

ECORD/ICDP

MagellanPlus Workshop Series Programme

Investigating Mediterranean-Atlantic Gateway Exchange (IMAGE)

May 5-8th 2015, Rabat, Morocco

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1) Summary

The MagellanPlus IMAGE workshop held in Rabat Morocco in May 2015 was embedded within an existing RCMNS Interim Colloquium entitled Mediterranean-Atlantic gateways (Neogene to present). The colloquium was originally designed as an opportunity to share with the wider scientific community the results of two independent but complementary research projects: IODP Expedition 339 which recovered a Pliocene–Recent record of Mediterranean Outflow from the Gulf of Cádiz; and the EU-funded Marie Curie Initial Training Network, MEDGATE which is reconstructing Mediterranean-Atlantic exchange during the Late Miocene when the gateway configuration was different (Fig. 1). However, after the colloquium was scheduled, the research environment shifted, primarily as a result of encouragement from IODP's Science Evaluation Panel to develop specific drilling proposals in the Mediterranean. All four of the scientific themes that are already being developed as Mediterranean drilling proposals include the recovery of its Late Miocene record of extreme salinity change, the Messinian Salinity Crisis. Consequently an understanding of Mediterranean-Atlantic exchange before, during and after the formation of the world's youngest and largest saline giant is required to evaluate its causes and consequences. The MagellanPlus IMAGE workshop was used to drive the meeting beyond merely being an opportunity to share and discuss new results, giving it a clear focus on building on this knowledge to explore the potential benefits of and problems with developing a drilling strategy for recovering this critical record of Mediterranean-Atlantic connectivity and exchange.



Figure 1 Map of the pre-Gibraltar Atlantic-Mediterranean gateways 5-10 million years ago.

The meeting comprised a series of four conference-style presentation sessions with associated posters and a half-day fieldtrip to acclaimed local successions at the western end of the Rifian corridor (Fig. 1). In all sessions and during the fieldtrip, convenors sought to capture key insights pertinent to the drilling objective. The meeting culminated in the final workshop session in which seismic data from the gateway region was presented, key research questions identified and possible

drilling targets were discussed. A two-day post-conference fieldtrip was organised to enable those that wished to visit important, but more inaccessible and less well known successions from axial parts of the Rifian corridor.

As a result of this MagellanPlus IMAGE workshop, the proponents received a clear mandate from the diverse community that attended, to work towards developing new drilling proposals for recovering a complete record of Late Miocene Mediterranean-Atlantic exchange. This is likely to require an amphibious strategy involving both offshore and onshore drilling. There are however two major challenges that need to be overcome before such a proposal is ready for submission and strategies to address these were discussed and agreed on at the meeting.

1. There are several key pieces of research that need to be undertaken and published in order to give the drilling proposal scientific credibility. Following the meeting, the proponents met to identify the nature of this research and construct the teams that could undertake the work. This will form a special issue to be published in due course.
2. More work needs to be done to identify ideal target locations for drilling. Those presenting seismic data agreed to work together with each other and the proponents to refine suitable drilling targets.

A final important component of the success of the workshop was the high profile role given to Early Stage Researchers from both IODP Expedition 339 and MEDGATE. These researchers were involved in a leadership capacity in all aspects of the meeting. They designed and convened sessions, led the fieldtrips, identified and invited keynote speakers and judged the prizes. We are proud to report that participants were extremely complimentary about the skill with which these individuals acquitted themselves and we look forward to seeing them take an increasing role in the development of this drilling project over the years to come.

Objectives

When the DREAM proposal was first conceived, only a single IODP drilling site in the Atlantic was considered necessary to constrain the connectivity history during the MSC. However, results from IODP Expedition 339 and recent modelling research have demonstrated how much the plume of Mediterranean outflow water migrates as its density fluctuates (e.g. with temperature and salinity). This, taken together with the changing location of the Mediterranean-Atlantic gateways during the Late Miocene-Pliocene (Fig. 1), means that a single drilling location will never recover the entire connectivity record. Instead, a suite of drill-sites is required, situated on the Atlantic margin, in the Alboran Sea and also potentially derived from land-based drilling within the fossil corridors in Morocco and Spain.

The objectives of the workshop were therefore to:

1. Draw together the expertise of a wide range of scientists from both academia and industry who are actively engaged in marine gateway research related to the Mediterranean and/or elsewhere;
2. Develop and compile key research questions pertaining to Mediterranean-Atlantic exchange and to consider how drilling could address these;
3. Examine the seismic data available in the in the gateway region with a view to assessing its distribution and quality and identifying suitable drilling sites;

4. Engage and develop Early Stage Researchers with specific expertise in the area and provide them with opportunities to build their profile and academic leadership skills.

