Classroom teaching

CONTINENTAL CARBONATES: APPLICATIONS FOR THE SOUTH ATLANTIC PRE-SALT DEPOSITS

Workshop on continental carbonate environments, facies, textures and the depositional processes controlling heterogeneity and diagenesis

Workshop on-request

Summary

Continental carbonates are extremely heterogeneous deposits that can accumulate in a large spectrum of depositional settings from freshwater, alkaline and saline lakes, freshwater palustrine, fluvial and calcrete environments, or sublacustrine to subaerial thermal springs.

During the first part of the workshop we will provide with the basic knowledge to understand continental carbonate environments, including facies, textures, geochemistry and the depositional processes controlling their occurrence and diversity.

In the second part, we will critically review the lessons learned from outcrop analogues, experimental datasets and numerical models to offer an integrated process-product perspective of the Pre-Salt non-marine reservoirs from offshore Brazil and West Africa.

Instructor: Ramon Mercedes-Martín, PhD

Venue: In-house course

Cost: Ask for a quote today!

Duration: 7 days (42 hours)

Audience: Geoscientists who wish to expand their knowledge of non-marine carbonates and its application to the South Atlantic Pre-salt reservoirs.

Level: Basic to Skill

Outcomes: Classroom lectures and discussions

Workshop on-request

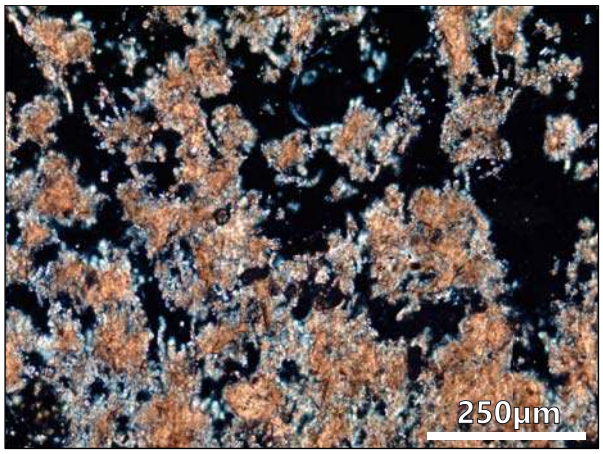
Course outline

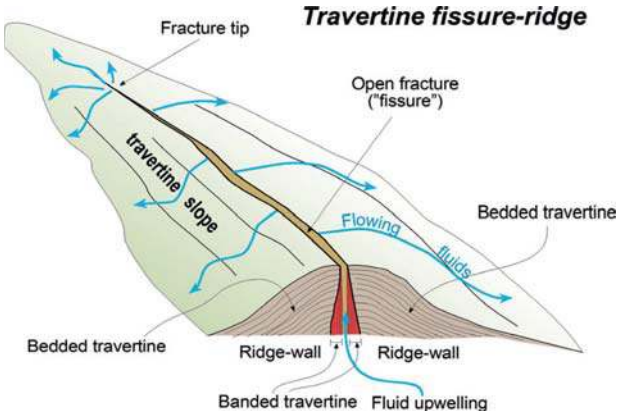
Objectives :

- Review the physical, chemical and biological processes involved in continental carbonate precipitation and deposition in calcareous springs, hot-springs, lacustrine, palustrine and pedogenic environments

- Review the controls on facies, mineralogy, crystal morphology and sedimentary architecture of continental carbonates based on updated literature (outcrop, thin-section, geochemical, SEM data)

- Analysis of selected outcrop case studies, and experimental, geochemical, and numerical data to provide with a refined framework to understand the Pre-Salt carbonate occurrences of the South Atlantic margins





Impressive Mono Lake tufa chimneys formed in lacustrine alkaline and saline waters, California (top left). A groundmass of stevensite clay sediment permineralised to aragonite in the vicinity of cyanobacterial filaments forming thrombolite microbialites in Lake Clifton, Australia (top right). Fissure ridge geomorphological features (bottom left). Tufa forming deposits in fast flowing steeped waterfalls (bottom right).

