UNCOVERING GANYMEDE'S PAST: CRATER SIZE FREQUENCY DISTRIBUTIONS ON NIPPUR/PHILUS SULCI.

L.M. Burkhard[1], E.S. Costello[1,3], M.E. Cameron[2] [1]University of Hawaii, Honolulu, HI [2]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA [3]Hawaii Institute of Geophysics and Planetology, Honolulu HI.

Introduction: Crater counts and size frequency distributions can be used to define the relative ages of terrains and their individual geologic units. Using the base maps produced by Cameron et al. [1] and stitching high-resolution *Galileo* Solid State Imaging (SSI) camera images [2] onto the base map, we digitized more than 15,000 craters between 60°S-60°N on Ganymede down to 100 m in diameter. Our overall cumulative size frequency distributions for Ganymede fit previous crater density measurements on Ganymede and Callisto [3]. Here, we investigate the area of Nippur/Philus Sulci (36.9ºN, 175ºE), where various geologic units align on a single line of longitude, eliminating the need to correct for possible leading/trailing hemisphere disparities. Several crosscutting bands of light terrain in the Nippur/Philus Sulci site's three-frame mosaic with an average resolution of 100m/pixel show varying degrees of tectonic distortion, ranging from smooth and less distorted bands to highly grooved and deformed terrain [4]. The chronology of tectonic activity implied by crosscutting relationships [1,4] is consistent with our findings from analyses of crater densities on each unit.

Methods: During the mapping process for the geologic map of Ganymede published by Cameron et al. [1, 4], a large number of craters were digitized. Using ArcGIS, we expanded and refined the digitized craters to create a database of over 15,000 individual craters (844 at the Nippur/Philus Sulcus site) that could be used to derive cumulative crater size frequency distributions for geologic units of relatively small size. The size and location of craters within the areas of high-resolution *Galileo* SSI camera [2] images of Ganymede stitched into the basemap and sections of the equatorial mosaic 60°S-60°N were mapped. Following the guidelines of the Crater Analysis Working Group [5], we produced plots of cumulative crater size frequency and count errors.

Discussion: The crater counts for Nippur/Philus Sulci (**Figure 1**) demonstrate the effectiveness of this region to determine relative age of individual geologic units. Stretching from North to South, this region offers the opportunity to study four distinctive geologic units. To capture the crater size frequency distributions of each unit, we divided the site into four regions. The produced crater size frequency distributions reveal the relative age of the units within Nippur/Philus Sulci (**Figure 2**).

