CRATER SIZE DISTRIBUTIONS ON CALLISTO: A GALILEO SSI SUMMARY. R. Wagner[1], U. Wolf[1], and G. Neukum[2], [1]Institute of Planetary Research, German Aerospace Center (DLR), Rutherfordstrasse 2, D-12489 Berlin, Germany, [2]Institute of Geosciences, Dep. of Earth Sciences, Freie Universität Berlin, D-12249 Berlin, Germany.

Introduction: Callisto, the outermost icy satellite of Jupiter, shows a surface exclusively dominated by impact features at medium resolution (1-2 km/pxl) [1][2][3]. The SSI camera onboard the Galileo spacecraft which was in orbit around Jupiter from December 1995 to September 2003, imaged Callisto's surface at high resolutions during six close flybys (C3, C9, C10, C20, C20, C30). In this paper we present results from measurements of crater size-frequency distributions (CSFD) in various localities imaged at resolutions down to 7 m/pxl. Topics addressed in this work are (1) whether CSFDs on Callisto are production or equilibrium distributions, (2) if there are variations in crater frequency with angular distance to the apex point of orbital motion, and (3) if there is a general depletion of small craters. Also, we address the issue of possible impactor sources in the Jovian system which is still in debate but as yet still is an unsolved question.

Equilibrium versus production distributions and possible impactor sources: Measurements carried out in the cratered plains show that most CSFDs measured in SSI and Voyager data at larger diameters down to about 5 km are still in production, but can come close to a –2 equilibrium distribution. Hence it is possible to assign relative ages to cratered plains units. Examples are given in *figure 1* measured in SSI target areas G8CSVGRGAP01 (900 m/pxl resolution) and 10CSSMTHPL02 (270 m/pxl). In some areas, e.g. the cratered plains south of the Asgard basin (target area 10CSASGARD01), are in equilibrium (-2 slope) between about 10 and 3 km crater diameter. In target area C3CSCATENA01 (*fig. 1*), a steep distribution is found at diameters smaller than 3 km. This single measurement, however, has to be treated with some caution since it was derived from highly degraded crater ruins. It is uncertain if the features measured here are truly the remains of impact features. Also, it is not clear if these ruins are the remains of primary or secondary craters.

It has been shown by Neukum et al. [4][5] that CSFDs both on Callisto and Ganymede have a shape similar to CSFDs on terrestrial planets. The most straightforward interpretation is that the craters on the icy Galilean satellites were derived mainly from asteroids. On the other hand, Zahnle et al. [6][7] conclude from theoretical modelling that Main Belt asteroids are more or less negligible as impactors in the Jovian system and that craters were created preferably by ecliptic comets. Recently a more important role of members of the Hilda asteroid group has been discussed in creating the smaller craters, emphasizing the impact rate of these bodies could exceed the one of JFCs [8].

Apex-antapex variations in crater frequencies: The SSI camera has completed global coverage of Callisto at least at a resolution of 700 m/pxl to 2 km/pxl. Since Callisto has only a limited number of geologic units at this scale [1][2][3], and since we have shown that CSFDs are production distributions, we could examine possible apex-antapex variations in crater frequency. This was carried out for two cratered plains units, one with a generally higher frequency and one with a frequency generally lower within a factor of 2-3 (*fig. 2*, for a cumulative frequency of craters N>20 km). Our data show no apex-antapex variation in crater frequency and can not account for a factor of about 10 difference in cratering rate between apex and antapex points of Callisto's orbital motion [9]. Similar results were obtained for N>10, N>30 and N>50 km. Two explanations are possible: (1) Craters were created mainly from impactors in planetocentric orbits. (2) Callisto rotates asynchronously. The possible existence of an ocean [10] could favor case 2 even at a very slow synchronous rotation (on the order ot 1-10 Myr), but this seems rather unlikely. Planetocentric impactors have considerably short lifetimes (10 Myr at most) [11]. A continuous source of impactors is therefore required. A scenario has been discussed where planetocentric projectiles can be created by a smaller number of heliocentric bodies destroying small inner satellites of Jupiter [12].

