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Hot Rocky Super-Earths atmospheres, a revision of gas phase metal chemistry and the relevance of reverse chemistry

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There are approximately 2600 reported exoplanets. Among these celestial bodies there is a class of super-Hearts with an orbit smaller than Mercury (0.387 AU) know as Hot Rocky Super-Earths (HRSE). The proximity of this rocky type of planets to their parent start means that their surface can be similar to Bulk Silicate Earth (BSE) at high temperatures. Currently, there are few attempts to estimate the atmospheric composition and chemistry of a HRSE.

We implemented the PATMO model to calculate the chemistry of these peculiarly complicated type of atmosphere. The most likely flux of material from the surface is a mixed composition of thermally decomposed BSE. The chemistry of this type of atmosphere is fundamentally thermal decomposition of silica and iron oxides followed by chemistry of atomic Na, O, Fe, Si and other minor species. The high temperatures of this system makes necessary to account for reverse reactions and equilibrium chemistry. The PATMO model accounts for reverse chemistry by calculating equilibrium constants by applying NASA polynomials. These polynomials are a 7-coefficients power series fitted from thermodynamic data. Although the tabulated data for these coefficients is constantly updated there are some chemical species that lack this thermodynamic data. We further implemented ab-initio calculations to compute this thermochemical data.

We present an updated chemical network capable of accounting for this type of atmospheres and a revision of the thermochemical data necessary for computing equilibrium constants.