IODP Proposal Cover Sheet

DREAM: Balearic Promontory

857B - Pre

Title	Deep-Sea Records of the Messinian Salinity Crisis
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Abstract

Less than 6 Myrs ago, the Mediterranean was transformed into a giant saline basin during the Messinian Salinity Crisis (MSC). This geologically short-term event (~640 ka) resulted from the progressive restriction of the two connections between the Atlantic Ocean and the Mediterranean Sea that led to increasing salinity in Mediterranean. As a result, more than one million cubic kilometres of salt (i.e. ~6% of the total dissolved oceanic salt) accumulated, locally exceeding a thickness of 3 km in the deep central basins. The resulting Mediterranean Salt Giant is one of the youngest and relatively un-deformed salt giant on Earth, accessible to scientific drilling in a state close to its original configuration. Since the formulation of the Mediterranean desiccation theory following DSDP Leg XIII in 1970, modalities, causes, chronology and consequence at local and planetary scale of the MSC salt giant are still not fully understood, and the MSC remains one of the longest-living controversies in Earth Science.

The MSC changed the chemistry of the global ocean and had a permanent impact on both the terrestrial and marine ecosystems in the Mediterranean region. It has deeply influenced the sedimentary evolution of the Mediterranean margins, and is thought to have triggered kilometer-scale vertical displacements of the Earth lithosphere. Moreover, the Mediterranean Salt Giant may harbor a deep biosphere involved in extensive mineral transformations that provide oxidative energy for life, that are the driving force for the development of an unprecedented diversity of microbial life with exceptional metabolic activity.

DREAM aims at answering some of the still open fundamental questions related to the MSC Salt Giant by drilling with the JOIDES Resolution a transect of sites on the southern margin of the Balearic promontory (Western Mediterranean). We identified this area as the only place where we could implement a shallow-to-deep transect of non-riser drilling sites. While most of other Mediterranean margins have undergone MSC erosion, seismic data have provided evidence of well-defined and almost un-deformed MSC deposits preserved on this margin. These deposits are found in a series of sedimentary basins lying at different water depths between the present-day coastline and the deep central salt basins. DREAM is an extraordinary opportunity to access a unique sedimentary record of the MSC that will allow uncovering some of the secrets of the Mediterranean Salt Giant, which could be used as a reference for older salt giants found on Earth.

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Scientific Objectives

As non-riser JOIDES Resolution drilling implementation of the Multiplatform Drilling Proposal "Uncovering a Salt Giant", this pre-proposal builds on 4 prioritized and interrelated overarching scientific objectives addressing a wide spectrum of scientific disciplines:

Priority 1:
- to understand the causes, timing and emplacement mechanisms of the Messinian Salinity Crisis (MSC) and the Mediterranean salt giant;
- to investigate a previously unexplored deep-biosphere habitat with the potential to be a microbial hotspot.

Priority 2:
- to understand the mechanisms underlying the vertical motions inside salt basins and their margins.

Priority 3:
- to Identify the factors responsible for early salt deformation and fluid flow across and out of the halite layer.

Secondary objective: the valorization of the post-MSC sedimentary section aims at providing a detailed shallow-to-deep record of the Plio-Quaternary Mediterranean paleocirculation and possible turnover around 3.2 Ma.

Non-standard measurements technology needed to achieve the proposed scientific objectives.

Proposed Sites

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
BAL-02A	38.039976, 2.228299	2636	773	0	773	Deep-water end-member of a shallow-to-deep transect located across stepped basins. This site is mandatory to quantify the amplitude of the MSC base level change and to test the hypotheses of a stratified water column and of a diachronous/synchronous onset and end of the salinity crisis (Priority 1). This site is also designed to assess the evaporite-associated deep biosphere potential (Priority 1). It will allow assessing the differential response to lithosphere rapid loading and unloading during the MSC (Priority 2) and drawing general conclusions on early-stage gravity driven salt tectonics in a halite rich basin (Priority 3).
BAL-03A	38.081026, 1.702132	1749	602	0	602	Member of a shallow-to-deep transect located across stepped basins. This site is mandatory to quantify the amplitude of the MSC base level

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BAL-07A	38.9014, 2.275628	1015	869	0	869	Member of a shallow-to-deep transect located across stepped basins. This site is mandatory to quantify the amplitude of the MSC base level change and to test the hypotheses of a stratified water column and of a diachronous/synchron ous onset and end of the salinity crisis (Priority 1). This site is also designed to assess the evaporite-associated deep biosphere potential (Priority 1). It will allow assessing the differential response to lithosphere rapid loading and unloading during the MSC (Priority 2) and drawing general conclusions on early-stage salt tectonics and fluid flow across a halite rich basin (Priority 3).
BAL-05A	39.206038, 2.551727	320	401	0	401	Shallow end-member of a shallow-to-deep transect located across stepped basins. This site is mandatory to quantify the amplitude of the MSC base level change and to test the hypotheses of a stratified water column and of a diachronous/synchron ous onset and end of the salinity crisis (Priority 1). This site will also allow drawing general conclusions on early-stage salt tectonics and fluid flow across a halite rich basin (Priority 3).