Detecting Volcanic Signatures on an ExoEarth Using Direct Imaging

Future direct imaging missions will be sensitive enough to characterize the atmospheres of Earth-like exoplanets around Sun-like stars. Learning how to identify indicators of volcanism will be crucial, since it can provide invaluable insight into the state of the planet's interior. Gathering information about the interiors of a variety of exoEarths will illustrate whether Earth's interior state is common and will help determine which exoplanets may be habitable.

A team of Goddard scientists used the Goddard chemistry climate model (GEOSCCM) to simulate to simulate several volcanic eruptions on Earth. Then, treating Earth as an exoplanet being observed by a hypothetical telescope with a coronagraph, they simulated the planet's reflectance spectrum using Goddard's PSG and recorded how the spectrum changed over time.

Results of the study show that the absorptions of light due to ozone and water decrease during volcanic eruptions and slowly return to their initial original sizes after the eruptions stop. A series of observations to detect changes in these absorption features may provide the evidence needed to identify volcanism on an exoEarth.

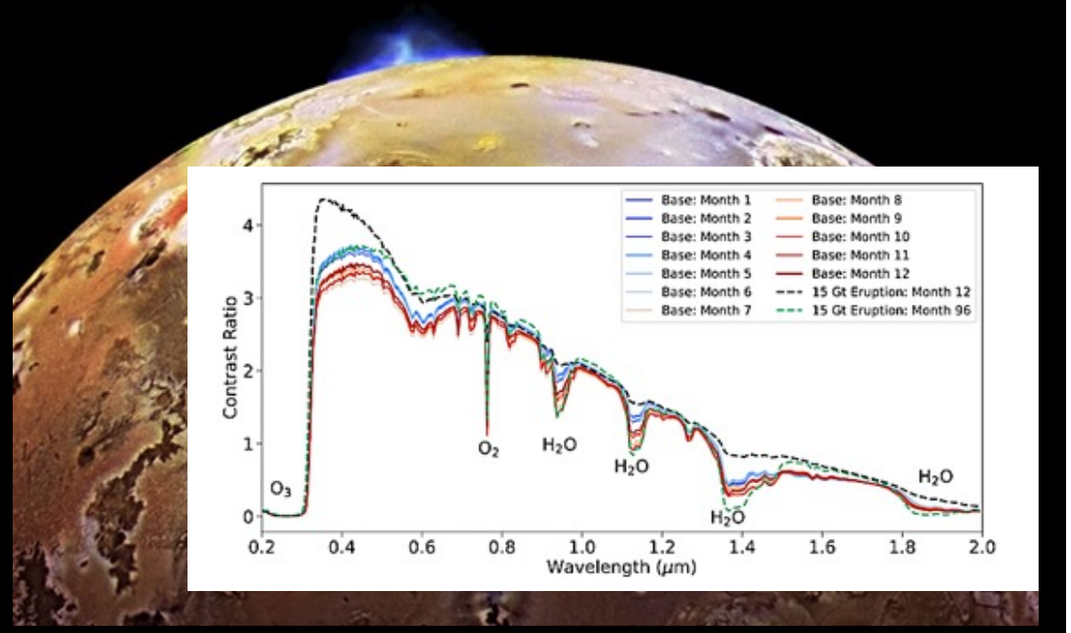

Image: A volcano erupting on Jupiter's moon Io, as imaged by the Galileo spacecraft. Inset: The absorptions of light due to oxygen O_2, ozone O_3, and water H_2O at various times before and after large volcanic eruptions as modeled by the Goddard team for a hypothetical exoEarth.

Ostberg, Guzewich, Kohler, Oman, Fauchez, Kopparapu, Richardson, Whelley, et al., 2023. AJ 166 199. http://doi.org/10.3847/1538-3881/acfe12
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