Europlanet TA Scientific Report

PROJECT LEADER

Project number: ***20-EPN2-085***
Name: Charlotte Spencer-Jones
Home Institution: Durham University
TA Facility visited: Makgadikgadi salt pans

Project Title:

Scientific Report Summary.
(plain text, no figures, maximum 250 words, to be included in database and published)

The geological history of Mars indicates that this planet has transitioned between conditions that could have supported life. Extensive fluvial features on the Martian surface provides evidence for the presence of water in Martian history and suggests that Mars may have been habitable during the Noachian period (4.1-3.7 Ga). Therefore, establishing a suite of relevant and robust biosignatures diagnostic for past life remains one of the key methods for detecting extinct Martian lifeforms. Organic compounds are the fundamental building blocks of all terrestrial life and are widespread throughout the solar system with structurally diverse organic compounds detected in a range of extra-terrestrial samples.

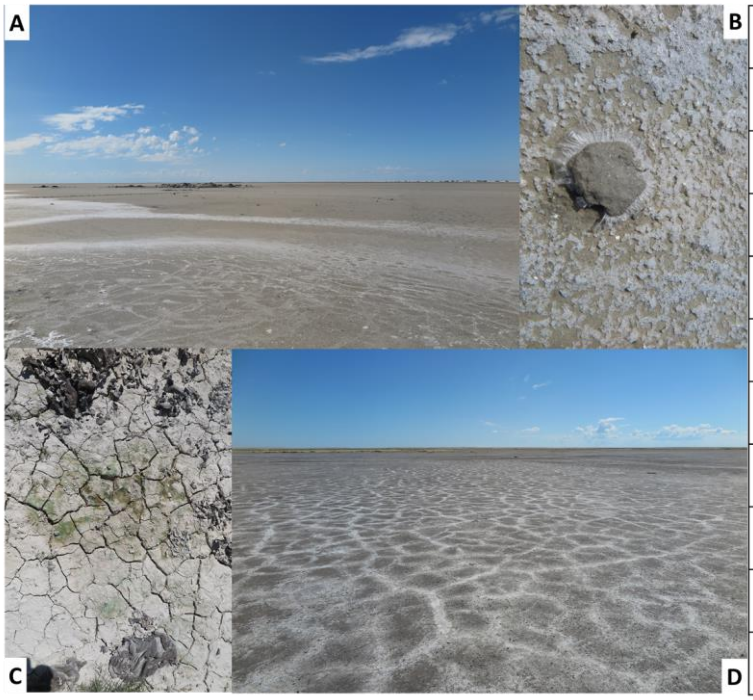
The main aims of this fieldwork campaign (20-EPN2-085) were to collect a range of samples, including sediments, biofilms, and salts from the Makgadikgadi basin with accompanying physical data from the basin. The second phase of this study will characterise organic compounds within the samples. The outcome of this work will be to establish the key parameters that control organic compound preservation within Martian analogue environments. These results will determine biosignatures that could be identified during future Mars missions (e.g. ExoMars 2020) and thus highlight the mineralogies present that have the highest preservation potential for biosignatures.

Full Scientific Report on the outcome of your TNA visit

Organic compounds such as those synthesised by microorganisms are abundant in the terrestrial environment and can be preserved on millennial timescales. Organic compounds have potential as biomarkers in the detection of extra-terrestrial life. Identifying the factors that control the distribution and preservation of organic compounds is, therefore, important in the application of organic biomarkers in the planetary sciences. The Makgadikgadi salt pans are an analogue environment for areas of Mars that are hypothesised to have held liquid water in the past (e.g. Oxia Planum). The aims of this work were to (1) characterise organic compounds in contrasting environments across the Makgadikgadi salt pans, and (2) identify the controls on organic compound preservation within the high salinity dryland environments.

The field campaign in the Makgadikgadi salt pans was performed between 18th – 30th April 2022. The flights from the UK arrived in Botswana on 19th April, the fieldwork equipment was packed, with the fieldwork team arriving in Moriti Wa Selemo Bush Camp on 20th April.

Field sampling of the Makgadikgadi basin occurred during 21st - 27th April. During the fieldwork, surface sediment, salts, and biofilm samples were collected from 31 sites (Figure 1, Table 1).



Date	Activity
21/04/2022	Ephemeral river sampling
22/04/2022	
23/04/2022	Sua pan sampling
24/04/2022	
25/04/2022	Twetwe pan sampling
26/04/2022	
27/04/2022	
28/04/2022	Return to Palapye
29/04/2022	Packed samples at BIUST
30/04/2022	End of field work

Figure 1. Images from the Makgadikgadi salt pan. A and B: salt crystals from Kubu Island, C and D: biofilms, algae, and polygons from Ntwetwe pan © C.Spencer-Jones. Table 1. Summary of sampling activity in the Makgadikgadi basin.

In addition to a site description, air and subsurface (0-5 cm) temperatures were measured using a thermocouple probe and light levels were measured using a Lux meter at each sampling location. In locations on the pan where water was present, water temperature and pH were also measured. During the fieldwork, daytime air temperatures ranged between 18.1 – 46.0 °C and subsurface temperature ranged between 19.7 – 45.7 °C. The pH of the ephemeral lake water was approximately 9. Following the fieldwork activity, the samples were taken to the Geology laboratories at BIUST where they were sorted and packaged for shipping.

The second phase of this research will include organic compound characterisation using a selection of techniques to quantify molecules ranging from small volatile compounds to large macromolecules. Mineralogy, bulk geochemical and isotopic analyses will also be performed. Using these approaches, we aim to identify suites of compounds that could be diagnostic indicators of extra-terrestrial life (biosignatures) and establish mechanisms for their preservation in equivalent Martian environments.

- Give details of any publications arising/planned (include conference abstracts etc)

- We envisage multiple scientific journal articles will come from this work. Notably, at least 2 journal articles will arise from the organic compound analysis.
- Conference abstracts will be submitted to BOGs 2022 and EPSC 2023.

- Host confirmation

Please can hosts fill in/check this table confirming the breakdown of time for this TA project:

Dates for travel to accommodation for TA visit (if physical visit by applicant)	Start Date of TA project at facility	Number of lab/field days spent on TA Visit pre-analytical preparation	Number of days in lab/field site for TA Visit	Number of days spent in lab for TA Visit data analysis	End Date of TA project at facility	Dates for travel home (if physical visit by applicant)
Departed: 18-04-2022 Arrived: 19-04-2022	19-04-22	2	9	1	30-04-2022	Departed: 30-04-2022 Arrived: 01-05-2022

The host is required to approve the report agreeing it is an accurate account of the research performed.

Host Name	Fulvio Franchi
Host Signature	
Date	26 May 2022

- Project Leader confirmation

Do you give permission for the full version of this TA Scientific Report (in addition to the 250 word summary) to be published by Europlanet 2024 RI on its website and/or public reports? YES

Project Leader Name	**Charlotte Spencer-Jones**
Project Leader Signature	
Date	**30/5/2022**