Stratigraphy of Ganymede's light terrain: a case study at Mummu and Sippar Sulci. N. R. Baby[1], K. Stephan[1], R. J. Wagner[1], T. Kenkmann[2], N. Schmedemann[3] and E. Hauber[1]. [1]Institute of Planetary Research (DLR), Berlin, Germany (Email: Namitha.Baby@dlr.de); [2]University of Freiburg, Freiburg, Germany; [3]University of Muenster, Muenster, Germany.

Introduction: In order to better understand the formation of Ganymede's bright (or light) tectonically resurfaced terrain and possible interaction with a subsurface ocean, its investigation has been made one of the top goals of the upcoming JUICE mission [1]. In preparation of the JUICE mission, we investigate the currently available imaging data returned by the cameras aboard Voyager and Galileo covering Ganymede's light terrain with sufficient spatial resolution. Our focus lies on (1) the definition and characterization of the tectonic subunits/cells of the light terrain including its contact to the neighboring dark terrain and (2) their stratigraphic relationship to each other. Our goal is to study the local formation processes, to identify any changes in tectonic style through time across Ganymede, and also to compare possible differences and similarities of light terrain at different locations.

Study Areas: Galileo SSI observed Ganymede with spatial resolutions up to 11 m/pxl. The areas observed by Galileo SSI which we selected for this study are Mummu and Sippar Sulci (31° S, 175° E). These areas complement our studies of 1) Byblus and Nippur Sulcus (39°N/160°E and 49°N/157°E), 2) Arbela Sulcus (15°S/13°E), 3) Harpagia Sulcus (16°S/50°E) as presented in [2].

Geologic Mapping Results: The geologic mapping procedure using ArcGIS and the naming/categorization of various geological units follows previous studies [3, 4] but are modified where necessary due to the higher resolution of the Galileo SSI images. Based on the prominence of grooves and their orientation, the light terrain can be subdivided into four main terrain units: light grooved terrain (lg), light subdued terrain (ls), light irregular terrain (li) and an undivided region. Each of these light terrain units are further classified into 3 main categories based on the principle of cross-cutting relationships. The Category 1 (lg_1, ls_1 and li_1) contains light terrain units, which are crosscut by all other light terrain units. The Category 3 (lg_3, lg_3 and li_3) contains those light terrain units, which crosscut all adjacent light terrains. The Category 2 (lg_2, ls_2 and li_2) contains those light terrain units, which crosscut the Category 1 terrain units and are crosscut by Category 3 units [3].

Figure 1 shows a detailed geologic map for Mummu and Sippar Sulci located in the anti-Jovian hemisphere. The mapped units are characterized by grooves and ridges ranging from sharp edged (grooved and irregular terrains) to faint ones (subdued terrains). The detailed mapping enabled to investigate the light terrain on a more local scale. Here, about 28 terrain units have been mapped and about 7 pateras could be identified.

Stratigraphic Relationships: The stratigraphy of light terrain units is based on the application of the principle of cross-cutting relationships [3]. In addition, measurement of relative geologic ages of the mapped units have been performed by crater counts using the ArcGIS plug-in Crater tool and the IDL procedure Crater stats [5] (Fig. 2). In case of the study area special care has to be taken during the crater counting process because of the numerous secondary craters originating from bright ray crater [6].

The stratigraphic comparison of mapping and crater counting of Mummu /Sippar Sulci shows partly conflicting results: the narrow NE-SW striking band that bifurcates in the western part in Figure 1 crosscuts all other geological units and is consequently mapped as the youngest terrain (ls_3) followed by pateras, which are being crosscut by ls_3. However, according to our crater counting results (Fig. 2), ls_3 shows an age similar or slightly older than the adjacent crosscutting terrains like lg_2(3) and lg_1. A similar discrepancy is also observed for the adjacent terrains lying south of ls_3, where the terrain li_1 is the youngest in crater-counting age and lg_2(5), li_1(2) are older in age and lg_2 of the same age (Fig. 2a). Apart from the light terrains, Ganymede's unique reticulate terrains, whose formation and association with the light terrain is still in question [4], are older than ls3.

Discussion: Our results generally confirm previously described stratigraphic relationships [3, 4]. Particularly, the light subdued terrains which are thought to be formed in the earliest stages of light terrain formation and were possibly affected by cryovolcanism [7]. They are always found associated with light grooved terrains (Fig. 1). Among the light terrains mapped so far [2], the light subdued terrains show an age equal to, or greater than light grooved/irregular terrains. However, in Mummu/Sippar Sulci this terrain (ls_3) appears to be the youngest terrain derived from cross-cutting relationships (Fig. 1). This, however, contradicts the crater counting results of this area (Fig. 2a). Here, ls_3 seems to be older with respect to lg_2(3), lg_1 and li_1. Maybe, surficial processes may have eroded preexisting craters. However, it cannot be excluded that secondary craters significantly affect the crater counting results and cause ages, which are too high [6]. Possibly, (i) the mapped units have been formed in a time interval too short, so that a chronological classification is no longer possible due to the crater density. Currently, we also are testing to what extent the size of the study area influences the relative ages determined. Still, this does not explain the differences in age and stratigraphic position of the subdued terrains in the areas studied so far (Fig. 2b). In order to evaluate the differences in the relative ages of similar terrain types at different locations on the body in more detail, our further work will also include the position of the studied regions with respect to Ganymede's apex/antapex [8].

References: [1] Stephan, K. et al. (2021) *PSS*. 208, 105324. [2] Baby, N. R. et al. (2021) EPSC abstracts, #EPSC2021-352. [3] Patterson, W et al. (2010) *Icarus*, 848-867. [4] Collins, G. C. et al. (2013) USGS Sci. Inv. Map #3237. [5] Michael, G.G. et al. (2010) *EPSL*, 294 (3-4), 223-229. [6] Wagner, R. J. et al. (2018) EPSC abstracts, #EPSC2018-855. [7] Pappalardo, R. T. et al. (2004), *CUP*, 363-396.

