2023 ECCA Final Report

Understanding the surrounding geology and preservation potential through wet/dry cycles in acidic saline lakes in Western Australia

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The Early Career Collaboration Award (ECCA) supported two weeks of in-person research with Dr. Jessica Weber at the Origins and Habitability Laboratory (OHL) at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California. The primary objectives were to (1) gain hands-on experience with laboratory spectroscopy and mineral characterization techniques, including visible and near-infrared (VNIR) spectroscopy, X-ray diffraction (XRD), and X-ray fluorescence (XRF), and (2) characterize mineral samples collected from acidic saline lakes across the Yilgarn Craton of Western Australia, which we collectively refer to as the Western Australia Hypersaline/Saline Lakes (WAHLs). The overall goal of this project is to better understand how repeated wet-dry cycles and interactions between water and rock have shaped these lakes over thousands to millions of years. Because these lakes are approaching complete desiccation, they provide an important window into how similar environments on Mars may have evolved during the Amazonian era.

Figure 1. Western Australia lake samples were dried (if needed), powdered, and then processed by XRD, shown in this image.

During the visit, we prepared field samples, collected VNIR spectra at JPL, and collaborated with Aaron Celestian, Mineral Curator at the Natural History Museum of Los Angeles County, to conduct XRF and XRD analyses. These complementary datasets allowed us to identify the mineralogical composition of evaporite deposits and weathered outcrops, improving our understanding of mineral assemblages and geochemical processes operating within these complex lake systems.

Our analyses revealed two distinct lake environments across paleovalleys in the Yilgarn Craton. Most lakes occupy shallow, surficial basins with little to no exposed outcrops and are dominated by halite-rich evaporites, with gypsum occurring primarily in the subsurface. In contrast, a smaller number of deeply incised lakes expose truncated lateritic profiles containing Al-clay minerals, quartz veins, and iron oxides. These contrasting environments reflect different pathways of geologic and geochemical evolution driven by evaporative concentration and interactions with acidic groundwater. Part of this work contributed to our understanding of the WAHLs as important analogs for the Terra Sirenum region of Mars, where similar features on the Martian surface preserve layered, Al-rich clay outcrops and localized acidic weathering minerals that may similarly record prolonged groundwater activity and evaporitic processes (Plattner et al., 2026).

This collaboration directly contributed to my first first-author publication describing the geochemistry and mineralogy of the WAHLs and their implications for understanding analogous acidic and saline environments in Terra Sirenum on Mars (Plattner et al., 2026).

Figure 2. Image of salt pans (left) and weathered outcrops (right) around some Western Australia lakes that were sampled and then processed for this work.

References:

Plattner, T. A., Schmidt, B. E., Fernandez, N. M., Doran, P. T., Birmingham, M. A., Weber, J. M., et al. (2026). Groundwater connectivity and buffering in Western Australian hypersaline lakes: Implications for late-stage Martian lacustrine systems. *Earth and Space Science*, *13*, e2026EA005066. https://doi.org/10.1029/2026EA005066.