Programme

Wednesday 6th May	
Session 1	<p>Processes and patterns of past and present Mediterranean-Atlantic exchange. Convenors: Sevasti Modestou, Marlies van der Schee and Montserrat Alonso-García.</p>
Talks	
Jesus Garcia Lafuente	<p>Keynote Presentation The present state of the water exchange through the Strait of Gibraltar.</p>
Simone Sammartino	Ten years of marine current measurements in Espartel Sill, Strait of Gibraltar.
Paul Meijer	The effect of sea-level change—via gateway flow—on Mediterranean overturning circulation.
Alba de la Vara	Water exchange through the Betic and Rifian corridors prior to the Messinian Salinity Crisis: A model study.
Claudia Wienberg	Cold-water corals at both sides of the Strait of Gibraltar - MeBo-drillings as a new approach to study their past development and potential exchange.
Susana M. Lebreiro	Zooming into the Mediterranean Outflow moat during the 1.2-1.8 million years period (Mid-Pleistocene) - an approach by stable and radiogenic isotopes.
Marlies van der Schee	Tentative identification of the Mio-Pliocene boundary and onset of the MOW recorded at IODP Site U1387C in the Gulf of Cádiz.
Nick Evans	Geochemical evidence for meteoric water and precession control of basin hydrology during gypsum-marl deposition of the Messinian Yesares Member, Sorbas Basin (SE Spain).
Sevasti Modestou	Climatic influences in the Eastern Betic Corridor from radiogenic Pb isotopes.
Posters	
Montserrat Alonso-Garcia	Mediterranean Overflow water signal during the Plio-Pleistocene transition: a new perspective from IODP Site U1391.
Jaime Frigola	Neodymium isotopes as tracer of Mediterranean water masses: preliminary results on modern and past conditions.
Sevasti Modestou	Neodymium in the Med-Atlantic gateway: a cautionary tale.
Session 2	<p>Causes and consequences of Mediterranean-Atlantic exchange, past and present. Convenors: Alice Marzocchi, Jan Peter Mayser, Maria Tulbure and Bas van den Berg.</p>
Talks	
Antje Voelker	<p>Keynote Presentation The Mediterranean Outflow Water in the Gulf of Cadiz and its linkages to Mediterranean and North Atlantic climate.</p>

Ángela García Gallardo	The influence of the Mediterranean Outflow Water on the Late Miocene Gulf of Cádiz.
Patrick Grunert	Mediterranean Outflow Water during the late Pliocene: New stratigraphic constraints from micropaleontology and XRF core-scanning (IODP Expedition 339, Hole U1389E).
Michael Sarnthein	Late Pliocene–to–early Pleistocene Mediterranean Outflow Waters in the N.E. Atlantic: Where? When? and Forcings of Change.
André Bahr	Coupled low- and high-latitude forcing on Mediterranean Outflow strength.
Stefanie Kaboth	Glacial-interglacial sea level reconstruction of the last 570ka: Inferences from a new benthic d18O record of IODP Site U1386 in the Gulf of Cadiz.
Francisco Sierro	Astronomical and millennial-scale events of freshwater discharge to the Mediterranean triggered collapses of the Mediterranean Outflow at Gibraltar during the last 150 Kyr.
Camille Contoux	Impact of increased salinity in the Mediterranean Sea on simulated Atlantic oceanic circulation during the Pliocene with NorESM-L.
David Van Rooij	Impact of the Mediterranean-Atlantic Exchange beyond the Iberian margin: the Porcupine Contourite Depositional System.
Jamie Boyd	Responses of dinoflagellate cysts to Neogene ocean gateway closures in the Mediterranean Sea.
Posters	
Isabel Cacho	Key changes in the interior of the Western Mediterranean Sea since the last glacial maximum.
Arjen Grothe	The final stages of the Messinian Salinity Crisis on the Atlantic side of the Riffian and Betic corridors: insights from dinocyst assemblages.
Johanna Lofi	Regional scale Gamma Ray signature of the Gulf of Cadiz Contourite Depositional System over the last 1 My.
Alice Marzocchi	Simulated orbital forcing control on Western-Eastern Mediterranean Sea dynamics and high resolution late Miocene model-data comparisons.
Erik van Sebille	The fate of Mediterranean Outflow Water in the North Atlantic and its mixing with Labrador Sea Water.
Field trip	
Afternoon field trip to Ain El Beida and Loujia sections	
Thursday 7th May	
Session 3	Tectonics, palaeogeographic evolution and economic implications of the Mediterranean-Atlantic gateway. <i>Convenors: Walter Capella, Evelina Dmitrieva, Diana Ochoa and Jan Peter Mayser.</i>
Talks	
César Rodríguez Ranero	Keynote Presentation Miocene formation and Plio-Pleistocene deformation of Gibraltar Arc System.
Diana Ochoa	Land-sea correlation of evaporites from the SW Balearic

