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Interior Evolution of Magma Oceans Exoplanets

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The magma ocean (MO) phase typically describes the early stage of rocky planets, during which the entire planet is molten due to heat generated by accretion processes. In the case of short-period exoplanets inside the runaway greenhouse limit, this phase may last Gyrs, until the inventory of major greenhouse gasses, such as H2O and H2, is exhausted. The internal evolution of these planets is influenced by various factors, including the exchange of volatiles between the molten planetary interior and the atmosphere. This exchange significantly impacts planetary climate, exoplanet bulk densities, surface conditions , and long-term geodynamic activity by controlling greenhouse effects, surface water stability, and atmospheric composition. This research focuses on modeling this interaction under different redox conditions. Using a coupled computational framework of the planetary interior and atmosphere, we study the detailed evolution of the magma oceans phase, aiming to understand the crystallization sequence and the resulting internal structure of the planet. We investigate the impact of the cooling sequence and evolving climatic conditions on mantle differentiation, mineralogy, formation of crusts, and the consequent composition of the atmosphere.