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Short Cruise Report

R/V METEOR – M214 (GPF 2024/036)

Las Palmas (Spain) Malaga (Spain) Heraklion (Greece) – Heraklion (Greece)

October 25 – December 13, 2025

Chief Scientist: Gerhard Bohrmann

Captain: Rainer Hammacher

Track lines from Las Palmas to the eastern Mediterranean and research areas in Greece of R/V METEOR Cruise M214.

Objectives

The Hellenic Subduction Zone, Eastern Mediterranean, represents an area where major faults south of Crete, well imaged geophysically and some associated with active mud volcanism, provide a window into the intermediate loop. The objectives of the expedition were to map faults and mud volcanoes by AUV (MARUM Seal5000), and to perform ROV dives (GEOMAR ROV Kiel 6000) so that locations of extruded altered mud and fault gouge can be identified and sampled to study the origin of such materials, the degree of alteration, and the role in element budgets at the interface between geosphere and hydrosphere. Heat flow was proposed be measured complementarily.

Cruise Narrative

On **Saturday, 25 October, 2025,** the METEOR left its berth at the Muelle Pesquero in the port of Las Palmas at 7 p.m. Prior to this, the research vessel spent two weeks in the port of Gran Canaria for repairs. In addition to numerous repairs, two of the four diesel generators were thoroughly overhauled to ensure the ship's seaworthiness for future reseach cruises. During its stay in port, the ship was visited by military attaché Colonel Marcus Bungert from Madrid. Mr. Bungert expressed great interest in the ship, its research, and especially in the challenges associated with official approval procedures in foreign waters and ports. The discussions with the ship's command and scientific cruise director demonstrated the importance and usefulness of the exchange between diplomatic authorities and German research vessels operating worldwide.

A small group of scientists from Germany, Morocco, and Greece embarked on **Friday, 24 October**, to be well prepared for the upcoming departure day. After the METEOR's departure that evening, a safety drill, called a steering maneuver, was carried out for everyone on board when the general alarm was triggered. After Sunday blessed us with wonderfully calm weather and bright sunshine, it became somewhat cloudier during our transit from the Canary Islands northwards. On Tuesday morning at approximately 5:00 a.m., we crossed Spain's Exclusive Economic Zone (EEZ) into Morocco and were able to begin the hydroacoustic recordings, as we had obtained official permission from Morocco and intended to use the transit route to collect scientific data. The hydroacoustic instruments, or echo sounders, of the METEOR provide us geoscientists with clear indications of structures on the seabed, the formation of which sheds light on important processes in the upper part of the marine crust. Following the survey line northward, we first crossed the Agadir Canyon, an underwater gorge carved deep into the continental margin by east-west sediment transport from the Moroccan continent. Suspended currents flow through the canyon far into the deep-sea plains. After the METEOR crossed the canyon, we traversed a broad ridge interpreted as an extension of Morocco's High Atlas Mountains into the marine environment. We then encountered several round to elliptical elevations, rising approximately 100-200 meters above the seabed. A review of published literature reveals that these are isolated salt domes in the subsurface, causing localized uplift of the seabed. Eighty nautical miles before entering the Strait of Gibraltar, we surveyed the Meknes mud volcano using a cross-section. In contrast to the salt dome structures, no deposits were detected on the summit of the mud volcano using sediment echo sounding, whereas these were clearly present at the salt domes. Of particular interest are the inclusions of former cold-water coral mounds embedded in the sediments of the western, steeper flank of the mud volcano. These significantly more solid structures, composed of coral limestone, extend down to the seabed, and the individual limestone mounds are also visible in the multibeam echosounder bathymetry of the seabed. Unfortunately, the hope of encountering further mud volcanoes was not realized, but the four-day transit to the next port was generally used for continuous data acquisition.

