Taylor PLATTNER Final report rcvd. 9.30.22
Lewis and Clark Fund for Exploration and Field Research in Astrobiology
Date of the award: 06/08/2020 – Requested extension for 08/31/2022

Potential Biomarkers in Planetary Analog Brine Environments
Project Report

Lewis and Clark Astrobiology Grant – Project Report (Supplemental Material)

Introduction & Motivation

Mars has been at the forefront of planetary exploration in part due to evidence that a large amount of its surface has been altered by liquid water, suggesting that Mars could have been globally habitable in the past (Ehlmann & Edwards, 2014). Whether habitable niches have survived to present day is still not clear. As a result, many investigations of the Martian geologic record via satellites, landers, and rovers have focused on potentially habitable environments that existed on early Mars during the Noachian and Hesperian eras (~4.0-~3.0 Gya) (Amador & Ehlmann, 2020). Examples include crossbedding seen in images from Curiosity at Gale Crater (Grotzinger et al., 2014; Grotzinger et al., 2015) and hematite "blueberries" imaged by Opportunity at Meridiani Planum (Squyres et al., 2004; Arvidson et al., 2014) which revealed geochemically complex ancient lake beds indicating that early Mars could have had diverse geochemical conditions. Although these environments were altered by water, the exact water-rock interactions and environmental conditions on early Mars remain poorly understood. Additionally, these lake beds contain evaporite deposits that could be favorable for the preservation of ancient biomarkers (Hays et al., 2017), making them a good place to look for signs of life.

While only remnant altered rocks can be studied on Mars, analog environments on Earth such as the wide biogeochemical range spanned by the Western Australia Transient Lakes (WATL) present an opportunity to investigate what early lacustrine Martian environments could have been like, and understand how once active lake systems leave a record of their presence behind. The WATL are a system of hundreds of chemically complex, ephemeral saline lakes which host complex microbial communities in the Archean Yilgarn Craton (Benison et al., 2007; Benison & Bowen, 2015; Bowen & Benison, 2009; Mormile et. al, 2009). The Yilgarn craton is approximately the same age as Noachian and Hesperian terrains on Mars, which along with its composition makes this system a uniquely suited analog for Mars to explore the preservation of exotic putative biomarkers (Benison et al., 2007; Benison & Bowen, 2015; Bowen & Benison, 2009). In particular, "Hairy Blobs" (HBs) are among the first microbial remains described in acidic saline lake environments (Benison et al., 2008). These structures are peculiar because they appear biotic in origin, but whether they are preserved microorganisms or pseudofossils is not yet clear. My work will seek to uncover how the WATL evolve in order to contextualize putative biomarkers in the WATL environments towards comparing these to Mars. My work is modeled after the approach described as the "Ladder of Life Detection" (LOLD) (Neveu et al., 2018) and the central idea is to contextualize a Mars-analog system, and resolve microscale morphological fabrics and their applicability to life detection.

