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Analyzing organic compounds trapped within 3.7 billion years old liquid inclusions

MAGNUS A R HARDING[1,2], AUSTIN JARL BOYD[1], SANDRA SILJESTRÖM[3], ABHAY SHIVAYOGIMATH[4], HENNING O SØRENSEN[4], MADINA SHAMSUYEVA[5], POOYAN ALIUOS[5], MINIK T ROSING[1] AND TUE HASSENKAM[1]

[1]University of Copenhagen

[2]Sino-Danish College (SDC), University of Chinese Academy of Sciences

[3]RISE Research Institutes of Sweden

[4]Technical University of Denmark

[5]Leibniz University Hannover

Presenting Author: magnus.harding@sund.ku.dk

The >3.7 billion-year-old Isua Supracrustal Belt in SW Greenland contains the oldest sedimentary successions on the planet. Among these are rare sequences of fine-grained siliciclastic deposits containing abundant horizons of graphite interrupted by layers of turbidite-like beds, indicative of a seafloor sediment displaying intervals of quiescent periods with pelagic sedimentation interrupted by intervals of rapid deposition. The carbon in these sedimentary sequences have previously been shown to exhibit certain intrinsic characteristics of a biogenic origin, such as low $\delta^{13}C$-values. More recently, studies have focused on inclusions of carbonaceous material within garnet porphyroblasts, which form part of contiguous horizons of organic carbon. These studies have shown that the armouring of the carbonaceous matter within the garnet mineral allowed for the preservation of nitrogen and oxygen in association with the reduced carbon.

Liquid-like inclusions were also observed within the garnet porphyroblasts. Here, we present elemental and spectroscopic data from these carbonaceous inclusions found within the Isua rocks obtained using a variety of analytical methods, such as atomic force microscopy-based IR spectroscopy, Raman and IR-coupled optical photothermal spectroscopy, time-of-flight secondary ion mass spectrometry and X-ray nanotomography. These methods yield high resolution, *in situ* data in a practically non-destructive manner, and are as such ideal when dealing with minute samples of scarce quantity.