

Europlanet TA Scientific Report

PROJECT LEADER

Project number: 20-EPN-028
Name: Claudia Pacelli
Home Institution: Agenzia Spaziale Italiana (ASI), Università degli studi della Tuscia
TA Facility visited: Makgadikgadi salt pans

Project Title: Microbial adaptation in the hypersaline environment of Sua Pan Evaporator Ponds in Botswana and implications for search for life on Mars. Part 1_Sampling campaign

Scientific Report Summary.

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

The current conditions of the Martian surface are considered prohibitive for life as we know it, due to strong radiation, highly oxidizing conditions, concentrated evaporative salts, and relatively low water activity. The Earth hosts a multitude of extreme environments whose physico-chemical properties partly match extraterrestrial planetary bodies (e.g. Mars). Such environments are defined “analogue sites” and may offer critical test-bed for astrobiological studies in characterizing the physical and chemical boundaries within which life may exist on Earth and in assessing the habitability of other planets, understanding the biological mechanisms for survival in extreme environments.

For example, the Makgadikgadi desert, located in north central Botswana is considered one of the largest deserts on Earth, where the salts concentration is up to 21% of NaCl. These conditions may be compared with those detected on Mars.

Here, the main aim of this Europlanet project was to collect soil samples of Makgadikgadi salt pans in order to i) understand the adaptations of microbial systems to extreme conditions in natural terrestrial environments, ii) correlate the biodiversity with the geological context.

This study is of significant interest to astrobiology investigations, allowing to assess the effects of hypersaline environment on the survival potential of microorganism and to understand if hypothetical life-forms may exist or have existed on Mars, where the concentration of chlorate salts has been detected in many different locations, from 1970s.

Full Scientific Report on the outcome of your TNA visit

The field campaign in the Makgadikgadi Salts Pans was performed from 13 July to 18 July 2022. The main goal of the campaign was to collect soil samples from Kudiakam, Nxai and Nwetwe pans, in order to study the limits of microbial life in a terrestrial environment similar to the Martian surface.

The work schedule, created with the logistical assistance of Botswana International University of Sciences and Technology (BIUST), was based on a 10-day period of activity, which included arrival in Botswana, transportation to the university for pre-analytical preparation on the first day, and transportation to Gweta (2nd day).

The fieldwork in the Nxai Pan National Park began on Day 3 and was overseen on days 4, 5, and 6. Kudiakam and Nxai pan samples were collected in the first four days of sampling (14-15-16-17 July 2022). For the Kudiakam pan, samples were taken along latitudinal and longitudinal transects (Fig. 1).

