Uncovering the Mediterranean Salt Giant (MEDSALT) – Scientific Networking as Incubator of Cross- disciplinary Research in Earth Sciences

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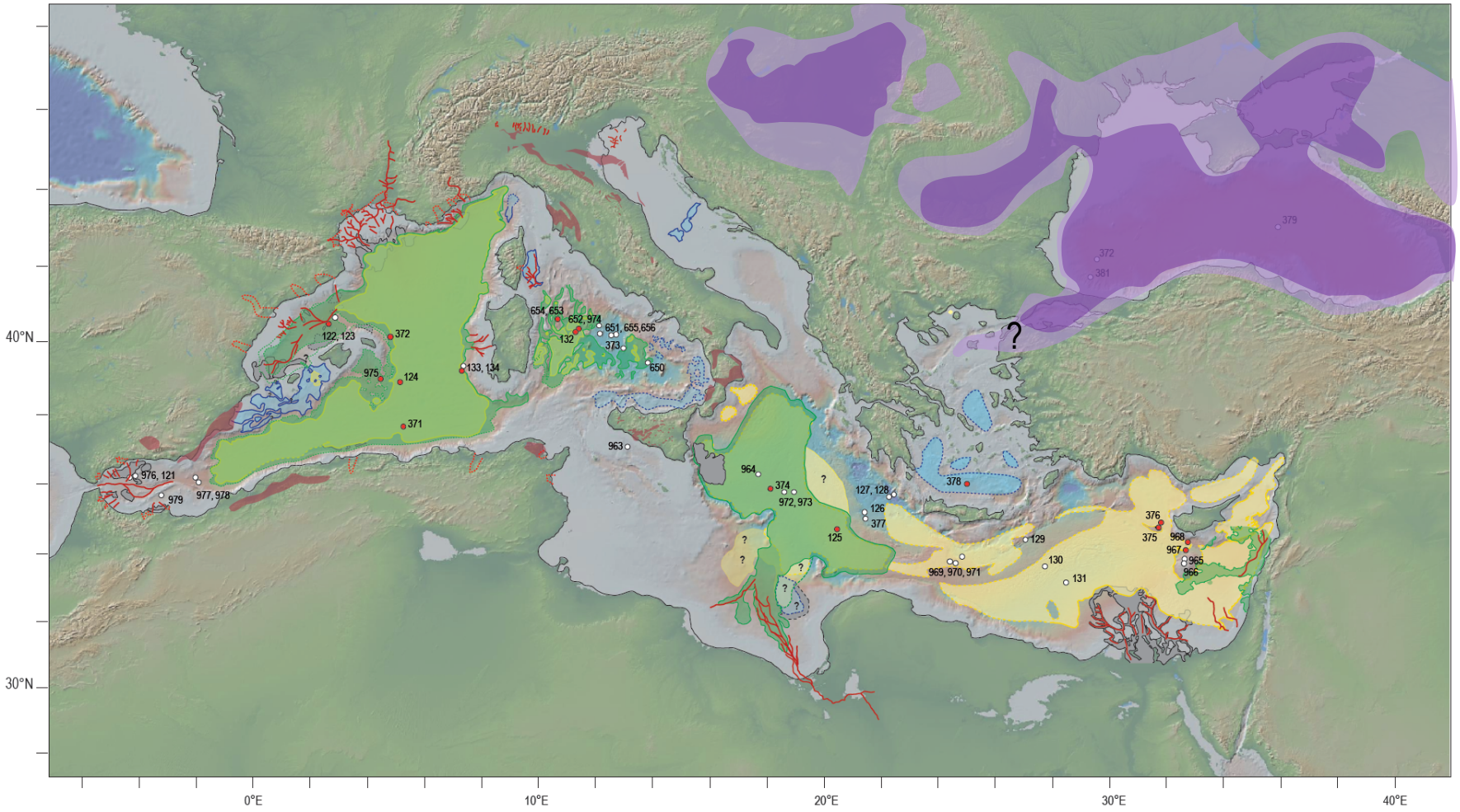
COST Action MEDSALT is a scientific network addressing the causes, timing, emplacement mechanisms, and consequences at local and planetary scale of the largest and most recent ‘salt giant’ on Earth: the Mediterranean Salt Giant (MSG).

The MSG is a 1.5 km-thick salt layer that was deposited on the bottom of the deep Mediterranean basins about 5.5 million years ago, in late Miocene (Messinian), and is preserved beneath the deep ocean floor today. The origin of the Mediterranean salt giant is linked to an extraordinary event in the geological history of the Mediterranean region, commonly referred to as the Messinian Salinity Crisis.

