Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.16945

ON THE LIKELY PREVALENCE OF OCEAN-WORLDS IN M-DWARF SYSTEMS.

LUJENDRA OJHA[1], JACOB BUFFO[2], BRYCE TRONCONE[1], BAPTISTE JOURNAUX[3] AND GEORGE MCDONALD[4]

[1]Rutgers, The State Univesity of New Jersey
[2]Dartmouth College
[3]University of Washington
[4]University of Oregon

Presenting Author: luju.ojha@rutgers.edu

The habitability potential of planets in the circumstellar habitable zone (CHZ) of M-dwarf stars are of great interest because M-dwarf stars make up 75% of the population of stars in the galaxy, and >40% of M-dwarfs stars are expected to harbor exo-Earths in their CHZ. However, key differences between the stellar and planetary environments between M-dwarf stars and the more luminous Sun-like stars have led to a long-standing debate around the habitability of M-dwarf orbiting exo-Earths. Even if the harsh effects of the M-dwarf stellar environment were absent, a significant fraction of the M-dwarf orbiting exo-Earths would still require substantial greenhouse warming for liquid water to be stable on the surface, given their relatively low equilibrium temperature. Another notable, common feature of these planets is tidal locking, possibly leading to an eyeball-like climate state, where most of the planet is frozen, with the exception of the substellar point, where liquid water may exist. In such cold, icy, rocky planets, basal melting may provide an alternative means of forming liquid water in a subsurface environment shielded from high-energy radiation. Basal melting is responsible for the formation of subglacial liquid water lakes in various areas of Earth. Similarly, basal melting of thick ice deposits during the Noachian era [>4 Ga] has been proposed as a potential solution to reconciling fluvial feature generation with the faint young sun paradox on Mars. As such, basal melting may play an equally important role in the habitability of cold, icy exo-Earths. In this work, we demonstrate that basal melting is likely prevalent on M-dwarf orbiting exo-Earths, even with modest, Moon-like geothermal heat flow and that subglacial oceans may persist on exo-Earths for a prolonged period. Our findings suggest that exo-Earths resembling the icy moons of Jupiter and Saturn may be common in the Milky-way galaxy (Fig. 1).

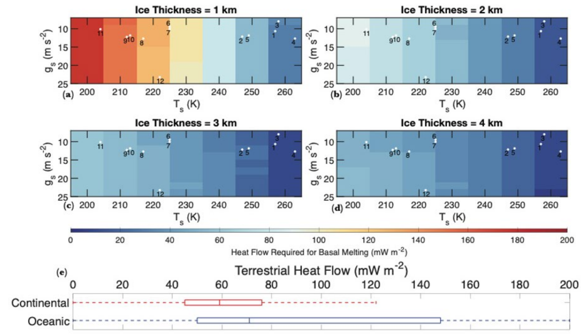

Fig1. Heat flow required for basal melting as a function of surface gravity and temperature for ice sheets 1 – 4 km in thickness. The numbered white dots correspond to the index number of planets in ref [1].

Reference:

[1] Ojha et al. *Nat Comms*, 2022. 13(1): p. 7521.