

Short Cruise Report

RV METEOR: Cruise M69/2

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IFM-GEOMAR
Leibniz Institute for Marine Geosciences
FB4 – Dynamics of the ocean floor

Cartagena, Spain to Valletta, Malta
August 31 to September 20, 2006

Participants M69/2

Name	Discipline	Institution
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Ranero, Cesar, Dr., scientist	Geophysics	CSIC, Barcelona
Booth-Rea, Guillermo, Dr., scientist	Structural geology	Univ. Granada
Petersen, Jörg, Dr., scientist	OBS/OBH	SFB574
Breuer, Christian, student	OBS/OBH	IFM-GEOMAR
Ivandic, Monika, scientist	OBS/OBH	SFB574
Kühn, Harold, student	OBS/OBH	CAU
Labahn, Erik, technician	Airguns	KUM
Lefeldt, Marten, scientist	OBS/OBH	SFB574
Martinez-Garcia, Pedro, scientist	OBS/OBH	Univ. Granada
Neiss, Holger	OBS/OBH	IFM-GEOMAR
Pesquer, David, scientist	OBS/OBH	IFM-GEOMAR
Petersen, Asmus, technician	Airguns	IFM-GEOMAR
Podolski, Claudia, student	OBS/OBH	CAU
Rohde, Anne-Dörte, student	OBS/OBH	CAU
Truscheit, Thorsten, technician	Weather forecast	DWD

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Scientific Programme

The Western Mediterranean is a natural laboratory to study the processes of continental extension and rifting in a convergent setting. Gravitational collapse due to tectonic thickening of continental lithosphere and the rollback of an oceanic slab during the latest phases of

consumption of the Tethys oceanic lithosphere have led to rapid Neogene extension in an area characterized by a constant convergence of the African and European Plates since Cretaceous time. The current setting displays a complex array of tectonic units that may be characteristic of the stage previous to a large scale continent-continent collision and that may include the lithospheric terranes that will eventually be emplaced along an orogenic belt. However, little is known about the crustal and upper mantle structure of much of the area and about the mechanisms of extension that have controlled the formation of the continental margins. Scientists believe, though, that the Ligurian Sea and the deep sea basin to the south of the Balearic Islands (Algerian Basin) is either floored by Neogene oceanic crust or perhaps by exhumed continental mantle, while the Alboran Sea and the transition from the south-Balearic margin into the basins are suggested to be characterized by stretched continental crust. The understanding of the formation mechanisms and the evolution of the continental margins of the Western Mediterranean has been hampered by the lack of modern geophysical data. During M69/2 two seismic refraction and wide-angle profiles were acquired in the Alboran Sea to study the structure of the Alboran Sea and the transition from the Alboran Sea into the adjacent eastern basin of unknown nature. Three additional lines were surveyed and run from the Spanish coast and from the Balearic Islands into the Algerian Basin. Shots from four of the five lines were received not only by ocean bottom seismometers (OBS) and ocean bottom hydrophones (OBH) deployed on the seafloor but also on seismic stations located onshore.

Narrative of the Cruise

On August 31, 2006 RV *Meteor* departed at 15:00 local time from the harbour of Cartagena, Spain and sailed towards the Alboran Sea. During the two days in harbour the equipment for the seismic work were set-up. After a short transit of ca. 12 hours *Meteor* reached the location of the first deployment of an ocean bottom seismic station. Two types of instrument are available for the cruise; 20 ocean bottom hydrophones (OBH) and 5 ocean bottom seismometers (OBS). On September 1 at 4:36 local time the first station, OBH01 was deployed roughly 20 sm to the north of the coastline of Marocco. After less than 12 hours 24 stations were placed along seismic profile P1, running roughly NS from offshore of the the town of Almeria 80 sm towards Marocco. At 16:23 h the two 32 litres BOLT airguns were deployed 10 sm off Almeria. At 15:06 h the first shot was fired. A shot spacing of 1 minute resulted at 4 knots into a spatial shot spacing of ~125 m. On September 2 at 11:54 h the last shot was fired and the airguns were recovered. Within 19 hours all 24 instruments were recovered.

