

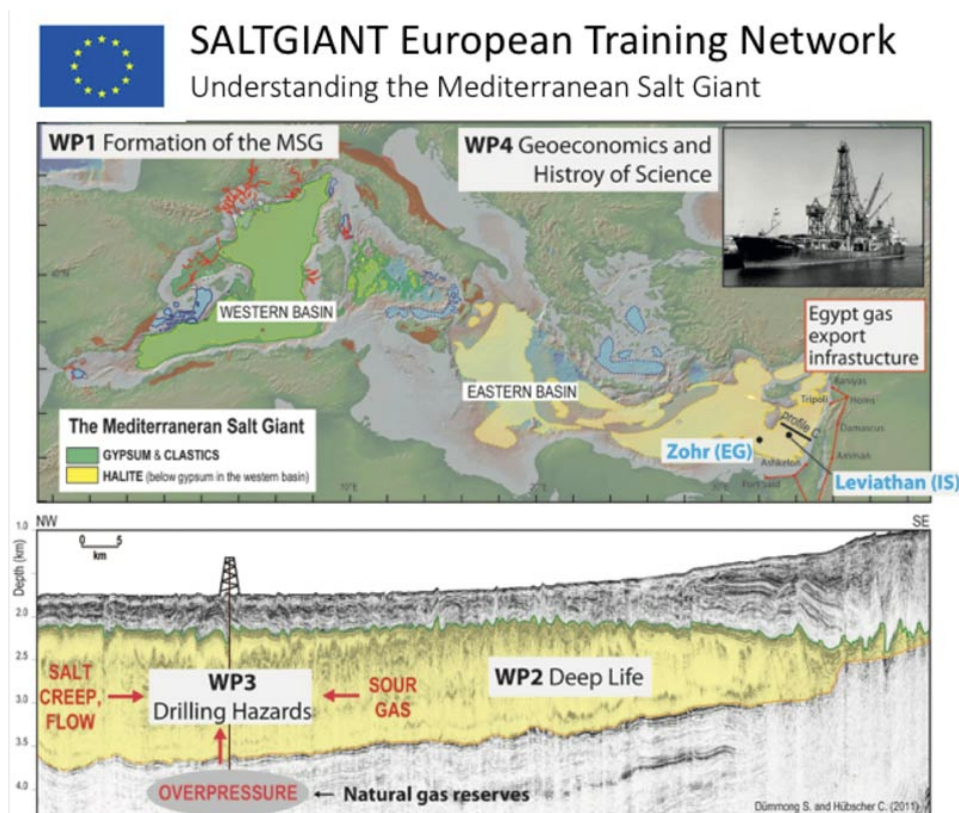


## SALTGIANT Newsletter # 1- January 2019

by Simon Rouwendaal, Francesca Bulian and the collaboration of the ESRs

### ABOUT SALTGIANT

SALTGIANT is a rare cross-disciplinary network of natural and social scientists dedicated to understanding the formation of the Mediterranean Salt Giant, one of the largest salt deposits on Earth, and its implications for sub-seafloor microbial life, risk assessment in the oil industry, geo-economics of the Mediterranean region and the history of oceanography.



SALTGIANT contributes to respond to the growing demand for a new generation of scientists working in the interface between the natural and social sciences.

SALTGIANT brings together 24 academic organizations (13 beneficiaries, 11 partners), 6 private sector Oil&Gas companies, 2 mining sector companies, 1 biotechnology company, 1 geopolitics think tank, 1 museum and 1 specialist in transferable skills training from 11 countries to stimulate interdisciplinary and

intersectorial knowledge exchange between geologists, geophysicists, geochemists, microbiologist, geographers and historians in a network with PhD students at its core.

SALTGIANT is developed within the EU MEDSALT COST action: <https://medsalt.eu/the-project/>

## NEWSLETTER

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## 1. INTRODUCING THE FELLOWS



### ESR 1 – Francesca Bulian

**Affiliation:** University of Salamanca (Spain)

**Project title:** Late Miocene-Early Pliocene offshore onshore sedimentary records in the vicinity of Gibraltar

**Scientific background:** Sedimentology, Geochemistry, Micropaleontology, Paleoclimate.

**Why this project?** It aims to unravel one of the missing pieces necessary to understand the MSC dynamics: the evolution of the Gibraltar strait. In order to do so I will focus on high resolution cyclostratigraphic and biostratigraphic (Foraminifera) analyses of the complex Miocene-Pliocene boundary of several sites, both offshore and onshore.

