Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

PPS21-P17 会場:コンベンションホール 時間:5 月 20 日 18:15-19:30

太陽系外惑星系のウォーターワールド・レジームにおける水惑星の進化
Evolution of planets with oceans within the Water World Regime around a main sequence star

福島 俊 [1*], 門屋 辰太郎 [1], 田近 英一 [2]
Satoshi Fukushima[1*], Shintaro Kadoya[1], Eiichi Tajika[2]

[1] 東京大学理学系研究科地球惑星科学専攻, [2] 東京大学大学院新領域創成科学研究科複雑理工学専攻
[1]Department of Earth and Planetary Science, The University of Tokyo, [2]Department of Complexity Science and Engineering, The University of Tokyo

The Habitable Zone (HZ) around a main sequence star is the orbital condition in which planets could have liquid water on their surface, although greenhouse effect of the atmospheres due to some greenhouse gasses (e.g., CO_2) is generally required. On the other hand, we propose here the Water World Regime (WWR) which is the orbital condition for the planets to have liquid water even if the planetary atmospheres do not have any greenhouse gasses except water vapor.The WWR is therefore much narrower condition than the HZ, estimated to be an annual mean insolation from 1.07 to 1.41 S_0 (where S_0 is the solar constant for the present Earth). Most of the WWR condition is, however, under the moist greenhouse condition in which water should escape to space during the planetary evolution (e.g., Kasting, 1988). The time scale of water loss should therefore be discussed for the planets with different amount of H_2O and XUV from the central stars.

We estimated life time of oceans on the planets orbiting within WWR by assuming water loss due to hydrogen escape by diffusion-limited (Hunten, 1973 ; Walker, 1977), and energy-limited water loss mechanisms (Watson et al., 1981), with considering steller luminosity evolution (Gough, 1981 ; Iben, 1967), and steller EUV evolution (Lammer et al., 2009).

We will show that the life time of oceans may be longer than that considered generally. For example, if the Earth is orbiting within the WWR around a M-type star and has liquid water of 5 times the amount of ocean today, liquid water may be able to exist for 10 billion years.

キーワード: 系外惑星
Keywords: Extrasolar planet