Small crater distributions: At higher resolutions (< 500 m/pxl), slopes of CSFD on Callisto become flatter with decreasing crater size. This has been attributed to a depletion of small craters and, hence, small projectiles [13]. Since this feature is unique to Callisto and is not observed in CSFDs on Ganymede, it must have been caused by geological processes [3][4][5][14]. Sublimation degradation has been inferred as a likely process [15].

Highest-resolution data (15 m/pxl) were obtained for the first time in orbit C21 (*figure 3*). A steep slope was observed at the smallest crater sizes [16][17]. While these craters, at least those outside of clusters, were interpreted as small primary craters by [16] they could also be mostly secondaries from an impact event [17]. Unfortunately, there is no context at lower resolution available for these data.

During the last close flyby (C30), highest-resolution data (4-9 m/pxl) could be taken. Again, missing context produces problems in interpretation. These data also show a steep distributions at small sizes (*fig. 3*). Even with only a limited number of highest-resolution data available, it is most likely that (1) the small crater generally show a steep slope at diameters <150 m and (2) this steep slope could not be seen in other data due to insufficient image resolution.

Summary: (1) Most CSFD at >5 km are production distributions, similar in shape to CSFDs on e.g. the moon. (2) Possible projectile sources are (a) asteroids or (b) ecliptic comets if these latter bodies are collisionally evolved in a similar way as asteroids. (3) Sublimation degradation is responsible for size-dependent crater removal, producing a dark, smooth lag [15]. (4) At least in two target areas (C21, C30), a steep distribution formed at crater diameters <150 m, either mostly from secondary cratering, or from small craters which have not yet been eroded.

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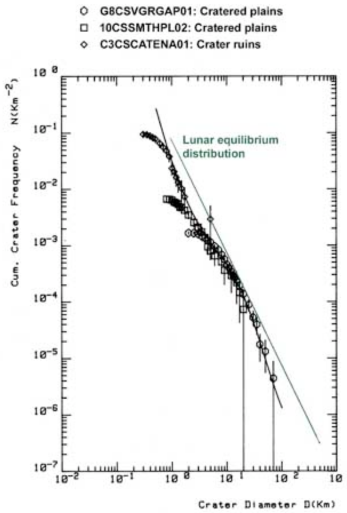

Figure 1: Production distributions in Callisto's cratered plains. Curve shown is the Callistoan production function polynomial [4][5].

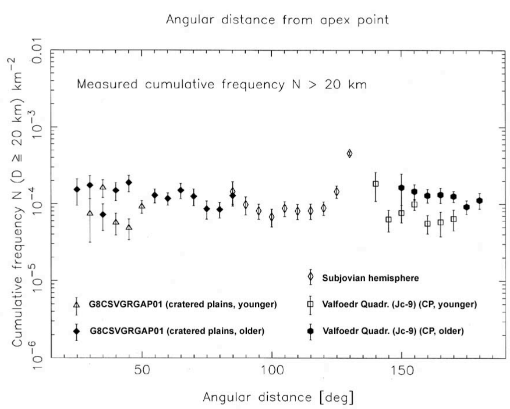

Figure 2: Cumulative frequencies for crater diameters N>20 km dependent of distance to the apex point of orbital motion.

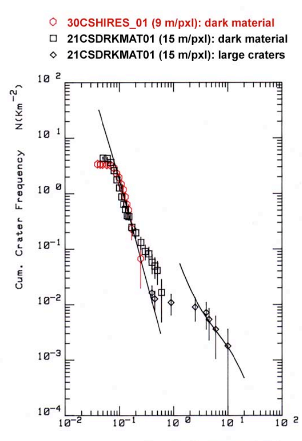

Figure 3: Cumulative distributions measured on highest-resolution data from orbits C21 and C30.