

## Raman characterization of the UV-protective pigment gloeocapsin-potential biosignatures of early Earth records

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### Abstract

Extracellular UV-screening pigments gloeocapsin and scytonemin present in the EPS envelopes of freshwater and marine cyanobacteria were studied by different spectroscopy methods. The Raman spectral analysis and the UV-VIS light absorbance spectra of the extracellular pigment gloeocapsin showed that it shared Raman and UV spectral signatures with parietin, a radiation-protective pigment present in lichens. Gloeocapsin occurs in several cyanobacterial species, mostly with exclusion of scytonemin, indicating that these pigments have evolved in cyanobacteria as separate protective strategies. Both gloeocapsin and scytonemin are widely and species-specifically distributed across different cyanobacterial taxa. The widespread occurrence of these pigments may suggest an early origin, while their detection by Raman Spectroscopy makes them potential biosignatures for cyanobacteria in the early Earth record and demonstrates the usefulness of non-destructive Raman spectroscopy analyses for the search of complex organics, including possible photosynthetic pigments, in early Earth and extraterrestrial samples.