**GANYMEDE RAMPART CRATERS: THEIR POSSIBLE IMPLICATIONS TO THE ROLE OF SUBSURFACE VOLATILES IN EMPLACEMENT OF MARTIAN LAYERED EJECTA:** Joseph Boyce[1], Nadine Barlow[2], Peter Mouginis-Mark[1], and Sarah Stewart[3], [1]Hawaii Institute of Geophysics and Planetology, University of Hawaii, Honolulu, HI, 96922; [2]Depth. of Physics and Astronomy, Northern Arizona University, Flagstaff, AZ, 86001, [3]Dept. of Earth and Planetary Science, Harvard University, Cambridge, MA, 02138.

A 30 + year controversy has raged over the emplacement mechanism of layered impact crater ejecta on Mars that centers on the role of volatiles and from where those volatiles are derived. Most current models propose that the volatiles were derived either from the target materials, the atmosphere, or some combination of both (e.g., 1-7). Ganymede may provide some tantalizing insight into this controversy. It has layered ejecta impact craters, abundant crustal volatiles, but lacks an atmosphere. Previous investigators have described lobate, layered ejecta craters on Ganymede, attributing their morphology to the affects of volatiles in the target [e.g., 8-14]. However, no ramparts like those at the distal edges of nearly every Martian layered ejecta craters deposit were reported in these studies.

We have re-examined Galileo and Voyager images of Ganymede specifically to search for rampart craters. We have found 17 (in the size range of ~ 8-100 km dia.) fresh crater that have layered ejecta craters with ramparts (Figure 1) similar to layered crater types on Mars [13]. However, all of these craters are located on Ganymede's grooved terrain.

The average width of ramparts ($W_{av}$) around the Ganymede SLE craters is $W_{av}$ = $\sim 0.14\ D^{0.95}$, compared with $W_{av} = \sim 0.1\ D^{1.01}$ for Martian craters [14]. Our measurement of ejecta mobility (EM) and lobateness ($\Gamma$) of these craters is generally consistent with that in the large database of [15]. For example, EM of Ganymede ejecta is EM = ~ 1 for SLE craters, and inner ejecta layer of MLE crater, and EM = ~ 2 for the outer ejecta layers of MLE craters. This is lower than for Martian craters and consistent with predicted narrower ejecta layers by [16] for a target with high ice content. In addition, [17] found that $\Gamma$ of the SLE craters is ~ 1.17, and for the outer of DLE craters is ~1.11 for the inner layer and ~ 1.06 for the outer layer (statistically the same, but different than for Mars DLE craters that show much higher $\Gamma$ for the outer layer than the inner layer).

Layered craters with terminal ramparts on Ganymede are also found exclusively in the grooved terrain. This may be due to 1) difficulty in identifying low-relief ramparts in the rough, dark heavily cratered terrain, 2) ramparts not forming because of disruption of ejecta flow by the topography [19], 3) random selection affect caused by the limited high-quality image coverage, or 4), a genetic relationship between ejecta fluidization and the tectonically active grooved terrain. In addition, we have examined images of craters on other outer solar system satellites (i.e., Europa, Callisto and Enceladus) and found no rampart ejecta.

We suggest that the presence of layered ejecta with terminal ramparts around Ganymede craters that are morphologically similar to that of Martian layered ejecta most likely indicates that both ejecta deposits have been emplaced through similar processes. Considering the absences of an atmosphere on Ganymede and assuming that the ejecta emplacement processes are the same on both bodies, an atmosphere appears to not be necessary for production of layered ejecta. Therefore, we suggest that these results support the idea that suggests that subsurface properties rather than atmospheric properties dominate the formation of rampart structures.

