Variability in the Small Crater Population on Callisto. K. E. Williams and R. T. Pappalardo, Laboratory for Atmospheric and Space Physics, UCB 392, University of Colorado, Boulder CO 80309-0392 kaj.williams@colorado.edu, Astrophysical and Planetary Sciences dept. & Laboratory for Atmospheric and Space Physics, UCB 392, University of Colorado, Boulder CO 80309-0392 robert.pappalardo@colorado.edu.

Introduction: There are two important issues involving crater fluxes in the context of Callisto. First, there is the issue of establishing absolute crater fluxes, and several researchers have modeled absolute cratering fluxes of large craters on the Jovian Satellites [1]. Second, and the focus of the present study, is the issue of the lack of small craters relative to other crater sizes on Callisto’s surface. Some researchers [2] have emphasized the lack of craters as regional, considering that the small crater counts in the C21 orbit far exceeded previous small crater counts in other regions. Bierhaus et al. [2] also claim that many of the observed small impacts may in fact be secondary craters.

Other researchers [3] postulate that the smaller craters have been removed by sublimation degradation or by mass wasting/slumping [4] though there is some doubt of the effectiveness of this crater removal mechanism [5]. In sum, there is a lack of a satisfying overall explanation for the apparently widely varying small crater populations on Callisto. Here we examine the available images in order to determine to what extent the small crater population really is varying.

Methodology: There were several Galileo orbits which produced sufficiently high resolution images for identifying small (sub-kilometer) craters: C3, C10, C21 and C30. All four orbits have at least one high resolution image mosaic of sufficient resolution to enable small crater counting. We have made no attempt to omit obvious secondaries. Instead we are attempting to face the secondary cratering issue directly, finding where there are excess small craters, possibly suggesting excess secondaries, or a lack of small craters.

Results: The results of the crater counting are presented as R-plots according to the region (orbit) in which imaged, and are here discussed by orbit.

C3. We examined three image mosaics from the C3 orbit: Catena, Valhalla graben, and Valhalla plains. The Catena image was an inset of an area that spanned a chain of large craters. The R-plot for craters adjacent to the catena (Fig. 1) suggests a lack of craters in size range of 270-700 m. The catena itself has craters approximately 7.6 km in diameter. We believe in this case the catena impact event has essentially reset the nearby surface by burying the smaller craters with ejecta. The smallest crater sizes in this area are probably replenishing as a production population, but the intermediate sizes (270-700 m) have not fully recovered to their levels prior to the crater chain impacts.

Both the Valhalla plains and the Valhalla graben regions appear to be relatively old. However, we see that the R-value of ~0.02-0.03 is still considerably lower than expected for equilibrium (R = 0.22 if equilibrium is assumed ~7% of geometric saturation [6]).

C10. The images from the C10 region are taken from both within and near the edge of the Asgard impact structure. The northernmost imaged area (Fig. 2, “C10 Asgard top”) is just outside of the initial ring structure that surrounds the central palimpsest. Examination here suggests there is an abundance of the smallest sizes measured (~640-1300 m), which plausibly may be due to secondary impacts from Asgard.
The third C10 counting area was near the southern end of the Asgard transect. This region may have been influenced by the Asgard impact less than the previous two areas. The corresponding R-plot (Fig. 2 “C10 Asgard Bottom”) suggests the smallest measured crater (600-900 m) population appears to be recovering from the Asgard impact.

**C21 dark material.** The C21 image of dark material shows many signs of secondary cratering. This observation is consistent with the R-plot as well (Fig. 3), as in the range 100-150 m it appears that small craters are very close to equilibrium. Between 150-3400 m, however, there is an apparent deficit of craters. We note that [2] obtained a very similar plot for C21 small crater population, including the relative minimum for approximately 1 km diameter craters. The C21 region may have been reset by an impact that erased craters <3.4 km in diameter, and the smallest craters in the area have since recovered. Alternatively, the smallest craters represent secondaries.

**C30.** Most of the C30 hires images gave crater distributions that are fairly similar to one another (Fig. 4). C30 high resolution images are interesting in that the R-plot for 50-100 m craters is essentially flat. The value of 0.02-0.03 is below what is expected of equilibrium, and curiously nearly identical to the value found for the Valhalla plains and graben regions.

All the C30 counting regions are relatively depleted in craters of the size range 100-1000 m. The C30 hires03 western (“LHS”) region R-plot is similar to the other C30 high resolution images, but curiously shifted to the right. As with the C21 region, perhaps large impacts have reset these regions which are recovering at small (<100 m) sizes, or the relative abundance of craters <100 m may represent secondaries.

**Discussion and Conclusions:** We note that the plots for C3 Valhalla plains and graben are relatively flat but at a much lower level than the presumed equilibrium value of R = 0.22. It appears that while relative counts for this size interval remain consistent, the absolute crater counts are low. This seems to be consistent with previous claims that posit a lack of smaller craters for C3 in particular [2]. For C10, our results are consistent with other research that acknowledges crater paucity near the influence of the giant impact basins such as Asgard [2]. It is possible that the C21 and C30 regions were reset by large impacts and are now recovering at small sizes (<100 m), or that craters <100 m represent secondaries.

In sum, most regions are depleted in small craters relative to equilibrium. As others have discussed [1], this could mean that small craters are erased by mass wasting, or that there are relatively few small impactors. Some regions (the C3 Valhalla plains and Valhalla graben, and C30 regions) have flat R-plots for small craters, but at values less than expected for equilibrium. The C10 Asgard transect shows an excess of small craters near the basin edge, and suggests that craters are recovering from the Asgard impact farther from the basin.

Given the numbers of nearby impacts of applicable large sizes as well as evidence of secondary impacts, we believe that much of the variability in the small crater population on Callisto can be attributed to both secondary cratering and local resetting events.

**References:**