### ESR 2 – Hanneke Heida

**Affiliation:** Institute of Earth Sciences Jaume Almera (ICTJA-CSIC) (Spain)

**Project title:** Vertical Motions of Marginal Basins in the Mediterranean

**Scientific background:** Geology/Tectonics

**Why this project?** I am working on paleotopographic reconstructions using numerical modelling of vertical motions due to lithospheric flexure. Although this is quite different from my background so far, I love the opportunity to use modelling to quantify processes working on such a large scale, and the opportunity to acquire a wide range of new skills.



### ESR 3 – Fadl Raad

**Affiliation:** University of Montpellier (France)

**Project title:** Balearic promontory architecture and history since the formation of the Mediterranean Salt Giant (MSG)

**Scientific background:** Geology, Geophysics, Potential methods in geophysics, Seismic reflection data acquisition and interpretation, GIS.

**Why this project?** For my master thesis I've focused my studies on the geologic structures and stratigraphy in the Levant Basin (Eastern Mediterranean), with special attention on the Messinian Salt. Thus I consider my current PhD project a natural continuation of the argument that I've been already involved in, and I couldn't have hoped for a better opportunity to carry forward my research than the Salt Giant project.

#### ESR 4 – Athina Tzevahirtzian



**Affiliation:** Università degli Studi di Palermo (UNIPA)

**Project title:** Sicilian Basin Architecture

**Scientific background:** Oceanography specialised in Sedimentology and Paleoceanography, and Geography

**Why this project?** My goal was always to study the Mediterranean Sea and to better understand its formation and its evolution. Thus, this project matches perfectly with my wish since I will acquire new insight from stratigraphic relationships between the evaporite series and the pre-Messinian sediments by carrying out detailed geological mapping of wedge-top basins of the north-western Sicily and the Hyblean Plateau, in order to clarify the inception of the Messinian Salinity Crisis.

#### ESR 5 – Federico Andreetto

**Affiliation:** Utrecht University (The Netherlands)

**Project title:** Reconstructing Mediterranean water level and hydrological fluxes during the final phase of the Messinian Salinity Crisis

**Scientific background:** Field geology, stratigraphy, sedimentology, thin sections study

**Why this project?** Because the goal is to get a detailed paleogeographic and paleoenvironmental framework of the whole Mediterranean during the "Lago Mare" event, a goal that cannot prescind from an extended field work (both stratigraphic and sedimentological)



#### ESR 6 – Laetitia Guibourdenche



**Affiliation:** Institut de Physique du Globe de Paris (IPGP). Paris, France.

**Project title:** Hydrology of Mediterranean Marginal basins during the formation of the MSG

**Scientific background:** BSc in Sciences of the Nature, Earth and Environment in Aix-Marseille University III, Faculté de Montperrin, Aix en Provence, France. MSc. In Earth and Atmospheric Sciences, Université du Québec à Montréal (UQAM), Geotop, Montreal, Quebec, Canada

**Why this project?** This PhD is the perfect way for me to develop my skills in my favourite field of research: isotope geochemistry. Furthermore, I have been particularly seduced by the opportunity to join an international research network and to work with people from very different fields with the common goal of deciphering one of the greatest mystery in Earth Sciences.



## ESR 7 – Ronja Ebner

**Affiliation:** Universiteit Utrecht (The Netherlands)

**Project title:** Modelling the (bio-) geochemical evolution and circulation of Messinian brine

**Scientific background:** physical Oceanography, Limnology, Numerical Modelling

**Why this project?** The water bodies of the Earth are my passion and I want to understand the dynamics of as many of them as possible. This project additionally adds the thrill of not being able to measure in-situ but to sample its remains. I have never worked that way before and I am looking forward to learn from the wide spread experience in this project.



## ESR 8 – Simon Rouwendaal



**Affiliation:** University of Hamburg (Germany)

**Project title:** The microbial sulphur cycle in Messinian evaporites

**Scientific background:** (organic) geochemistry, petrology, mineralogy, ore geology

**Why this project?** Although I am interested in organic geochemistry, all aspects of geosciences fascinate me. This project is multidisciplinary, combining organic geochemistry with isotope geochemistry, petrography and field geology. Combining these techniques, I hope to get a better understanding of the microbes and their biogeochemical processes in the formation of secondary carbonates and native sulphur from gypsum dissolution. The outcome of this project is not only interesting for gypsum mining companies, but also has astrobiological

implications for the search for life on Mars.