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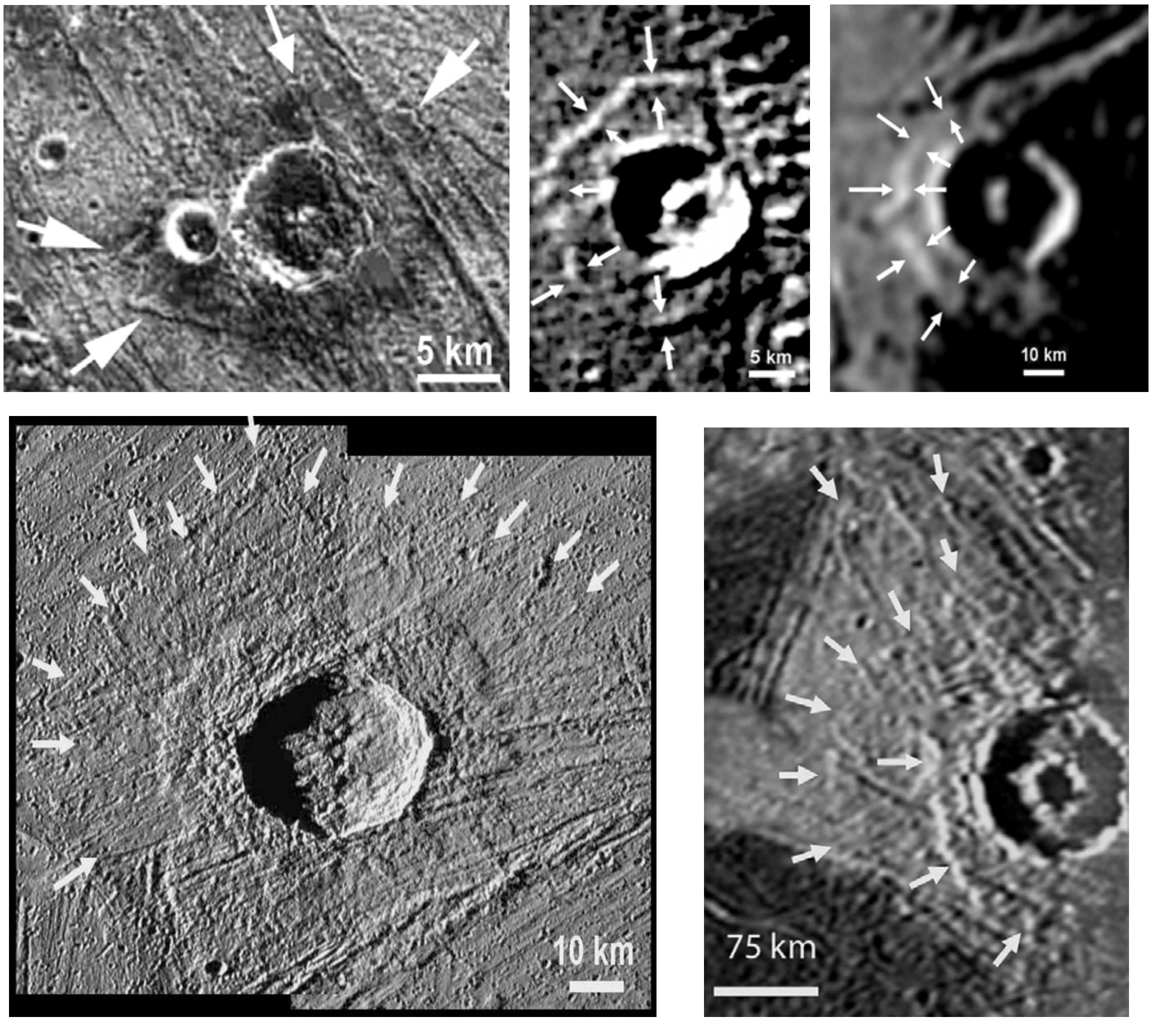


**Figure 1**: Rampart Craters on Ganymede *(arrows point to ejecta layers). Image at top left is of the SLE crater Nergal (8 km diameter, 39ºN, 201ºW) showing lobate ejecta deposits with terminal ramparts (~ 1 km wide) similar to those of Martian SLE craters. The image at the top middle is an unnamed 15 km diameter SLE crater with terminal ramparts that are ~ 2 - 2.5 wide. The unnamed SLE crater on the top right (54ºN, 48ºW) is ~ 34 km across with a rampart ~ 3.5 - 4 km wide. The mosaic at the bottom left is of the crater Achelous (63ºN, 12.5ºW), a DLE crater with a thick pedestal-like inner layer, and thin outer ejecta layers with V-shaped rampart (~ 1 km wide). The crater on the bottom right is Ta-urt (27ºN, 56ºW), a ~ 100 km diameter MLE crater.*