GLOBAL TECTONIC MAPPING OF GANYMEDE: A PRELIMINARY REPORT Scott L. Murchie and James W. Head, Dept. of Geological Sciences, Brown University, Providence, RI 02906

Shoemaker et al (1) first mapped the geology of Ganymede on a global basis. This study, together with those of other investigators (2-4), suggested the division of Ganymede's surface into three main material units, crater material, bright terrain, and dark terrain. Both the bright and dark terrains contain systems of parallel linear to curvilinear fracture or graben-like troughs. In the dark terrain most of the troughs, known as *furrows*, belong to two arcuate systems located in the sub-Jovian and anti-Jovian hemispheres respectively (3). Two additional furrow sets have been identified in the largest of the dark cratered regions, Galileo Regio, of which one set is orthogonal to the arcuate furrows (5).

Bright terrain may be divided into three main structural types (3). The most common is *bright grooved terrain*, cut by parallel sets of *grooves*, which are morphologically distinct from furrows. Areas of bright as well as dark terrain contain orthogonal sets of grooves or fractures *(reticulate terrain)* (3,5). In *bright smooth terrain*, grooves are rare and usually divide the smooth terrain into a complex of polygonal regions. Bright smooth material commonly embays craters and the boundaries of dark terrain, suggesting deposition in a fluid mode (1,3,4). The excavation of dark material by craters in the bright terrain (6) and the lack of major lateral offset across regions of bright terrain (4) suggest that dark cratered terrain has been converted to bright terrain *in situ* by emplacement of higher albedo material at most a few km thick. Large regions of bright terrain consist of a complex intersecting pattern of both smooth polygons and grooved structural domains (1) having parallel groove orientations within the domains.

Few studies have been done of regional patterns of groove orientations in the bright terrain. Bianchi et al (7) found two dominant orientations in Uruk Sulcus, a large area of bright terrain south of Galileo Regio. These orientations are parallel and orthogonal to arcuate furrows just to the north. Murchie and Head (8) found dominant orientations of groove sets parallel and perpendicular to furrow sets west of Galileo Regio, and proposed that emplacement of grooved terrain is structurally controlled by furrow sets.

The aim of this study is to identify global distribution of tectonic patterns and structural types. We constructed a global map of regions with uniform structural patterns (dark furrowed terrain, reticulate terrain, grooved terrain, smooth terrain, and crater material). Structural domains were both outlined and the orientations of their groove sets depicted. Structural domains were mapped as two subtypes. One of these, *groove lanes*, is a class of highly elongate domains whose grooves are parallel to the long axes of the domains. As the width of groove lanes decreases, the lanes grade into throughgoing grooves and groove pairs. The other subtype consists of generally polygonal structural domains with a small length to width ratio and groove sets oblique to the long axes of the domains. We call these *grooved polygons*. The dominant relationship between the two structural subtypes of grooved terrain is that intersecting groove lanes or throughgoing grooves define single or multiple grooved polygons. Groove sets in the polygons commonly terminate abruptly at the groove lanes.

Our results indicate that occurrence of groove sets parallel and orthogonal to furrow sets is a global phenomenon. In addition to the previously mentioned regions where groove orientations are consistent with structural control by furrows, we identify two other large areas. One is the region north of 20S and east of 10W. Both groove lanes and throughgoing grooves are dominantly parallel and perpendicular to NE-SW oriented furrows. The other region is between 20S and 60S, and 170W and 210W, where there is a concentration of reticulate terrain of both bright and dark albedo. One of the orthogonal groove sets in the reticulate terrain traces an arcuate pattern that appears to be a continuation of the furrow pattern to the north. In Galileo Regio, the most thoroughly studied region of furrowed terrain, the cross-cutting by the arcuate furrows of the orthogonal furrows led to the interpretation that the arcuate furrows are clearly younger. However, the global nature of apparent zones of weakness parallel and perpendicular to arcuate furrows suggests that orthogonal furrow sets may be related genetically.

Although the largest fraction of smooth terrain is concentrated in the northern part of the sub-Jovian hemisphere, two modes of occurrence of smooth terrain are associated with grooved terrain. These are as flood-type deposits in the central portions of groove domains, and as feather-edged deposits on adjacent dark cratered terrain. Considering the evidence for emplacement of smooth material in a fluid mode, this suggests that the areas of grooved terrain and especially their central portions were topographic lows at the time of smooth terrain emplacement.

In summary, the grooved terrain of Ganymede consists of long groove lanes which outline polygonal blocks containing one or multiple groove domains. Regional distribution of groove orientations suggests structural control of groove emplacement by zones of weakness parallel and orthogonal to furrow sets. The distribution of smooth terrain, believed to have been deposited in a fluid mode, indicates regional slope toward the central portions of grooved regions. Current research involves measurement of global trends in groove orientation, and the synthesis of a model of the sequence of events during the emplacement of grooved terrain.

