Formation condition of oceans under hydrogen-rich atmospheres

*Keiko Hamano[1], Hidenori Genda[1], Yutaka Abe[2], Masanori Onishi[3]

1. Earth-Life Science Institute (ELSI), Tokyo Institute of Technology, 2. Department of Earth and Planetary Science, University of Tokyo, 3. Graduate school of natural science and technology, Okayama University

The formation of oceans requires thermodynamic conditions allowing the presence of liquid water on planetary surface. Such conditions have been explored under CO_2-H_2O atmospheres, while early atmospheres may contain some amount of H_2. Pierrehumbert and Gaidos (2011) showed that collision induced absorption of tens bar of H_2 atmospheres can keep a surface temperature above 280 K beyond a habitable zone.
Adding hydrogen to a steam atmosphere increases atmospheric scale height. Given that a partial pressure of water vapor at the surface is equal to its saturation pressure, a column mass of water vapor would increase. This means that a larger amount of water is required to keep a sufficient partial pressure for ocean formation.

In this study, we investigate atmospheric structure of an H_2-H_2O atmosphere using a 1D radiative-convective equilibrium model. We present a relation among incident stellar flux, partial pressure of hydrogen, and a total mass of surface water, which is required for an ocean to form.

Keywords: Reducing atmospheres, Formation of oceans, Early surface environment, Habitable zone