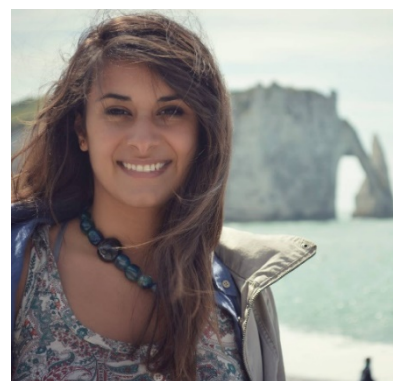
## ESR 9 - Maria Magliulo

**Affiliation:** University of Essex (UK)

**Project title:** Long-term survival of microbes in halite brine inclusions

**Scientific background:** molecular biology, marine biology, microbial ecology

**Why this project?** Microbes that can survive over geological time scales opened a new era in the field of microbial ecology: how long can a life form survive? Which are the conditions for a successful long-term survival? My goal is to answer those questions, and with the same questions, I look up in the sky to Mars.



## ESR 10 – in process of being recruited

## ESR 11 – Jimmy Moneron



**Affiliation:** Based in Jerusalem, Israel. Working & studying mostly at the Geological Survey of Israel and partly at the Hebrew University of Jerusalem

**Project title:** Salt Tectonics in the Levant Basin

**Scientific background:** Geoscience, Petroleum & exploration geology, Basin analysis, Messinian Salinity Crisis, Mediterranean Sea

**Why this project?** After studying the Messinian salt giant and working on a research project on the evaporites within the Mediterranean, I wanted to further my knowledge in the MSC and decipher the mechanisms behind salt deformation in the Eastern Mediterranean Sea.

## ESR 12 – Michael Dale

**Affiliation:** University of Southampton/ National Oceanographic Centre

**Project title:** Overpressure development in rapidly deposited salt basins. Application to the Salt Giant on the Mediterranean Basin

**Scientific background:** Rock Mechanics and Structural Geology. Previously employed as Exploration Geologist for Royal Dutch Shell and Oil Search Ltd.

**Why this project?** My research project allows the opportunity to develop my knowledge of Rock Mechanics and overpressure development and the ability to utilise numerical modelling techniques to quantify and assess influence of overpressure on evolution of evaporites.



## ESR 13 – Gaia Travan



**Affiliation:** University of Lille, CNRS, Univ. Littoral Côte d'Opale, UMR 8187 LOG, Laboratoire d'Océanologie et de Géoscience (France)

**Project title:** Interactions between salt tectonics and crustal tectonics in Mediterranean: comparison between seismic examples and analogue modelling

**Scientific background:** geology, seismic data processing, seismic data interpretation, salt tectonics, analogue modelling

**Why this project?** This project is the perfect link between my background of studies about the Messinian Salinity Crisis and seismic data interpretation and my wish to work as a researcher in the salt tectonics field. Moreover, the possibility to be part of the multidisciplinary and international community of SaltGiant makes this project more stimulating from the human and scientific point of view.

## ESR 14 – Mariam Attalla

**Affiliation:** Fondation nationale des sciences politiques (Sciences Po) (France)

**Project title:** The Contested Geopolitics of Eastern Mediterranean Oil and Gas Discoveries and Exploitation Process

**Scientific background:** Economic Development, Macroeconomics, Political Economy, Statistics

**Why this project?** Personal curiosity in development economics has shaped my interest in understanding how natural resources may represent an opportunity or an impediment to local and regional economics and politics.



## ESR 15 – Beatriz Martínez Rius

**Affiliation:** Sorbonne Université (France).

**Project title:** Salt, vessels and maps: the discovery of the Mediterranean Salt Giant.

**Scientific background:** Environmental Biology, History of Science.

**Why this project?** I'm deeply interested in the history of marine geosciences during the 20th century. This project will allow me to write the history of the scientific controversy around the Messinian Salinity Crisis, connecting it with its economic and political context.

## 2. 2018 ACTIVITIES

### 2.1. Workshops and training events

#### 1st SALTGIANT workshop in Palermo, Italy



From the 26th till 29th of November 2018 the first SALTGIANT workshop was hosted by the University of Palermo in Palermo, Italy. This event marked the first formal meeting where all the Early Stage Researchers (ESRs), their Principal Investigators and their Partner Organizations were present. During the first two days of the event, held in the Botanical Gardens of Palermo, workgroup packages were introduced and the ESRs were invited to give presentations on their Masters and PhD projects, with the goal of familiarizing the SALTGIANT group with their scientific background and PhD projects. During these two days, invited speakers also held presentations on topics related to the research done in the SALTGIANT projects. The first part of the workshop was concluded at the historical Palazzo Asmundo, where the participants had the opportunity to enjoy real Italian cuisine and meet each other informally.

The second part of the event was dedicated to the first Transferable Skills Training for the ESRs. During this soft skills training course the ESRs were taught in communicating research and scientific writing by Simona Cerrato and Elizabeth Griffin.