References: (1) Shoemaker, E.M. et al (1982) in *The Satellites of Jupiter*, Univ. of Arizona Press, p.435-520. (2) Smith, B.A. et al (1979a) *Nature* 204, p.951-972. (3) Smith, B.A. et al (1979b) *Nature* 206, p.927-950. (4) Lucchitta, B.K. (1980) *Icarus* 44, p.481-501. (5) Casacchia, R. and R.G. Strom (1984) *Proc. Lunar Planet. Sci. Conf. 14th*, p. B419-B428. (6) Schenk, P.M. and W.B. McKinnon (1984) *Lunar Planet. Sci. XV*, p. 720-721. (7) Bianchi, R. et al (1984) *Lunar Planet. Sci. XV*, p. 54-55. (8) Murchie, S. and J.W. Head (1985) *Lunar Planet. Sci. XVI*, this issue.

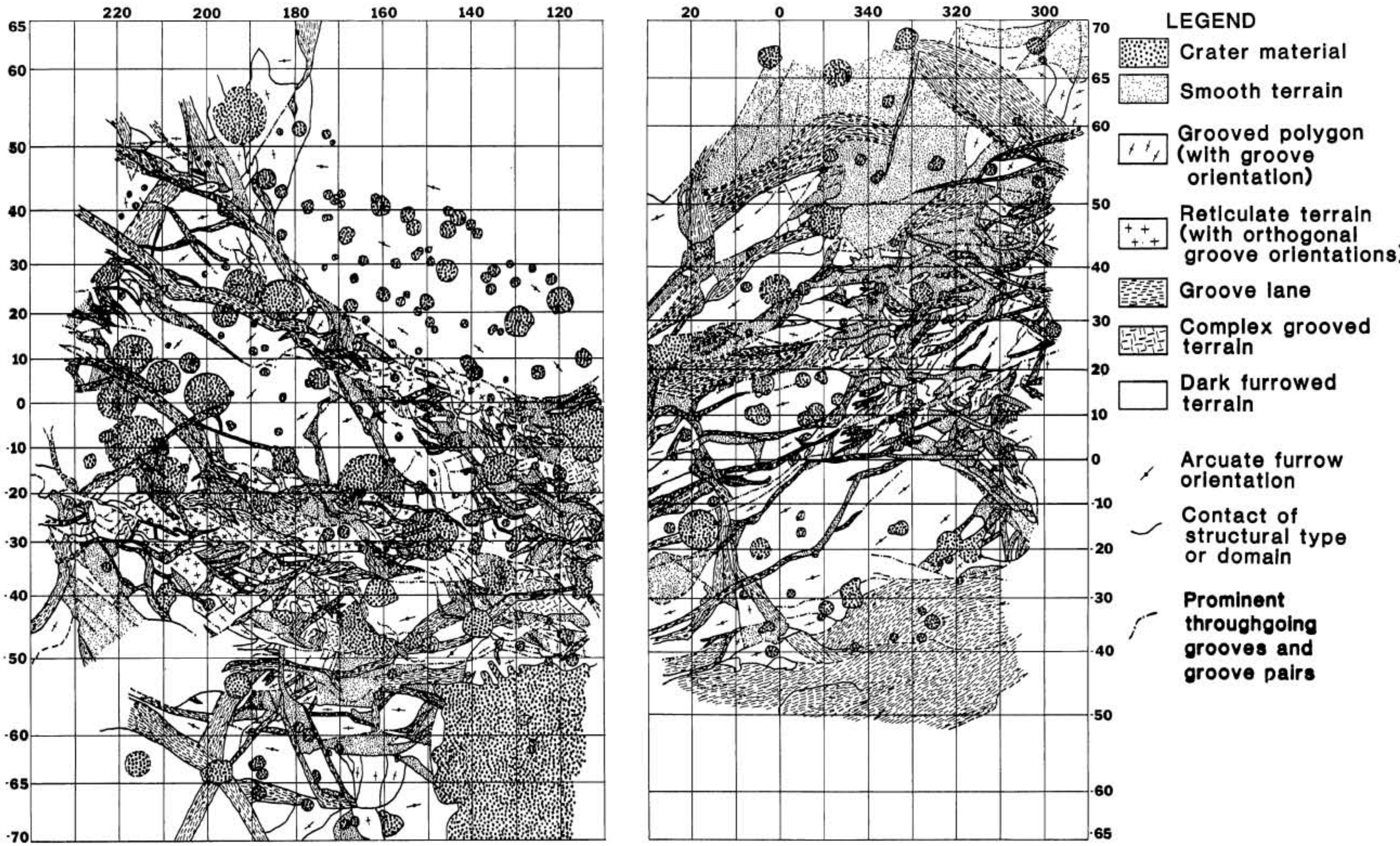

Fig. 1. Preliminary global tectonic map of Ganymede.