Searching for Organics under a Simulated Mars Robotic Drilling Mission (Rio Tinto, Spain): What Lies Underground?

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The subsurface is the key environment for searching for life on planets lacking surface life. Determining bulk organics of biological origin in a subsurface sample is a key step to assess possible life within it.

We present here results on the preservation of organics in highly oxidized rock materials and clay layers drilled from 0-6m-depth (Borehole-7) under the Mars Analog Rio Tinto Experiment (MARTE). This simulated a Mars robotic drilling mission at the RioTinto (Spain) [2,5]. The RT represents an important analog of the Sinus Meridiani Mars Site, and an ideal model for a potential deep subsurface Martian biosphere including anaerobic chemoautotrophs and strict anaerobic methanogens (sustained by Fe and S minerals) [2,4].

28 mini-cores were processed within a robotic system that included subsystems for hands-off drilling, core acquisition, sample handling, physical data acquisition, and sample transfer to life detection instruments [7] under anti-contamination protocols [2,4,6].

The bulk organic analysis was performed with an Elemental Analyzer-Isotope Ratio Mass Spectrometer (EA-IRMS). ATP amounts (Adenosine5-triphosphate) were estimated by Luminometry assay as proxy for total biomass in surface soil/core-samples [6,8].

The organic carbon varies up to four orders of magnitude between the surface litter layer (C-org~11%Wt at 0-1 cm) and the first 6-m-depth (C-org=0.02-0.38 %Wt) [3]. The preservation of plant/soil-derived organics (C/N=50; d13C-org=-26‰-to-24‰) is higher (C-org=0.3 %Wt) in hematite-poor clays, XRD-data [9], than in hematite-rich samples (C-org=<0.01 %Wt). This suggesting that not-oxidized clay layers bear a better potential for preserving organics.

Results from this experiment will support future Astrobiology-driven Mars drilling mission