	Promontory.
Jan Peter Mayser	Biomarker-based salinity reconstruction prior to the Messinian Salinity Crisis (Pissouri Basin, Cyprus).
Gert de Lange	Messinian Salinity Crisis-related hypersaline fluids expelled at deep- Mediterranean brine basins and mud volcanoes; an overview of offshore- observations.
Tanja Kouwenhoven	Benthic foraminifera and the onset of the Messinian Salinity Crisis.
Maria Tulbure	Planktonic and benthic foraminifera study of the latest Messinian in the Loulja section.
Evelina Dmitrieva	Mio-Pliocene evolution and exploration potential of the west Rifian corridor, Gharb Sub-Basin, offshore Morocco.
Thomas Vandorpe	Tectonically induced contourites in the El Arraiche area and their link with cold-water corals.
Nabil Khélifi	Evolution of Mediterranean climate and water outflow inferred from neodymium isotopes and grain size distribution in the Gulf of Cadiz during the past 3.2 million years.
Bastiaan C.J. van den Berg	Messinian high resolution XRF and stable isotope records from the Guadalquivir basin, Spain yield complex interplay between local basin fillings, regional impact of Messinian Salinity Crisis and global ocean trends.
Posters	
Nadia Barhoun	Environmental reconstruction of the Mellilia-Nador Basin (eastern Rifian Corridor, NE Morocco) during the Messinian.
Walter Capella	How did the Rifian Corridor close?
F. Javier Hernandez Molina	Late Miocene to present sedimentary stacking pattern of the Gulf of Cadiz Margin and west off Portugal: tectonic, sedimentary and paleoceanographic implications of IODP 339 expedition results.
Juan Cruz Larrasoaña	An up-dated chronostratigraphic framework for the lower Guadalquivir Basin; tectono-sedimentary implications.
Estefania Llave	Sedimentology of sandy contourites occurring during the Pliocene and Quaternary on the middle slope of the Gulf of Cadiz.
Johanna Lofi	The Messinian Salinity Crisis: what can we expect from drilling the perched basins from the Balearic Promontory?
Luis Lopez-Alcaide	Geochemical constrains on cold-water coral buildups from the Melilla Mound Field (East Alboran Sea, Western Mediterranean).
Guillem Mas-Gornals	A bridge to isolation: new evidence for the sea level drawdown in the western Mediterranean during the MSC.
Diana Ochoa	Contrasting log and seismic expression of evaporitic deposits along the Valencia Basin.
Marina Rabineau	Probing connections between deep earth and surface processes in a land-locked ocean basin transformed into a giant saline basin: the Mediterranean IODP Pre-857A project.
Florence Sylvestre	The Lake CHAd Deep DRILLing Project (CHADRILL) -- Unravelling 10 Million Years of environmental and climatic changes in Africa: Implications for human migration and deep life.
Yousfi Mohamed	Micropaleontological contribution (foraminifera) to

Zakaria	biostratigraphy and palaeoenvironmental reconstruction (Gharb Basin, Neogene, Morocco)
Friday 8th May	
Session 4	Past and present ocean gateways across the globe: what lessons can we learn from them? <i>Convenors: Dirk Simon and Alice Marzocchi.</i>
Talks	
Erik van Sebille	Keynote Presentation On gateways, bottlenecks and drift: considering the global ocean circulation from a foraminifera's perspective.
Peter K. Bijl	Is the early Eocene opening of the Tasmanian Gateway linked to the onset of Eocene cooling?
Catherine Bradshaw	The development of modern ocean circulation in the Nordic Seas cannot be explained by major ocean gateway changes.
Mike Rogerson	What would the Early Pliocene Med Outflow look like?
Conference group photo	
Arjen Grothe	Strontium isotopes and dinocysts as tracers for late Miocene connectivity of the Eastern Paratethys and the Mediterranean Sea with global ocean.
Chris van Baak	The other Medgate: Gateway connectivity between the Mediterranean and Paratethys.
Alice Marzocchi	Orbital control on the simulated Mediterranean Sea and Paratethys hydrologic budgets: precession vs obliquity forcing.
Dirk Simon	Late Miocene Mediterranean Evolution: Climate vs. Gateway.
Posters	
Alba de la Vara	Modelling the sensitivity of Paratethys sea level to changes in the hydrological budget.
Lara Pérez	Southern Ocean connections: the evolution of the south Scotia Sea basins.
Session 5	Formulating new IODP and/or ICDP proposals to recover a Late Miocene record of Mediterranean-Atlantic exchange. <i>Convenors: Rachel Flecker, Francisco José Jimenez-Espejo and Johanna Lofi.</i>
Talks	
Introduction	
F. Javier Hernandez Molina	Lessons learned from IODP Expedition 339
Johanna Lofi	The DREAM Project
Marina Rabineau	The GOLD Project
Florence Sylvestre	The CHADRILL Project
Input from previous sessions	