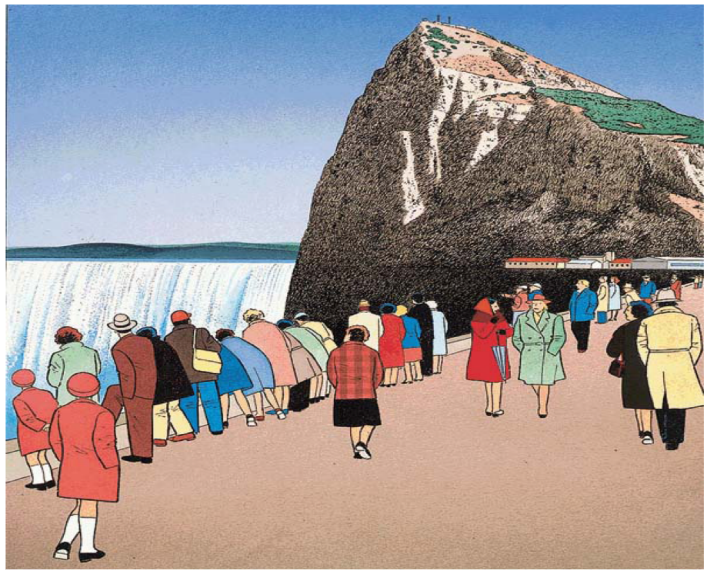
THE MEDITERANEAN SALT GIANT



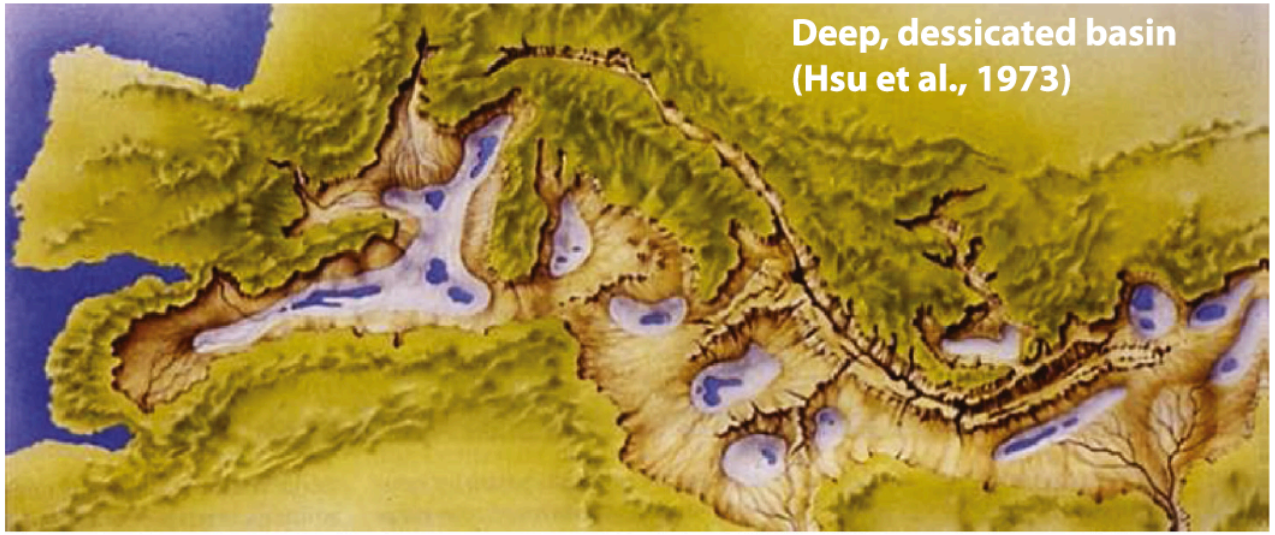
Brown: undifferentiated evaporites outcropping on land; yellow: Deep basin halite Mobile Unit; green: deep basins gypsum and clastics, Upper Unit (light green is where overlying the Mobile Unit); blue: gypsum and/or clastics of various age Bedded Unit; Gray: clastics Complex Unit; Red: Messinan thalwegs. Paratethys: Light purple: Lower Pontian; dark purple: Middle Pontian.

