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► To cite this version:

Artyom Aguchine, Olivier Mousis, Magali Deleuil, Emmanuel Marcq. A self-consistent thermodynamic approach to compute the interiors of irradiated ocean planets. Europlanet Science Congress 2020, Sep 2020, Online, Unknown Region. pp.EPSC2020-610, 10.5194/epsc2020-610 . insu-04477316

HAL Id: insu-04477316

<https://insu.hal.science/insu-04477316>

Submitted on 26 Feb 2024

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Europlanet Science Congress 2020

Virtual meeting

21 September – 9 October 2020

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EPSC Abstracts

Vol.14, EPSC2020-610, 2020

<https://doi.org/10.5194/epsc2020-610>

Europlanet Science Congress 2020

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A self-consistent thermodynamic approach to compute the interiors of irradiated ocean planets

Artyom Aguichine et al.

Planetary interior models rely on the thermodynamic properties of the used materials. Equations of states (EOSs) are key ingredients to compute internal structures, as they link the pressure and density profiles, and leave a unique solution satisfying all equations describing the interior of the planet. Often, when thermodynamic data are lacking, the formulation of EOSs allow extrapolation in both pressure and temperature. The effect of temperature on EOSs is often minor, implying that models of isothermal planets provide consistent results. This approach meets limitations in the case of fluids (liquids, gases and supercritical fluids), whose properties are very sensitive to variations in temperature. Here we propose a way to compute the relevant thermodynamic parameters in supercritical water from the most recent EOSs, in order to compute the internal structures of irradiated ocean planets, coupled with a 1D convective-radiative atmospheric model. Our results allow a better understanding of the diversity of observed sub-Neptunes, linking their internal structure to formation conditions.

How to cite: Aguichine, A., Mousis, O., Deleuil, M., and Marcq, E.: A self-consistent thermodynamic approach to compute the interiors of irradiated ocean planets, Europlanet Science Congress 2020, online, 21 September–9 Oct 2020, EPSC2020-610, <https://doi.org/10.5194/epsc2020-610>, 2020



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