As we passed through the Strait of Gibraltar on **Wednesday, 29 October**, we enjoyed glorious sunshine and could clearly see both coastlines in Morocco and Spain, albeit somewhat hazy. Unfortunately, the sky clouded over in the afternoon, and it even started to rain when we entered the port of Malta around 7:00 p.m. Once the METEOR docked at the pier in the port of Malaga, the first leg of the M214 was complete. On **Thursday, 30 October**, under a bright blue sky, our three containers, transported from Bremen, were unloaded from the ship, and the crew and scientists distributed the contents of the containers among the laboratories and on the working deck. Three of the eight scientists from the first leg disembarked, and on **Friday, 31 November**, 15 newly arrived scientists from Germany, Spain, Switzerland, and Greece boarded. The last day before the METEOR's departure, **Saturday, 1 October**, was entirely dedicated to further preparations for the upcoming scientific work. On **Sunday, 2 November**, the METEOR left the port of Malaga punctually at 08:30 a.m. and embarked on the six-day transit from the Alboran Sea of the western Mediterranean via the Tyrrhenian and Ionian Seas to our destination area south of Crete.

The program (FRINGE II) of the METEOR expedition, number M214, investigates fluid and gas vents in the accretionary wedge of the Mediterranean collision zone between the African and Eurasian tectonic plates. In the accretionary wedge, deposits are accumulated by lateral pressure from plate convergence and form a complex underwater mountain range in the eastern Mediterranean, known as the Hellenic Arc. The "FRINGE II" expedition is part of the Bremen Cluster of Excellence at MARUM "The Ocean Floor – Earth's Uncharted Interface" and investigates geological structures, fluids, and gases that occur along prominent fault systems, where previous studies have identified deep-rooted mud volcanism and fault deposits on the ocean floor. The journey east from Malaga led through the Alboran Sea, across the Balearic Basin, south of Sardinia, into the Tyrrhenian Sea, and along the northern coast of Sicily. We then proceeded through the Strait of Messina, across the Calabrian Arc of the Ionian Sea, to the Mediterranean Ridge, where we reached the study area on Saturday afternoon and began the scientific work program with the first CTD station, reaching a depth of 2,200 m. During the night, we conducted extensive mapping using the multibeam echosounder and, in particular, the Parasound sediment echosounder over several mud volcanoes of particular importance to us, which we intend to investigate in greater detail during the expedition. On **Sunday, 9 November**, the MARUM AUV-Seal5000 was launched for the first time to conduct micro-bathymetric surveys of the Gelendzhik mud volcano. We are pleased to have finally begun the actual research work after the long transition period.

At the start of week 4, on **Monday, 10 November**, we began sampling the Nice mud volcano and a small mud mound on its western side. This mound lies precisely on a north-south strike-slip fault, which we interpret on the bathymetric map as a displacement of morphological structures between the eastern and western blocks, extending for approximately 30 kilometers. On the micro-bathymetric map of the Nice mud volcano, this fault is marked by a thin fissure on the western edge of the map. The small mud mound lies exactly on this fissure, and sampling with the gravity corer yielded very dry mud, which explains why we only managed to extract a core sample of slightly over one meter. This strike-slip fault appears to be a tectonic feature of regional scale, as it is accompanied by several mud volcanoes along its north-south extent. The two largest mud volcanoes (Nice and Gelendzhik), whose mudflows cover the largest areas on the seabed, lie along this tectonic structure. Based on the multibeam echosounder backscatter map, the Nice mud volcano covers an area of approximately 4 x 5 km with mud breccia, while the Gelendzhik mud volcano covers an even larger area of approximately 9 x 9 km. Several morphological vent structures are present, so it can be considered a volcanic field. However, the size of the area is not the reason why we prioritized sampling the Gelendzhik mud volcano field. The reason is the presence of a fresh mudflow, which we discovered emanating from the summit of the northernmost vent in the Gelendzhik volcanic field.

Previously, during the night, we conducted a survey drive to the north, primarily investigating a 3,500 m deep basin with three parallel parasound profiles. We were able to trace up to five characteristic horizons across the basin's sedimentary sequence, showing signs of mass waste deposits, the sedimentation of which is very likely related to earthquake events in the subduction zone. The uppermost of these redistribution layers, which appears to be approximately 10 m thick on average in the parasound, was thinned to a depth of up to 5 m at the basin's periphery. The following day, we attempted to penetrate the mass waste deposit layer there using a gravity corer, hoping to determine the age of the redeposition and, consequently, the timing of the associated earthquake event through further laboratory analyses. Unfortunately, the corer only yielded a recovery of 4.22 m, preventing us from coreing the underlying layer and thus rendering the investigation impossible. On **Tuesday, 12**

