GLOBAL GEOLOGIC MAP OF EUROPA. T. Doggett[1], P. Figueredo[1,*], R. Greeley[1], T. Hare[2], E. Kolb[1], K. Mullins[2], D. Senske[3], K. Tanaka[2] and S. Weiser[1], [1]School of Earth and Space Exploration, Arizona State University, Tempe, AZ, [2]U.S. Geological Survey, Flagstaff, AZ, [3]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, (*currently at the ExxonMobil Research Company, Houston, TX).

Introduction: Europa, with its indications of a sub-ice ocean, is of keen interest to astrobiology and planetary geology. Knowledge of the global distribution and timing of Europan geologic units is a key step for the synthesis of data from the *Galileo* mission, and for the planning of future missions to the satellite.

The first geologic map of Europa [1] was produced at a hemisphere scale with low resolution *Voyager* data. Following the acquisition of higher resolution data by the *Galileo* mission, researchers have identified surface units and determined sequences of events in relatively small areas of Europa through geologic mapping [2-6] using images at various resolutions acquired by *Galileo*'s Solid State Imaging (SSI) camera [7]. These works [2-6] provided a local to sub-regional perspective and employed different criteria for the determination and naming of units. Unified guidelines for the identification, mapping and naming of Europan geologic units were put forth by [8] and employed in regional-to-hemispheric scale mapping [9,10] which is now being expanded into a global geologic map.

Methodology: A global photomosaic [11] of *Galileo* and *Voyager* data was used as a basemap for mapping in ArcGIS, following suggested methodology of allo-stratigraphy for planetary mapping [12]. Due caution was exercised given that the mosaic has a resolution varying from 12.6 to 0.23 km per pixel, as well as variations in illumination and viewing geometry, to avoid making distinctions between units that are artifacts of these variations. In areas of high resolution coverage, contacts were marked as definite, and left as queried in areas of low resolution coverage. The cut-off between these two mapping regimes is a resolution of 1.7km/pixel.

Material Units: The following units have been defined in global mapping (Figure 1), and are listed in stratigraphic order from oldest to youngest:

Ridged Plains Material (unit p_1). Forms globally extensive plains that appear smooth at regional or global resolution, but are intensely ridged at higher resolution. Characterized by cross-cutting ridges and troughs at multiple scales, with various geometries including arcuate, sinuous and anastomosing. It is disrupted in some localities by pits and domes and is sparsely cratered.

Argadnel Regio Unit (p_2). In Argadnel Regio the ridged plains unit is disrupted by wide cycloid lineaments and "wedges" to a degree that warrants a definition as a separate, younger plains unit.

Dark Plains Material (unit p_3). Has three occurrences: at the north pole, and in two equatorial regions centered on the sub-Jovian and anti-Jovian points respectively. It embays surrounding plains (p_1, p_2) units, but is cross-cut by numerous lineaments continuing from adjacent units. At low resolution, the inter-ridge areas are filled with dark material; a high resolution image at the north pole (E25POLE01) shows the inter-ridge areas to be chaos-like. Whether the ridges cross-cut a previously formed chaos region, or simply resisted break-up into chaos, is unclear.

Lineaments. Distinct from the densely spaced ridges in p_1 are the widely spaced lineaments that consistently cross-cut younger plains units (p_1, p_2 and p_3). These lineaments appear to represent a middle period of the geologic time represented by Europa's current surface, with some lineaments being overprinted by younger chaos and plains units, and all but two craters (the exceptions being Tyre and Callanish, which have some superimposed lineaments).

Disrupted Plains Material (unit p_4). Forms a hummocky terrain which is cross-cut by narrow lineaments, mostly troughs. It has a sharp contact with surrounding plains units (p_1 and p_3), which it embays, and a sharp contact with the chaos unit that in turn embays it. Triple bands coming from surrounding plains become obscured within the unit, transitioning to narrow troughs or fading altogether.

Lenticulated Plains Material (unit p_l). Forms regions where a plains unit (p_1 or p_2) acts as a matrix upon which lenticuale have been emplaced. No craters are observed within the lenticulated plains, consistent with a young age, or simply too little areal coverage. It is either younger or contemporaneous with p_3, p_4 and chaos units. It is cross-cut by most, but not all, lineaments. They can either be younger or contemporary to more continuous chaos units, and were called micro-chaos in some regional mapping [3].

Chaos Material (unit ch). Disrupted terrain which forms dark albedo features in global or regional resolution, having sharp embaying contacts with brighter, smoother plains units. In low resolution can also have transitional areas of dark albedo spots in a light albedo matrix, but this could also be equivalent to what has been mapped as lenticulated plains in high resolution. At higher resolution the chaos is seen to be hummocky plains, with plates of younger plains units in a matrix of dark, knobby material. This unit has several separated occurrences globally, with different appearances, but nothing that could not be explained by differences in photometry and resolution within the base mosaic. Chaos is younger than all surrounding material units, with some cross-cutting lineaments. A sub-type is elevated or knobby chaos that is younger than other chaos units [9, 10].