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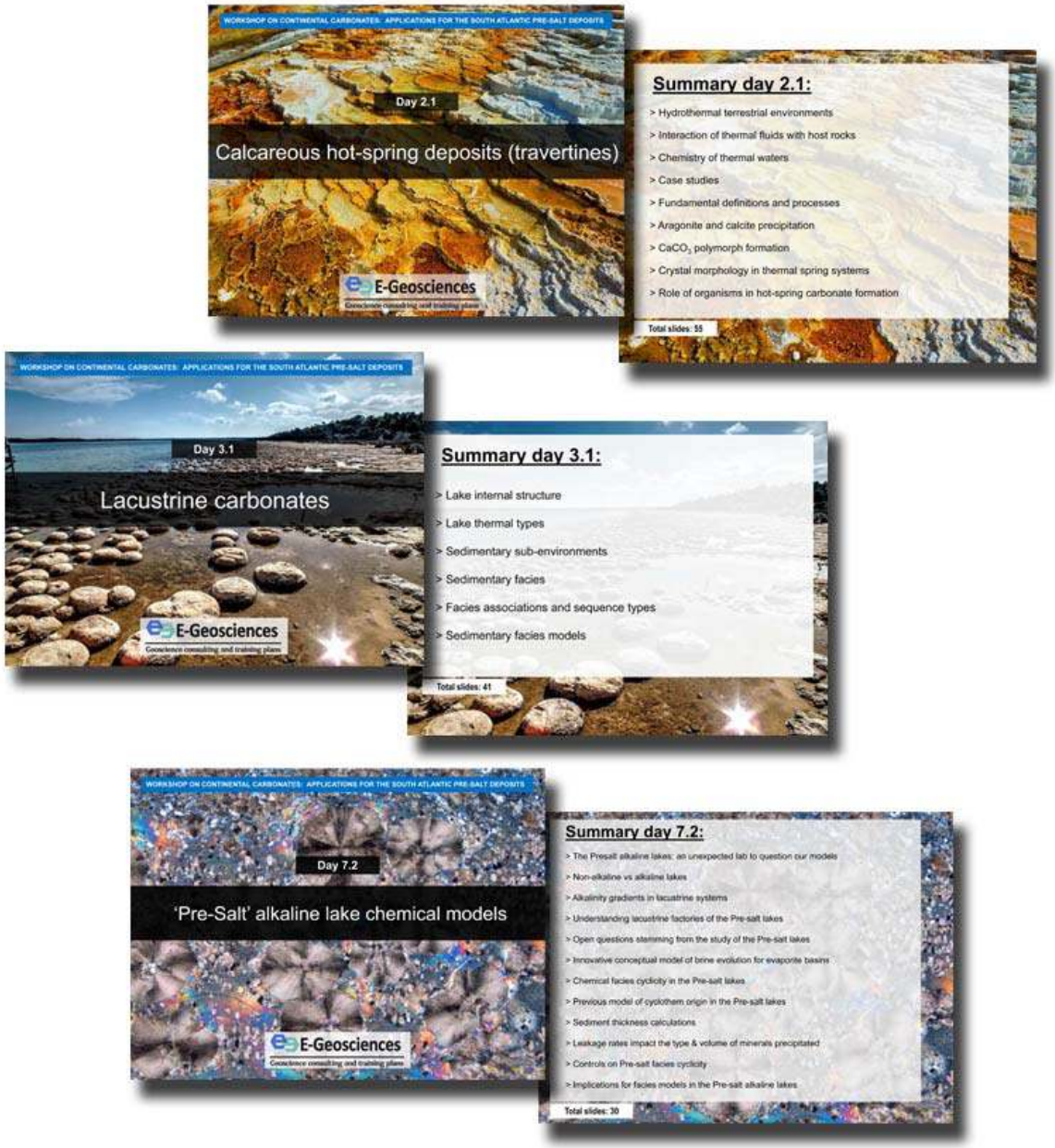
Daily programme

In the first part of this workshop we will examine the basic sedimentological and geochemical concepts associated to continental carbonates, while in the second part we will review the innovative approaches in the study of the Pre-Salt non-marine carbonate basins.



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Part I – TECHNICAL COURSE

Day 1:

Day 1.1 – Calcareous ambient deposits (tufas)

Fundamental definitions
Fundamental processes
Degassing vs microbial photosynthetic CO2 - uptake
Tufas as paleoclimatic indicators
Geochemistry of stable isotopes (oxygen and carbon)

Day 1.2 – Calcareous ambient deposits (tufas)

Tufa classification
Textural classifications
Sedimentary sub-environments
Sedimentary facies
Facies associations and sequence types
Sedimentary facies models

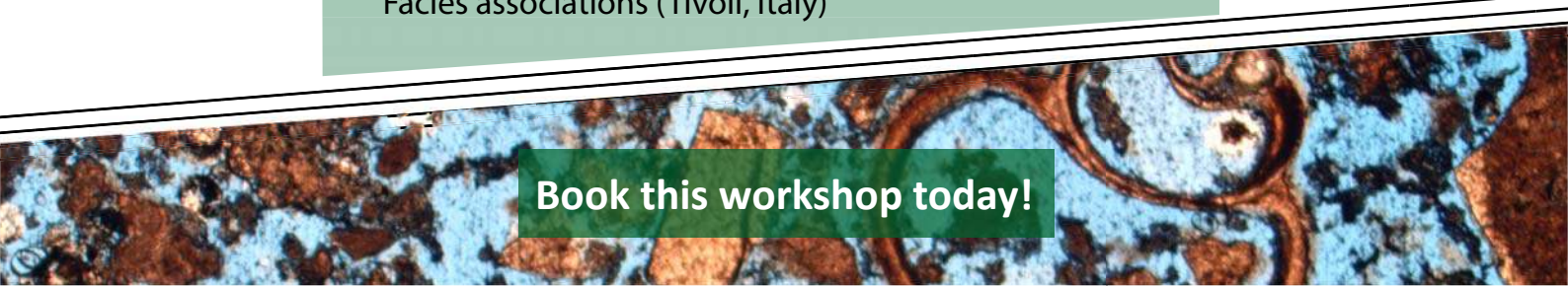
Day 2:

