CORELESS EARTH-MASS EXOMOON OF AN EGP. P. Futó[1] & A. Gucsik[2,3], [1]Csorna, 15 Szt. István square, H-9300, Hungary, (E-mail:dvision@citromail.hu); [2]Department of Earth and Planetary Materials Science, Graduate School of Science, Tohoku University, Sendai 980-8578, Japan; [3]Konkoly Observatory of the Hungarian Academy of Sciences, H-1121 Budapest, Konkoly Thege Miklós út 15-17., Hungary

Introduction: In the known planetary systems, different types of satellites may orbit around the extrasolar giant planets (EGPs). Some of these may have a large size and they composed of water ice, moreover, silicate and metallic compounds in their rocky cores. While other types of the satellites are might be terrestrial similarly to the Moon. A giant gaseous exoplanet with masses of 10 $M_{Jupiter}$ or more, is capable of sustaining accretion disks in that an Earth-mass moon could form. According to the other scenario, Earth-size or larger moons could form independently but later they become captured satellites by a massive planet's gravity. In consequence of stellar tides and other gravitational effects, massive moons cannot survive in orbit around Sun-like stars if the semimajor axis of the host planet is less than 0.6 AU [1].

The detectable exomoons with transit method will be especially interesting because from transit light curves the mass of the examined moons can be determined [2] and combining this parameter with the radius data, the average density of the moon is also computable.

In this study, we focused on the silicate composition of a theoretical exomoon model. Following its formation, the giant planet with its satellite-system has migrated from the outer colder region of planetary system into habitable zone of a Solar-type star.

Modeled exomoon: We have numerically modeled a possible Earth-like moon of an EGP using by our theoretical disk model for proto-satellites and considering by properties of the giant planet's satellite-systems in the Solar-System. Titan is the second-largest moon in the Solar-System, after Ganymede. Their masses are 1.3452×10^{23} kg for Titan [3] and 1.4819×10^{23} kg for Ganymede [4] .

The modeled exomoon is a terrestrial-type satellite, which is the same mass as Earth, but it has no metallic core. Such type objects have a thick silicate mantle in which the metallic iron is oxidized by water (FeO) [5] . In our model, the moon's material was fully oxidized before accretion.

Here, we calculate the average surface gravity for this Earth-massive exomoon without core. Furthermore, we assume the plate tectonics on its massive moon-model because in term of the modern geodynamical theories the plate thickness does not depend on the thickness of the convective layer. Hence the plate tectonics might operate efficiently on this planetary body depending on the required geological conditions.

Physical properties for modeled moon: Its calculated radius is about 7008 km (1.1 R_{Earth} with roughly 2% uncertainty) and the obtained average continental lithospheric thickness is 114 km (Fig.1). Calculating the average surface gravity, the obtained value is 8.1 m/s^2 that is 82.5 percent of the Earth average value. It is a reasonable assumption, outside the snowline of a planetary system, that the water (or oxidized iron) fraction in the proto-satellite disks, is likely to be substantial.

Radius of the largest terrestrial objects with no metallic core is roughly 2.1-2.2 R_{Earth} theoretically, but such type planets would not be expected to have magnetic field.

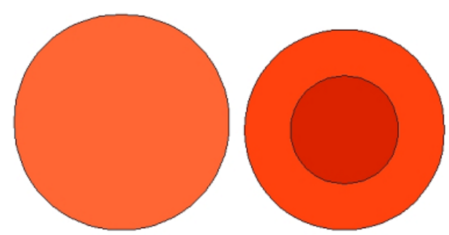

Figure 1. *Schematic model for the 1 Earth-mass coreless exoplanet (R=7008 km) showing with the Earth model representation.*

Summary: There is a great chance of discovery of the massive satellites by space missions such as Kepler (NASA; launched in 2009).Using their observational data, approximate structure models can be calculated concerning the different object-types. Considering the accuracy of calculations, we can more easily constitute models if the existence of giant exomoons will be scientifically identified. In the near future, biomarkers will be detectable on the supposed Earth-like exomoons with transmission spectroscopy.

References:

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