PLANETARY ANALOG RESEARCH AND CLIMATE CHANGE MONITORING IN A LAND OF EXTREMES: THE UBEHEBE VOLCANIC FIELD, DEATH VALLEY, CALIFORNIA. R. Bonaccorsi[(1,2,3)], D. Willson[(1,4)], C.P. McKay[(1)], A. Zent[(1)], G.Valdre[(5)], R. Friese[(3)] ¨ [(1)]NASA Ames, Moffett Field, CA 94035, USA (rosalba.bonaccorsi-1@nasa.gov); [(2)]Carl Sagan Center/SETI Institute, Mountain View, CA 94043; [(3)]Death Valley Natl. Park (Death Valley, CA 92328), [(4)]KISS Institute for Practical Robotics; [(5)]Department of Earth and Geo-Environmental Sciences, University of Bologna, Italy.

Introduction: We report results from our Astrobiology Field Analog work under way at the Ubehebe Volcanic Field (UVF) in Death Valley National Park. Furthermore, we outline the relevance of cross-disciplinary and multi-component investigations to themes such as climate change and water resources monitoring.

The Ubehebe Volcanic Field (UVF) (~15 Km^2) includes a dozen craters formed during hydro magmatic explosions occurred sometime between 1 thousand (Ka) and 6 Ka years ago (Figure 1).

Figure 1. View of the UVF (~2 km^2). The Ubehebe Crater (37°0'35"N, 117°27'01"W, ~752 meters elevation) is ~0.8 km-wide and ~150-200 meter-deep.

Clay-rich sediments are unambiguous indicators of past aqueous activity on Mars. Therefore, understanding the climatic context under which clay-rich sediments are formed and recycled in extreme terrestrial environments is the cornerstone for addressing the potential of sedimentary and mineral settings to support microbial life on Earth [e.g., 6] as well as, possibly, on a wetter warmer early Mars [1-2, 7].

Observations: The Ubehebe Crater (UC) encompasses several features seen at Gale Crater, the Mars Science Laboratory (MSL) Landing Site, including a variety of fine- to coarse-grained sediments (e.g., Figure 2). These fluvial, alluvial, and lacustrine facies include claystone, siltstone, sandstones, and fanglomeratic deposits (of Miocene age) as found at Yellowknife Bay, Gale Crater [5], (Figure 2).

Results: To date, the conditions conducive to formation/recycling of smectite-rich sediments (20%Wt.) at UC (Figure 2) include:

a) ~50mm to >250 mm/y rainfall in water years (WY) 2004-2013 comprising wet and dry years as well as an increasing occurrence of Summer monsoonal flash floods in the area. In WY 2011, 2012, and 2013, Summer rainfalls accounted for ~30% and ~50% of the total annual precipitation, respectively.

b) Sedimentation rates ~ 1mm/y to ~40 cm/y.

c) Ground moisture ranging from dry-very dry (1-3% to <10 %Wt. water content for a. 87% of time, WY 2011) to wet-saturated (10-60 %Wt. water content for a. 10% of time). Ephemeral ponds appear to form once a year and can last for one-two weeks (2008-2011 study years).

d) Ground temperature between -16ºC and + 70ºC.

e) pH ~8-9.5.

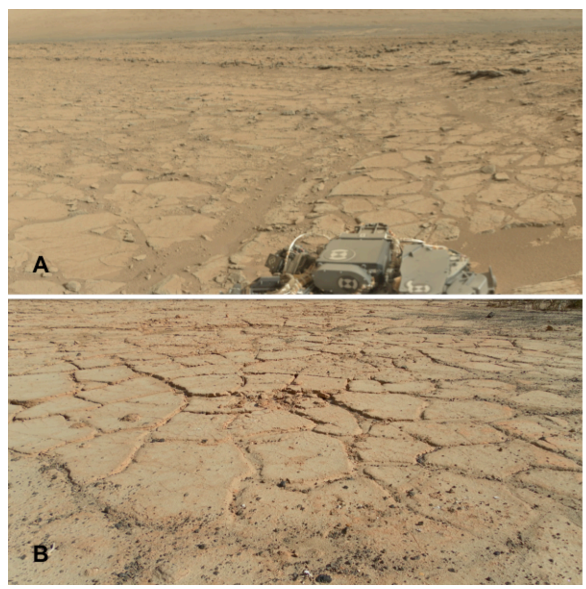

Figure 2. Comparison between UC intracrater fill deposits i.e., diagenetically young clay-rich deposits and Gale Crater mudstones. ***A:*** *Gale Crater: Claystone deposits from Yellow Knife Bay Site 20130115_Sol137_Mastcam34_m. The John Klein sample represents the terminal part of an alluvial fan system that post-dates the crater floor deposits and*

may be of mid Hesperian age. ***B:*** *Ubehebe Crater Floor Site 20130305.*

Conclusions: The UC represents an ideal natural laboratory to observe processes and test hypotheses concerning the deposition of clay-rich crater fill sediments under analog hydro-climatic conditions [1-2]. For instance, here we can study the relationship among rainfall (amounts, intensity, and frequency), erosion, deposition of Gale Crater-like sediments, and formation of hydrated minerals (sulfates, clays) [3-4]. Furthermore, the UC site offers the opportunity to monitor the surface water cycle of this increasingly extreme dry and hot desert environment.

References: [1] Barnhart et al., (2009). J. Geophys. Res. [2] Craddock & Howard, (2002) *Geophys. Res., 107*(E11),5111. [3] Mustard et al., (2008) *Nature, 454*(7202):305-309. [4] Milliken and Bish (2010) *Phil. Mag. 90*(17-18):2293-2308. [5] Vaniman et al. (2014) Science *343, 6169*. [6] Bonaccorsi et al., (2010) *Phil. Mag. 90(17-18):2309-2327.* [7] Grotzinger et al., (2014) *Science 343, 6169.*