WHY RAMAN AND LIBS FOR EXPLORING ICY MOONS?

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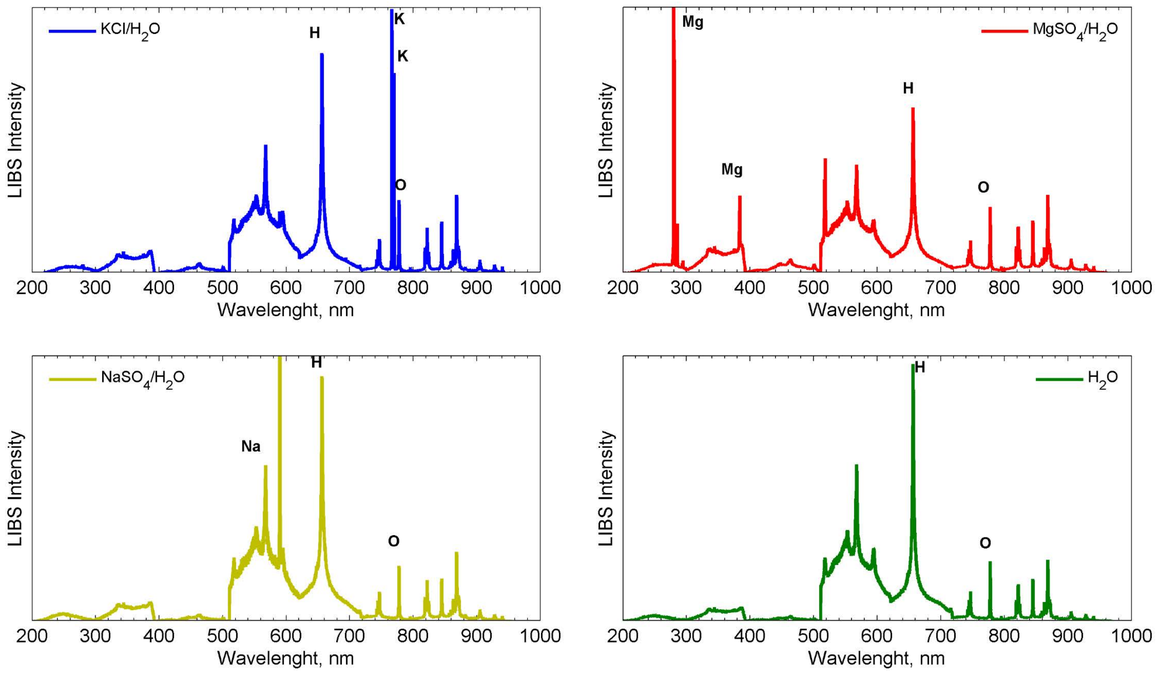
ICY MOONS

- The most compelling locations to seek an answer to the question of whether life exists beyond our own planet.
- Analysis of the composition of the icy crust is critical for determining the availability of nutrients for life that may be present in subsurface liquid reservoirs.
- "The surface ice is providing us a window into that potentially habitable ocean below," [1]

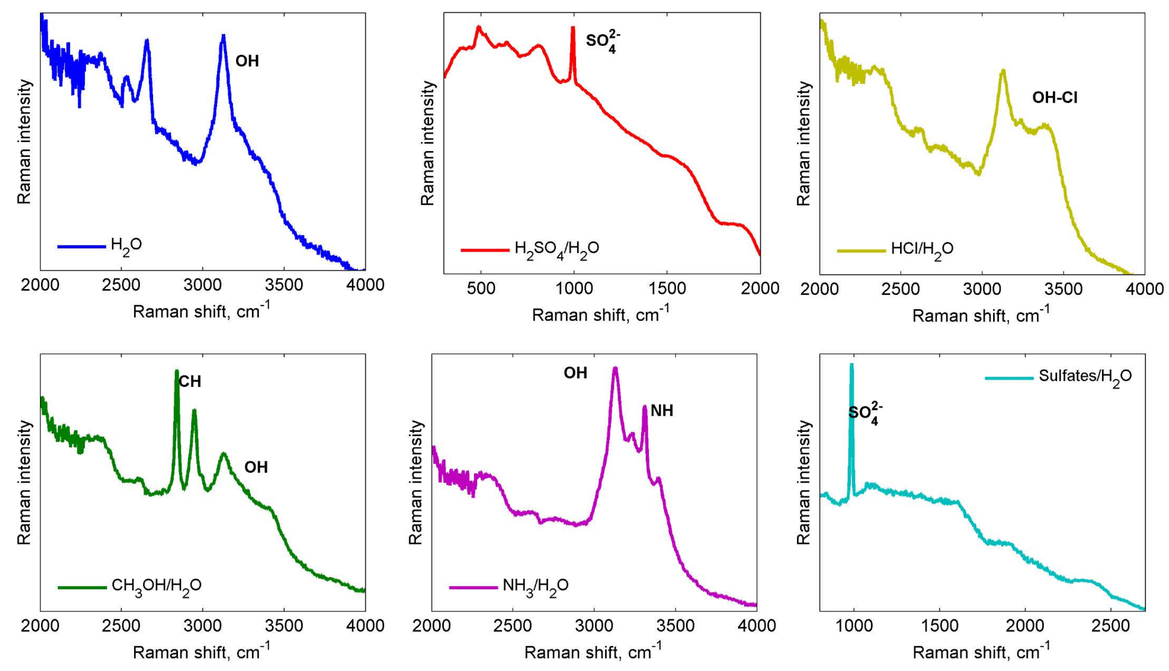
RAMAN-LIBS ADVANTAGE

- Laser Raman and laser-induced breakdown spectroscopy (LIBS) are uniquely suited tools for detailed mineralogy and geochemistry investigations on planetary bodies.
- LIBS can reveal the relative concentration of major (and often trace) elements present in a bulk sample.
- Raman yields information on the individual mineral species and their chemical and structural nature.
- Thus, combining the data from both tools enables definitive mineral phase identification with precise chemical characterization of most major and minor and some trace mineral species.
- A combined instrument can provide a rapid mineralogical/chemical evaluation of the target

CASE STUDY: LIBS AND RAMAN SPECTRA OF MIXTURES OF ICE WITH SALTS AND ORGANICS



LIBS spectra of ionized H2O and frozen supersaturated solutions of KCl, MgSO4, and NaSO4 in water. Spectra recorded at -25 °C and 1020 mbar of air with instrumentation described in [2]. The emission lines related to H and O were monitored at 656.3 and 777.4 nm, respectively. K, Mg, and Na are monitored at 766.6, 285.6, and 568.8 nm, respectively.



Raman spectra of several mixtures, including a mixture of Ca, Mg, Na, and K-sulfates and H2O ice (sulfates/H2O). The spectra were obtained at -50 °C. Molecular vibrational modes have been identified, which in turn inform about potential associated ions, thus complementing LIBS.

CONCLUSIONS

- ***Elemental and molecular features of water ice mixed with salts and organics, relevant to icy planetary bodies, can be analyzed using laser Raman and LIBS.***
- ***We are developing quantitative methods for the determination of species' abundances in mixtures.***

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REFERENCES: [1] Brown, M. and Hand, K. (2013) *Astronomical Journal*, In Press. [2] Koujelev A., et. al. (2010) *Planetary and Space Science*, 58:682-690.