Modeling silicate atmospheres on hot rocky exoplanets

Buchem, C.P.A. van; Miguel, Y.; Westrenen, W. van; Zilinskas, M.

Bulletin of the AAS • Vol. 54, Issue 5

Modeling silicate atmospheres on hot rocky exoplanets

Christiaan PA Van Buchem[1] Yamila Miguel[1] Wim Van Westrenen[2] Mantas Zilinskas[1]

[1]Leiden University, [2]Vrije Universiteit Amsterdam

Published on: Jun 20, 2022

URL: https://baas.aas.org/pub/2022n5i102p161

Hot rocky exoplanets with equilibrium temperatures above about 2000 K (e.g. 55 Cnc e, K2-141 b, and GJ 367 b) are thought that have molten surfaces. This implies that there is a direct interface between the planet’s lava ocean and atmosphere. Hence, the composition of these planet’s atmospheres is likely to be closely linked to the composition of their lava oceans. This provides a unique opportunity for astronomers to characterize the mantle composition of such planets based on the composition of their atmospheres. With the recent launch of JWST and the future prospect of ARIEL ushering in a new era of exoplanet observations, this topic is now more relevant than ever.

In order to accomplish this, we must first gain a deeper understanding of the way in which a lava ocean interacts with an atmosphere. The first step in this process is to model the outgassing that takes place in a silicate melt. Using the thermodynamic data of the magma ocean provided by the MELTS code, we developed an open source code that predicts the composition of such a vaporised atmosphere for a given magma composition and temperature. In this talk we will present out methods and first results.

The successful development of this method and subsequent comparisons to observations would allow us to start characterising rocky exoplanet compositions based on their atmosphere compositions, which could lead to new insights for formation models. Furthermore, it would also allow us to model the effects of transient magma oceans though to be present on young earth analogs. Deepening our understanding of how such processes influence the conditions present during later evolutionary stages and possibly give us new insights in the conditions necessary to sustain life.