# BRISTOL DRY LAKE, CALIFORNIA: AN ANALOG FOR ANCIENT LACUSTRINE ENVIRONMENTS ON MARS.

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**Introduction:** Bristol Lake is a dried lake bed at the foot of a young volcano in the Mojave Desert. It is considered a Mars analog for several reasons. First, the chemistry and distribution of the evaporite deposits are very similar to putative lake deposits observed on Mars from orbit [1]. Second, the volcanic geology surrounding the lake is similar to much of the martian surface in that it is dominated by basalt [2]. Third, brines found in the playa are believed to be sourced primarily from hydrothermal groundwaters, which are rich in chloride, sodium, and calcium, and were heated by near-surface magma [3]. Waters on ancient Mars are thought to have at least partially evolved from hydrothermal fluids [4] and therefore have a similar origin to those found at Bristol Lake. Fourth, the dry nature of the Mojave Desert, where Bristol Lake is located, is similar to the dry environment on the surface of Mars.

Few Mars analog studies have been conducted at the Bristol Lake playa, though the volcano nearby has been used for Mars and autonomous rover testing [5]. The playa is therefore a prime site for astrobiological and geochemical investigations. This study aims to investigate the geochemical environment at Bristol Lake (BL) within the context of Mars remote sensing studies by addressing the following questions:

- What is the distribution of evaporites in BL and how is it similar to analogous sites on Mars?
- What type of chloride is most likely to exist on Mars based on analyses of Bristol Lake?
- What is the chemistry of the brines at BL? Would this site qualify as a “Special Region?”
- Do brines vary in composition across BL? Are they similar to current/ancient martian brines?

By comparing the mineralogy at Bristol Lake to sites on Mars, conclusions can be drawn as to the nature of brines that existed in Mars’ late-Noachian/early Hesperian [6] and could exist temporally on Mars today.

**Methods:** The distribution of evaporite minerals will be compared to lacustrine sites on Mars using a combination of field samples, remote sensing data, and existing field maps of the region. Field samples will be characterized using thin sections and electron microprobe analyses. Thermal emission and near-infrared reflectance spectra will be collected for samples representative of each mineralogic unit in the evaporite sequence. These spectra will be compared to those collected by instruments orbiting Mars: thermal emission spectra from the Thermal Emission Spectrometer (TES) and Thermal Emission Imaging System (THEMIS), and near-infrared spectra from the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM). Basalt samples from the nearby young volcano, Amboy Crater, will also be collected and subject to the same analyses as the evaporite samples.

**Figure 1. Bristol Lake salt deposits, field excursion 1 (03/11/16).**

Brine samples from ponds distributed throughout the playa will be analyzed for pH, conductivity, major ions, and trace metals. Changes in the composition of dissolved solids in the brine will be compared to the surrounding geology to better understand the context in which the brines and evaporite deposits formed.

**Discussion:** Compositional, spectroscopic, and chemical analyses of geologic and water samples will allow the geochemical environment at Bristol Lake to be characterized. Comparisons in mineralogy and morphology will be made between Bristol Lake and lacustrine sites on the martian surface. The constraints set by the Committee on Space Research (COSPAR) for astrobiological Special Regions will be used to assess whether Bristol Lake is representative of Mars Special Regions [7]. If distinct commonalities are found between Bristol Lake and sites on Mars such as Miyamoto Crater [8], the astrobiological context of current and ancient Mars will be better constrained. Further characterization of the microbial communities (if such exist) in the Bristol Lake region could provide clues as to the type of microorganisms that could be found on Mars. Field excursions at Bristol Lake will also characterize the hazards future crews or rovers could experience during surface exploration operations.

**References:** [1] Burt, D., et al. (2003) *LPSC XXXIV*, Abstract #1860. [2] Gale, H. (1951) USGS Special Report 13. [3] Lowenstein, T., et al. (2009) *Aquat. Geochem.*, 15, 71-94. [4] Tosca, N. J., et al. (2005) *EPSL*, *240*, 122-148. [5] Thompson, D. R. and Wettergreen, D. (2008) *LPS XXXVI*, Abstract #2332. [6] Osterloo, M., et al. (2008) *Science*, *319*, 1651. [7] Rummel, J. D., et al. (2014) *Astrobiology*, *14*, 11. [8] Hynek, B., et al. (2015) *Geology*, *43*, 9.