Analysis Of Organic Films On Serpentinite Wafers Via Micro Fourier Transform Infrared (μ FTIR) Spectroscopy and X-ray Photoelectron Spectroscopy (XPS) Analyses

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Serpentinizing systems yield free energy via the hydration of ultramafic rock—a potential chemosynthetic support system for microbial life on Earth and other planetary settings [1–3]. However, the abiotic synthesis and degradation of organic molecules under high pH, strongly negative Eh, and vigorous heat production confound biosignature identification. Minerals may enhance our ability to detect biomarkers via processes like sorption and concentration [4–6]. Here we present XPS spectra, μ-FTIR spectral maps, and XRD diffractograms of incubated rock and mineral wafers to determine limits of resolution of organic films/biofilms associated with serpentinite minerals, including specimens collected from near surface sites associated with the NASA Astrobiology Institute-sponsored Coast Range Ophiolite Microbial Observatory (CROMO), in Lower Lake, CA [7]

Analysis of transmission mode μ-FTIR spectra show peaks at 2955, 2870, 2850, and 1675 cm^{-1} indicating aliphatic CH_2, CH_3 and C-C double bond stretching. XPS analysis of carbon peaks at 285 eV combined with Ar ion sputter cleaning indicate that organic matieral is confined to the first tens of angstroms and unlikely to be the result of contamination. We leverage this data set in microbial colonization experiments aimed at parsing background organic loads in serpentinites from surficial/fracture-localized modern biofilm signatures. XPS analysis of iron at 709-724 eV binding energies offers complementary data related to Fe valence state, which may prove useful in assessing alteration after incubation with live cultures.

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