Europlanet TA Scientific Report

PROJECT LEADER

Project number: 22-EPN3-024
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TA1.05 Makgadikgadi Salt Pans, BIUST, Botswana.
Date of TNA visit: Dr. Marco Ferrari / Mauro Ciarniello (Italy): 9-17 September but in the field 11-16 th (6 days) (9-10th and 17th traveling going and back)

COLLABORATOR

Name: Mauro Ciarniello **e-mail: mauro.ciarniello@inaf.it**
Home Institution: **ISTITUTO DI ASTROFISICA E PLANETOLOGIA SPAZIALI-INAF** **VIA DEL FOSSO DEL CAVALIERE, 100 - 00133 ROMA**

Project Title: **VIS-NIR AND RAMAN MEASUREMENT OF CLAYS AND EVAPORITIC PRODUCTS AS ANALOGS OF OXIA PLANUM IN THE FRAMEWORK OF THE ROSALIND FRANKLIN ROVER MISSION**

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

This project aimed at a sampling campaign of evaporite and sedimentary products (e.g., sulfates, clays) and deposits showing evidence of biosignatures in the Makgadikgadi Salt Pans, Botswana. Samples taken from this location will be used for VIS-NIR and Raman spectroscopy measurements in the context of the future ExoMars mission.

To achieve this, we visited 10 different sites in the Makgadikgadi Pan area, distributed across both the Ntwentwe Pan and Sue Pan during our visit. We collected 35 samples in different forms, both loose sediments with grain sizes varying from clays to sand, and cohesive sediments such as the salt crusts that characterize the top surface of the Pan. We also collected some solid rock blocks with sizes suitable for the laboratory setup of the Ma_MISS (Mars Multispectral Imager for Subsurface Studies) instrument (i.e. blocks with a maximum size of 10x10x10 cm), to perform drilling operations and spectroscopic measurements in the wall of the borehole.

This campaign will allow us to confirm the ability of the Ma_MISS instrument to detect spectral signatures of organic substances in geological samples containing biosignatures. With the spectroscopic data obtained in the laboratory on the collected samples, we will build a spectral database that will be useful to the scientific community.

These activities on terrestrial analogs have proven useful for understanding life in extreme conditions and how these can be preserved in the form of biosignatures and detected by the scientific instruments that will be on board future missions to Mars. In addition, this work will help to acquire crucial preparation for the exploitation and interpretation of the scientific data that the Ma_MISS instrument will provide during the active phase of the mission.

Full Scientific Report on the outcome of your TNA visit

The Ma_MISS instrument is a miniaturized visible and near-infrared (VIS-NIR) spectrometer integrated into the drill system of ESA's Rosalind Franklin rover mission. Ma_MISS is designed to explore the Martian subsurface at the micrometer scale and will acquire spectral data on the wall of the well (borehole?) drilled into the Martian terrain.

The landing site selected for the mission, Oxia Planum, is located on the border of the Martian dichotomy and is part of a large basin characterized by the extensive presence of Noachian phyllosilicates rich in Fe/Mg. Hydrated silica and Al-rich phyllosilicates may be present to a lesser extent in the eastern sector of the site, where Hesperian alluvial and deltaic sediments overlie Fe/Mg-rich phyllosilicates.

This evidence suggests that Oxia Planum was influenced by long-lasting aqueous surface activity, which is a factor consistent with conditions favorable to the development of life.

In this context, we carried out a sampling campaign in the Makgadikgadi Salt Pans, where the presence of lake basin sediments together with deltaic morphologies and sediments make this terrestrial site an excellent analog of geological processes that may have occurred in Oxia Planum.

The collected samples will be measured in the laboratory with different spectroscopic techniques including the measurements with the laboratory model of the Ma_MISS instrument. Field- and laboratory-based research activities in the Makgadikgadi Salt Pans facility will be important for enriching the scientific community's grasp on the Martian environment and for obtaining key information on the geological evolution of the Martian surface/subsurface.

FIELD ACTIVITY: During our field trip to the Makgadikgadi Salt Pans area, we visited the following locations reported in Figure 1:

Day 1 (12 Sept 23) Ntwentwe Pan Fan Delta

Day 2 (13 Sept 23) Ntwentwe Pan Mounds

Day 3 (14 Sept 23) Nata River mouth

Day 4 (15 Sept 23) Kubu Island

Day 5 (16 Sept 23) Kubu Island Inner pan - Kubu Island west sector

The day of 11 September was spent on logistics operations.

