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DON QUIXOTE POND: A SMALL SCALE MODEL OF WEATHERING AND SALT ACCUMULATION.

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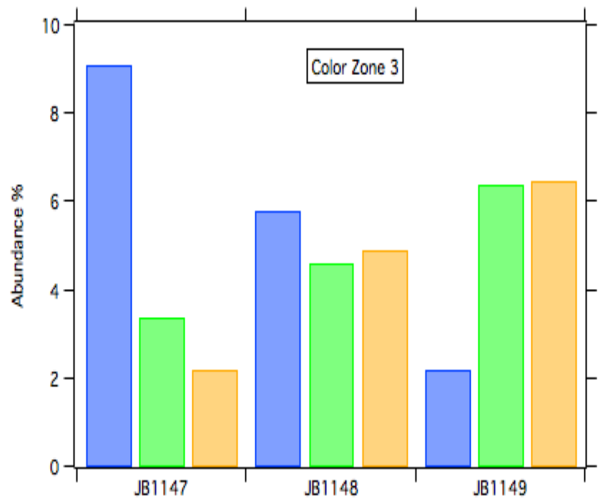
Introduction: The formation of Don Quixote Pond in the North Fork of Wright Valley, Antarctica, is a model for unique terrestrial calcium, chlorine, and sulfate weathering, accumulation, and distribution processes [1, 2]. The formation of Don Quixote Pond by simple shallow and deep groundwater [1] contrasts more complex models for Don Juan Pond in the South Fork of Wright Valley [3]. Our study intends to understand the formation of Don Quixote Pond as unique terrestrial processes and as a model for Ca, Cl, and S weathering and distribution on Mars.

Sampling Locations: Don Quixote Pond is located in the western part of the North Fork about 100 m above Mean Seawater Level. The Don Quixote Pond brine is seasonally frozen [1]. Valley walls are up to 2500 m high. Samples were collected from the surface and as depth profiles during the 1979/1980 field season [4]. They were analyzed by X-ray diffraction, reflectance spectroscopy and other analysis methods [5].

A field photograph and drawing show sampling locations and zones of coloration (1-5) that grow lighter with distance from the pond center (Fig. 1). Surface samples are available from every color zone. A subset of surface samples were investigated from a radial sampling traverse to the south, extending more than 50 m from the pond center.

Results: Low sulfate concentrations are generally observed at the surface near Don Quixote pond. Zone 3 is an exception and the radial traverse samples here (JB1147, JB1148, JB1149) show consistently high abundances of salts and sulfates (Fig. 2). The sulfates observed include gypsum, anhydrite, bassanite and thenardite. Halite was observed to decrease radially outward across zone 3, while gypsum and anhydrite increase radially outward (Fig. 2).



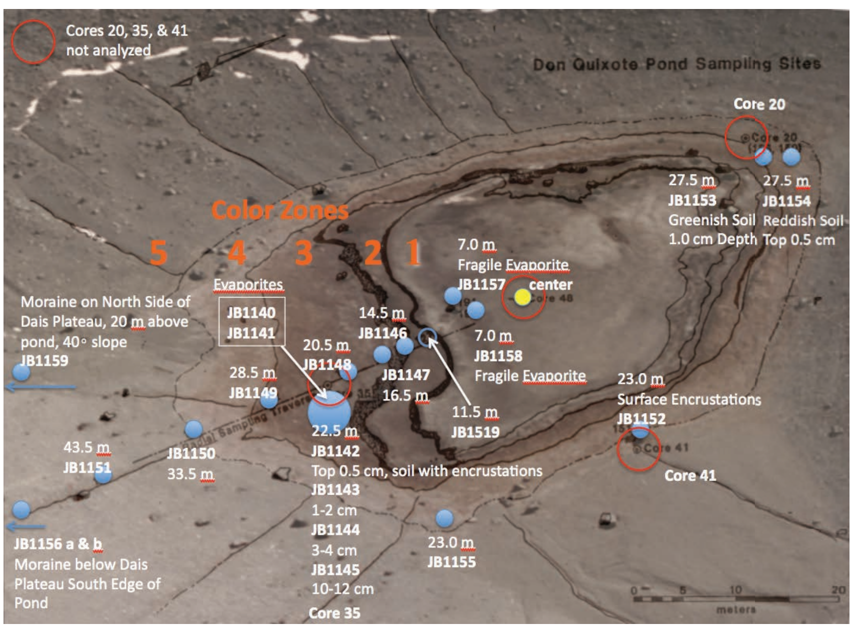


Fig.1. Don Quixote Pond Sampling Locations. Sampling sites at the pond and nearby are marked in blue. Color zones extend radially outward.