Discussion	
What are the science questions? What are the drilling target criteria for recovering cores that will answer these questions?	
Poster presentations	
Estefania Llave, F. Javier Hernandez Molina	Poster presentations of available seismic data
Gemma Ercilla, Ferran Estrada	
Cristina Roque	
Carlota Escutia	
Additional seismic data presentations	
Discussions	
Best possible targets for the science questions	
Planning future activities	
Prize presentations and Conference Close	

Outcomes and future plans

The participants at this MagellanPlus IMAGE workshop committed to develop new IODP and/or ICDP pre-proposals for drilling the Mediterranean-Atlantic gateway with a view to recovering a complete record of exchange before, during and after the Messinian Salinity Crisis. This record is critical to understanding both the causes and the consequences of salt giant formation locally, regionally and globally.

Objective 1: Draw together the expertise of a wide range of scientists from both academia and industry who are actively engaged in marine gateway research

The workshop was attended by 75 scientists from 13 different countries. Most were from academic institutes, but the meeting also attracted the attendance of and sponsorship from several companies including Anadarko, Repsol, CASP, Thermo Scientific and Petrostrat. It is clear from the conference participants that we were successful in attracting both strong participation from scientists involved in IODP Expedition 339 (13) and MEDGATE (17) and a broader community of scientists involved in research on Mediterranean-Atlantic gateways or other marine gateway systems. The keynote speakers: Antje Voelker (IPMA, Portugal); Jesus Garcia La Fuente (University of Malaga, Spain); Cesar Rodriguez Ranero (ICM, ICREA, CSIC, Barcelona, Spain); Erik van Sebille (Imperial College, UK) provided inspirational input from an exceptional range of different perspectives and their contributions provoked considerable discussion and debate. National IODP offices supported the attendance of participants from the UK, France and Germany.

Objective 2: Develop and compile key research questions pertaining to Mediterranean-Atlantic exchange and to consider how drilling could address these;

Several key questions were identified during the MagellanPlus IMAGE workshop, but most of them require further work to refine the hypothesis they articulate and clarify how a sedimentary record of exchange would test them.

- *What is the impact of a different MOW (no MOW, reduced MOW, MOW with anomalously high or low salinity) on North Atlantic circulation and sensitivity?*

There is clear modelling evidence that MOW contributes to North Atlantic circulation via changes to AMOC. Much of this work has focussed on the implied changes to MOW

during sapropel formation which also occurs during periods of weak AMOC. This is now being tested in part through the results of IODP Expedition 339. During the MSC, fluctuations in MOW volume and salinity are likely to have been significantly larger, though the periodicity of the variability is still thought to be dominantly precessional (e.g. during MSC Stage 1 and 3). From a drilling perspective, this requires the targeting and recovery of a complete record of exchange such that periods during which no contourites were deposited, can be identified and correlated with sensitive records of AMOC in the north Atlantic.

- *What is the impact of reduced global ocean salinity?*

Back of the envelope calculations suggest that the volume of halite sequestered in the Mediterranean represents approximately 6% of global ocean salt. This equates to a reduction of salinity from 35 g/kg to 32.9 g/kg. One recurrent question prompted by the observation that northern hemisphere glaciation initiated during the Late Miocene-Early Pliocene is whether the two are connected such that sea ice is formed at warmer temperatures under lower salinity conditions. From the graph of the melting point of water along with some unpublished climate model runs with lower ocean salinity designed to monitor sea ice formation, it seems unlikely that this is the major trigger for northern hemisphere glaciation; the influence of MOW-driven changes in AMOC produces a much more amplified signal in the Arctic and consequently is likely to have been a more important process. This question requires further development to explore the extent to which MOW-driven changes in AMOC may have triggered northern hemisphere glaciation. It will also be necessary to identify a suitable existing record of AMOC and its impact in the north Atlantic with which to compare any Mediterranean gateway record of MOW.

