Carbon Monoxide May Not Rule out the Presence of Life

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.

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.

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.

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