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Spectroscopy of Arctic Ice Samples as Planetary Field Analogues for Astrobiology

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Icy moons that gather the pillars of habitability, i.e., that contain (1) liquid water, (2) essential chemical elements (carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur – CHNOPS) and (3) a source of energy, hold the attention of space agencies. Because of the sub-surface ocean, Europa and Enceladus are extensively studied for the possibility of extra-terrestrial life forms. With that intent, planetary field analogues (i.e., places on Earth that mimic one or more conditions of other planetary sites) are used to prepare future space missions. The Canadian sub-arctic was chosen for our project, because it allows the testing of a spectroscopic protocol to assess biosignatures.

In the region of Kuujjuarapik in Quebec, several sites of interest are found, namely an ice layer atop flowing water, mimicking the ice shell involving the sub-surface ocean of potentially habitable moons. Kuujjuarapik presents this ice-water model with different salinities from 0% to 36%, while also containing sites rich or depleted of organic matter. By collecting ice cores and surfacing water, and applying UV-Vis molecular spectroscopy and FTIR, we can assess the presence of molecule that may be used as evidence of living organisms. The biosignatures chosen for this project are aromatic amino acids, humic acid and β-carotene.

A kinetic essay performed in the research station suggested no degradation of the molecules in the sampling process. The results of such protocol indicate an absorption peak at 260 nm, and a broad band from 400 nm to 500 nm in the fluorescence spectra for all samples, corresponding to humic acid. Such identification validates this methodology for the search of organic molecules in the natural ice samples. Further purifications will be made to identify other compounds, as promising signals become clearer with subsequent approaches. Standard solutions were prepared in different concentration and salinities, to better confront the signals of the analytes chosen.

Further studies will determine whether these methodologies may be implemented on future *in situ* sampling missions to icy moons in the search for biosignatures.