November, at 10:15 a.m. ship's time, we had to suspend sampling operations at the northern volcanic structure of the Gelendzhik field. A person overboard (MOB) was reported, and a search and rescue operation was initiated. It wasn't until 10:30 p.m. that we received instructions from the SAR coordination center to be relieved by the MV Evgenia and thus released from the SAR operation. After 12 hours and 35 minutes, we were able to return to our daily research routine and continue the interrupted sampling on the fresh mud flow of the Gelendzhik mud volcano.
On **Friday, 14 November**, we performed a heat flow program, which occupied the remainder of the day, a seabed survey was carried out using the ship's sonar. On Saturday morning, core instruments were deployed, and the water column was sampled using the CTD/rosette. Initial analyses of the AUV measurements revealed several gas bubble vents in the water column, which are associated with higher concentrations of methane in the water samplers. Methane concentrations in ocean water are very low, with background values typically ranging from 1 to 4 nmol/L. Around the gas vents, the values increase significantly, and so far, we have detected concentrations up to 60 nmol/L. The AUV dive planned for the night at the Heraklion dive site had to be postponed to Sunday morning due to weather conditions, when the weather had calmed down again. During the 117th dive of AUV SEAL 5000 on **Sunday, 16 November**, the summit and northwestern slope of the Heraklion mud volcano were surveyed. The mud volcano lies within an elliptical caldera, the rim of which is approximately 5 km east-west and 2.5 km north-south. Compared to the surrounding area, the caldera has sunk over 100 m due to mud eruption from the depths of the Heraklion volcano and the corresponding mass deficit in the subsurface. The micro-bathymetric map illustrated that mud flows in earlier times were predominantly directed southward, but that more recently, mud transport has clearly been directed northward, with some mud flows already reaching the caldera rim. During a second dive on Monday night, we mapped the eastern part of the volcano with the AUV, so that the structure is now completely recorded microbathymetrically. During the day, we conducted sampling with the gravity corer and multicorer. When sampling the relatively fresh mud that had erupted from the vent, we found the highest salinity levels in the pore water. With a salinity of up to 30%, we are well above the solubility limit of sodium chlorite, so it is no surprise that we can see precipitates of individual small halite crystals in the mud. In addition, there are a number of different clasts, the most striking being a boulder of pure halite with an average diameter of almost 10 cm. This clast has distinctly cubic halite crystal faces and certainly originates from the Messinian evaporite sequence of the Upper Miocene; it is therefore approximately 5-6 million years old. The transport of mud has penetrated this subsurface formation, carrying various rock fragments from the formation to the seabed surface. A comprehensive analysis of the clasts will reveal which other formations have also been breached.
A night-time program of heat flow measurements on **Tuesday, 18 November**, was dedicated to the northern volcanic vent of the Gelendzhig volcanic field. This vent was successfully sampled the following day using a gravity corer, and the analysis of the pore water salinity yielded further surprises. A sediment core taken directly from the vent's upwelling channel showed a salinity of 1%, a clear indication of freshwater compared to the 4% salinity of seawater. As has been observed in other mud volcanoes, this freshening of the pore water most likely results from the release of water molecules from minerals undergoing transformation in deeper sediment layers. One known transformation of clay minerals is the change of smectite to illite, which leads to this water release. Just a few dozen meters away from this mud containing freshened pore water, another mud with elevated salinity levels of 10-27% is found, which can only be explained by the influence of the Messinian salinar sequence. A core sample taken further north along the mudflow draining from the summit yielded the same high dissolved salt concentrations, but only at a greater depth. Sampling a sediment core between the summit and the location mentioned before was not possible, as we had to leave the position that day due to an urgent military alert. We used the night of **Wednesday, 19 November**, to survey a basin at a depth of 3500 meters using Parasound, with the aim of collecting a sediment core for seismic event analysis. The survey during the night was very promising but had to be aborted at 2:18 a.m. due to an emergency call from the Greek authorities requesting the rescue of refugees in a boat very close to us. The boat was spotted in the searchlight, and all 35 refugees were rescued and

cared for aboard the METEOR. They were safely handed over to the coast guard in the port of Kali Limenes at approximately 10:00 AM ship's time on **20 November**. We were able to conduct a CTD measurement and a heat flow analysis until the next distress call came in at 11:00 AM on **21 November**, and we were ordered to search for another boat. We were finally released at 11:00 PM that night and set sail for our next port of call in Heraklion, where we arrived today, **Sunday, 23 November**, a day earlier than planned.

