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Biosignature stability in space enables their use for life detection on Mars: Results of the BIOMEX experiment in LEO

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Two rover missions to Mars aim to detect biomolecules as a sign of extinct or extant life with, among other instruments, Raman spectrometers. Raman spectrometers are indeed particularly suited for the fast and non-destructive identification of biomolecules embedded in minerals. However, little is known about the stability of Raman biosignatures in the Martian environment. We addressed this particular aspect as part of the BIOMEX mission: biomolecules were exposed for 16 months to a simulated Martian environment in Low Earth Orbit (LEO). This environment was provided in the EXPOSE-R2 module, outside the International Space Station and comprised of UV and ionizing radiation, a Mars-like atmosphere, extreme temperature cycles, and analogues of Martian regolith. Seven of those biomolecules were analyzed post-flight using Raman spectroscopy; all remained detectable. UV radiation strongly degraded the Raman signals but, when samples were shielded from it, detectability was hardly affected. In addition to supporting the relevance of Raman instruments for the search for life on Mars, our study reports for the first-time results on the Raman biosignatures of isolated, LEO-exposed biomolecules, laying the groundwork for a database of spectroscopy biosignatures in targeted environments. Such a database will serve as a reference for biomolecule detection on Mars and other planetary bodies, increasing our odds of finding life if it is present.

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