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Maps

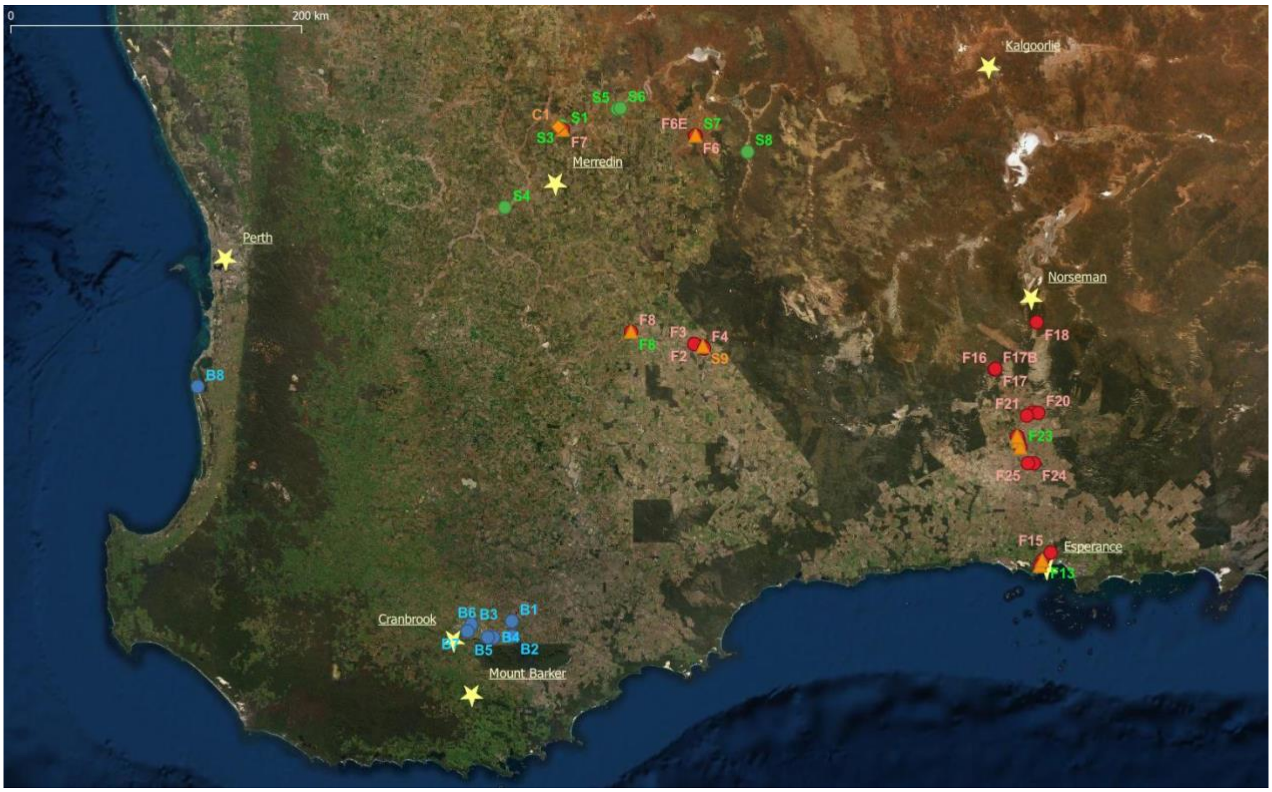

Figure 1: QGIS map of our field sites throughout the Yilgarn Craton in Western Australia.

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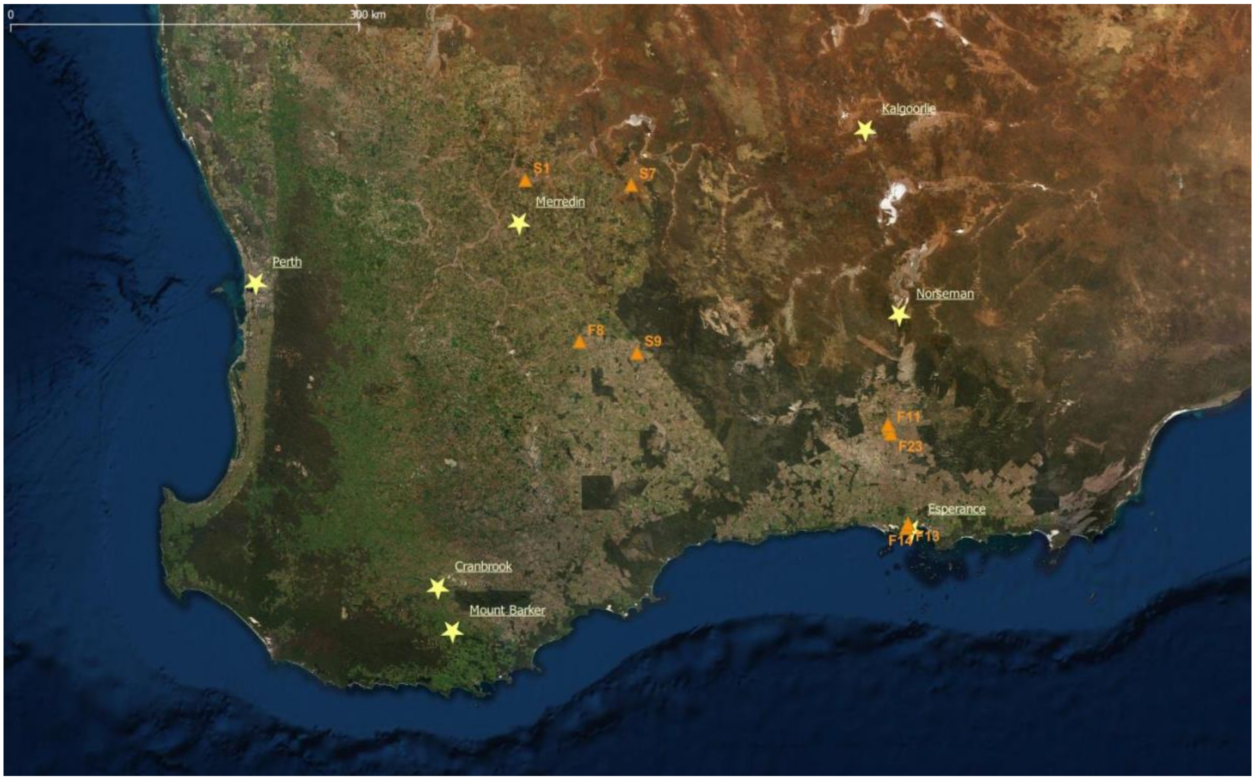

Figure 2: QGIS map of our field sites in Western Australia, in which these lakes were sampled twice to capture change over time.

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Images of Fieldwork

Figure 3: Me in the field with the portable spectrometer at site C1.

Figure 4: Meg Birmingham and I working with the portable spectrometer at site C1.

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Figure 5: Meg Birmingham, Jessica Weber, and I working with the portable spectrometer, LIBS, and XRF instruments at site C1.

Figure 6: Meg Birmingham, Jessica Weber, Britney Schmidt, and I working with the portable spectrometer, LIBS, Raman, and XRF instruments at site C1.