COMPARISON OF CRATER CLASSIFICATION SCHEMES ON GANYMEDE. J. P. Kay[1], G. C. Collins[1], and G. W. Patterson[2], [1]Physics and Astronomy Dept., Wheaton College, Norton MA 02766, [2]Dept. of Geological Sciences, Brown University, Providence RI 02912.

Introduction: Craters offer a means of determining the relative age of planetary surfaces. It is common to classify craters by the degradation of the rim [e.g., 1] and this classification scheme has been used on Ganymede [2-5]. Various impact crater morphologies that overlap in size are found on Ganymede, contrary to more well-defined transition diameters on other planetary bodies [6]. This phenomenon appears to be related to internal properties and possibly the thermal state of the lithosphere [6,7].

As part of an effort to produce a global geologic map of Ganymede [8] a classification scheme for craters has been developed that relies more on the presence of deposits (i.e. crater rays and ejecta) and less on rim degradation state. This scheme was adopted because image coverage of Ganymede obtained by the Voyager and Galileo spacecraft does not occur at consistent resolutions and illumination angles across the surface [9]. This makes applying the previous classification schemes to the global map of Ganymede difficult. As part of that mapping process we have identified 880 craters > 30km in diameter across the surface (this diameter cutoff was chosen due to the scale of the global map [10]).

In this analysis we compare three schemes for classifying craters on Ganymede. Our primary purpose is to ensure that the classification scheme being used for the global map represents a similar crater age progression as was previously accepted for USGS quadrangles. We are also interested in any correlations that may exist between relative age-based classification schemes (USGS quads, global map), and classification schemes based on interior morphology [6].

Background: The established method of crater classification for relative ages is based on rim degradation, as well as the presence/absence of various deposits related to the cratering process [1]. For Ganymede, USGS maps published at 1:5M have utilized this method of classification [e.g., 3,4] and defined three categories of relative age based on crater rim degradation. The youngest of the three (c3) is defined by the presence of a sharp rim crest, high relief craters with high albedo ejecta and rays present. An intermediate unit (c2) is defined as having slightly subdued to subdued rim crest with a general absence of bright ejecta. An older unit (c1) is suggested as having a highly degraded rim crest with an absence of ejecta.

Applying the USGS classification scheme consistently to the global map of Ganymede is difficult, becasue image coverage of the surface of Ganymede is inconsistent in terms of lighting angle and resolution. To resolve this issue, the definitions of crater materials for the global map of Ganymede do not take rim degradation into consideration [8]. Instead they rely solely on the presence or absence of ejecta and/or crater rays. Furthermore, an additional class (cu) was added for craters at such low resolution as to be unclassifiable.

Another classification scheme we chose to examine classifies craters based on interior morphology [6-7]. This scheme can be used to examine crater formation mechanisms and lithospheric thickness at different points in the history of Ganymede. This scheme is published online (www.lpi.usra.edu) and contains over 150 craters. We have incorporated this data into our global map database and expanded the classification criteria to the remaining 730 craters in our database. A varying thermal history of the lithosphere would change the initial morphology of impact structures [6]. Mapping structures of different ages could be used to map changes in the lithosphere over time. Schenk [6-8] has reported changes in morphology with time, for example small anomalous dome craters early in Ganymede's history. We have also investigated this using our crater database.

Results: Table 1 presents the total number of craters in the crater database in each class for each of the three classification systems. One item of note is that the scheme we have used for the global map places a majority of craters in the c1 class, while the USGS scheme places the majority in the c2 class. We compared this pattern to USGS quadrangles [4-5] and found the same pattern, giving us confidence that we were applying the criteria consistently with previous mappers. Individual craters were also spot-checked against published maps to ensure consistency.

Schenk	Total	USGS	Total	Global map	Total
AD	25	C1	245	C1	467
CD	96	C2	472	C2	291
CP	485	C3	117	C3	76
Peak	176	CU	51	CU	51
UC	10	Total	885	Total	885

Table 1. Number of craters in each class, for each of the three classification schemes used in the crater database.

The Schenk classification includes anomalous dome (AD), central dome (CD), central pit (CP), and central peak (peak) craters. The majority of the craters in our database are central pit craters.

Anomalous dome craters are not associated with high albedo terrain or rays; they also have higher internal crater densities as compared to central dome craters [6]. This suggests that anomalous dome craters are generally older than central dome craters. Our data also shows this pattern, as there is only one AD crater in the c2 age category, and no anomalous dome craters in the c3 age category. Table 2 lists the average diameter of craters in each global mapping class, divided into the different interior morphology categories. In the first time period, anomalous domes are the largest impact feature on the surface of Ganymede. This continues thought the c2 time period. In the third time c3, the central dome crater class increases by more than 25% on average to become the largest impact feature on the surface, while anomalous domes are no longer present. Another noticeable feature of the table is the consistent average diameters of both the central peak craters and the central pit craters.

References: [1] Wilhelms, USGS Prof. Paper 1348, 1987; [2] Passey, and Shoemaker, in Sats. of Jupiter, 379 1982; [3] Shoemaker et. al., Sats. Of Jupiter, 435, 1982; [4] Guest et.al., USGS Map I-1934, 1988; [5] Murchie and Head., USGS Map I-1966, 1989; [6] Schenk et al., in Jupiter, 427-456, 2004; [7] Schenk, J. Geophys. Res., 98, 7475-7498, 1993; [8] Patterson et. al., LPSC XXXVIII #1098, 2007; [9] Becker et. al., LPSC XXXII, #2009, 2001; [10] Patterson et. al., PGG Mappers Mtg. 2005.

	AD	CD	CP	Peak
c1	92.9±51.2	74.8±22.4	46.1± 11.9	38± 6.7
c2	127.7	75.8±22.7	46.2± 12.3	37.9± 8.8
c3	0	101.2±43.7	49.3± 15.2	36.1± 7.3

Table 2. Average diameter (and standard deviation) of craters in each age category (global mapping scheme), divided by interior morphology class.