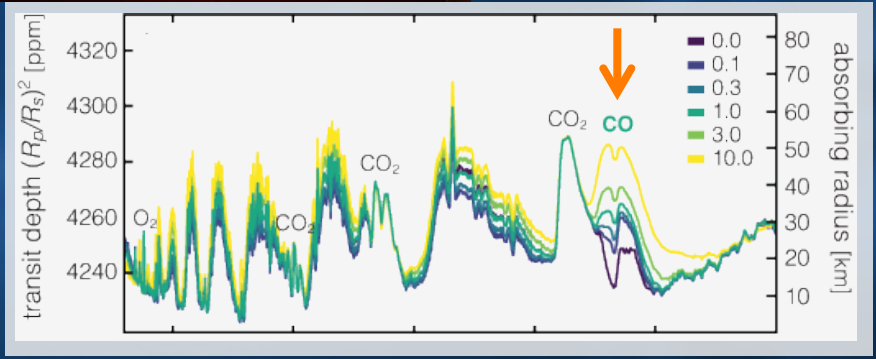
ALTERNATIVE EARTHS

Carbon Monoxide May Not Rule out the Presence of Life

PROXIMA CENTAURI (artist's depiction)
Credit: NASA, ESA, G. Bacon (STScI)

For some exoplanets, remotely detectable carbon monoxide may actually be diagnostic of a robust microbial biosphere.

INNOVATION | Certain atmospheric gases such as carbon monoxide (CO) have been proposed as 'antibiosignatures'— evidence that a planet is *not* inhabited —if remotely detectable at sufficient abundance. This study uses 1-D ecosphere-atmosphere and photochemical models to quantify the extent to which CO could exist in the atmospheres of living planets.



CARBON MONOXIDE is a prominent feature in simulated transmission spectra for oxygen-rich, modern Earth–like atmospheres in the habitable zone of an M-dwarf star like Proxima Centauri. Colors correspond to the magnitude of the assumed surface molecular CO flux scaled to that of the modern Earth (e.g., modern = 1.0). Unlabeled features are due to CH_4.

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DISCOVERY | Reducing biospheres around sun-like stars, like the Archean Earth of three billions years ago, can maintain CO levels of ~100 parts per million (ppm)—orders of magnitude greater the parts-per-billion traces of CO in the atmosphere of modern Earth. Considerably more favorable for the buildup of CO is the photochemistry around M-dwarf stars like Proxima Centauri, with plausible concentrations for inhabited, oxygen-rich planets extending from hundreds of ppm to several percent.

MISSION RELEVANCE | Transit spectroscopy of rocky exoplanets with the James Webb Space Telescope could detect CO that is compatible with—or even diagnostic of—the presence of life (see figure). Validating CO as an antibiosignature rather than a product of life will require a comprehensive planetary assessment.