Day 2.1 – Calcareous hot-spring deposits (travertine)

Hydrothermal terrestrial environments
Interaction of thermal fluids with host rocks
Chemistry of thermal waters
Case studies (Ballik área, Acque Albule, Lake Bogoria)
Fundamental definitions and processes
Aragonite and calcite precipitation
CaCO3 polymorph formation
Crystal morphology in thermal spring systems
Role of organisms in hot-spring carbonate formation

Day 2.2 – Calcareous hot-spring deposits (travertine)

Travertine classifications
Summary of depositional elements and processes
Depositional geometries in hot-springs
Depositional environments in hot-springs
Crystal types in hot-spring carbonate settings
Facies associations (Tivoli, Italy)



Day 3:

Day 3.1 – Lacustrine carbonates

Lake internal structure
Thermal behaviour of lakes
Sedimentary sub-environments
Sedimentary facies
Facies associations and sequence types
Sedimentary facies models

Day 3.2 – Lacustrine carbonates

Lacustrine carbonate facies
-Laminated facies
-Massive facies
-Microbial facies
-Marginal facies
-Open-water facies
Carbonate lake types
Dominantly carbonate lakes
-Low energy bench
-High energy bench
-Low energy ramp
-High energy ramp

Day 4:

Day 4.1 – Lacustrine magnesium clays

Lacustrine magnesium clays
Overview
Internal structure of magnesium clays
Processes of formation
Formation of aluminium-bearing Mg-clays
Formation of aluminium-free Mg-clays

Day 4.2 – Lacustrine carbonate case studies

Mono Lake (California): a saline, alkaline, meromictic lake
-Geological framework
-Hydrology
-Paleohydrological fluctuations
-Limnology
-Sedimentology and facies architecture

Lake Clifton (Australia): an hiposaline, coastal lake
-Geological framework
-Hydrology
-Microbial communities
-Sedimentology and facies architecture
-Microbialite characteristics

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Day 5:

Day 5 – Palustrine carbonates and calcretes

Overview palustrine carbonates
Palustrine carbonate mineralogies
Palustrine carbonate facies
Processes and products in palustrine carbonates
End-member products in subaerial exposure
Calcrete definitions and types
Calcrete: origin of calcium
Calcretes: abiotic versus biogenic origins
Calcretes: idealised profile development

Part 2 – INNOVATIVE TOOLS FOR THE STUDY OF THE PRE-SALT CARBONATES

Day 6:

Day 6.1 – Non-skeletal carbonate factories: evaluating the sedimentary processes in rift tectonic settings

Rifts, failed rifts and continental margins: basins due to lithospheric extension
Rifted continental margins: ideal scenarios for carbonate platform development
Stratal patterns and facies architecture in skeletal carbonate rift settings
Sediment production and dispersal in skeletal carbonate settings
Predicting facies heterogeneities in skeletal carbonate settings
Non-skeletal carbonates: understanding their sedimentary processes
The Middle Triassic fault-block non-skeletal carbonate ramp of the Catalan Basin (Spain)
Facies architecture of a fault-block non-skeletal ramp (Catalan Basin)
Microbialite distribution in a fault-block carbonate ramp (Catalan Basin)
Controls on microbialite growth and distribution in syn-rift settings (Catalan Basin)

Day 6.2 – 'Pre-Salt' alkaline lake outcrop analogues

Spherulitic carbonate deposits as hydrocarbon reservoirs
Alkaline lakes and stevensite deposition
What about spherulitic carbonates?
East Kirkton Limestone: an outcrop analogue
East Kirkton Limestone facies types
East Kirkton Limestone depositional model
Inorganic versus organic gels

Day 7:

Day 7.1 – 'Pre-Salt' alkaline lake experimental analogues

The origin of carbonate factories
The 'Pre-salt' non-skeletal carbonates of the South Atlantic lakes
Looking at crystallographic patterns… because they matter
Outcrop analogues for lacustrine non-skeletal carbonates?
Finding outcrop analogues… and so what?
Linking processes to products: the ultimate challenge
Posing the right questions and implement new strategies
Recent hypothesis: thermodynamic versus biotic influence
Thermodynamic-influenced calcite growth (abiotic)
Microbial-influenced calcite growth (biotic)
The central question
Why calcium carbonate achieves such morphologies?

Day 7.2 – 'Pre-Salt' alkaline lake chemical models

The Presalt alkaline lakes: an unexpected lab to question our models
Non-alkaline vs alkaline lakes
Alkalinity gradients in lacustrine systems
Understanding lacustrine factories of the Pre-salt lakes
Open questions stemming from the study of the Pre-salt lakes
Innovative conceptual model of brine evolution for evaporite basins
Origin of facies cyclicity in the Pre-salt lakes
Previous models of cyclothem development in the Pre-salt lakes
Sediment thickness calculations
Leakage rates impact the type and thickenesses of minerals precipitated
Controls on Pre-salt facies cyclicity
Implications for facies models in the Pre-salt alkaline lakes

Classroom teaching

Book this workshop by e-mail
Feel free to request more information (by email or phone):

Technical content and logistics:

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