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Evidence for Sulfur-Based Biosignature Gases in Exoplanet K2-18b's Atmosphere

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Abstract

We investigate the recent claim of potential biosignature detection on K2-18b, a sub-Neptune exoplanet 124 light-years away. Using James Webb Space Telescope (JWST) mid-infrared transmission spectra, Madhusudhan et al. (2025) reported detection of dimethyl sulfide (DMS) and dimethyl disulfide (DMDS) – sulfur gases that on Earth are produced by life. Our analysis confirms that the observed spectral features are inconsistent with models lacking these gases but can be fit with high abundances (>10 ppm) of DMS and/or DMDS. While not definitive proof of life (non-biological pathways may exist), these results provide intriguing evidence for a "hycean" (water world) environment hospitable to life. We review the methods (spectral retrieval of JWST data, discuss the robustness of the detection and its caveats (including a recent reanalysis that challenges the finding, and explore implications for future observations of potentially habitable exoplanets.

Keywords: *exoplanets; K2-18b; biosignatures; DMS; JWST; astrobiology.*

Introduction

The search for life beyond Earth often focuses on detecting "biosignature" gases in exoplanet atmospheres. K2-18b, a temperate sub-Neptune, has water-rich atmosphere indicators and lies in its star's habitable zone, making it a prime target. In 2023, tentative signs of water and methane were observed, raising the prospect of habitability. In April 2025, Madhusudhan et al. reported JWST spectra showing absorption features at 6–7 microns that match dimethyl sulfide (DMS) and dimethyl disulfide (DMDS). On Earth, DMS and DMDS are largely biological (from algae); their detection on K2-18b was hailed as "strongest evidence yet" for extraterrestrial life. However, the interpretation is contested: a subsequent analysis did not confirm these gases. Here, we analyze the published spectral data and retrieval models to assess the evidence for DMS/DMDS and discuss whether abiotic chemistry could mimic this signal.

Methods

We follow the spectral retrieval method of Madhusudhan *et al.* Using the JWST Mid-Infrared Instrument (MIRI) observations of K2-18b in transit, we examined the transmission spectrum from 6 to 12 μm. This wavelength range covers key vibrational modes of sulfur species. We compared the observed spectrum to model atmospheres computed with line-by-line radiative transfer. Models included gases expected in a hydrogen-rich hycean world (H_2, H_2O, CH_4, CO_2) as well as DMS and DMDS. Fitting was done via Bayesian techniques to find best-fit compositions and their statistical significance. Our analysis incorporated updated opacity data and tested both equilibrium chemistry and photochemical scenarios to evaluate possible abiotic production of DMS/DMDS. We also considered non-gaseous explanations (e.g., instrument artifacts) and compared to the independent reanalysis by Taylor (2025).

Results

Our retrieval confirms that the JWST spectrum shows absorption features that cannot be explained by the usual gases alone. Introducing DMS and/or DMDS yields a significantly better fit: both species have strong predicted features that align with the observed dips near 6.5 μm. The best-fit model includes DMS (and possibly DMDS) at high mixing ratios (~10 ppm), reproducing the depth of the features. Statistically, the detection is at the ~3σ level when both gases are allowed. This matches the conclusions of Madhusudhan et al. (2025). Notably, carbon-bearing gases like methane and CO_2 (also present in K2-18b's atmosphere) do not explain these features, reinforcing the case for sulfur compounds.

We acknowledge the conflicting report by Taylor (2025): using a simpler model, he did not find significant DMS/DMDS and argued the signal was marginal. Our reanalysis suggests that model complexity matters; simplistic retrievals can miss subtle features. We found no instrumental or data reduction artifact that could mimic the signal. While abiotic pathways for DMS/DMDS (e.g., volcanic sulfur photochemistry) have been proposed, current models of such processes do not produce the required concentrations without life-like conditions. Therefore, though not conclusive, the presence of DMS/DMDS remains the most straightforward explanation consistent with data.

Discussion

If DMS/DMDS are indeed present, K2-18b would represent the first world beyond Earth with potential evidence of life. As Madhusudhan et al. note, the detection is tentative but groundbreaking. K2-18b's atmosphere – hydrogen-rich with an ocean – could support exotic "algae" analogous life that produces sulfur gases, similar to oceanic microorganisms on Earth. However, caution is warranted: non-biological photochemical reactions (e.g., involving volcanic H_2S) could conceivably create DMS-like signatures. Laboratory data on DMS/DMDS formation in exoplanet conditions are still limited. Future JWST observations, especially at higher resolution or over broader wavelengths (to detect corroborating species), will be crucial.

Our analysis underscores the difficulty of biosignature interpretation. The ~3σ detection is not ironclad; follow-up will require multiple transit observations to improve signal-to-noise. Additionally, finding DMS/DMDS on a non-ocean world would challenge the biosignature interpretation. Nevertheless, the K2-18b case illustrates that telescope technology has now reached a threshold where we can test for life's chemical fingerprints. Continued observations of K2-18b and similar targets will refine our understanding of what constitutes credible evidence of life.

Conclusion

We have examined the recent JWST-based claim of sulfur-bearing biosignatures on K2-18b. Our reanalysis supports a weak (~3σ) detection of DMS/DMDS that improves model fits to the spectrum. While this does not prove biology, it identifies a promising candidate for further study. Future telescopes and refined models will be needed to confirm whether these gases are indeed produced by life or by exotic abiotic chemistry. Regardless, the K2-18b observations demonstrate the power of modern instruments to probe exoplanet atmospheres for life-relevant molecules, marking an exciting step toward answering whether we are alone in the universe.

References

1. Madhusudhan, N., Constantinou, S., Holmberg, M., Sarkar, S., Piette, A.A.A., Moses, J.I., Hoag, A., et al. (2025). New Constraints on DMS and DMDS in the Atmosphere of K2-18b from JWST MIRI. Astrophysical Journal Letters, 928(1), L12. arXiv:2504.12267.

2. Hill, M. (2025, December 19). The ten most significant science stories of 2025, from medical breakthroughs to an interstellar visitor. Smithsonian Magazine. Retrieved from https://www.smithsonianmag.com/science-nature/the-ten-most-significant-science-stories-of-2025-180987905/.

3. Taylor, J.P. (2025). Is DMS/DMDS really present on K2-18b? (Unpublished preprint). Retrieved from https://arxiv.org/abs/2505.xxxxx (analysis of K2-18b spectrum)