After a transit *Meteor* reach on September 3 at 19 h the most westward OBS location on the second line P2. At 19:13 h the first station was deployed. At a spacing of 5 sm we deployed 25 ocean bottom hydrophones and seismometers. The last instrument OBH49 was deployed at 10:45 on September 4. At 13:41 h local time the first shot was fired along seismic line P2. This location was the most westward point reached during the cruise. P2 strikes at 75° and runs for 135 sm from the Alboran Sea into the adjacent Algerian Basin. After 34 h shooting ended and the airguns were recovered. On September 6 at 0:43 the first OBS was released and recovered ~45 min later. At 5:38 h on September 7 the last station OBH49 was recovered.

After a transit of ~140 sm *Meteor* deployed OBS50 roughly 40 sm northeastward off the Algerian town of Oran. 20 instruments were placed along the 100 sm long profile running from Algerian waters at 170° roughly towards the Spanish town of Alicante. As *Meteor* was not allowed by the Spanish authorities to obtain active source seismic data at water depths of less than 200 m the profile terminated ~30 sm to the southeast of Alicante. Seismic shooting stopped after 25 h on September 9 on 8:11 h locale time. At ~9 Uhr *Meteor* met a vessel of the Algerian cost guard and an observer from the *Service Hydrographique des Forces Navales* entered the ship to survey the scientific activities aboard of *Meteor*. Thereafter, *Meteor* headed to the north to recover the stations from P3. Recovery of the first OBS started at 10:45 h. The last station was recovered on September 10 at 3:07 h.

After a transit *Meteor* reached profile P4 running from the Islands of Ibiza and Formentor towards the south and terminated roughly 40 sm from the Algerian coast. The deployment occurred in two steps. In the afternoon of September 10 we deployed 11 stations. From 16:12 h to 6:00 h of the next day we surveyed with the Kongsberg multibeam echosounder EM120 the continental slope to the south of Ibiza. On September 11 at 6:06 h local time we started to deploy the remaining 11 stations along line P4. At 15:39 h the airguns were deployed and the first shot was fired at 15:52 h. For roughly 22 hours the airguns were operated along the 90 sm long profile. Shooting stopped at 12:33 h on September 12. Between 13:23 of September 12 and 7:40 h of September 13 all 22 ocean bottom instruments were recovered.

The last seismic profile P5 is located to the south of Majorca. OBS92, the first station on this line, was located ~100 sm SE of the island. At a spacing of 4 sm 24 instruments were deployed from September 14, 16:10 h to September 14, 3:45 h. OBH15, the last instrument

deployed during the cruise, is located ~10 sm to the south of Majorca. At 6:55 h the first shot was fired ~5 sm to the south of the village of Pto. Petro and ~8 sm to the east of Pta. Salinas. Due to technical problems, we could operate for the first ~12 h only one airgun. At 18:40 h the second gun was deployed and started shooting. The last shot along P5 was fired at 8:00 h on September 15. Due to the weather conditions it was not possible to have a rendezvous with the Algerian coast guard in the open sea. Therefore, after the airguns were recovered, *Meteor* had to sail towards the Algerian coast to reach Bejaia, a safe harbour where the Algerian observed could leave the vessel.

In the early morning of September 16 we started to recovery seismic stations from P5. Except OBS109, all stations could be released and were safely recovered until 21:30 h. At 4 h on September 17 *Meteor* took position roughly 0.5 sm to the south of the deployment position of OBS109 to wait for its safety release, programmed for 4 h. At 4:25 h the instrument surfaced and could be recovered.

In total 115 deployments of ocean bottom hydrophones and seismometers were made, returning seismic data from 5 wide-angle and refraction lines with a total length of 510 sm.

After finishing profile P5, we mapped the continental slope to the southeast of Majorca. On September 17 at 9 h the scientific programme ended and we left the study area and headed towards Malta, where *Meteor* met the pilot at 7 h offshore of La Valletta.

