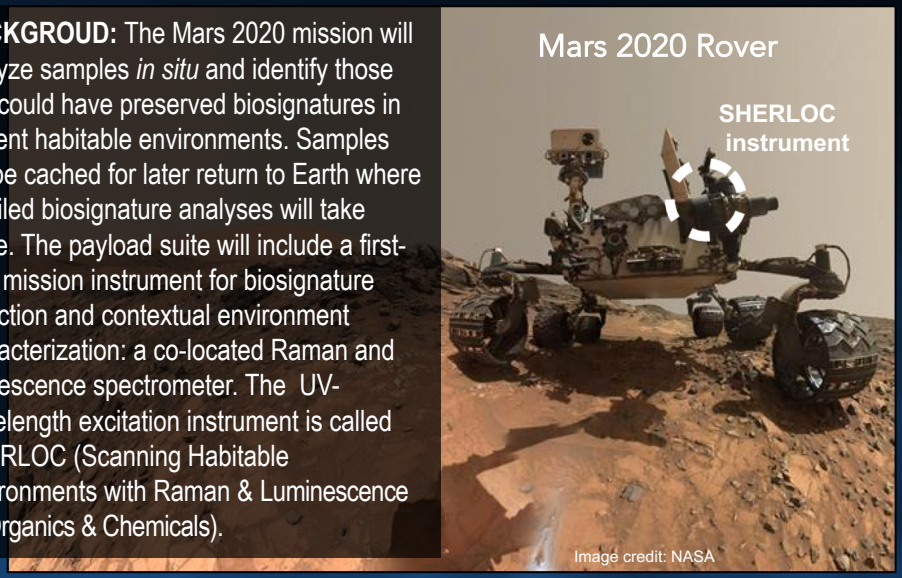
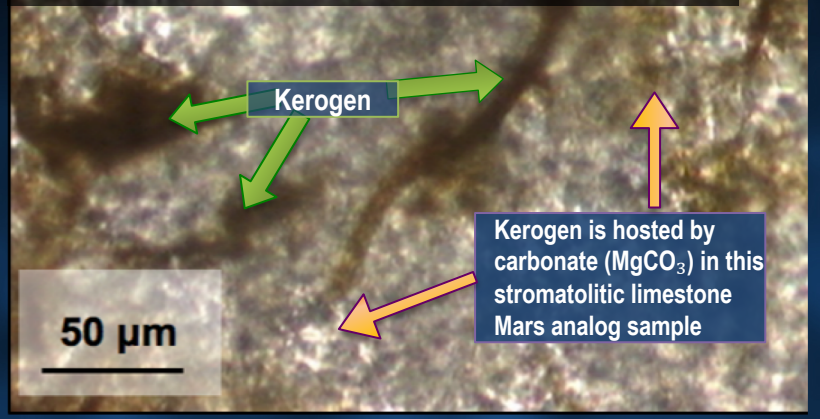
Detecting Kerogen as a Biosignature Using the Mars 2020 SHERLOC Instrument

BACKGROUD: The Mars 2020 mission will analyze samples *in situ* and identify those that could have preserved biosignatures in ancient habitable environments. Samples will be cached for later return to Earth where detailed biosignature analyses will take place. The payload suite will include a first-time mission instrument for biosignature detection and contextual environment characterization: a co-located Raman and fluorescence spectrometer. The UV-wavelength excitation instrument is called SHERLOC (Scanning Habitable Environments with Raman & Luminescence for Organics & Chemicals).



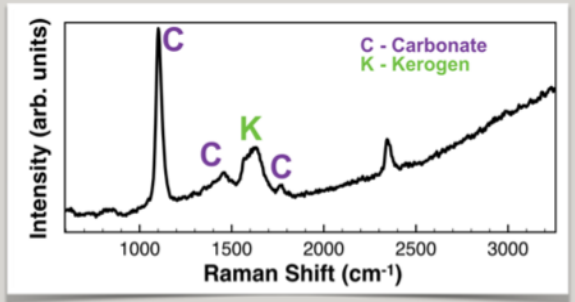
SAMPLES: The highest priority targeted samples on Mars will include aqueously formed sedimentary rocks. On Earth, such rocks commonly contain biosignatures as fossil macromolecular, aromatic carbon (kerogen).



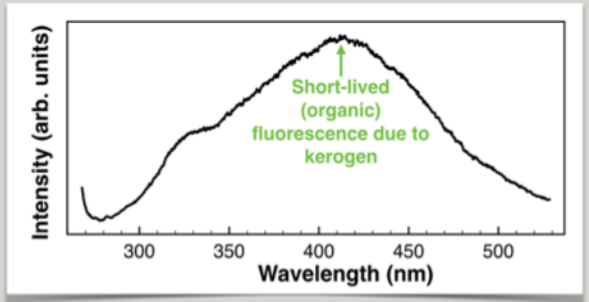
METHOD: To inform SHERLOC strategies, this research team analyzed non-extracted kerogen and its hosting mineral matrix in a diverse suite of natural samples using co-located UV excitation time-gated Raman and laser-induced fluorescence spectroscopies. The objectives were to (1) explore the capabilities of UV time-gated Raman and fluorescence spectroscopies for detecting kerogen in high-priority targets in the search for possible biosignatures on Mars; (2) assess the effectiveness of time gating and UV laser wavelength in reducing interfering background fluorescence in Raman spectra; and (3) identify sample-specific issues that could challenge rover-based identifications of kerogen using UV time-gated Raman spectroscopy.

Shkolyar *et al.* (2018) Astrobiology, 18(4), 431-453.
DOI: 10.1089/ast.2017.1716

IMPACT OF RESULTS: This research found that ungated UV Raman spectroscopy is suited to identify diagnostic kerogen Raman bands without interfering background fluorescence and that UV fluorescence spectroscopy is able to distinguish kerogen from other organic sources. This work highlights the value of combining co-located Raman and fluorescence spectroscopies, similar to those obtainable by SHERLOC, to strengthen the confidence of kerogen detection as a potential biosignature in complex samples.



UV gated Raman spectroscopy successfully identified kerogen and the hosting mineral phase in all samples.



Time-Resolved UV fluorescence spectroscopy identified a unique kerogen feature, distinct from other organics.