During the workshop, Laetitia Guibourdenche was elected ESR representative for 2019.

#### COST MEDSALT Training School 4: Deep Life in Buried Salt in Colchester and Whitby, UK



*SALTGIANT is an European project funded by the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement n° 765256.*



The COST MEDSALT action, within which SALTGIANT is implemented, organized a training school at the University of Essex and at Boulby International Subsurface Astrobiology Laboratory. The training school took place from the 9th till the 16th of September 2018. The aim of the training school was to provide training in microbiology and geochemistry needed to investigate life in buried salt deposits. Three SALTGIANT ESRs participated in this training school. This training consisted of lectures, laboratory practicals and a visit to an underground lab facility. During the lectures and lab practicals at the University of Essex, the topics salt deposits, microbes and the Earth were covered from a multidisciplinary approach. The practicals comprised microbial culturing and fluorescence in-situ hybridization. During their free time, there was plenty of opportunity for the participants to discover the local town of Colchester and socialize.

The second part of the training school consisted of a visit to the Boulby underground laboratory in northern England. During their visit, the participants were educated about the mine and its subsurface experiments in physics and astrobiology, culminating in a visit to the mine 1400 meters below the ground. The end of the training school was celebrated with a dinner in the town of Whitby.

## 2.2. Highlighted research

### Hydrology of Messinian Marginal Basins (Laetitia Guibourdenche, ESR 6)

The formation of the Mediterranean Salt Giant about 5.5 million years ago remains poorly understood. This thick layer of salt is mainly found in the form of halite-and-gypsum deposit in the deep basins of the Mediterranean Sea. But these evaporites are difficult to sample and study because they are offshore and covered by a large amount of younger deposits.

Another way to study the formation of the Mediterranean Saltgiant is to investigate the large amount of gypsum deposits which are outcropping onshore and easily accessible for sampling in Italy, Cyprus, South of Spain... These gypsum deposits have been formed in peripheral basins of the Mediterranean Sea that were hydrologically separated from the main Mediterranean basin. Gypsum crystals are made up of calcium, sulphate and water. These molecules are naturally present in seawater but gypsum does not precipitate from seawater because calcium and sulphate are not concentrated enough. Conversely, gypsum precipitates in hypersaline environments with high evaporation rates that concentrate dissolved ions. This is why the easiest way to explain the formation of gypsum in marginal Mediterranean basins during the Messinian Salinity crisis is to imagine that it formed in water with much higher salinity than that of the modern Mediterranean Sea. To investigate this hypothesis, researchers have measured the salinity of small quantities of water captured in gypsum crystals during its formation, reflecting the composition of the water from which the gypsum formed. And, against all expectations, the results showed that these fluid inclusions contain low-salinity water, and in most cases that the salinity is lower than that of sea water. Furthermore, isotopic analyses of the gypsum water molecules support this result and show that the water from which the gypsum formed had experienced limited evaporative concentration.

So, how is it possible to accumulate enough sulphate and calcium as to promote gypsum precipitation in a poorly-saline water mass?

In my PhD project, I will try to answer this question by reconstructing the hydrological budget of the basins where gypsum formed. I am currently focusing on the sulphate ion: what brought so much sulphate in these peripheral basins? Was sulfate brought in by rivers? Or was it produced biogeochemically by microbial oxidation of reduced sulfur compounds?

## **Vertical Motions of Marginal Basins in the Mediterranean (Hanneke Heida, ESR 2)**

After obtaining my MSc. in Earth Sciences at Utrecht University, I moved to ICTJA-CSIC in Barcelona to work on the paleogeographic reconstruction of the Mediterranean during the Messinian Salinity Crisis within the SaltGiant project. Numerical modelling of the flexural response to both sediment deposition and variations in sea level allows us to understand the connectivity of the deep and peripheral basins during the crisis. This in turn can provide us with a better understanding of the driving forces of and processes acting during the MSC.

Perhaps the most obvious example of the way such reconstructions can illuminate big issues in MSC research is the elevation on the Messinian Erosion surface at its formation. As this erosion surface constrains the maximum sea level drop during its formation, a low paleo-elevation of this surface would indicate a phase of desiccation and shallow waters in a Mediterranean disconnected from the Atlantic, crucial to understanding how the huge salt deposits present in the deep basins formed.

