Analysis of space weathering using correlation of luminescence and Raman signatures for silicate mineral mixes

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Analytical capability of Raman scattering spectroscopy to provide comprehensive clues into geochemical, thermal, or radiation processes that led to the formation and alteration of rock-forming minerals, occurrent at surfaces of atmosphere-less celestial bodies. This causes the intensified development of space research instrumentation (such as the dedicated to in-situ exploration of the Martian Moon Phobos [1]) and new studies related to space weathering (SW) of rock-forming minerals, mainly by the simulated micrometeoritic bombardement [2]. Photoluminescence (PL) contributions to the Raman spectra have been observed for the samples returned from space missions to asteroids [4] and are generally expected to be presented for atmosphere-less bodies. We discuss the use of the correlations between PL and Raman signals (RS) in the spectra of silicate mix samples under simulated SW using pulsed laser ablation (Fig. 1); the relationship of RS/PL contrast to the alteration extent (due individual enthalpy of fusion, melting temperature, irradiation laser absorption) and to the relevant Raman studies on extraterrestrial samples.

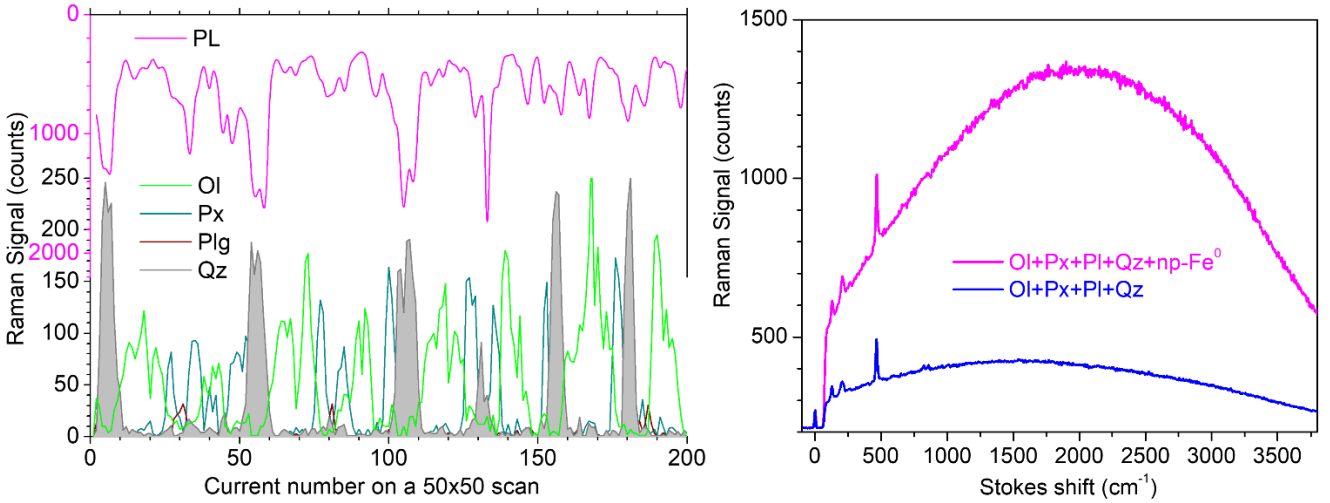

Figure 1: (Left) Correlation of PL signal with particular mineral phases (Qz, Px) in the silicate mix sample; (Right) Typical averaged spectra of Raman spectra scan over original (blue) and irradiated (magenta) mineral mix samples (example: Olivine, Pyroxenes, Plagioclase, Quartz).

References

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[3] Böttger U., Maiwald M., Hanke F., et al., Shifted Excitation Raman Difference Spectroscopy applied to extraterrestrial particles returned from the asteroid Itokawa, *Planetary and Space Science* (2017); **144**, 106-111