ANTARCTIC DRY VALLEY SEDIMENTS AS ANALOGS FOR MICROBIAL SYSTEMS IN A COLD MARS-LIKE ENVIRONMENT.

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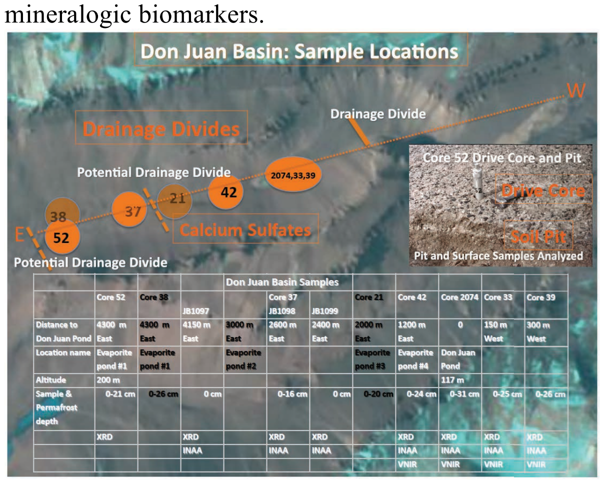
Introduction: The Antarctic Dry Valleys (ADV) were valued very early as microbiological proxies for Mars exploration [e.g. 1], and the geological significance of cold and arid deserts as Mars analogs concerning past and present water action and salt formation was suggested by Gibson et al. [2]. Since that time numerous studies have investigated the chemical, physical and biologic properties of sediments, both from the bottom of ice-covered lakes and from surface regions [e.g. 3-8]. These studies observed microbial life nearly everywhere and some evidence for clays, carbonates, sulfates and other minerals associated with microbes in the sediments.

Lake bottom sediments: Studies of the mineralogy, geochemistry, spectroscopy, and isotope patterns have been performed on igneous sediments from Lake Hoare, a nearly isolated ADV ecosystem [e.g. 6]. The mineralogy and chemistry of these sediments were studied in order to gain insights into the biogeochemical processes occurring in a permanently ice-covered lake and to assist in characterizing potential habitats for life in paleolakes on Mars. Obtaining VNIR, mid-IR, and Raman spectra of such sediments provides the ground truth needed for remote exploration of geology, and perhaps biology, on Mars.

These sediments are dominated by quartz, pyroxene, plagioclase, and K-feldspar, but also contain calcite, organics, clays, sulfides, and iron oxides/hydroxides that resulted from chemical and biological alteration processes [6]. Chlorophyll-like bands are observed in the spectra of the sediment-mat layers on the surface of the lake bottom, especially in the deep anoxic region. Layers of high calcite concentration in the oxic sediments and layers of high pyrite concentration in the anoxic sediments are indicators of periods of active biogeochemical processing in the lake. Micro-Raman spectra revealed the presence of ~5 µm-sized pyrite deposits on the surface of quartz grains in the anoxic sediments. C, N, and S isotope trends were compared with the chemistry and spectral properties. The $\delta^{13}C$ and $\delta^{15}N$ highlight differences in the balance of microbial processes in the anoxic sediments versus the oxic sediments. Biogenic pyrite found in the anoxic zone sediments is associated with depleted $\delta^{34}S$ values, high organic C levels, and chlorophyll spectral bands, and could be used as a potential biomarker mineral for paleolakes on Mars.

Surface Sediments: ADV surface sediments surrounding Lakes Fryxell, Vanda and Brownworth were investigated as analogs for the cold, dry environment on Mars [8]. Sediments were sampled from regions surrounding the lakes and from the ice cover on the lakes. The ADV sediments were studied using Raman spectra of individual grains and reflectance spectra of bulk samples. Elemental abundances were coordinated with the spectral data in order to assess trends in sediment alteration. The surface sediments in this study were compared with lakebottom sediments [6] and samples from soil pits [7]. Feldspar, quartz and pyroxene are common minerals found in all the sediments. Minor abundances of carbonate, chlorite, actinolite and allophane are also found in the surface sediments, and are similar to minerals found in greater abundance in the lakebottom sediments. Surface sediment formation is dominated by physical processes in contrast to biomineralization taking place in lakebottom sediments. Characterizing the mineralogic variations in these samples provides insights into the alteration processes occurring in the ADV and supports understanding alteration in the cold and dry environment on Mars.

High Saline Ponds: Don Juan Pond (DJP) in Wright Valley has a high salinity of 40 wt.% or more salt content. Salt accumulation and its history is complex and is still waiting to be unraveled. The focus of the current study is on characterizing the mineralogy and salt chemistry at the DJP region through analyses of multiple sediment cores (Figure 1). We are applying XRD, VNIR and mid-IR reflectance spectroscopy, Raman spectroscopy and chemical analyses toward understanding the geochemistry of the DJP basin. This will enable documentation of potential elemental and mineralogic biomarkers.



				Don Juan Basin Samples							
	Core 52	Core 38	JB1097		Core 37 JB1098	JB1099	Core 21	Core 42	Core 2074	Core 33	Core 39
Distance to Don Juan Pond	4300 m East	4300 m East	4150 m East	3000 m East	2600 m East	2400 m East	2000 m East	1200 m East	0	150 m West	300 m West
Location name	Evaporite pond #1	Evaporite pond #1		Evaporite pond #2			Evaporite pond #3	Evaporite pond #4	Don Juan Pond		
Altitude	200 m								117 m		
Sample & Permafrost depth	0-21 cm	0-26 cm	0 cm		0-16 cm	0 cm	0-20 cm	0-24 cm	0-31 cm	0-25 cm	0-26 cm
	XRD		XRD		XRD	XRD		XRD	XRD	XRD	XRD
			INAA		INAA	INAA		INAA	INAA	INAA	INAA
								VNIR	VNIR	VNIR	VNIR

Figure 1. Selected sample locations at Don Juan Pond.

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