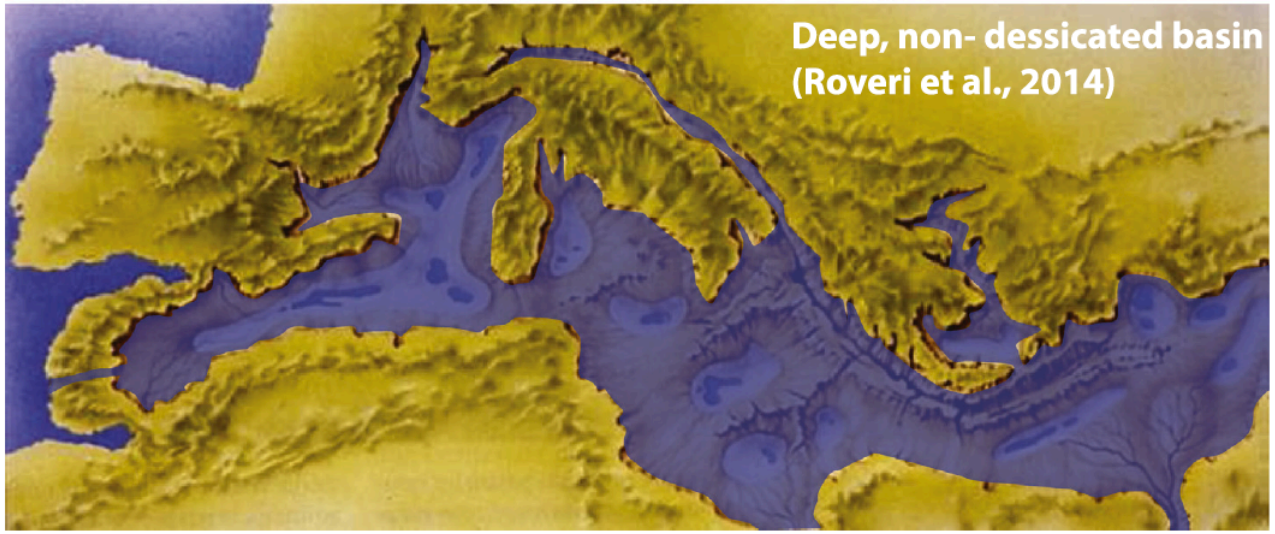
Research on the MSC, has initiated the longest-living scientific controversy in Earth Science. Pioneering scientific drilling in 1970 induced some researchers to publish the theory of the desiccation of the Mediterranean during the Messinian. In their view, the Mediterranean sea level dropped by 1-2 km and was transformed in a huge hot, dry salt lake as a consequence of the tectonically-driven closure of the Atlantic gateway at the present-day Gibraltar strait.

William B.F. Ryan, Maria Bianca Cita and Kenneth Hsü. (Credit: L. Lourens). Brisighella, May 2013. ECORD Magellan Plus Workshop DREAM



The “Gibraltar Cataracts” in the view of Guy Billout, first published in The Atlantic Monthly ©1986.





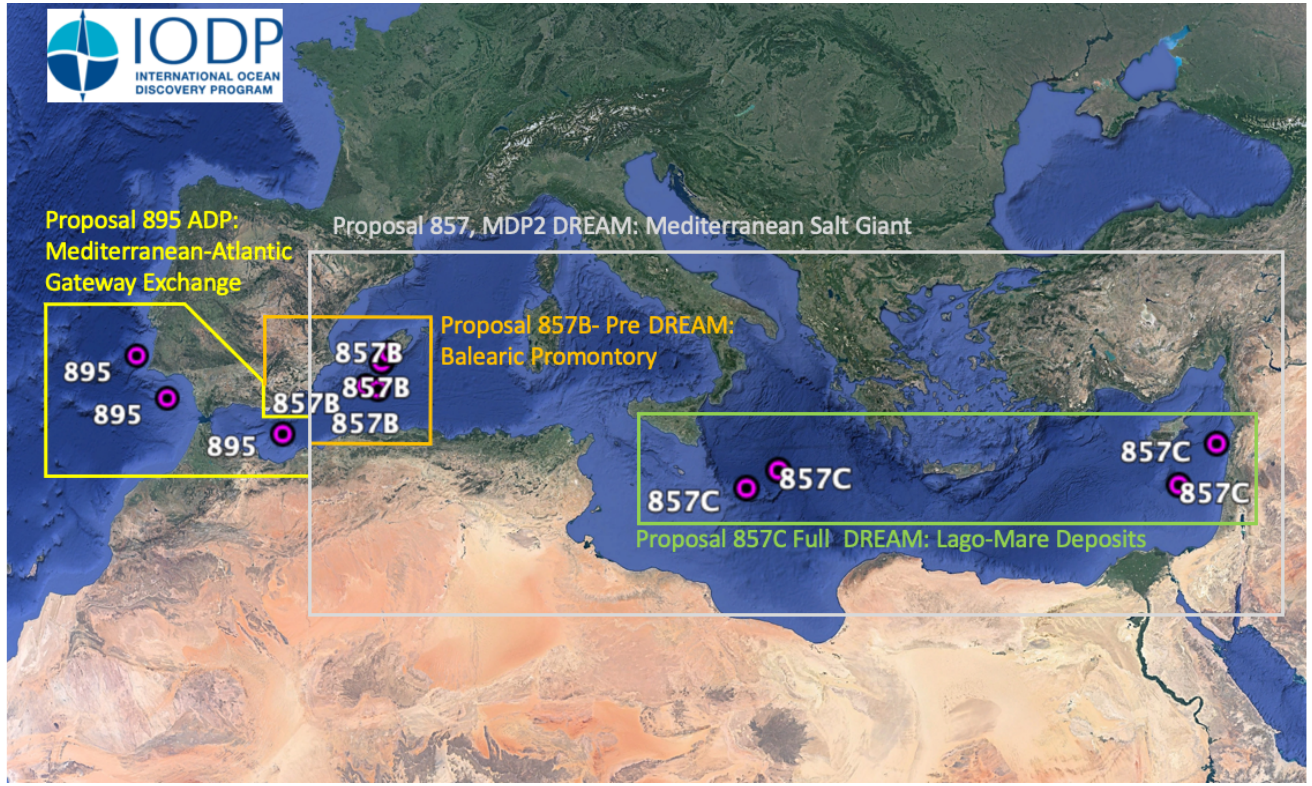
An artist's vision of the desiccated Mediterranean Sea during the Late Miocene (above), and the contrasting hypothesis of a deep, non-desiccated basin (below). The two scenarios are part of the MSC controversy today. Illustration from Krijgsman et al., 2018, modified after "The First Eden: The Mediterranean World and Man" by David Attenborough (1987).