The rapid termination of research activities, following our involvement in search and rescue (SAR) operations for two consecutive days, was followed by extensive discussions with the shipping company and the German Research Fleet Coordination center in Hamburg. Research activities repeatedly disrupted by such significant aid activities are not productive. The research vessel's heavy reliance on external resources led to the decision to discontinue operating in the area south of Crete. The region between the city of Tobruk in Libya and the island of Crete is currently used as a major refugee route, where the issue of external control would cause further complications for the METEOR and could potentially jeopardize future cruises. We subsequently searched for alternative research areas and, with the assistance of the control center, applied through diplomatic channels for a research area northwest of Crete with the Greek authorities. Simultaneously, we inquired about an area in Calabria, Italy, where we also have sufficient preliminary reconnaissance to ensure successful diving operations in the following leg of the cruise. The problem is that such diplomatic requests for research permits usually take several weeks. In our case, the German embassies in Rome and Athens submitted the two applications with great urgency, and we are hopeful that we will receive approval for one of the two new areas of research by the middle of next week.

The METEOR itself had its regular port call in Heraklion from Sunday to **Friday, 28 November**, during which crew and container changes took place. The Bremen AUV was disembarked and the Kiel ROV was installed on board. On Friday, the METEOR set sail, and stayed in a waiting position in Greek waters, from which the vessel can quickly reach both of the targeted research areas. On **Thursday afternoon, 4 December**, the official permit letters from the authorities finally arrived, much to our relief. Surprisingly, the letters arrived at roughly the same time, even though they came from authorities in different countries. A huge thank you goes to the staff of both embassies and especially to the German Research Fleet Coordination Centre in Hamburg, which persistently addressed our problem of the missing research permit. We had prepared corresponding work programs for the METEOR in both regions and were able to begin our scientific activities immediately in the so-called "Cobblestone Area." First, a CTD profile was recorded across the water column to generate a current underwater acoustic model, which was then used to calibrate the acoustic measuring instruments. During the night from Thursday to Friday, several soundings were taken at the Prometheus mud volcano, in a basin at a depth of 3230 m, and at the Novorossiysk mud volcano to map the distribution of mud flows in the sediments and to collect the pore water from these sediments. On **Friday, 5 December**, the ROV Kiel 6000 was finally able to launch. We dove on the Helios mud volcano, which was surveyed in detail with the MARUM AUV SEAL 5000 during the SONNE expedition SO278 in 2020. The map served as the basis for the dive and already showed readily interpretable phenomena of mud volcanism. The volcanic structure, which rises about 100 m above the seabed at a water depth of 2,950 m, has a diameter of about 2 km at its base and a plateau of approximately 180 m in diameter at its top. The flattened top area of the mud volcano, the youngest mudflow, is clearly separated from the older mudflows by a 1 m drop in elevation. The homogeneous distribution and a channel approximately 10-15 m wide and up to 3 m deep, connected to the plateau's mud cake and extending to the base of the mud volcano on the south side, indicate a formerly quite water-rich mudflow. Two similarly furrowed, older channels are morphologically formed on the southwest and southeast flanks. During the first dive, we were able to clearly distinguish the most recent mudflow from the older mudflows in the video footage based on its surface structure. There, a significantly more uneven surface with narrow ridges and interspersed elongated depressions with depth differences of 10-50 cm is evident, barely covered by younger hemipelagic sediments. This surface morphology appears to be a result of the mudflow, with the longitudinal structures of the ridges and interspersed depressions forming perpendicular to the flow direction. This was particularly evident during the dive in the south-facing gully, as the longitudinal structures are arranged parallel to the slope and the mudflow followed the gradient of the hillside. No immediate outflow area at the top of the mud volcano could be observed.

