

The Andrew Whitham CASP Fieldwork Award - 2020-21 Winner

Applicant: Mercedes-Martin Ramon

Project title: Unravelling the factors controlling the heterogeneity of spherulite-bearing stromatolites in the Salta Basin (Argentina)

Specific objectives and deliverables: Understand the factors governing microbialite distribution in alkaline lacustrine basins represent a fundamental challenge since these deposits can host significant oil volumes such those reported in the economically-important carbonate reservoirs of the 'Pre-salt' Cretaceous units. So far, multiple outcrop analogues have been studied but only few are comparable in terms of facies and textural attributes to the Aptian 'Pre-salt' occurrences. The Cretaceous-Danian Yacoraite Fm. in Salta Basin (Argentina) yields unique examples of metre-scale spherulite-bearing microbialite buildups grown in extensive alkaline lacustrine basins which formed during stages of intraplate rifting (Bunevich et al., 2017).

Despite previous work, a detailed basin-scale lithofacies characterisation of the microbialite-bearing units and related deposits remains essentially lacking. Thus, the purpose of this project is to seek funding for field-work to perform a detailed geological mapping of the northern portion of the Metán sub-basin, to recognise the major depositional units, exposure surfaces and cycle stacking patterns in microbial and non-microbial lacustrine to brackish facies. A prime objective of this work is to map microbialite distribution at outcrop scale to understand the depositional controls on the sedimentary architecture.

Previous petrographic analysis shows that microbialite heads are composed of columnar structures consisting in an alternation of spherulite-rich laminae with clotted-rich laminae where inter-columnar spaces are filled by intraclastic, ooidal and ostracod packstone-grainstone. Thus, a second goal is to elucidate the environmental mechanisms likely involved in the millimetre-scale textural heterogeneity encouraging the formation of spherulite-rich facies. To this end, a detailed petrographical and geochemical study will be performed across different microfacies groups. The results of this study will be of critical importance to predict the local and regional environmental contexts of spherulite-bearing carbonate formation in alkaline lakes, and will provide insights about the controls on potential reservoir character, distribution and connectivity for 'Pre-salt' reservoir modelisation.

Proposed work plan:

This project includes a high resolution sedimentary study from selected Maastrichtian-Danian outcrops in the northern part of the Metán sub-basin between Humahuaca and Salta (Argentina) belonging to the Yacoraite Formation. Outcrops are easily accessible across main roads. The proposed work plan can be summarised as follows:

- Review of the available geological maps at 1:50,000 scale to clarify the structural and sedimentary geology of the region and identify suitable areas for logging and sampling. Recognise basic geomorphological elements, geometries of sedimentary bodies, regional faults and possible routes to access the study area using Google Earth and aerial photos.
- Three weeks of fieldwork (mapping, sedimentary logging, rock sampling) planned for Summer-Autumn 2020.
- Facies correlation and sequence stratigraphic analysis in the framework of a collaboration with Dr. Carlos Cónsole (INSUGEO- CONICET Research Centre) in San Miguel de Tucumán (Argentina).
- Petrographical (optical and SEM) and geochemical analyses (stable C and O isotopes and REE/ major/minor trace elements) on microbialite and associated facies will be performed at the Vrije University Amsterdam and INSUGEO-CONICET, respectively.
- Elaborate 4D lacustrine depositional models, and build outcrop-scale growth models for microbialite reservoir characterisation planned for Spring-Summer 2021.
- Showcase the scientific results in international meetings, and publish at least one paper in a peer-reviewed journal, scheduled for Winter 2021.

Proposed expenditure, including details of any other sources of funding:

Expenditures include flight costs from Barcelona, and also quotes for local car rental/ petrol costs, accommodation & subsistence allowance for the field campaign (21 days) while in Argentina.

- Flight Barcelona (BCN) – San Miguel de Tucumán (TUC) in economy fare (including transfers, taxi and bus tickets): £1,385
- Car rental for 3 weeks: £700
- Petrol (we expect to drive around 3,300 Km): £300
- Accommodation and subsistence allowance for 3 weeks (different villages across the studied transect): £600

Total: £2,985