- *What was the pattern of Mediterranean-Atlantic exchange before, during and after the MSC?*

Changes in the salinity of the Mediterranean depend upon the volume and salinity of both water flowing into the basin and its outflow. Consequently, we need to know not only whether or not exchange occurred, but how much and their relative densities. The strong precessional signal of both Mediterranean successions and those along the Atlantic margin indicate variability in exchange on sub-precessional timescales. To address this, any drill core would need to be both high resolution and complete. Because of the ongoing tectonic uplift of the area it is likely that the drilling strategy would comprise an onshore-offshore transect.

- *What were the relative importance of the different drivers of exchange?*

Controls on gateway exchange include tectonics, eustatic and local sea-level change and climatic drivers of the density contrast between the Mediterranean and Atlantic, primarily the Mediterranean net freshwater export. Disentangling this is critical to understanding the causes of the MSC. A key to doing this will be recovering records long enough to isolate the different drivers through the timescale of their impact on exchange.

- *What was the nature of the Atlantic adjacent to the gateway?*

Any Atlantic record collected from close to the gateway or in the pathway of MOW will provide a hybrid Mediterranean-Atlantic signal. To deduce the nature of the Atlantic water with which the Mediterranean was exchanging, we require a record collected

considerably to the south of Gibraltar, offshore Morocco. This record should contain a precessional periodicity from the Saharan dust record and will consequently be correlated on a bed-by-bed basis with successions elsewhere in the gateway region and throughout the Mediterranean.

Objective 3: Examine the seismic data available in the area with a view to assessing its distribution and quality

Those participants working with seismic data in and around the gateway region both on the Atlantic margin and within the Mediterranean were contacted in advance and asked to bring with them both a poster and a brief (5 minute) presentation. In both they were required to show a map illustrating the distribution of the seismic data, an example of the quality of the data they have, some water-depth reconstructions and an identification of the locations of the areas most likely to contain a complete record of Mediterranean-Atlantic exchange during the Late Miocene to Early Pliocene. Here we present a brief summary of the data presented and the issues it raises.

a. Atlantic margin – Iberian Peninsula

There is an extensive seismic database that has been shot around the southern margin of the Iberian Peninsula (Fig. 2). The quality of this data is variable, but much of it is excellent. In view of the problems that IODP Expedition 339 had in recovering the Mio-Pliocene boundary, the workshop discussed various possible strategies for recovering Late Miocene MOW. This is particularly problematic because the density of MOW changes considerably immediately before and during the MSC and consequently the location of any contourites resulting from the outflow will also change. Numerical modelling will be required to help narrow down likely targets. The workshop also considered targeting subbasins on top of the accretionary wedge in order to recover pre-Gibraltar outflow funnelled down the Guadalquivir Basin (Fig. 1 and 2)

b. Atlantic margin – offshore Morocco

The database here (Fig. 3) was presented by Evelina Dmetrieva from Repsol. Repsol has access to a variety of different quality seismic data has been shot along the Moroccan margin and more seismic acquisition in the area is planned. Some of this data is available to the academic community including the high quality regional seismic line shown in figure 3.

