Supersonic winds, rocky rains forecasted on lava planet

Among the most extreme planets discovered beyond the edges of our solar system are lava planets: fiery hot worlds that circle so close to their host star that some regions are likely oceans of molten lava. We used computer simulations to predict the conditions on K2-141b, an Earth-size exoplanet with a surface, ocean, and atmosphere all made up of the same ingredients: rocks. In analyzing the illumination pattern of the exoplanet, we discovered that about two-thirds of K2-141b faces perpetual daylight – rather than the illuminated hemisphere we are used to on Earth.

The night side experiences frigid temperatures of below -200 C. The day side of the exoplanet, at an estimated 3000 C, is hot enough to not only melt rocks but vaporize them as well, ultimately creating a thin atmosphere in some areas. Remarkably, the rock vapour atmosphere created by the extreme heat undergoes precipitation. Just like the water cycle on Earth, where water evaporates, rises into the atmosphere, condenses, and falls back as rain, so too does the sodium, silicon monoxide, and silicon dioxide on K2-141b. On Earth, rain flows back into the oceans, where it will once more evaporate and the water cycle is repeated. On K2-141b, the mineral vapour formed by evaporated rock is swept to the frigid night side by supersonic winds and rocks "rain" back down into a magma ocean. The resulting currents flow back to the hot day side of the exoplanet, where rock evaporates once more.

Still, the cycle on K2-141b is not as stable as the one on Earth, we found. The return flow of the magma ocean to the day side is slow, and as a result we predicted that the mineral composition will change over time, eventually changing the very surface and atmosphere of K2-141b.

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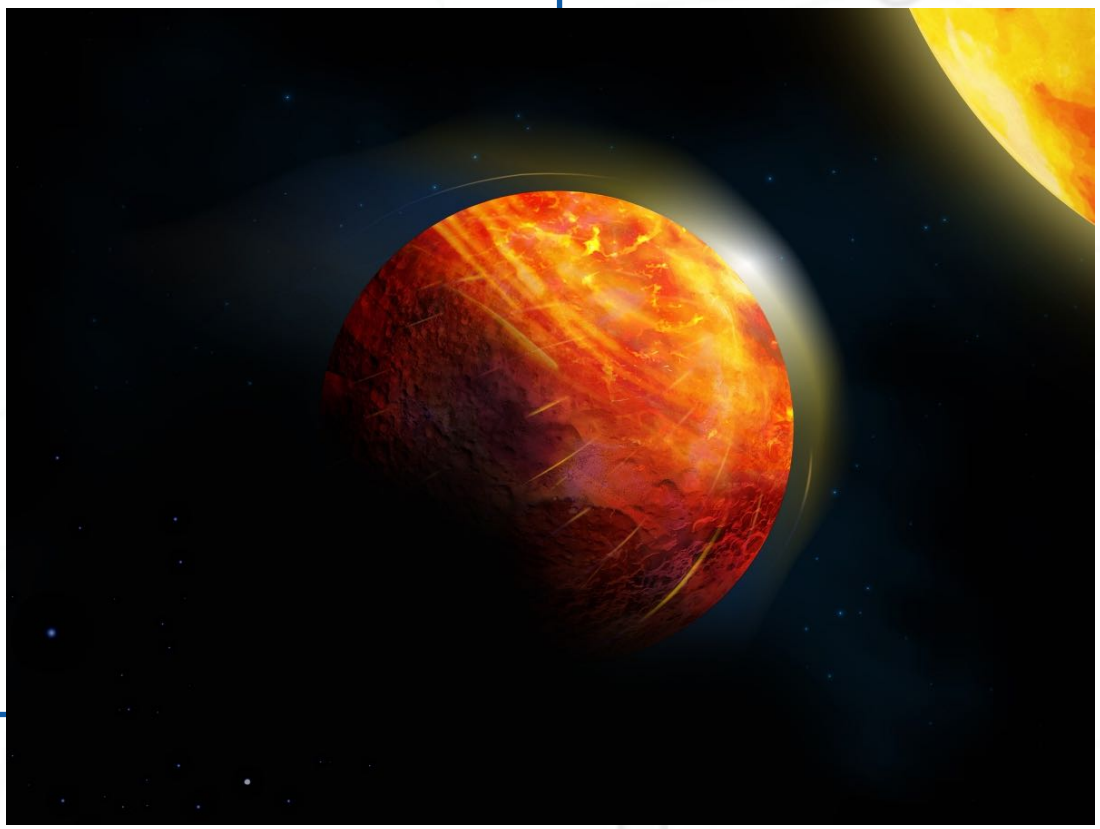
Giang Nguyen is a PhD student at York University. He performed this research with MSI professor Nicolas Cowan as part of an interdisciplinary research rotation. Agnibha Banerjee is an undergraduate at the Indian Institute of Science Education and Research and was a MITACS Globalink fellow in the MSI summer 2019. John Moores is a professor at York University.

Why this is important

Lava planets offer a glimpse of what planets like the Earth must have looked like when they first formed.



Artist's rendition of a lava Planet. Credit: Julie Roussy, McGill Graphic Design and Getty Images.