Thermal evolution and stability of subsurface ocean in Pluto

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NASA's New Horizons spacecraft made its close flyby of the dwarf planet Pluto on July 14, 2015. The LORRI imaging system aboard spacecraft has acquired surface images and unveiled a diverse range of landforms, from rugged mountainous region to extremely smooth plains, indicating geological processes that have modified the surface substantially and recently. Accurate determinations of Pluto's radius from different images suggest that Pluto is almost perfectly spherical and had or has a relatively warm interior (maybe an ocean) for the most part of its history.

The New Horizons spacecraft has confirmed that N_2, CH_4 and CO ices are enriched in the heart-shaped bright smooth plains, e.g., Sputnik Planitia (SP). In parallel, water ice is widely distributed on Pluto, in particular, on rugged mountainous region and normal faults having relatively older age than SP. It implies that Pluto is covered by huge amount of water ice and few-km thickness nitrogen presents above water ice “bedrock” based on the molecular abundances in the Solar System.

Assuming the Pluto’s interior consists of two components, water and rock, and completely differentiated state, we find that a high-pressure ice layer could appear at the bottom of the water layer in case of a denser (smaller) rock core according to the Pluto’s bulk density. Here we are going to show the results of numerical simulation for the thermal history in Pluto considering various interior structures and initial thermal states, and to discuss this dwarf planet far away from the Sun could have a potential to harbor an ocean.