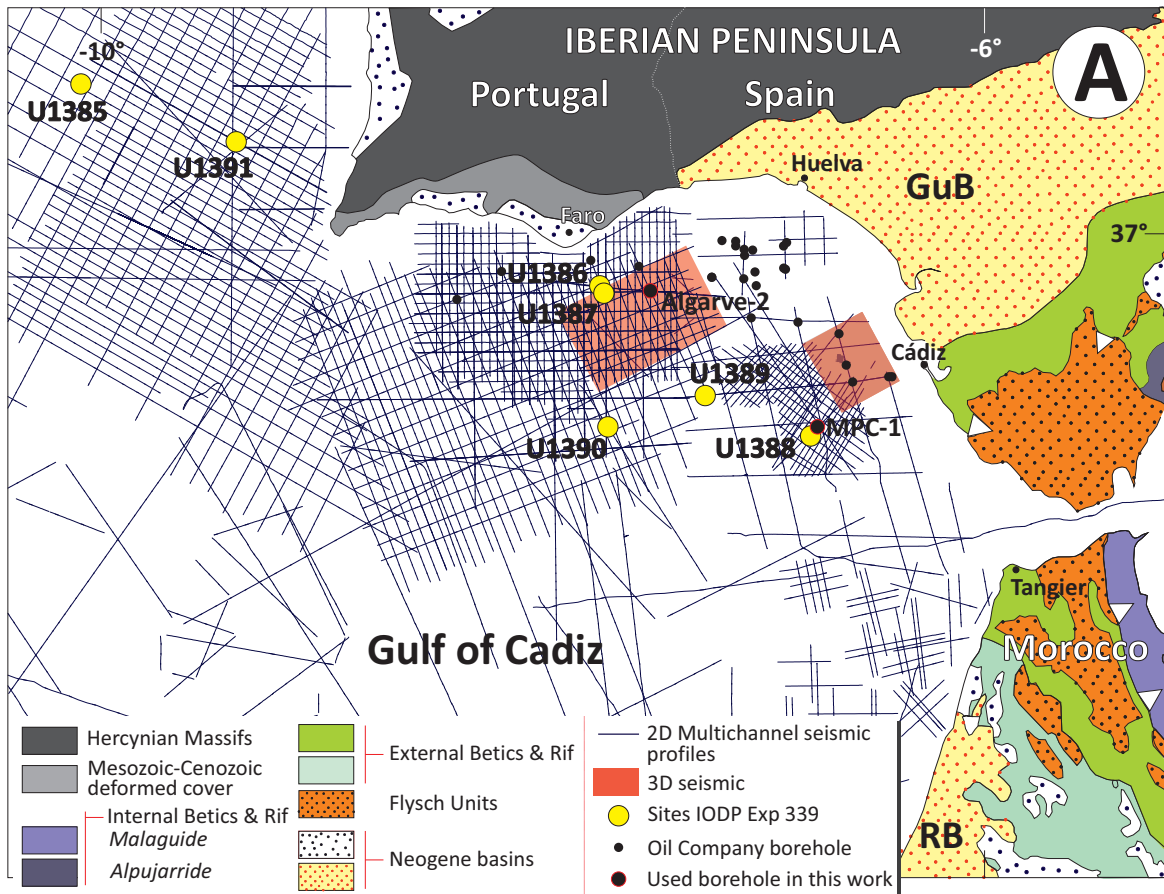


Fig. 2 Compilation of 2D and 3D seismic data available in the northern part of the Gulf of Cadiz presented at the workshop by Estafania Llave and Javier Hernández-Molina. Cristina Roque also presented seismic data from the Algarve Basin, shown here.

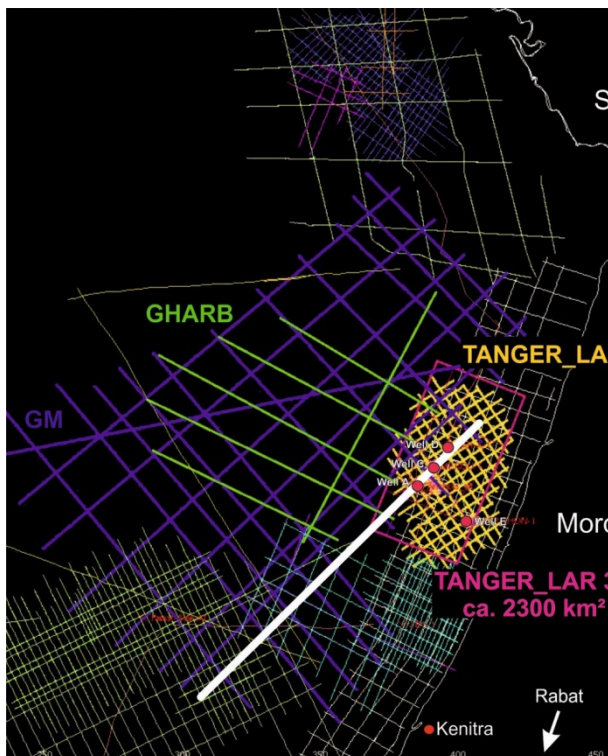


Fig. 3 Repsol's 2D and 3D seismic database from the Morocco margin presented at the workshop by Evelina Dmitrieva (Repsol). The white line shows the location of a regional seismic line.

c. Alboran Sea

There is an extensive seismic database right across the Alboran Basin (Fig. 4) providing excellent constraints on the palaeobathymetric evolution of the basin during the Late Miocene and Pliocene. Volumetric constraints provided by the thickness and extent of Mediterranean halite indicate that Atlantic inflow must have continued to supply evaporite ions to the basin through the MSC. Wherever that inflow was located, it must have passed during the Alboran Basin. Bathymetrically, the Alboran Basin is much shallower than the adjacent Algerian Basin to the east with the sharp drop in the sea floor associated in part with an island arc volcanic ridge which runs north south across the basin from Morocco (Melilla Peninsula) to Spain (Cabo de Gata). The combination of presentations from both Gemma Ercilla on the Mio-Pliocene evolution of the Alboran Basin and Cesar Rodriguez Ranero on the role of the island arc volcanics highlighted the importance of the Alboran Basin in understanding Mediterranean-Atlantic exchange. Critically, during Mediterranean lowstand conditions, the entire basin is likely to have acted as a connecting corridor between the Atlantic and Mediterranean, with an important barrier to exchange east of Gibraltar along the island arc volcanic ridge.

