tape recorder. It is presently expected that nearly all of that data can be returned prior to Galileo's preparation for its unique opportunity to observe the impacts of Comet Shoemaker-Levy 9 into Jupiter in mid-July.

References: [1] Binzel, R. P. et al. (1993), *Icarus* in press. [2] Gault, D. E. (1970), *Radio Sci.*, *5*, 273. [3] Chapman, C. R., Mosher, J.A., and Simmons, G. (1970), *JGR*, *75*, 1445. [4] Neukum, G., König, B., and Arkani-Hamed, J. (1975), *The Moon*, *12*, 201. [5] Belton, M. J. S. et al., *Science*, *257*, 1647. [6] Chapman et al. (1994), submitted to *Icarus*. [7] Binzel, R. P. (1992), *Icarus*, *100*, 274. [8] Greeley et al. (1994), abstract, this meeting. [9] Carlson, R. et al. (1993), presentation at 25th AAS/DPS meeting. [10] Geissler, P., Petit, J-M., and Greenberg, R. (1994), abstract, this meeting.

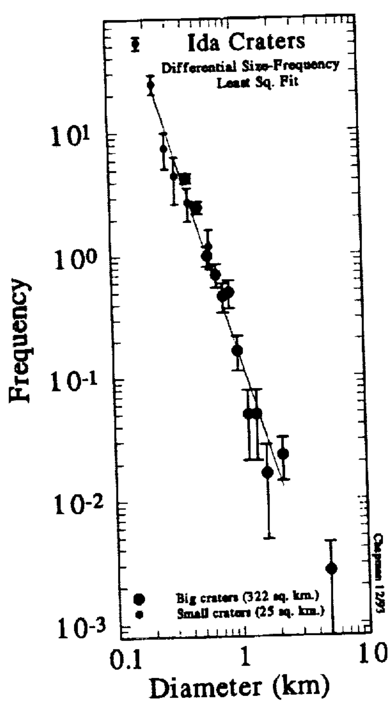

Fig. 1. Differential crater frequencies from 2 counting areas on Ida, with least squares fit power-law through reliable data points.

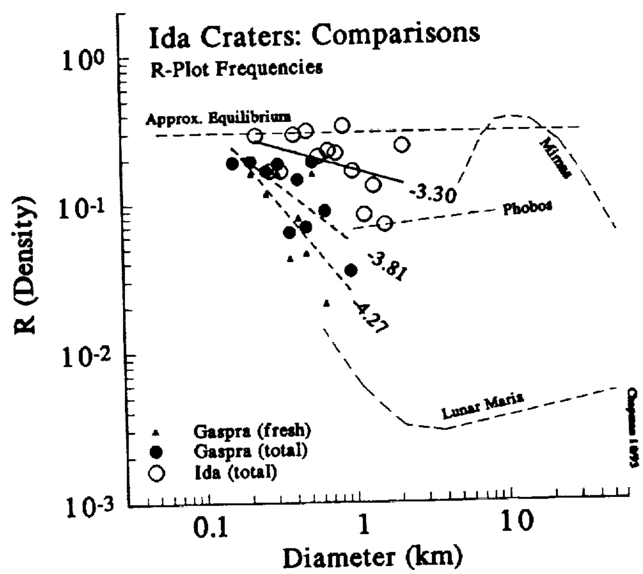

Fig. 2. R-plot crater densities for Ida and Gaspra (with least squares fits) shown in comparison with other satellite surfaces.