



Subject offered for a contract starting October 2018

**SUBJECT TITTLE:** Hydrology of Messinian marginal basins during the formation of the Messinian Salt Giant

Advisor: **ALOISI, Giovanni, DR CNRS, aloisi@ipgp.fr**

Host lab/ Team : **IPGP - UMR7154 - Geochemistry of stable isotopes**

Financing: **Salary from the ETN SALTGIANT project**

*For more information go to <http://ed560.ipgp.fr>, section: Offres de these ( PhD offer), You must apply on the Doctoral School website*

**Keywords:** Isotope geochemistry, field work, laboratory isotope measurements, modelling

**Scientific objective:** To reconstruct the hydrology of selected marginal basins of the Mediterranean Sea during the formation of the MSG using stable isotope tracers. Gypsum and carbonate minerals precipitated from the water column of Mediterranean marginal basins during the formation of the MSG record the isotope composition of basin water ( $\delta^{18}\text{O}_{\text{H}_2\text{O}}$  and  $\delta\text{D}_{\text{H}_2\text{O}}$ ) and of the dissolved sulfate ( $\delta^{34}\text{S}_{\text{SO}_4}$  and  $\delta^{18}\text{O}_{\text{SO}_4}$ ) and strontium ( $^{87}/^{86}\text{Sr}$ ) ions. These isotopes are sensitive to the hydrological exchanges between the ocean and continental runoff, as well as evaporation and precipitation processes (limited to  $\delta^{18}\text{O}_{\text{H}_2\text{O}}$  and  $\delta\text{D}_{\text{H}_2\text{O}}$ ). Ongoing geochemical investigations of Mediterranean marginal basins suggest that some of the gypsum deposits might have formed at salinity lower than modern seawater, under the influence of  $\text{SO}_4^-$  and/or  $\text{Ca}^{2+}$ - rich river runoff and with little exchange with the Mediterranean Sea. This scenario is radically different from the classical view interpreting the evaporites of the Mediterranean marginal basins as formed by evaporation of seawater. The PhD candidate will work in tight collaboration with field-based PhD candidates (including field work in Sicily in collaboration with Antonio Caruso - University of Palermo) within the SALTGIANT consortium and mining sector partner KNAUF, to carry out a detailed sampling of primary gypsum deposits outcropping on land. The isotope composition of gypsum will be measured at the geochemical facilities of IPGP. In collaboration with Paul Meijer (Utrecht University), the PhD candidate will apply simple numerical box models that simulate the isotopic composition of  $\text{H}_2\text{O}$  and dissolved  $\text{SO}_4$  and Sr in marginal basins. In conjunction with the isotope composition of gypsum, these models will be used to deduce the hydrological cycle that dominated at the time of gypsum deposition in the marginal basins of the Mediterranean Sea, tackling the apparent contradiction of a marine-type evaporitic sequence bearing a continental isotope signal.

**Scientific working environment:** the PhD candidate will work within the ETN SALTGIANT Consortium (2018-2021) in tight collaboration with other 15 PhD candidates investigating various aspects of the formation of the Mediterranean Salt Giant (MSG). 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 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 combines (i) geological and geochemical field work, (ii) laboratory measurements and experiments, (iii) numerical modelling at a wide range of spatial and temporal scales and (iv) empirical social sciences data collection and analysis, guaranteeing exposure of the research fellows to state-of-the-art scientific knowledge and hands-on practical training in a field rich in applications of both intellectual and societal relevance.

**Expected results:** A Mediterranean basin-wide overview of the hydrological regimes of marginal basins during the formation of the MSG.

**Specific requirements:** Completed MSc or Diploma degree in Geology, Geochemistry, Earth Sciences or related fields. Some numerical modelling experience is not mandatory but welcome

**Co-supervision and planned visits (secondments) to other laboratories within the SALTGIANT consortium:** (1) University of Palermo, Palermo, Italy (Antonio Caruso, for the geographically extensive, high-resolution sampling of Messinian gypsum deposits); (2) KNAUF Gips KG (Germany), field work in Mediterranean area (Matthias Reimann, for access to pristine samples of gypsum from active mines and prospection cores of the Mediterranean region); (3) Utrecht University, Utrecht, The Netherlands (Paul Meijer, for isotopic box modelling of hydrological exchanges in Mediterranean marginal basins).