As a consequence of the relatively shallow depth of the Alboran Basin, no halite is found within the basin and only small patches of probable Miocene sediments have been identified. Further investigation of these successions will be required before a drilling target to the east of the current gateway can be identified.

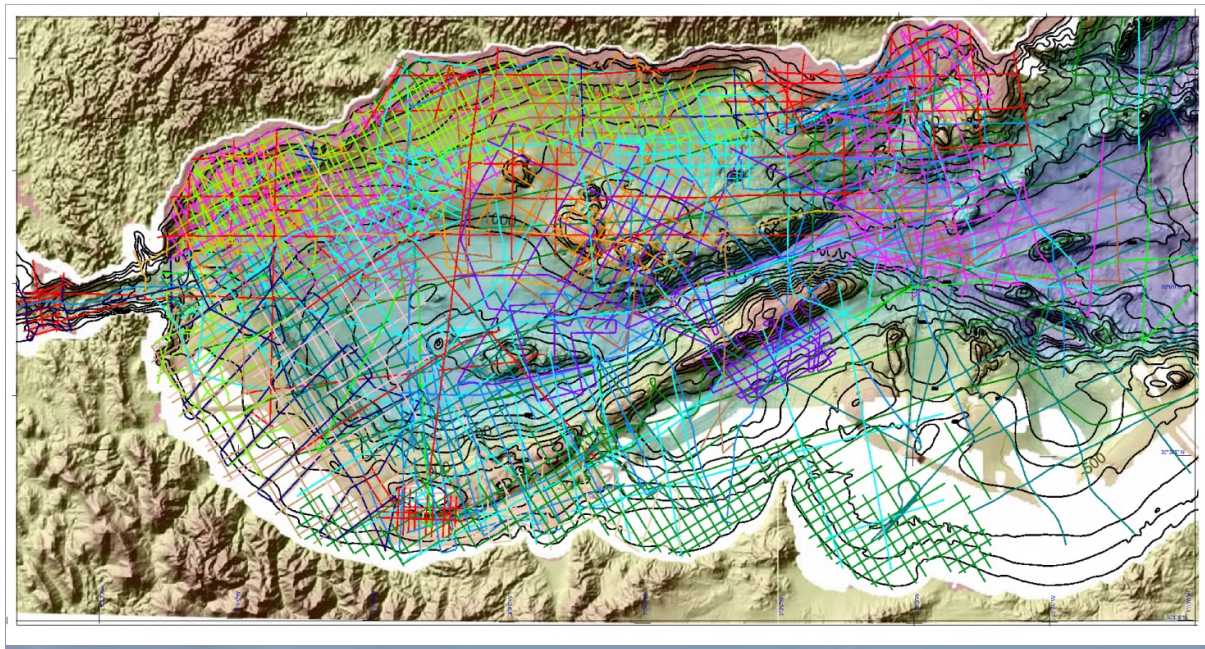


Fig. 4 Seismic database across the Alboran Sea comprises over 2000 km of multi- and single-channel seismic lines, together with high-resolution multi-beam bathymetry. Presented at the workshop by G. Ercilla, F. Estrada, C. Juan, C. Gorini, B. Alonso, E. D'Acromont, Casas, M. García, J. Hernández-Molina, M. Farran, J. T. Vázquez, D. Palomino, E. Llave, B. El Moumni, A. Ammar

Objective 5: Engage and develop early stage researchers with specific expertise in the area and provide them with opportunities to build their profile and academic leadership skills

Early Career Researchers made up around a third of the total participants at the meeting. In addition to the MagellanPlus funds provided for supporting the participation of 6 Early Stage researchers, the workshop received financial support for the attendance of Early Career Researchers from the Micropalaeontological Society. As a result we were able to offer an additional three individuals with micropalaeontological research projects, bursaries to support their participation in the meeting and/or the fieldtrip. Two industry funded prizes were awarded to ESRs with the best poster and oral presentation.

Early Career Researchers from both MEDGATE and IODP Expedition 339 contributed to the meeting in a whole range of ways. As well as presenting their own research, these new generation scientists have designed the schedule, identified and solicited the keynote speakers, encouraged participants. They also convened the sessions, judged the prizes and led the fieldtrips. Given that these individuals will be among those taking part in and probably leading any successful drilling application that comes of this exciting initiative, this development opportunity seems entirely appropriate. The feedback we received on the performance of these Early Career Researchers was, without exception, extremely positive, with several participants commenting that they had never seen or anticipated that Early Stage Researchers, particularly PhD students, could undertake such conspicuous roles so effectively.

