[JJ] Evening Poster | M (Multidisciplinary and Interdisciplinary) | M-IS Intersection

[M-IS18]Aqua planetology

convener:Yasuhito Sekine(Department of Earth and Planetary Science, University of Tokyo), Tomohiro Usui(Earth-Life Science Institute, Tokyo Institute of Technology), Hidenori Genda(東京工業大学 地球生命研究所, 共同), Takazo Shibuya(Japan Agency for Marine-Earth Science and Technology)
Tue. May 22, 2018 5:15 PM - 6:30 PM Poster Hall (International Exhibition Hall7, Makuhari Messe)
This proposed session covers a wide range of topics related to aqua planetology, including chemical reactions involving water on planetary bodies, water-rock reactions within planetesimals, distribution of water in the early Solar system and the origin of water on terrestrial planets, hydrological and biogeochemical processes on Earth, geochemical cycles and habitability on Mars and icy moons, exploration of water in the solar system, and theory to understand how to build a habitable aqua planet.

[MIS18-P03]Verification for water in the Mars' interior based on rheological structure

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Keywords:Mars, water, elastic thickness, rheological structure

Although it is suggested that early Mars had water on its surface, there is no stable liquid water on Mars. According to deuterium-to-hydrogen ratios, water may have escaped to space (Villanueva et al., 2015). However, these estimates do not sufficiently explain and therefore it is suggested that Mars has water reservoir in its interior(Carr and Head, 2003). In this study, we investigated possible existence of water in the Mars’ interior inferred from elastic thicknesses. Elastic thickness is roughly equivalent to Earth’s plate and is estimated from topography and gravity. It is also affected by water. We calculated respective elastic thicknesses under dry and wet conditions about 13 areas which had been estimated elastic thicknesses by topography and gravity. We compared resultant values with observed values (McGovern et al., 2004), then we verify presence of water in the Mars’ interior.

We estimated rheological structure to determine elastic thickness. Rock strength in brittle and ductile deformation regions was determined from the frictional strength (depending on pressure) and flow laws (depending on composition and temperature), respectively. Under wet conditions, we assumed pore pressure and decrease of frictional coefficient in brittle regions and intracrystalline water in ductile regions. We applied diffusion creep, dislocation creep and Peierls creep in ductile regions. We calculated temperature profiles from the concentration of radioactive isotopes and their half-time. Ages are determined by the crater chronology.

Consequently, the younger they are, the thicker elastic thicknesses are in general. In the case of younger areas, values under dry conditions are consistent with observed ones. However, values under wet conditions are more consistent in older areas. Therefore, it is suggested that older areas (especially formed in Noachian) were under wet conditions when they are formed.

If there had been plate tectonics on early Mars (Sleep, 1994), subduction by plate tectonics had carried water into the Mars’ interior and there were much water there in Noachian. However, plate tectonics stopped and no more water carried into the interior. Water decreased by degassing, then there were little or no water.