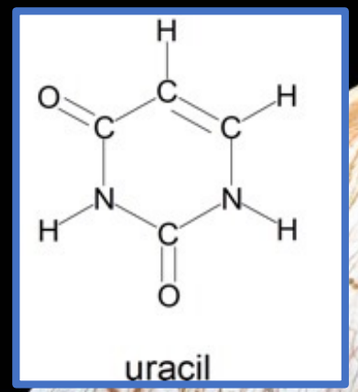
Can biomarkers survive radiation exposure?

Uracil is one of the four RNA nucleobases and a component of meteoritic organics. If delivered to the early Earth, uracil could have been involved in the origins of the first RNA-based life, and so this molecule could be a biomarker on other worlds, if it can survive cosmic radiation exposure.



uracil

Scientists in **NASA Goddard's Cosmic Ice Laboratory** measured uracil's destruction rate in ice samples exposed to irradiation by protons that simulate planetary magnetospheric radiation and the Solar wind.

At Europa-like temperatures, results show a more rapid destruction in ices dominated by CO_2 than in ices dominated by H_2O (approx. 2×).

Lifetimes in icy planetary environments were estimated, and these can be used to determine whether this important biomarker could survive and where it could be found today by missions (e.g., a Europa lander).

Uracil on Europa	Half-life in H_2O	Half-life in CO_2
At surface	2 months	30 days
Depth of 1 cm	140 years	73 years
Depth of 1 m	830,000 years	450,000 years

Gerakines P. A., Qasim D., Frail S., Hudson R. L., 2022. Astrobiology 22 (3), 233-241. https://doi.org/10.1089/ast.2021.0053