

Don Juan Basin, Antarctica: A chemically altering environment with martian analog potential

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ABSTRACT

The McMurdo Dry Valleys of Antarctica provide a testbed for alteration processes on Mars due to the cold, arid, and windy conditions. Analysis of three sediment cores collected from Don Juan Basin, Wright Valley, Antarctica, reveals that surface sediment formation is primarily dominated by physical alteration. Chemical alteration occurs sporadically in this region and is frequently indicated by the accumulation of sulfates and Cl-bearing salts. We investigated the effects of physical and chemical alteration in Don Juan Basin by considering major and trace element abundances in the sediments based on depth and location. Our results indicate inversely related chemical- and physical-alteration gradients with proximity to Don Juan Pond where the current center of the pond represents a more chemically altering environment and the perimeter a more physically altering one. Comparing calculated sulfate abundances for Don Juan Basin cores to rock and soil samples taken by the rover Curiosity at Gale crater, we observed that the core from within Don Juan Pond best matches Curiosity soil sulfate abundances.

A new Chemical Index of Alteration equation that adjusts for salt dilution was also applied to the Antarctic cores and Curiosity rocks and soils. Our analysis indicates a significantly higher degree of chemical alteration than originally reported for most Antarctic and martian samples. Our investigation provides evidence for aqueous-based chemical alteration under cold, hyper-arid conditions in Don Juan Basin, Antarctica. Our work also demonstrates the analogous nature of terrestrial microenvironments to similar, local-scale sample sites on Mars, thereby supporting past or present chemical alteration on Mars.

Keywords: Mars analog, McMurdo Dry Valleys, Antarctica; chemical alteration, geochemistry, spectroscopy, mineralogy; Earth Analogs for Martian Geological Materials and Processes