Future work

One key outcome of the MagellanPlus IMAGE workshop was the recognition that there are several key aspects of the science around the Miocene Mediterranean gateway exchange that are not currently published. Getting these articles out into the peer reviewed literature is critical in building the credibility of the science behind the drilling proposal. Consequently we are organising a post-workshop special issue comprising ~10 invited articles. Interestingly, these are mainly articles that do not cover material presented at the meeting itself as this research is typically already well on the way to being published. Rather, the articles designed for the special issue are new research partnerships identified during the meeting that will specifically address key gaps in the published literature. A list of those contacted with the putative title and authorship is provided in Table 1. Negotiations with journals to host this special issue are currently underway.

Table 1. Titles and authorship for special issue following the MagellanPlus IMAGE workshop

Title	Proposed authors
The present state of exchange through the Strait of Gibraltar and its application to past exchange reconstruction	Lafuente, J.G, Meijer, P., Sammartino, S
Cold water corals: their present day distribution relative to MOW and potential as a Late Miocene tracer of exchange	Van Rooij, D., Wienberg, C., Vandorpe, T., Lopez-Alcaide, L
Plugging the Mediterranean gateway: tectonic evolution of the Alboran Plate and its effect on Miocene Mediterranean-Atlantic exchange	Rodriguez Ranero, C., Govers, R., Capella, W
Consequences of Mediterranean salt precipitation for global salinity and glaciation	De Lange, G., Flecker., R., Hilgen, F., Lofi, J., Lunt., D., Jimenez, F.
Calculating the equilibrium level of Messinian Mediterranean outflow and its preservation potential	Rogerson, M., Hernandez Molina, J.F.
Late Miocene evolution of the Alboran Basin	Ercilla, G., Garcia-Castellanos, D., Estrada, F., Gorini, C.
Late Miocene evolution of the onshore basins	Capella, W., van den Berg, B., Krijgsman, W
Late Miocene evolution of the Atlantic margin including syn-tectonic processes deduced from seismic	Roque, C., Llave, E
Correlating the Gulf of Cadiz with Sicilian basins during the MSC: implications for Mediterranean-Atlantic exchange	Jimenez, F., Lugli, S., Kuroda, J.
a review of the physical oceanography literature on MOW spreading, applied to a palaeo-context	van Sebille, E., Rogerson, M., Flecker, R.

Participants



1. Loubna Terhzaz, 2. Francisca Martinez-Ruiz, 3. Mohammed Achab, 4. Carla Sands, 5. Javier Hernandez Molina, 6. Walter Capella, 7. Rachel Flecker, 8. Gert de Lange, 9. Agostina Vertino, 10. Antje Voelker, 11. Erik van Sebille, 12. Andre Bahr, 13. Andres Rueggeberg, 14. Montserrat Alonso-Garcia, 15. Luis Lopez-Alcaide, 16. Patrick Grunert, 17. Peter Bijl, 18. Juan Cruz Larrasoana, 19. Paul Meijer, 20. Florence Sylvestre, 21. Jan Peter Mayser, 22. Susana Martín Lebreiro, 23. Daniel Garcia-Castellanos, 24. Hussein Abdallah, 25. Francisco Sierra, 26. Ferran Estrada, 27. Richard Hedley, 28. Arjen Grothe, 29. Cesar Rodriguez Ranero, 30. Zakaria Yousfi, 31. Werner Piller, 32. Michael Sarnthein, 33. Nabil Khélifi, 34. Guillem Mas Gornals, 35. Frits Hilgen, 36. Estefania Llavec, 37. Sevasti Modestou, 38. Francisco Jimenez Espejo, 39. Marlies van der Schee, 40. Camille Contoux, 41. Evelina Dmitrieva, 42. Jamie Boyd, 43. Angela Garcia-Gallardo, 44. Diana Ochoa, 45. Stefanie Kaboth, 46. Nick Evans, 47. Maria Tulbure, 48. Chris van Baak, 49. Gemma Ercilla, 50. Alice Marzocchi, 51. Stephen Vincent, 52. Bas van den Berg, 53. Nadia Barhoun, 54. Johanna Lofi, 55. Isabel Cacho, 56. Mike Rogerson, 57. Cristina Roque, 58. Alba de la Vara, 59. Catherine Bradshaw, 60. Pilar Mata, 61. Fabrizio Lirer, 62. Carlota Escutia.

Full table of participants, affiliations and indications of the ESRs

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