GEOLOGY AND CRATERING HISTORY OF ARIEL J.B. Plescia, U.S.G.S., 2255 N. Gemini Drive, Flagstaff, AZ 86001, and J.M. Boyce, NASA Heaquarters, Washington, D.C. 20546

The surface of Ariel imaged by Voyager 2 (Smith et al., 1986) can be divided into several types of terrain on the basis of morphology: cratered terrain, subdued terrain, ridged terrain, and plains. Cratered terrain, at lat -20°, long 0° and at lat -30°, long 255°, is characterized by a rolling surface, east- or northeast-trending grabens and scarps, and scattered superposed impact craters. Between the two occurrences of cratered terrain are areas of subdued terrain characterized by highly degraded craters and narrow (<3 km wide) ridges. Ridged terrain bounds the subdued terrain and occurs as narrow bands within it. It is characterized by bands 25 to 70 km wide within which are parallel, east- or northeast-trending ridges and troughs typically about 10 to 35 km apart. Individual ridges and troughs extend 100 to 200 km, but the bands of ridged terrain extend many hundreds of kilometers. At several locations, bands of ridged terrain are continuations of well-defined grabens and follow the same structural trends. Plains fill topographically low areas such as graben floors and irregular depressions. The plains that partly fill the grabens locally exhibit a medial trough from which plains-forming material appears to have flowed out onto the surface.

Crater statistics were compiled for each of the terrain types (Table I). Despite differing morphology, the various terrains on Ariel do not exhibit large variations in crater frequency. The difference in crater frequency between the cratered terrain, the most heavily cratered surface, and the plains, the least cratered surface, is only a factor of 3 to 4, in distinct contrast to the order-of-magnitude differences observed on Miranda (Plescia and Boyce, 1986; Smith et al., 1986).

Crater saturation of the cratered terrain occurs at diameters of about 12 km, whereas that for the subdued and ridged terrains is closer to 7 km, suggesting that the cratered terrain is the oldest of the three. The ridged terrain cuts both the subdued and cratered terrains and is therefore younger than both. The plains, which are not saturated with craters, are the youngest terrain and apparently formed at different periods of time, as indicated by the crater-frequency data.

None of the observed surfaces on Ariel record the period of accretion. If the surface of Ariel were as old as that of Oberon or Umbriel, whose surfaces presumably reflect the period of accretion, it would have a frequency of about 1,800 craters $\geq$ 30 km/10^6 km^2. However, the observed crater frequencies on Ariel are clearly lower (Table 1). The presence of few craters larger than 50 km in diameter also indicates that its observed surface was not formed during accretion. Ariel appears to have been completely resurfaced since it formed.

The extensive network of grabens on Ariel indicates that it has experienced global tensional stresses. Freezing of an initially liquid water interior and the resultant satellite-wide expansion may have produced the necessary global tension. Because the grabens are locally floored by plains, they must have formed, at least in part, during that portion of Ariel's history when new terrains were being formed and when conditions were appropriate for the mobilization of material for resurfacing.

Ariel's geologic history may be better understood by a comparison with that of Dione, which has similar size, density, and surface temperature and for which extensive thermal modeling has been done (Stevenson, 1982; Ellsworth and Schubert, 1983). On the basis of the thermal models for Dione, solidstate convection within Ariel can be estimated to have lasted for several billion years, a situation conducive to the deformation of the brittle surface layer. Temperatures in excess of the ammonia-water ($NH_3 \cdot H_2O$) eutectic melting point (173 K) might be sustained for the first few hundred million years near the surface and for perhaps 2 billion years at deeper levels. If clathrate dissociation occurred catastrophically (Stevenson, 1982), then resurfacing could have been produced by the explosive eruption of material onto the surface. Because clathrate dissociation at shallow depths (<10 km) can occur at temperatures lower than the melting points of either water ice or ammonia-water ice mixtures, such resurfacing events would have been possible for a longer periods of time than the estimates given above. Thus, it seems that conditions appropriate for resurfacing could have occurred during Ariel's early history.

REFERENCES: Ellsworth, K., and Schubert, G., 1983, Icarus, 54, 490-510; Plescia, J.B, and Boyce, J.M., 1986, this volume; Smith, B.A., et al., 1986, Science, 233, 43-64; Stevenson, D.J., 1982, Nature, 298, 142-144.

TABLE I
ARIEL TERRAIN CRATER FREQUENCIES

REGION	COUNTING AREA KM^2	FREQUENCY OF CRATERS $\geq$ D / 10^6 KM^2 DIAMETER (KM) 2	5	10	20	30	LARGEST CRATER (KM)	DIST. SLOPE
Cratered terrain (lat -20°, long 0°)	66962	(22967±586)	2285±185	358±73	75±33	(19±17)	29	2.6
Cratered terrain (lat -30°, long 255°)	37684	(63908±1302)	4007±326	849±150	69±43	(34±30)	29	2.7
Subdued terrain (combined areas)	87706	(29663±582)	2497±169	376±66	62±27	33±19	69	2.7
Ridged terrain (combined areas)	46944	(37106±889)	2641±237	547±108	23±22	(18±20)	20	2.7
Plains (lat -45°, long 320°)	10740	(24484±1510)	1955±427	162±123	(46±65)	(15±37)	13	2.7
Plains (lat -15°, long 30°)	37893	(11365±548)	1311±186	198±72	87±48	34±30	33	2.5
Plains (lat -15°, long 345°)	16819	(13769±905)	1873±33	725±208	106±79	(68±64)	24	2.0

Numbers in parentheses indicate extrapolations of the data. At small diameters extrapolations are necessary due to resolution limits, at large diameters because of a lack of craters.