CAN WE ESTIMATE AN UPPER BOUND FOR THE MAGNETIC FIELD OF ROCKY PLANETS? M. Lasbleis[1] and R. Brasser[1] [1]Earth-Life Science Institute, Tokyo Institute of Technology (2-12-1-IE-1 Ookayama, Meguro-ku, Tokyo 152-8550, Japan. marine.lasbleis@gmail.com, brasser@elsi.jp).

Introduction: The question of whether or not Earth is the only habitable planet with a functioning biosphere is one of the fundamental pillars of research in astrobiology. The concept of `habitability' is still being debated, but the general trend leans towards the definition of the distance to the star where liquid water is stable on the surface.

Yet habitability encompasses much more: it requires geological activity, a stable atmosphere, and so forth. One issue that has so far gone mostly unnoticed is the role of a functioning dynamo that generates a stable, long-term magnetic field that partially shields the atmosphere from erosive effects from the stellar magnetosphere. It is generally known that Mars' atmosphere has been eroded by interaction with the solar wind over billions of years. Mars' low gravity also plays a role, but there is little doubt that a functioning magnetic field would have prevented much of the atmosphere loss we see today [1].

Method: What is peculiar in the solar system is that there appears to be a trend of magnetic field strength versus rotation rate of the planets. Whether such a trend truly exists is still being debated, but for this work we shall assume that the relation $B^2 \sim P^{-1}$ holds through the Elsasser number; additional relationships will also be explored [2].

Under this assumption it is expected that the magnetic field strength (B^2) of planets with longer rotation periods (P) are generally weaker than those with a short period. In this assumption, magnetic field strength does not depend on the available buoyancy fluxes for driving convection. This simplification is necessary when the thermal history or driving forces for the convection are not well defined (see [3] for an estimate of magnetic field in an Earth-like thermal history) We consider that, for rapidely rotating planets, the assumption of the Elsasser relationship provides an upper bound to the possible strength of magnetic field.

We combine this with simple models of the tidal evolution of the rate of rotation of the rocky planets to determine the volume of phase space where the magnetic field strength is generally sufficient to ward off strong interaction between the atmosphere and the stellar magnetosphere and shield a biosphere from harmful UV radiation.

Results: We present here preliminary results for the magnetic field strength of rocky planets in synchronous rotation around their star. We will discuss the different scaling laws proposed in the literature, using either the Elsasser number or other scaling laws (see [2] for a review of the proposed scaling laws). We choose to focus on the simplest models, for which it is possible to give an estimate for a larger range of planets, knowing the pitfalls of these estimates. We aim then to be able to explore a large parameter space of planets and stars, including different internal structures of the planets.

References: [1] Dehant V., et al. (2007) *Space Sci Rev 129*: 279–300. [2] Christensen U.R. (2010) *Space Sci Rev 152*: 565–590. [3] Driscoll P. and Olson P. (2011), *Icarus 213* 11-23.