References: [1] Lucchitta and Soderblom, in *The Satellites of Jupiter*: 521, 1982; [2] Senske et al., *LPSC* XXIX, #1743, 1998; [3] Prockter et al., *JGR., 104*: 16531-16540, 1999; [4] Kadel et al., *JGR*, 105, 22657-22669, 2000; [5] Figueredo et al., *JGR*, 107, 10.1029/2001JE001591, 2002; [6] Kattenhorn, *Icarus*, 157, 490-506, 2002; [7] Belton et al., *Space Science Reviews*, 60, 413-455, 1992; [8] Greeley et al., *JGR*, 105, 22559, 2000; [9] Figueredo and Greeley, *JGR*, 22629-22646, 2000; [10] Figueredo and Greeley, *Icarus*, 167, 287-312, 2004; [11] USGS, I-2757, 2003; [12] Skinner and Tanaka, *LPSC XXXIV*, #2100, 2003.

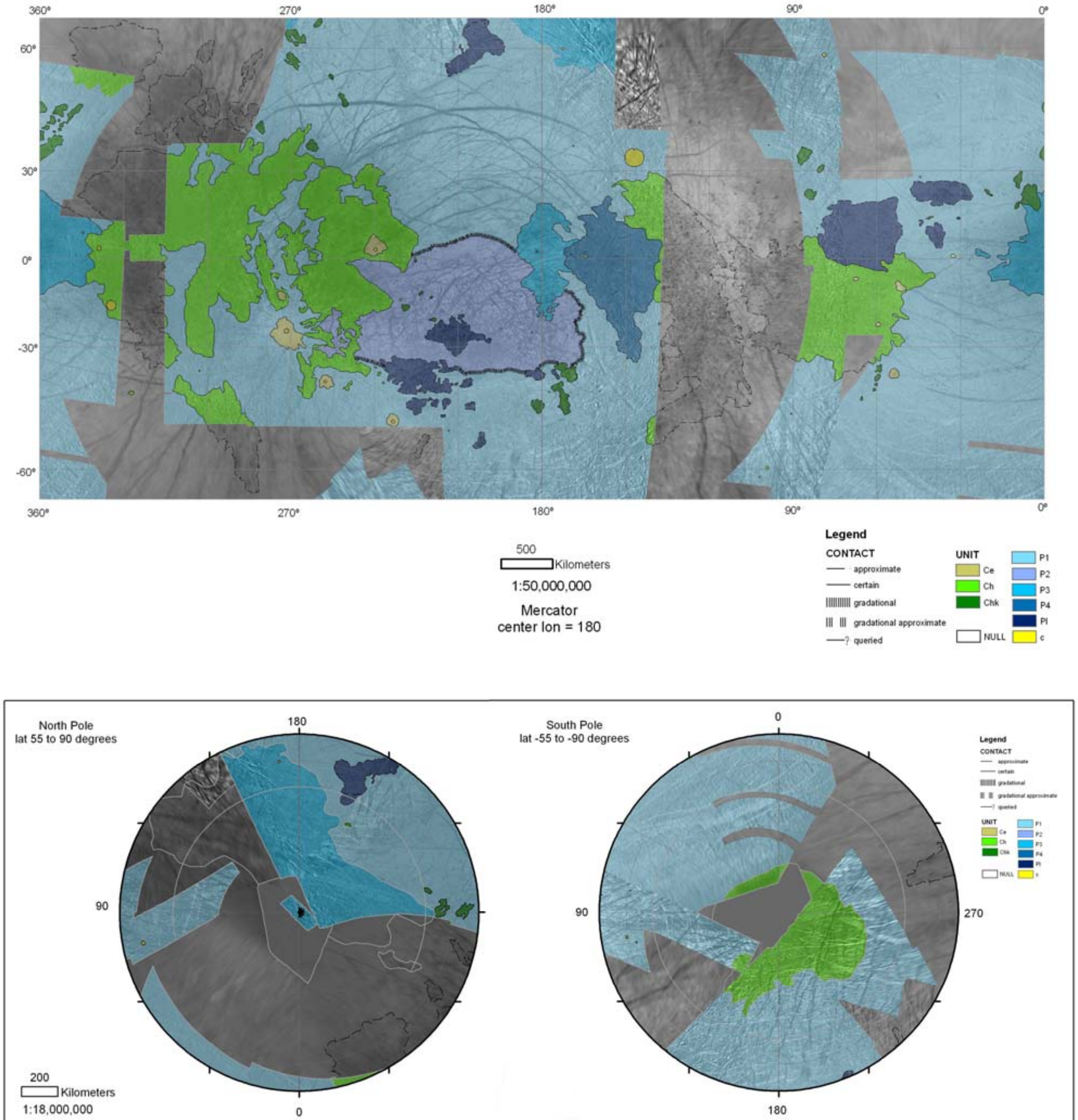

Figure 1: Global geologic map of Europa.