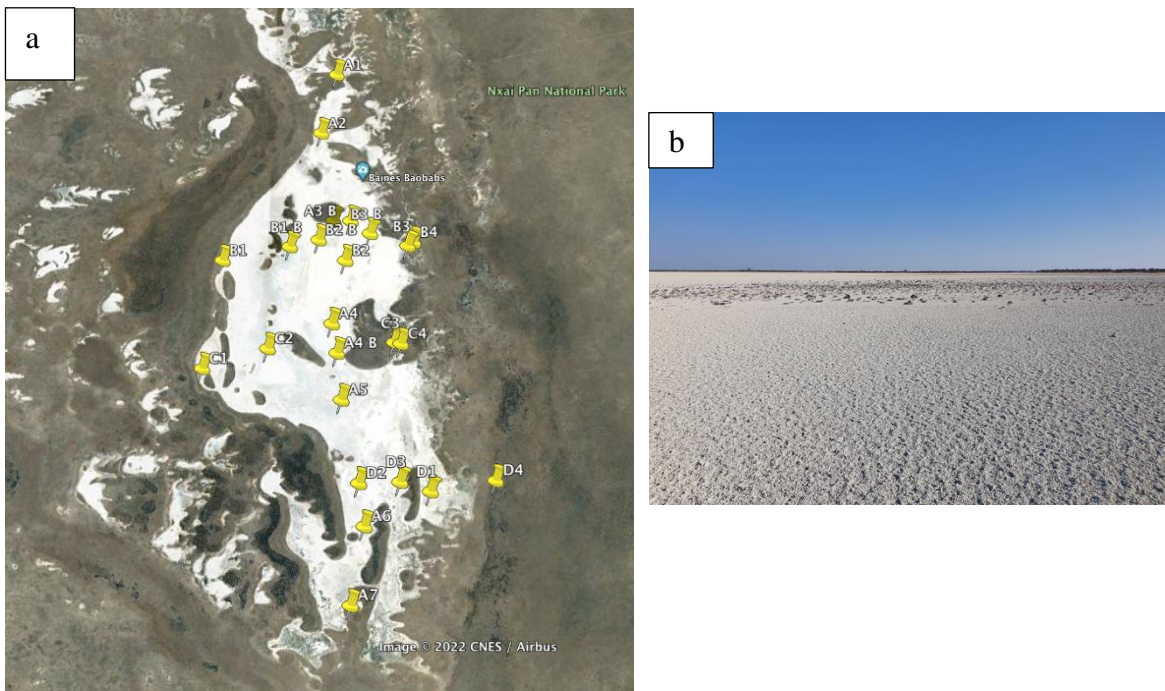


Figure 1. a) Overview map of the Kudiakam pan research area with detail of sample sites; b) Kudiakam pan sampling area.

For each sampling point (placed at a distance of about 2 km from the next point), three biological replicates were taken along an equilateral triangle transect at a distance of approximately 3 meters each (Fig. 2). Additionally, as shown in Fig. 2, three technical duplicates were collected for each apex at a distance of 50 cm. For each location, a 50 cm core drilling was carried out for subsequent geological analysis.

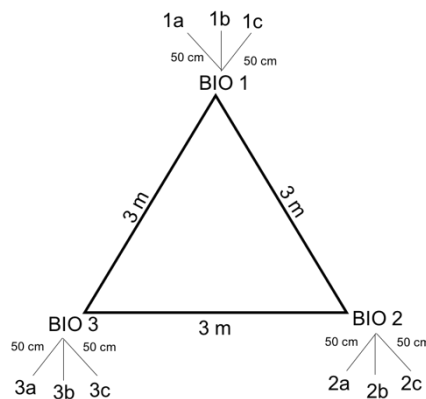


Figure 2. Detail of the sampling method performed following a triangular transect. BIO 1: Biological replicate 1; BIO 2: Biological replicate 2; BIO 3: Biological replicate 3. Samples a, b and c indicate technical replicates.

Each sample was collected into sterile bags with the use of sampling paddle, previous sterilized with 99% EtOh.

Samples collected in the Nxai pan, were taken follow the sample sampling method (Fig. 2) along a longitudinal transect (Fig. 3).

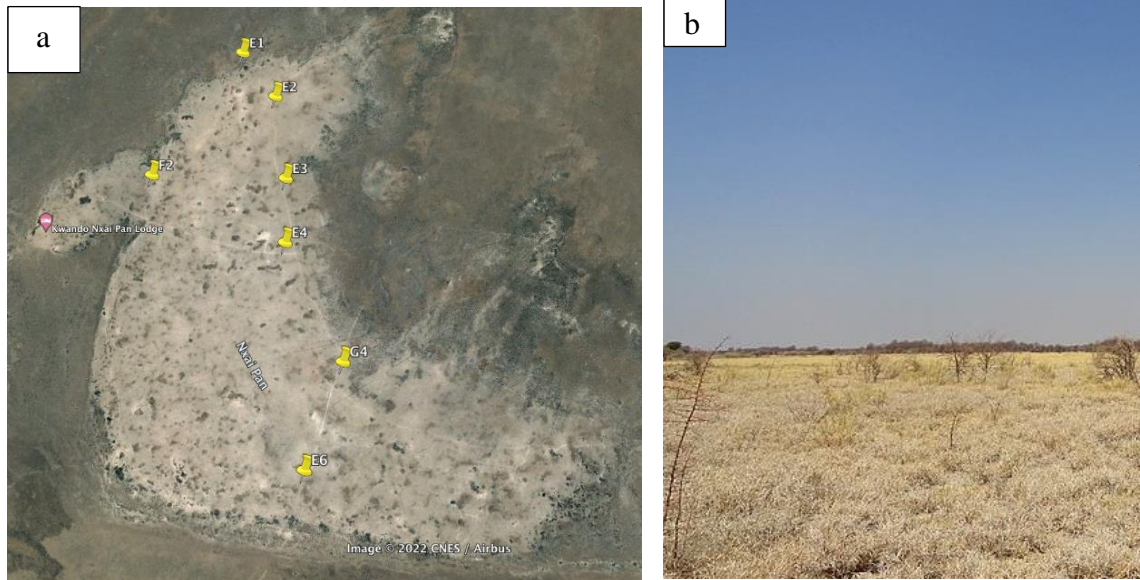


Figure 3. a) Overview map of the Nxai pan research area with detail of sample sites; b) Nxai pan sampling area.

