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The interior diversity of terrestrial-type exoplanets: constrained with devolatilized stellar abundances and mass-radius measurements

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A major goal in the discovery and characterization of exoplanets is to identify terrestrial-type worlds that are similar to (or otherwise distinct from) our Earth. The combination of mass-radius measurements and host stellar abundances has been proposed to constrain the interiors of small (rocky) exoplanets. In this work, we advocate the importance of using *devolatilized* stellar abundances, instead of *uncorrected* stellar abundances, to further reduce degeneracies in modelling the interiors of rocky exoplanets. We apply an empirical devolatilization model to a selected sample of 13 planet-hosting Sun-like stars, for which high-precision photospheric abundances have been available. With the resultant devolatilized stellar composition (i.e. the model planetary bulk composition), as well as other constraints including mass and radius, we model the detailed mineralogy and interior structure of hypothetical, habitable-zone terrestrial planets ('exo-Earths') around these stars. Model output shows that most of these exo-Earths are expected to have broadly Earth-like composition and interior structure, consistent with conclusions derived independently from analysis of polluted white dwarfs. Investigating the empirical devolatilization model at its extremes as well as varying planetary mass and radius (within the terrestrial regime) reveals potential diversities in the interiors of terrestrial planets. By considering (i) high-precision stellar abundances, (ii) devolatilization, and (iii) planetary mass and radius holistically, this work represents essential steps to explore the detailed mineralogy and interior structure of terrestrial-type exoplanets, which in turn are fundamental for a quantitative understanding of planetary long-term evolution including the interior-atmosphere interactions.