research highlights

BIOSIGNATURES

Hide and seek

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Now that exoplanetary science is moving steadily towards the characterization of extrasolar planets, the community is investigating the best way to unequivocally detect the presence of extraterrestrial life. Most of the attention is given to biosignatures: spectral signatures of atmospheric gases (particularly O₂, O₃ and CH₄) that could reveal disequilibrium in their abundances induced by biological processes. In this framework, researchers frequently focus on the identification of false positives — deceptive indications of the presence of life when there is none. The possibility of false negatives, when remote sensing fails to detect life that is actually there, is instead much less studied. Christopher Reinhard and co-authors show that this situation can occur more commonly than expected.

Reinhard *et al.* reconstruct the detectability of O₂, O₃ and CH₄ in the case of Earth throughout its history, using geochemical records and a radiative transfer model. They find that Earth would have probably been a false negative for most of its history. For example, methane could have been detected during the Archaean (3.8–2.5 Gyr ago) but the oxygen level would have been too low. Conversely, in more recent eras methane detection would have been problematic. Reinhard *et al.* also underline the problem of ‘cryptic’ biospheres developing within oceans, as they would be largely decoupled from atmospheric chemistry and thus undetectable. This work stresses the need to support standard biosignatures with other diagnostics, such as UV observations, high-resolution spectroscopy (resolving power $R > 20,000$) or a rigorous treatment of ocean biochemistry, in order to avoid the embarrassing situation of not recognizing life on Earth from afar.

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