# GEOMORPHIC STRUCTURES ON EUROPA: A NEW METHOD FOR THE RECOGNITION OF FEATURES NEAR THE LIMIT OF RESOLUTION

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Evidence of recent volcanism and resurfacing on Europa[1,2] has led to an investigation of possible topography associated with surface geological features. The highest resolution of Voyager Europa images is about 4 km/line-pair. At this resolution, reasonable estimates of topography using photoclinometry can only be obtained for features larger than about 40 km in diameter. This limitation motivated the development of a new digital image generation technique which facilitates geomorphic structure recognition. The following discussion describes this technique and some results of its preliminary application to structures on Europa.

The objective of the technique is to compare surface features visible in Voyager images with known geomorphic shapes having identical photometric properties, scale, and solar illumination. The method may be described in five steps. 1) The photometric properties of surface areas in an image must be empirically determined[3]. Where multispectral images are available, color ratio maps[4] may be used to isolate regions and features which most likely have similar photometric properties[5]. Separate photometric functions may thus be derived for different types of materials on the planet's surface. 2) The photometric functions and solar illumination direction are applied to correcting for darkening due to the spherical curvature of the planet and phase-angle effects[6]. This accentuates brightness variations due to changes in topography and makes the surface brightness more uniform. 3) An appropriate set of geomorphic models are defined. These may take the form of simple 3-dimensional geometric models or digitized topographic analogs. Examples include volcanic domes (Fig. 1) and bowl-shaped craters (Fig. 2). 4) The appropriate photometric function is then applied to the geomorphic models under illumination angles identical to those of an actual feature being studied. The models are scaled to match the dimensions of the feature. 5) Finally, the geomorphic models are superposed on the image adjacent to the actual feature. The topographic form of the feature may thus be qualitatively determined by comparison of suites of geomorphic models. Quantitative limits on the vertical dimensions of the feature may also be estimated.

A preliminary application of the technique to features on Europa suggest that some structures previously interpreted as albedo markings may exhibit topographic expression as well. These include small dark spots[7] with diameters less than a few tens of kilometers, similarly-sized bright spots, and some dark materials which appear to intrude fractures[8].

Examples of these features that appear to be elevated above the surrounding terrain have been identified. Circular arrays of dark spots suggest that some may be rims of craters which have either viscously relaxed or which have been mantled by icy materials. Further refinements of the technique currently under development may help to identify the origin and nature of these possible topographic variations. It is hoped that the method will ultimately find wider application as a tool for the identification of geomorphic features on other bodies.

References: [1]Cook, A.F. et al. (1982) Bull. AAS 14, 736-737. [2] Squyres, S.W., Reynolds, R.T., Peale, S.J. (1982) Nature, in press. [3]Hapke, B. and Wells, E. (1981) JGR 86, 3055-3060. [4]McCord, T.B. et al., (1982) Bull. AAS 14, p 737. [5] Siegal, B.S. and Gillespie, A.R. (1980) Remote Sensing in Geology, John Wiley & Sons, 156-165. [6] ibid., 202-205. [7]Lucchitta, B.K. and Soderblom, L.A. (1981) In Satellites of Jupiter, (D. Morrison, Ed.) In Press, [8] ibid.

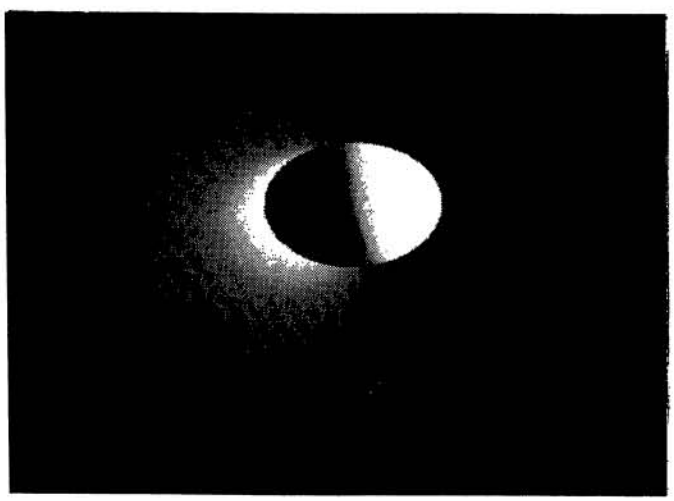

Figure 1. Perspective view of a 3-dimensional simple, bowl-shaped crater model. Lambertian surface illuminated from lower left with 30° solar elevation angle.

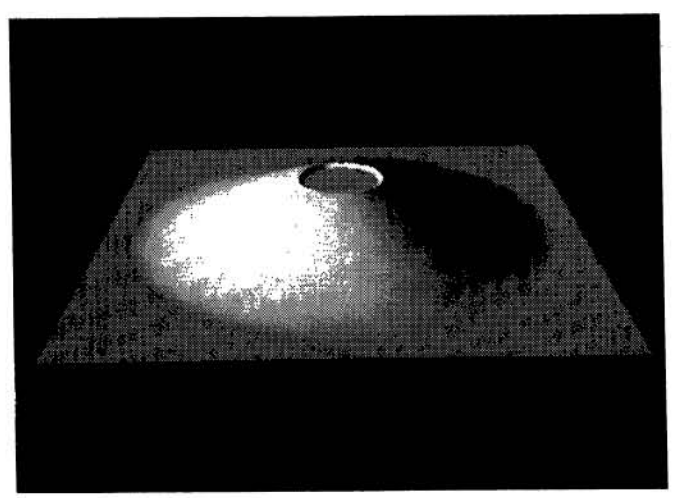

Figure 2. 3-dimensional geometric model of a volcanic dome with a simple caldera. Illumination geometry same as in Figure 1.