The research drilling ship Glomar Challenger, with whom the Deep Sea Drilling Project (DSDP) explored the world oceans from 1968 to 1983

The four overarching scientific objectives of COST action MEDSALT are:

- to understand salt giant formation and its relationship with local, regional and global environmental change;
- to investigate salt dynamics and associated fluid flow quantitatively in order to assess geohazards;
- to understand if salt giants promote the development of metabolically active and phylogenetically diverse deep biosphere communities of microbes and viruses;
- to model the isostatic response of the lithosphere to extreme and rapid mass transfer and to kilometre-scale differential vertical motions of the Mediterranean margins.

MEDSALT generated a renewed push to build a global scientific network unifying the different schools of thought on the Messinian Salinity Crisis. This initiative goes under the acronym of DREAM (Deep Sea Record of Mediterranean Messinian Events) and has elaborated a road map to address the Mediterranean Salt Giant through the International Continental Scientific Drilling Program.



Location of the scientific drilling sites under evaluazion by the International Ocean Discovery Program (IODP) for drilling before 2023.

The MEDSALT Incubator has not only produced and managed the drilling plans: it is training the next generation of scientists that will contribute to implement drilling projects. Training is taking place through the Marie Skłodowska-Curie Innovative Training Networks (ITN) “SALTGIANT - Understanding the Mediterranean Salt Giant”, that was launched in February 2018 (https://www.saltgiant-etn.com).

More ideas are in the MEDSALT incubator: to expand the drilling plan to the continental realm, addressed by the International Continental Drilling Project (ICDP); Integrate the knowledge gathered on the Mediterranean Salt giant (the youngest on Earth) to older salt giants, including the oldest on Earth (Onega Basin in Russian Karelia Paleoproterozoic era, 2.5 to 1.6 billion years ago); communicate to the different sectors of our society what are the scientific challenges in the Earth and biological sciences.

Scientific drilling and the geophysical exploration of the Earth subsurface (weather on land or below the oceans) is too often perceived by citizens as the precursor of industrial mining and hydrocarbon extraction operations. The legitimate ambitions of society to implement a sustainable carbon-free economy with minimum impact on the natural environment sometimes generate conflicts with the ambitions of scientific research, which shares tools, investigation techniques, and scientific knowledge with the industry.

All parties should make an effort to maintain an open and transparent dialogue, based on scientific knowledge, sharing of information, and mutual trust in order to guarantee the progress of science and society.

The network has further promoted one Marie Skłodowska-Curie European Training Network (SALTGIANT) offering 15 PhD fellowship across Europe. New contacts have been activated with a variety of stakeholders, including governmental administrations, non-governmental organizations, the industry, the and indirectly, the society at large, demonstrating the importance that science and society renew a relationship of trust and confidence. The first important scientific products are released in the scientific literature.

In all 200 scientists are working together across disciplines such as geophysics, geology, biology, microbiology, embracing also social sciences, are working together towards a common scientific goal.

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