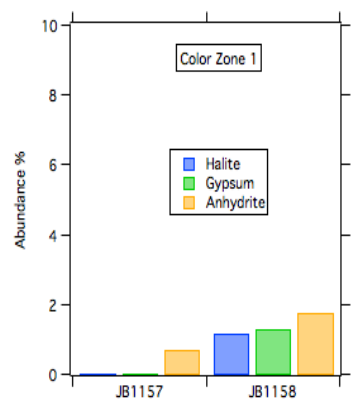


Fig.2. Halite and Sulfate Abundances in Color Zones 1 & 3. Halite is shown in blue, gypsum in green and anhydrite in yellow.

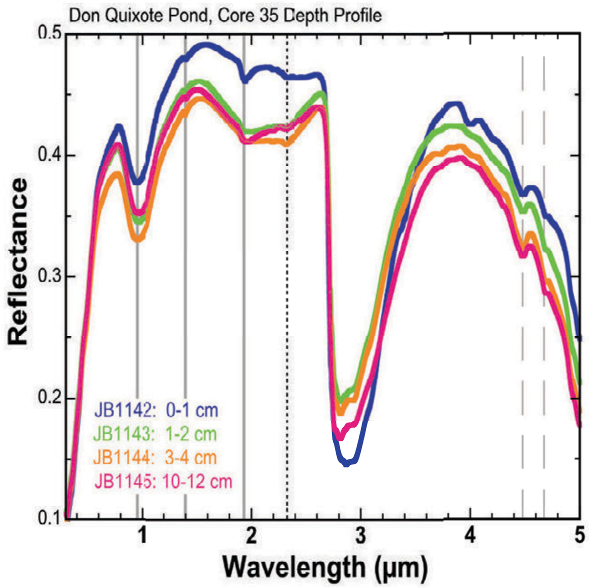


Fig.3. Reflectance Spectra of Don Quixote Pond Samples from a Depth Profile. These spectra show mineralogic differences with depth at core 35 including variations in the abundance of quartz, pyroxene and hydrated components. Dashed lines near 4.5 and 4.7 μm mark anhydrite bands and the line at 0.98 μm is due to Fe^{2+} in pyroxene. Weak bands consistent with Fe/Mg-phyllosilicates are present near 1.4, 1.9 and 2.35 μm.

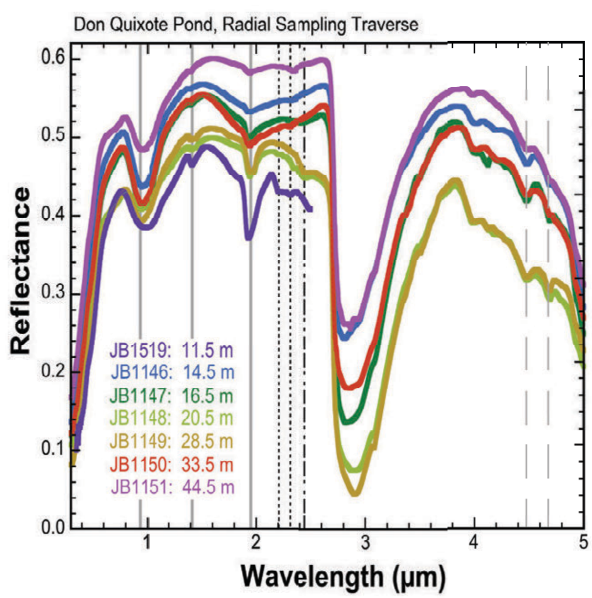


Fig.4. Reflectance Spectra of Samples from a Radial Traverse Extending Outward from Don Quixote Pond. Many of these spectra exhibit strong H_2O bands near 1.95 and 2.9 μm attributed to hydrated materials. Anhydrite bands are observed near 4.5 and 4.7 μm.

Discussion and Conclusion: Don Quixote Pond has generally high abundances of halite with gypsum and anhydrite present as the major sulfates. We are investigating variations in gypsum and anhydrite abundance with depth and distance from the center of the pond in order to determine if the hydration level of these Ca sulfates can be related to other salt abundances or iron oxide or clay mineralogy. Color zones are not correlated to salt abundances except for Color Zone 3, which has 15% salts of varying composition in all samples. All sediments also contain quartz, pyroxene and feldspar as observed in other studies [e.g. 5].

Further research may provide an explanation for the well-defined color zones. Don Quixote pond may well be a good example of what to expect in past or present small ponds on Mars.

References: [1] Harris H.J.H. & Cartwright K., (1981) *Antarctic Research Series 33*, 193-214. [2] Torii T. & Yamagata J. (1981) *Antarctic Research Series 33*, 141-157. [3] Dickson J. L. et al. (2013) *Sci. Rep. 3*: 1166. [4] Gibson E. K. et al. (1983) *JGR 88*, A912-A928. [5] Bishop J. L. et al. (2014) P*hil Trans Royal Soc. A*, **372**, 20140198.

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