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Possible Habitability of Ocean Worlds

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In the last decade, the number of detected exoplanets has increased to over thousand confirmed planets and more as yet unconfirmed planet candidates. The scientific community mainly concentrates on terrestrial planets (up to 10 Earth masses) in the habitable zone, which describes the distance from the host star where liquid water can exist at the surface (Kasting et al., 1993).
Another target group of interest are ocean worlds, where a terrestrial-like body (i.e. with an iron core and a silicate mantle) is covered by a thick water-ice layer - similar to the icy moons of our solar system but with several Earth masses (e.g. Grasset et al., 2009).
When an exoplanet is detected and confirmed as a planet, typically the radius and the mass of it are known, leading to the mean density of the planet that gives hints to possible interior structures. A planet with a large relative iron core and a thick ocean on top of the silicate mantle for example would have the same average planet density as a planet with a more Earth-like appearance (where the main contributor to the mass is the silicate mantle).

In this study we investigate

1. how the radius and mass of a planet depend on the amount of water, silicates and iron present (after Wagner et al., 2011)
2. the occurence of high-pressure-ice in the water-ice layer (note: we only consider surface temperatures at which liquid water exists at the surface)
3. if the ocean layer influences the initiation of plate tectonics

We assume that ocean worlds with a liquid ocean layer (and without the occurence of high-pressure ice anywhere in the water layer) and plate tectonics (especially the occurence of subduction zones, hydrothermal vents and continental formation) may be called habitable (Class III/IV habitats after Lammer et al., 2009).

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