[EE] Evening Poster | P (Space and Planetary Sciences) | P-PS Planetary Sciences

[P-PS01]Outer Solar System Exploration Today, and Tomorrow

convener:Jun Kimura(Osaka University), Yasumasa Kasaba(Dep. Geophysics Graduate School of Science Tohoku University), Steven Vance(Jet Propulsion Laboratory, Caltech, 共同), Kunio M. Sayanagi (Hampton University)

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The giant planets provide many keys to understanding planetary processes. They play an important role in shaping our solar system, and the physical and chemical processes they harbor also provide a unique opportunity to study the phenomena relevant for studying
Earth and other planets, including exoplanetary systems. In this session, we discuss a wide range of topics encompassing the giant planets and their moons, including their origins, interiors, atmospheres, compositions, surface features, and electromagnetic fields. To advocate for current and future outer planets exploration (Cassini, Juno, New Horizons, JUICE, and beyond), we also call for discussions on future missions to explore giant planet systems, including how to develop better international cooperation. Discussion in this latter category will include progress in developing a solar sail mission concept for observing the Jupiter system and its trojan asteroids.

[PPS01-P04]Ganymede's volume expansion in the intermediate stage : Clues to temperature change and phase change of ices.

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Surface features could provide important constraints on the interior dynamics of solid planetary bodies. Voyager and Galileo spacecrafts have revealed a wide variety of surface geomorphologic features exist on the surface of icy moons. On Ganymede, younger geologic units, Bright Terrain, tectonically divide relatively older units, Dark Terrain. Bright Terrain is composed of stratigraphic units with coherent parallel ridges and troughs, Grooves, which are considered to have been formed due to extensional stress (Pappalardo et al., 1998). The formation age of Grooves is estimated about 2 Gyr ago using impact crater size and distribution analysis (Zanhle et al., 2003). From the stratigraphic analysis, the origin of extensional stress would be a volume increase (5-8%), which implies a global expansion event during the intermediate stage in the history of Ganymede. (Collins et al., 1998, 2008). Differentiation, freezing of the liquid ocean and silicate dehydration would be strong candidates for the volume expansion (Squyres and Croft., 1986). However, these events would have occurred in the early stage of evolution and thus it would be inconsistent with geologic age. Therefore, another process must be needed.

We focus on the thermal evolution of the solid icy shell. Ganymede's ice shell can be divided into the upper elastic lithosphere and lower plastic asthenosphere due to the large viscosity contrast. In the lithosphere, thermal expansion coupled with thermal evolution could generate surface stress through entire evolution (Zuber et al., 1984). The asthenosphere is composed of high-density ices (ice II, ice III, ice V and ice VI) (Schubert et al., 1986). Phase change between high-density ice and low-density ice such as ice II to ice Ih could generate large amount of volume expansion. Detailed thermal profile and its temporal change, especially in the lithosphere where the temperature decreases drastically toward surface, are critical for the

evaluation of origin of the volume expansion.

Here, we are going to show the results of numerical simulation for thermal evolution, and discuss about accumulated stresses of elastic lithosphere especially during intermediate stage of Ganymede. In our simulation of thermal evolution based on the mixing length theory, the largest contribution to the volume expansion is associated with phase change of Ice２ to IceIh which overcomes the volume decreases due to growth of high-density ices. Our results indicate that phase change of ices generates enough volume increase during the intermediate stage and therefore we consider it as a plausible origin of Grooves.