Investigating the Effects of Micro-XRF Analysis on Common Geochemical Compounds

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We studied the effect of X-ray radiation produced by a micro-focus X-ray florescence (XRF) instrument on the chemical composition of two organic compounds representative of molecules commonly reported from the terrestrial rock record. Pyrene, a polycyclic aromatic hydrocarbon (PAH), and palmitic acid, a saturated fatty acid, were deposited in glass vials and irradiated by a Bruker ARTAX instrument fitted with a polycapillary focusing optic and a Rh anode X-ray tube operated at 50 kV/600 µA. Controls and samples were analyzed by Gas Chromatography/Mass Spectrometry and Raman spectroscopy before and after exposure to the test environment and/or X-ray beam. No indication of chemical alteration of the compounds was observed in data acquired using GCMS and Raman spectroscopy. A color change that was observed in samples after X-ray irradiation was likely caused by reversible activation of color centers in the borosilicate glass vials.

Figure 1. Bruker ARTAX sensor head showing XYZ stages, X-ray tube enclosure, polycapillary optic, fiducial laser, SDD detector and plumbing for He gas flow.

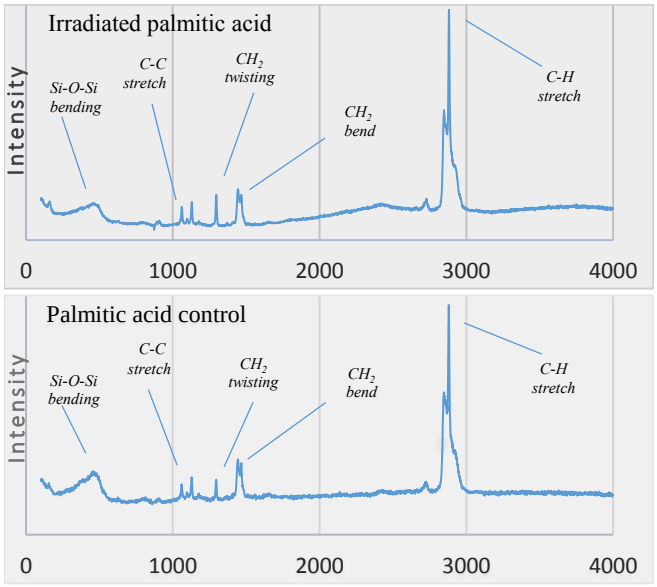

Figure 2. Raman Spectra obtained from palmitic acid before irradiation (upper panel), and after irradiation (lower panel) with excitation at 530 nm. The two spectra are very similar. The strong peak at around 2281 cm^{-1} represents the symmetric and non-symmetric stretches for CH_2.The peak around 450 cm^{-1} is associated with the Si-O-Si bending mode for the glass vial.