A temperature probe program, consisting of 15 measurements taken at various locations above the Helios mud volcano, was conducted during the night from Friday to Saturday. As expected, the results showed a higher heat flux in the center of the volcano than in the surrounding area. A highly interesting dive followed on **Saturday, 6 December**, guided by a complex backscatter pattern on the AUV map at the base of the Helios mud volcano. Right from the start, upon first seeing the bottom, numerous circular patches were observed, exhibiting dark gray discolorations at the edges and covered in the center by a snow-white bacterial mat. Sampling revealed a solid crust beneath the sediment, the presence of which can be explained by precipitation under the influence of rising fluids. Shimmering, denser water with schlieren formation was directly observed emerging from the surface. Such saline fluids were also observed elsewhere, where bacterial mats covered large areas. To our great surprise, we then discovered a very shallow lake with a higher salt concentration on the seabed. It appeared only a few centimeters deep in the flat terrain, but was clearly distinguished by a low backscatter in the forward-looking sonar of the deep-sea robot. After experiencing rather rough weather on **Sunday 7 November**, which prevented a dive with the ROV Kiel 6000, we avoided the bad weather by heading southeast as part of a survey, in order to begin a dive on **Monday 8 December** at the so-called "Thetis brine lake." The Thetis hypersaline anoxic lake forms an elongated depression in the seabed at the transition between the northern edge of the Mediterranean Ridge and the backstop of the collision zone between Africa and Europe. The Thetis lake is approximately 10 km long and up to 2 km wide. Using the Parasound echo sounder, we could clearly see both the brine surface at a depth of 3260 m and the seabed, which lies 160 m deeper. The brine was found to be saturated with NaCl, with a total salinity of 345‰, one of the highest values known from such hypersaline lakes. The brine lake was discovered in 2008 and named after the Italian research vessel that sank under dramatic circumstances in 2007. Previous investigations have focused on microbial communities at the seawater-brine interface, where a steep pycnocline and chemocline exist with strong gradients of salinity and electron donors. During our dive, we primarily examined the lake's shoreline and individual cliff areas on the lake's northern side to identify potential brine-rich inflows. The brines are formed by the dissolution of solid salt rocks of the Messinian Evaporite Formation, which are found in the vicinity of Lake Thetis. We repeatedly sampled the rocks with the ROV, but this did not yield any evidence of the presence of salts.

We observed only traces of former, downslope-flowing brine solutions, presumably draining from cavities in the underlying rock. ROV-Kiel 6000 returned to the ship with abundant rock, water, and brine samples, along with numerous photos and videos. That same night, the METEOR steamed north again to the Helios mud volcano, where, during another ROV dive, we investigated the salt lake at its base. Unlike Lake Thetis, this lake is only a few decimeters deep. Our measurements of the brine lake's water, at 70‰, indicate a lower salinity than Lake Thetis, strongly suggesting a mixture of a more concentrated brine with the bottom water, which has a salinity of 40‰. In the sediments below, which we were able to sample with a gravity corer more than 5 m long, the pore waters are significantly more concentrated, reaching concentrations of up to 270‰. While the lakebed is clearly visible, the brine surface is barely discernible. However, the brine surface is very clearly visible in the ROV's sonar, as the entire lake shows no backscatter, while the shoreline areas exhibit strong backscatter. Therefore, the outline of the brine lake is very easy to trace. Numerous patchy cold seeps occur in the vicinity of the lake, macroscopically conspicuous due to bacterial mats. As our sampling shows, the salt solutions in the sediment are enriched with dissolved methane, which, together with the sulfate from the seawater, provides sufficient sulfide through anaerobic methane oxidation in the area of the cold seeps for the bacterial mats to utilize. Furthermore, we were always able to detect carbonate precipitates in the form of crusts below the bacterial mats, which also arise as a product of anaerobic methane oxidation. We were able to conduct our fifth and final dive on **Wednesday, 10 December**, again at Lake Thetis. This was followed by a night program involving gravity coring and heat flow measurements in the vicinity of the hypersaline Lake Thetis. On **Friday, 12 December**, the scientific work was suspended at 5:50 p.m. before we crossed the boundary of the research area, and the METEOR set course for Heraklion, where we arrived at 9:00 a.m. local time on Saturday. Thus ends a voyage that had to overcome many challenges.