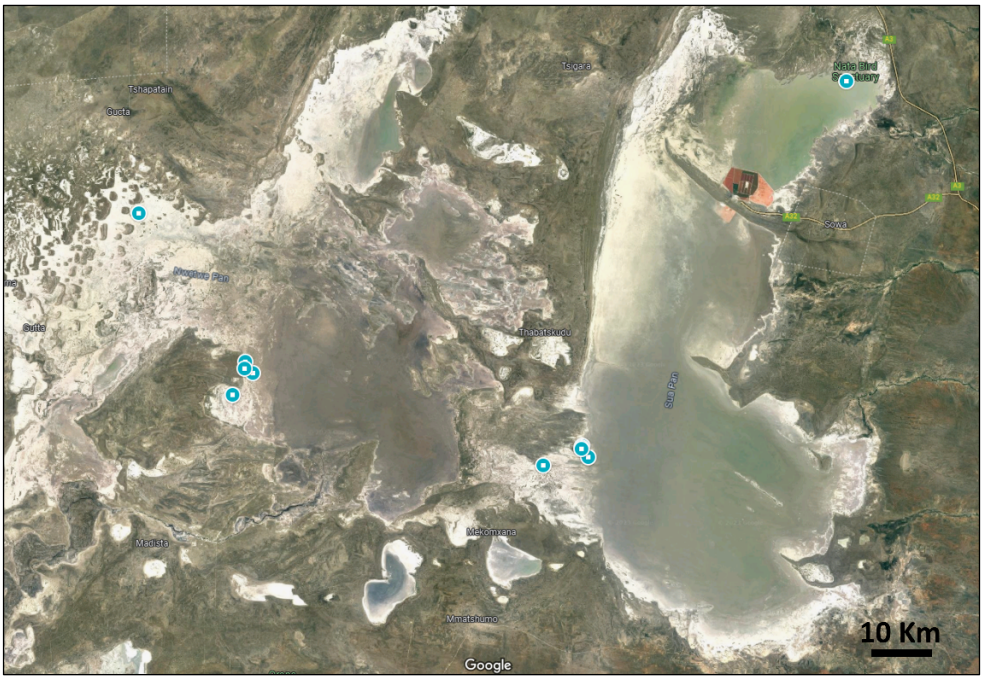

Fig 1. Satellite map of the Makgadikgadi Salt Pans with sampling sites marked.

During this campaign, we collected different types of samples representative of various geological processes that characterized the area.

In particular, samples of lacustrine sediment were collected at various depths to study their compositional and grain size variations and reconstruct a stratigraphic column of the examined sites. In addition, we sampled different types of salty crusts that characterize the surface layers and are representative of the evaporitic process (Fig.2).

Fig.2 Salty crust sampled in the Ntwentwe Pan Fan Delta area.

Part of the fieldwork was undertaken to sample different types of biofilms to test the Ma_MISS instrument in its ability to provide clues to the presence of biological molecules in mineral samples. In some cases, we managed to sample microstratigraphies of the first 10 cm of depth as in the case of the samples collected at the Nata River mouth.

For each sample we will record the following data at the time of collection: one picture of the context, one picture of the sample with the reference scale, and the geographic coordinates at the collection point using the WGS84 reference system. Every sample was sealed in a specific container to avoid any contamination. The samples' metadata will be registered in the System for Earth Samples Registration for long-term archival. Every sample will receive a unique IGSN code for referencing in this but also future projects.

The samples that we will bring back to our laboratory will be measured using the DAVIS instrument, a setup representative of Ma_MISS, made of spare elements of the flight model. For this reason, the measurements on the collected samples are very important for Ma_MISS characterization and future data interpretation. The collected sample blocks will be drilled to obtain a hole with the same characteristics (e.g., diameter; borehole-wall surface roughness) as those that the Rosalind Franklin rover will do on Mars. Finally, we will perform a series of in-hole spectral scans to characterize the chemical-physical properties of the collected samples.

All the collected samples will be characterized with micro-Raman spectroscopy to constrain their mineralogy. The high spatial resolution of this technique permits direct comparison with the data collected by the DAVIS instrument reconstructing the images of the samples at the micrometric scale.

The data collected on the samples will be analyzed to reconstruct their mineralogical assemblage and their textural relationship with the stratigraphy of the collection site. We will focus our efforts on any spectral signature related to the presence of clays and salts considering even different physical properties of deposits with different grain sizes and hydration states.

This work is necessary to test Ma_MISS' capacity to reconstruct the spectral stratigraphic column of the Martian subsurface, which is one of the main scientific objectives of this instrument. All measured spectra and the associated sample information will be made available to the whole scientific community within one year of the field activity.

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

- We plan to present an oral contribution reporting the findings of this field campaign at the Italian Congress of Planetary Science, Bormio 5-9 February 2024, and at the EPSC 2024.
- We plan to publish the Makgadikgadi Salt Pans field campaign results in a peer-reviewed journal (i.e., PSS, Icarus, etc.) within a year of the field activity.

- 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: dd-mm-yy 09/09/23 Arrived: dd-mm-yy 10/09/23	dd-mm-yy 11/09/23	1	6	0	dd-mm-yy 16/09/23	Departed: dd-mm-yy 17/09/2023 Arrived: dd-mm-yy 18/09/2023

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	**05/10/2023**

- 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	**Marco Ferrari**
Project Leader Signature	
Date	**04/10/2023**