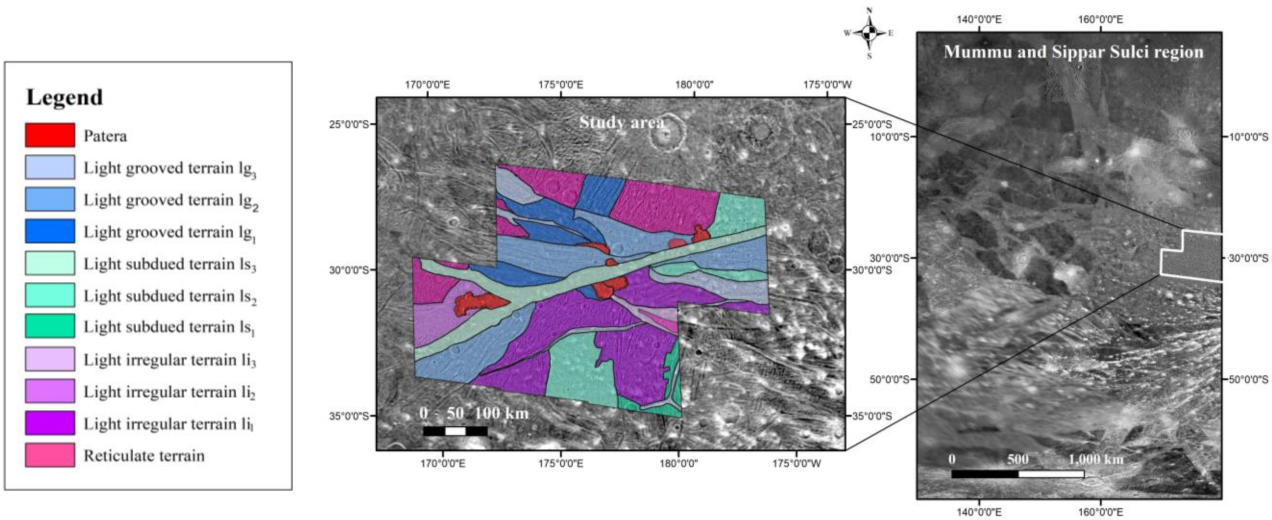

Figure 1: Geological map of Mummu/Sippar Sulci region based on the sequence of Galileo SSI images (G8GSCALDRA01).

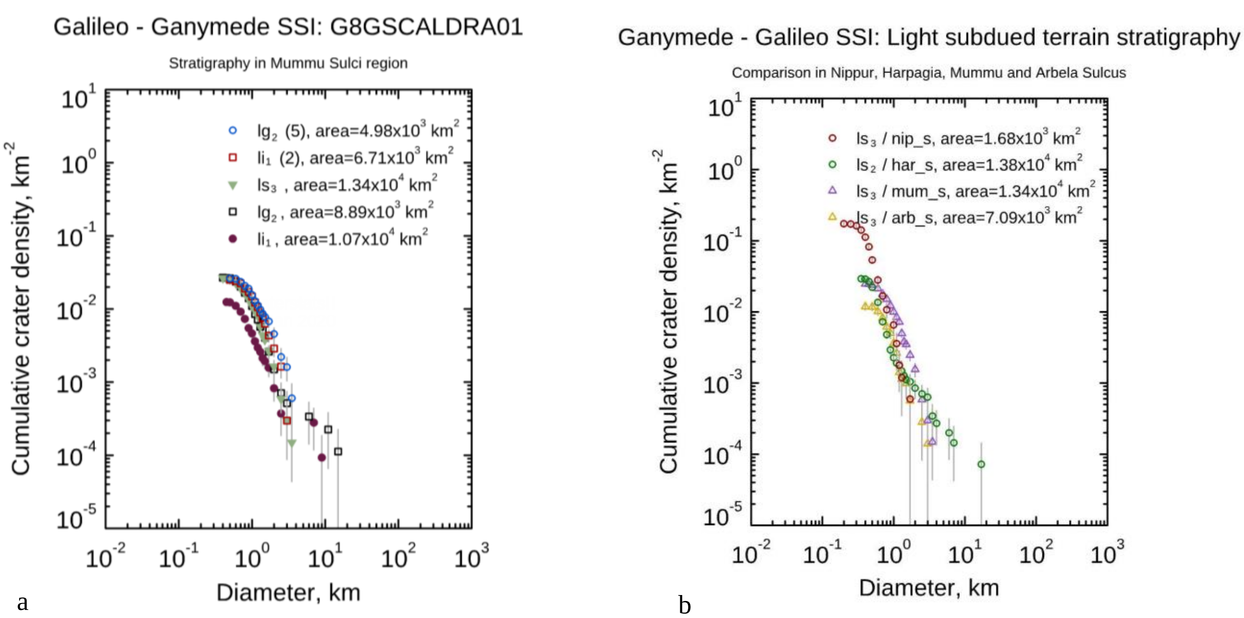

Figure 2: a) The cumulative crater size-density plots for the mapped units of the light terrain in Mummu and Sippar Sulcus including the light subdued terrain ls_3 (green) and four terrains lying below ls_3. The four terrains are: Light irregular terrain li_1 (brown), light grooved terrain lg_3 (black), light irregular terrain li_1(2) (red) and light grooved terrain lg_2(5) (blue) and b) comparison of cumulative crater size-density plot for the light subdued terrains in Nippur (red), Harpagia (green), Mummu (purple) and Arbela (yellow) Sulcus regions from [2].