Detectability of rocky-vapour atmospheres on super-Earths with Ariel

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Ariel will mark the dawn of a new era as the first large-scale survey characterising exoplanetary atmospheres with science objectives to address fundamental questions about planetary composition, evolution and formation. Also, until today, over 1000 exoplanets whose radii are less than 2 Earth radii have been discovered. About 50% of those planets have radiative equilibrium temperatures high enough to melt and vaporize rock. Thus, if rocky like CoRoT-7b, they likely have atmospheres composed of rocky materials (e.g., Schaefer & Fegley 2009, Ito et al.2015). We call such a rocky vapor atmosphere a mineral atmosphere. In this study, we explore the detectability of atmospheres vaporised from magma oceans on dry, rocky Super-Earths orbiting very close to their host stars. The detection of such atmospheres would provide a definitive piece of evidence for rocky planets but are challenging measurements with currently available instruments due to their small spectral signatures. However, some of the hottest planets are believed to have atmospheres composed of vaporised rock, such as Na and SiO, with spectral signatures bright enough to be detected through eclipse observations with planned space-based telescopes. In this study, we find that rocky super-Earths with a irradiation temperature of 3000 K and a distance from Earth of up to 20 pc, as well as planets hotter than 3500 K and closer than 50 pc, have SiO features which are potentially detectable in eclipse spectra observed with Ariel. In addition, we discuss the possibility of Ariel observations to distinguish mineral atmosphere from hydrogen-rich/water-rich atmospheres.

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