Potential biosignatures of surface alteration on Mars inferred from terrestrial analog regoliths

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Key objectives of the 2020 Mars Sample Return Mission include determining the history of water, paleoclimate and potential past life on Mars, using sedimentological, mineralogical, and geochemical aspects of the Martian regolith [1]. Interpretations of potential biosignatures depend on our knowledge of terrestrial analog material [2,3,4]. Therefore, we investigated fine-grained sediment (<63µm) (grain size- LPSA; surface area (SA)- BET; chemistry- ICP-MS and chemical indices of alteration; mineralogy- XRD; microbial influences- SEM and field observations) from Mars-analog hyper-arid and temperate glacial settings (Antarctic McMurdo Dry Valleys-MDV, Iceland [5], Norway), to determine potential relationships among sediment texture and primary mineralogy, bulk chemistry, depositional setting, alteration history and microbial influences. Here we report these relationships with ANOVA coupled with Tukey's post-hoc test pairwise comparisons, PCA, and box-plots.

SA varies significantly with the basal regimes, with high values in partly wet-based MDV (Taylor Valley; TV), followed by cold-based MDV sediments, where as the lowest values are evident in wet-based glacial sediments (Norway, Iceland). TV tills of the Last Glacial Maximum (LGM) exhibit the highest CIA and SA values, and show weathering textures and secondary Fe-hydroxide nanominerals associated with microbial influences. Preliminary results suggest that SA, Li, Fe_2O_3, P_2O_5 and clay% may be useful indicators of aqueous and biological processes; however, laboratory bioweathering experiments polyextremophilic microbes are necessary to test potential biosignatures and discriminate these from bedrock-sourced chemical signatures.

[1] McSween et al. (2019) *Meteorit. Planet. Sci.* **54(3)**, 667-671. [2] Cannon et al. (2015) *EPSL* **417**, 78-86. [3] Ehlmann et al. (2012) *J. Geophys. Res*. **117**, E00J16. [4] Olsson-Francis et al. (2017) *Front. Microbiol.* **8** doi: 10.3389/fmicb.2017.01668 [5] Demirel et al. (2018) 49th LPSC Abstract #1544.