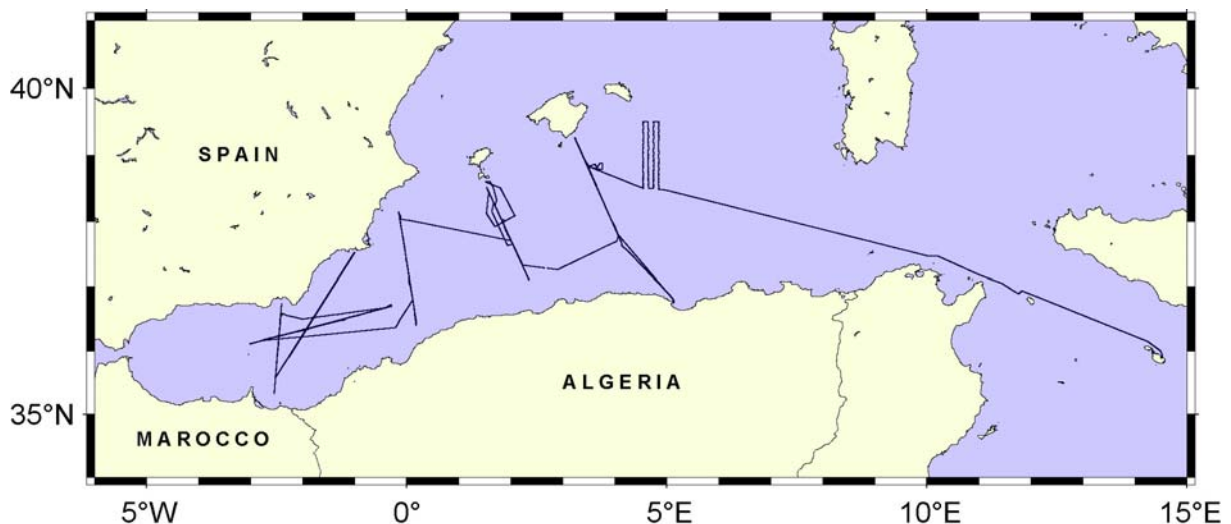


Fig. 1: Track plot of M69/2

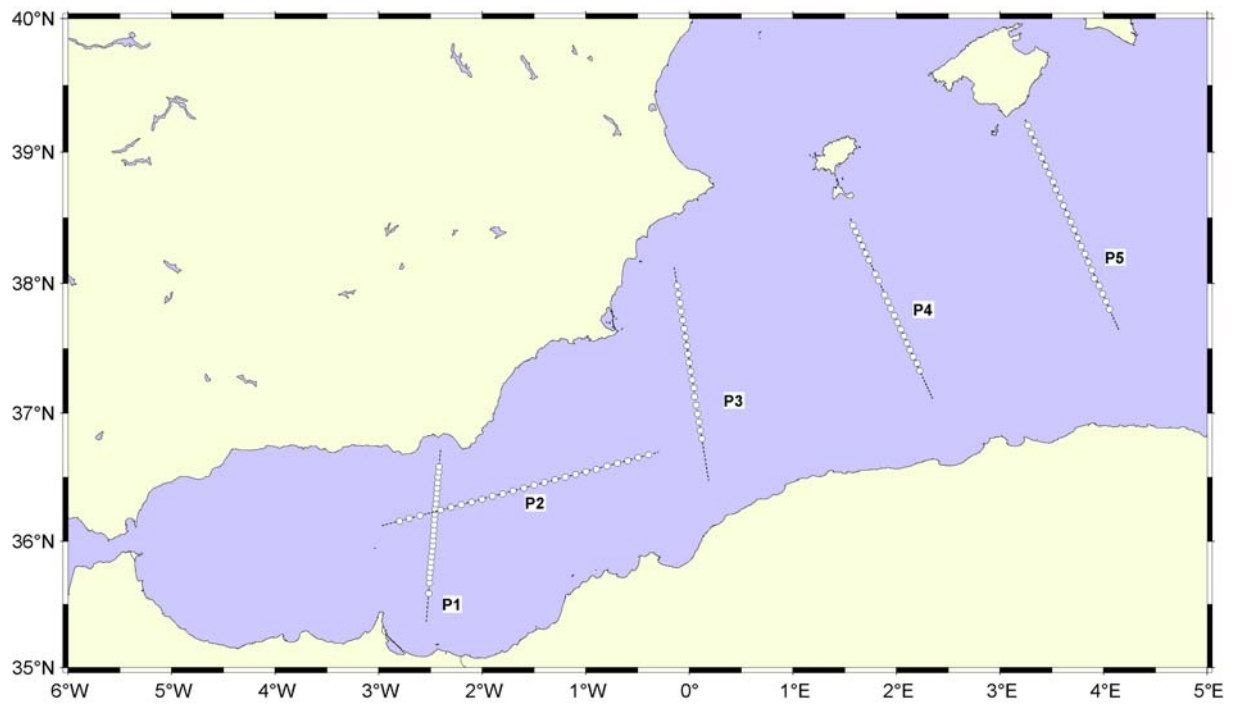


Fig. 2: Seismic wide-angle and refraction profile shot during M69/2