EGU21-9659
https://doi.org/10.5194/egusphere-egu21-9659
EGU General Assembly 2021

Searching for life in volcanic carbonate systems and the effect of temperature on organic molecules

Alexander O'Donnell
University of Aberdeen, Geoscience, Aberdeen, United Kingdom of Great Britain – England, Scotland, Wales
(a.odonnell.19@abdn.ac.uk)

Carotenoid compounds such as β-carotene are some of the most prevalent organic molecules on Earth and are key biomarkers as there is no known abiogenic source. During diagenesis and thermal alteration, carbon undergoes well-documented changes in Raman spectra.

There has been little research into the transitional degradation of carotenoid spectra to where they are fully replaced by the carbon spectra as the main identifier of thermal maturity under Raman spectroscopy. This is an overlooked regime when discussing the search for life, terrestrial and extra-terrestrial, where current research (using Raman spectroscopy) either focuses on finding living organisms displaying common organic molecules, or looks for the elemental carbon evidence of extinct fossil life. The real world is not usually so polarised, so covering the transition between these modes of life detection will improve any detection analysis.

For this study the volcanic thermal spring system in Viterbo, Italy was used as a field-based laboratory. The high rate of carbonate precipitation in these thermal springs, the wide range of thermal regimes (58°C to 25°C), and the prevalence of fast-growing algae in the run-off streams, give excellent preservation of a range of organic matter states at directly measurable temperatures.

The results demonstrate how the Raman spectra of the carotenoid compounds change with hydration, death of the organism, and thermal alteration of the organic material. The relationship between the spectra of the carotenoid compound and the elemental carbon spectra in the transition zone is also shown.

This study expands on the use of Raman spectroscopy of carbon as a low-temperature geothermometer, and provides a framework for the spectral response of organic matter in an often-overlooked geological regime. It is anticipated that the fields of geothermal energy, climatology, geobiology and astrogeobiology, could all benefit from this study, incorporating this enhanced thermal alteration data into existing and future work.