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Comparison of ice particle size variations across Ganymede and Callisto

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Ratios of band depths of different H_2O ice absorptions as measured by the Near Infrared Spectrometer NIMS onboard the Galileo spacecraft [1] have been found to be semi-quantitative indicator of changes in the particle size of ice across the surfaces of the Jovian satellite Ganymede [2]. This method is now applied to Ganymede's neighboring satellite Callisto. On Ganymede, sizes reach from 1 μm near the poles to 1 mm near the equator [2]. Smallest particles occur at latitudes higher than $\pm 30^\circ$ where the closed magnetic field lines of Ganymede's magnetic field change into open ones and Ganymede's polar caps become apparent. Thus, the formation of these polar caps has often been attributed to brightening effects due to plasma bombardment of the surface [3,4]. Callisto, which does not exhibit an intrinsic magnetic field, however, also shows the same trend as observed on Ganymede with slightly larger particle sizes on Callisto than on Ganymede at low and mid latitude but similar particle sizes in the polar regions. Similar trends in the particle size variations on Callisto and on Ganymede imply that these variations are caused by similar surface processes. Our measurements rather point to a continuous decreasing of ice particle sizes toward the poles on both satellites related to changes of the surface temperatures [5]. Maximum temperatures during the day reach 150 K and 165 K near the equator of Ganymede and Callisto [6, 7], respectively and sublimation of ice particles and crystal growth [8] is expected to be the dominant surface process in these regions. In contrast, polar temperatures do not exceed 80 $\pm$ 5 K [5]. Larger particles in the equatorial region of Callisto than on Ganymede could be explained due to the slight higher maximum temperature but also a longer Callistoan day (Callisto: $\sim$ 17 Earth days; Ganymede: $\sim$ 7 Earth days).

References:
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