In order to obtain these paleogeographic reconstructions using the TISC software developed by my supervisor Daniel Garcia-Castellanos a lot of data is required on the depths of the surfaces being reconstructed, the behaviour of the crust as a response to loading by sediments and water, and faults and other structures causing or accommodating vertical motions in the basins. These data are obtained by others in extensive surveys, which is why the collaboration with our (industry)partners is vital. My first efforts are aimed at determining the paleotopography of the Balearic Promontory in collaboration with our partners at Paul Sabatier University Toulouse and Université de Montpellier. In the future we plan to work on the Alboran Basin with ICM-CSIC (Barcelona) and straying further east to the Levant Basin with ENI (Milan) and hopefully providing us with a better understanding of the evolution of the Mediterranean during this fascinating and enigmatic phase in geological history.

## **Modelling the (bio-) geochemical evolution and circulation of Messinian brine (Ronja Ebne, ESR 7)**

I am Ronja, a 28-year-old German, and last November I started as an early stage researcher for this project in Utrecht, The Netherlands. As my scientific background is physics with emphasis on the physics of the oceans and the atmosphere, I will not interpret samples or seismics that much. My subproject 7 is located in the work package one and therefore deals with the formation of the Messinian Salinity Giant. My work focusses on the numerical modelling of the (bio-) geochemical evolution and circulation of Messinian brine. At first glance this might sound a little bit boring compared to field trips and if one does not like programming it probably is. Since I happen to like staring at the computer and thinking about the laws of physics, I am very happy to introduce you to my part to the project.

More specific the aim is to gain more insight into the spatial distributions of ions and stratification scenarios in the water column during that time. To tackle these broad topics, we use numerical modelling. Since the magnitude of the timespan (although geographically speaking very small) is quite big a detailed and complex model would take too long to cover the whole MSC and thus is unusable for a large set of calculations. We therefore use box models. This idea is as simple as it is complex. The whole Mediterranean is represented by a small amount of boxes that represent either specific basins, e.g. western Mediterranean basin and eastern Mediterranean basin, or types of basins, e.g. marginal basin and deep water. Those boxes communicate with each other via a set of rules, i.e. the laws of physics we implemented. The western and the eastern box for example constantly exchange water through the strait of Sicily. But there is not only a water mass flux, but also a flux of energy (temperature) and ions (salinity). Of course the model only does what we make it do. It therefore is crucial to know in advance what aspect is of interest and to implement the formulae needed.

Due to their simplicity those models do need very little time for those 120k years. Which enables us to calculate sets of scenarios to test their reaction to changes. For example, the efficiency of the strait of Sicily could gradually be in- or decreased to get an idea what influence this would have on the whole system. This



is a kind of reverse modelling. We test different sets of parameters in order to find a range where the results represent the reality. Using this we then can draw conclusions back to those times.

Therefore, instead of planning which areas are of interest and sampling outcrops, I am planning the model design. At this stage the scenarios of interest and the formulae needed to realise them are discussed.

I am really looking forward to diving deeper into this topic and hope I could give a small oversight of what I am doing and going to do.

### 3. Upcoming events : 2019 events

#### April 2019:

- **Training School 3: The Messinian Salinity Crisis from a fieldwork perspective, organized by the MEDSALT network** (Sorbas, Spain, Monday, April 22<sup>nd</sup> to Friday, April 26<sup>th</sup>)

The field course will provide training in stratigraphy, sedimentology, palaeontology, geochemistry and petrology of the Messinian geological record in the Sorbas Basin (Spain) with lectures, practical exercises, and fieldwork.

- **SALTGIANT Field Course 1 “Introduction to MSG Geology” in Sicily** (Monday, April 29<sup>th</sup> to Friday, May 3<sup>rd</sup>):

Field course introducing the MSC geology and evaporate deposits in several sites around Sicily providing the fundamentals of MSG science. This event will be open to external participation. A form will be available on the SaltGiant website: <https://www.saltgiant-etn.com/training/>

#### June 2019 (4 events from Monday, June 17<sup>th</sup> to Wednesday, June 26<sup>th</sup>)

- **2<sup>nd</sup> SALTGIANT Workshop in Trieste, Italy** (from Monday, June 24<sup>th</sup> to Tuesday, June 25<sup>th</sup>).

The aim of this workshop is that ESRs present the first results of their research projects. The workshop will be couple to three other events.

- **Short course 2 “Seismic data acquisition, processing, interpretation”** (from Monday, 17<sup>th</sup> to Wednesday, 19<sup>th</sup> of June) : will enable SALTGIANT ESRs to understand the principles of seismic data survey planning, acquisition and processing, and the principles of stratigraphic analysis and seismic-to-well-logs correlation
- **Transferable skills training on communicating current research** (from Tuesday, 20<sup>th</sup> to Friday 21<sup>th</sup>)
- **2<sup>nd</sup> Supervisory Board Meeting** (Wednesday, 26<sup>th</sup> June).



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