On July 17-19, sampling took place in Nwetwe pan. Due to the environmental conditions (wet soil difficult to drive on), sampling was limited only in a few points (Fig. 4), following a new sampling procedure compared to the one previously reported. Samples from H0 to H7 points were taken at a distance of 500 meters apart according to a latitudinal transect (Fig. 4).

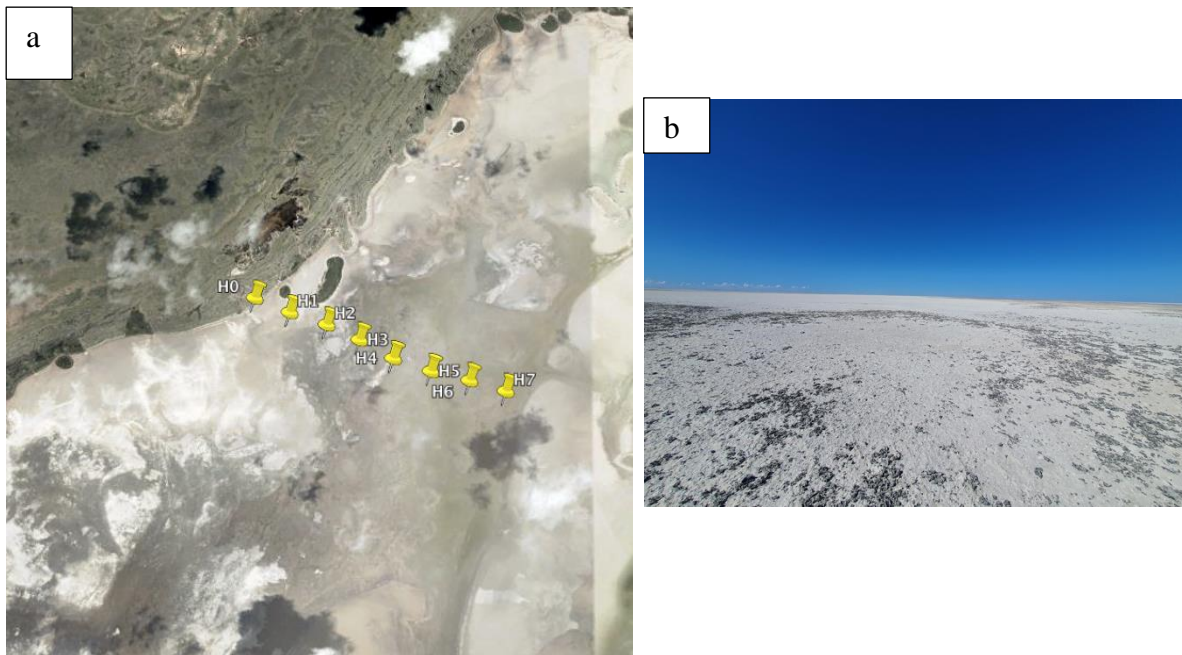


Figure 4. a) Overview map of the Nwetwe pan research area with detail of sample sites sampling points; b) Nwetwe pan sampling area.

The fieldwork ended with the transfer to Palapye at the BIUST. Over the next two days the samples were prepared for shipment, each sample being sealed and weighed before sending. In addition, a multiparameter analysis (HANNA instrument HI9829) was performed for each collected sample, in order to measure pH, salinity, dissolved oxygen concentration, resistivity, etc.

All the collected samples will now be shipped to the University of Tuscia (Viterbo, Italy) for future Next Generation Sequencing (Illumina MiSeq) analyses, in order to investigate the microbial diversity of the collected samples and the adaptation mechanisms of microorganisms. The obtained results will be implemented with the results of culture-based analyses, will be carried out through cultivation and isolation of new taxa. A part of the samples will be used for geochemical analysis, including XRF, SEM-EDX and grain size. All the geochemical analysis will be performed at BIUST.

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

Two papers about the microbial characterization of Kudiakam and Nxai pans will be submitted on geomicrobiological journal presenting the main results obtained from samples collected during the fieldwork.


-A conference abstract will be submitted to EPSC/EANA 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: 11-07-2022 Arrived: 12-07-2022	12-07-22	1	7	2	21-07-2022	Departed: 22-07-2022 Arrived: 23-07-2022

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

<u>Host Name</u>	Fulvio Franchi
<u>Host Signature</u>	
<u>Date</u>	27/07/2022

- 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

<u>Project Leader Name</u>	Claudia Pacelli
-----------------------------------	-----------------

<u>Project Leader Signature</u>	
<u>Date</u>	27.07.2022