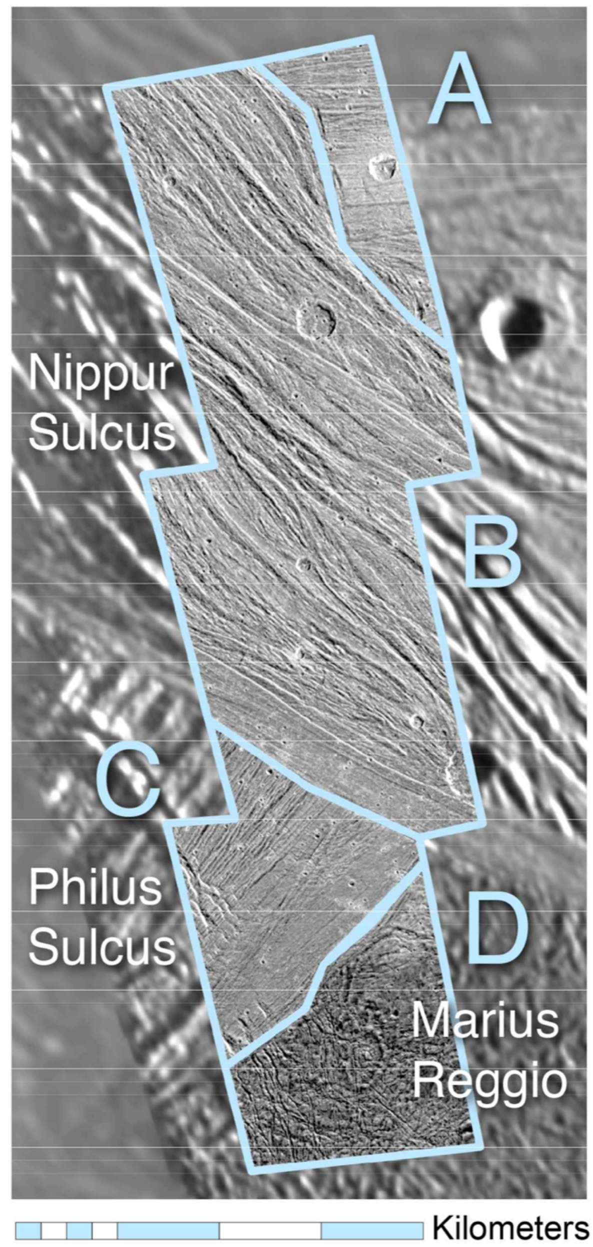

Figure 1. Nippur/Philus Sulci site sectioned into four regions of distinct morphology: section A in the NE, section B covering Nippur Sulcus itself, section C covering Philus Sulcus, and section D covering a dark Marius Reggio terrain. Our counts are complete down to ~300 m diameter craters in this area.

The Nippur/Philus Sulci crater size frequency distribution (**Figure 2**) shows that the southern Marius Regio dark terrain (D) is older than its light northern neighbors, which is consistent with stratigraphic findings. The produced crater size frequency distributions also support the inferred three main stages of tectonic deformation identified by Cameron et al. [4], affirming that unit D was furrowed during the initial deformation period (stage I). The prominent unnamed strained crater in unit D suggests that during stage II, possible right-lateral shearing could have affected the region and formed unit A through normal faulting. The tectonic deformation analysis concludes that unit B was formed during stage III, which is also evident in the crater size frequency distribution analysis presented. Unit C contains furrows trending NE-SW (whereas the youngest domains trend more NW-SE), containing offsets of drag features along a simple shear axis and a few direct indicators of strike-slip tectonism such as *en echelon* structures [4]. This makes area C difficult to date and place in a tectonic analysis. Our crater counts ranging from 400 - 900 m in diameter (**Figure 2**) indicate that terrains C and A are of similar age. As our crater analysis is in excellent agreement with previous studies of the sequence and formation of tectonic events, we can use our method to expand upon the inferred history of Ganymede.

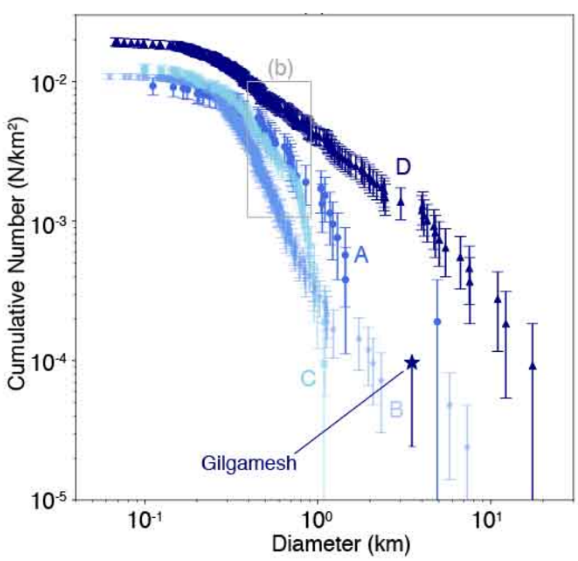

Figure 2: Crater size frequency distributions for areas A, B, C, and D of the Nippur/Philus Sulcus site. a) It is apparent from its NE offset that the dark Marius Regio terrain D is oldest. For comparison, the crater density of the Gilgamesh Basin ejecta (Schenk et al. 2004, Table 18.1) is plotted. b) The diameter range from 100 - 500 m shows how terrains A and C are of similar age.

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