Acknowledgements

R/V METEOR cruise M214 to the Mediterranean Ridge was planned, coordinated and carried out by MARUM "Center for Marine Environmental Sciences" at the University of Bremen. The cruise was financed by the "Deutsche Forschungsgemeinschaft" (DFG) through the cluster of excellence "The Ocean Floor – Earth's Uncharted Interface" (EXC 2077). We would like to specially acknowledge the master of the vessel, Rainer Hammacher and his crew for their continued contribution to a pleasant and professional atmosphere aboard R/V METEOR. Many thanks to the staff of the German Research Fleet Coordination Centre at the University of Hamburg and to the Logistic Department of MARUM (Marco Klann Julia Krahl and Götz Ruhland). We also would like to thank our colleagues of the German embassies in Greece and Italy for supporting our request of research at the foreign ministries.

Cruise participants

Name	Leg	Discipline	Affiliation
Adamou, Georgia	3	Hydro-acoustics	LPG
Ahrlich, Frauke	2	AUV deployments	MARUM
Bach, Alissa	2+3	Maps, GIS	GeoB/MARUM
Baur, Fabian	3	Meteorology	DWD
Berger, Anja	1+2	Hydro-acoustics	MARUM
Berger, Frederik	2+3	Sedimentology	MARUM
Bohrmann, Gerhard, Prof.	1,2,3	Chief scientist	GeoB/MARUM
Bolonakou, Vasiliki	3	Hydro-acoustics	LPG
Bouimetarhan, Ilham, Prof.	1	Hydro-acoustics	Uni Agadir
Camerlenghi, Angelo, Prof.	3	Geology	OGS
Cuno, Patrick	3	ROV deployments	GEOMAR
Fleer, Jan	3	ROV deployments	GEOMAR
Glüsen, Lasse	2+3	Oceanography	MARUM
Huusmann, Hannes	3	ROV deployments	GEOMAR
Katritsis, Ioannis	2	Hydro-acoustics	LPG
Kienitz, Tim	2	AUV deployments	MARUM
Kölling, Martin, Dr.	1	Hydro-acoustics	MARUM
Kopiske, Eberhard	3	Oceanography	MARUM
Kreiter, Stefan, Dr.	3	Geotechnics	MARUM
Kurbjuhn, Torge	3	ROV deployments	GEOMAR
Malnati, Janice	3	Gas chemistry	GeoB/MARUM
Mathiessen, Torge	3	ROV deployments	GEOMAR
Menapace, Walter, Dr.	2+3	Sedimentology	ICM, MARUM
Meyer-Schack, Birgit	2+3	Sedimentology	MARUM
Neumann, Florian, Dr.	2+3	Heat-flow	MARUM
Otte, Frank	1+2	Meteorology	DWD
Oestreicher, Anthea	2	Outreach	GeoB

Papazoi, Amalia Georgia	1+2	Hydro-acoustics	LPG
Pape, Thomas, Dr.	2	Gas geochemistry	GeoB/MARUM
Perea Manera, Hector, Dr.	2	Tectonics	ICM
Pfaffling, Leola	2+3	Sedimentology	MARUM
Pieper, Martin	3	ROV deployments	GEOMAR
Raeke, Andres	3	Meteorology	DWD
Renken, Jens	2	AUV deployments	MARUM
Römer, Miriam, Dr.	1+3	ROV dives, GIS	Geo/MARUM
Ruh, Jonas B., Dr.	2	Geology	ICM
Schreiber, Elmar, Prof.	1+2	Outreach	Jade Uni
Seeliger, Julian	2+3	Coring technology	MARUM
Spiesecke, Ulli	2	AUV deployments	MARUM
Suck, Inken	3	ROV deployments	GEOMAR
Täuber, Andreas	3	Outreach	GEO
Taylor, James	3	ROV deployments	GEOMAR
Warnken, Niklas	1,2,3	Heat-flow	MARUM
Xu, Shuhui, Dr.	2+3	Pore water geochemistry	MARUM
Zhang, Junli, Dr.	2	Geotechnics	MARUM

2.3 Participating Institutions

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GeoB Fachbereich Geowissenschaften der Universität Bremen, Klagenfurter Straße 2-4, D-28359 Bremen, Germany, https://www.geo.uni-bremen.de

GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel, Wischhofstr. 1-3, 24148 Kiel, Germany, https://www.geomar.de/

OGS Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, Borgo Grotta Gigante 42/C - 34010 - Sgonico (TS), Italy, https://www.inogs.it

DWD Deutscher Wetterdienst, Seeschifffahrtsberatung, Bernhard-Nocht-Straße 76, 20359 Hamburg, Germany, www.dwd.de

LPG Laboratory of Physical Geography, Department of Geography and Climatology, National & Kapodistrian University of Athens Panepistimiopolis, Zografou, GR-157 84 Zografou, Athens, Greece, https://lpg.geol.uoa.gr/?lang=en

ICM Institut de Ciències del Mar, Passeig Marítim de la Barceloneta, 37-49, 08003 Barcelona, Spain, https://www.icm.csic.es/en/about-icm

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List of Stations

Date 2025	St. M214/	Instrument	on seafloor	off seafloor	Latitude N	Longitude E	Water depth (m)
08.11.2025	**01-1**	**CTD-01**	14:11		33° 53.837'	24° 21.698'	2229
09.11.2025	**02-1**	**AUV-114**	06:55	13:05	33° 53.586'	24° 16.947'	1710
09.11.2025	**03-1**	**HF-01-01**	16:36	16:53	34° 3.661'	24° 20.440'	1950
09.11.2025	**03-2**	**HF-01-02**	17:35	17:52	34° 3.712'	24° 20.142'	1964
09.11.2025	**03-3**	**HF-01-03**	18:35	18:53	34° 3.760'	24° 19.842'	1926
09.11.2025	**03-4**	**HF-01-04**	19:19	19:27	34° 3.809'	24° 19.546'	1890
09.11.2025	**03-5**	**HF-01-05**	20:09	20:26	34° 3.856'	24° 19.251'	1854
09.11.2025	**03-6**	**HF-01-06**	21:09	21:17	34° 3.904'	24° 18.955'	1816
09.11.2025	**03-7**	**HF-01-07**	22:01	22:09	34° 3.952'	24° 18.655'	1773
09.11.2025	**03-8**	**HF-01-08**	22:55	23:16	34° 3.999'	24° 18.362'	1721

10.11.2025	**03-9**	**HF-01-09**	00:08	00:24	34° 4.248'	24° 18.180'	1781
10.11.2025	**03-10**	**HF-01-10**	01:07	01:15	34° 4.477'	24° 17.990'	1815
10.11.2025	**03-11**	**HF-01-11**	01:53	02:10	34° 4.708'	24° 17.796'	1847
10.11.2025	**03-12**	**HF-01-12**	02:51	02:59	34° 4.938'	24° 17.603'	1782
10.11.2025	**03-13**	**HF-01-13**	03:40	04:00	34° 5.164'	24° 17.412'	1750
10.11.2025	**03-14**	**HF-01-14**	04:34	04:51	34° 5.392'	24° 17.221'	1700
10.11.2025	**04-1**	**MUC-01**	07:06		34° 2.472'	24° 17.158'	1787
10.11.2025	**04-2**	**GC-01**	09:03		34° 2.470'	24° 17.160'	1787
10.11.2025	**05-1**	**GC-02**	11:35		34° 3.066'	24° 18.519'	1778
10.11.2025	**05-2**	**MUC-02**	13:10		34° 3.066'	24° 18.518'	1779
10.11.2025	**06-1**	**CTD-02**	18:31		34° 9.862'	24° 18.833'	1862
11.11.2025	**07-1**	**MUC-03**	08:03		34° 34.199'	24° 13.362'	3560
11.11.2025	**07-2**	**GC-03**	09:24		34° 34.198'	24° 13.362'	3555
11.11.2025	**08-1**	**AUV-115**	18:39	03:51	33° 53.233'	24° 33.982'	1760
13.11.2025	**09-1**	**CTD-03**	06:49		33° 54.047'	24° 16.264'	1714
13.11.2025	**10-1**	**MUC-04**	08:35		33° 54.083'	24° 16.141'	1696
13.11.2025	**10-2**	**MUC-05**	09:50		33° 54.081'	24° 16.147'	1700
13.11.2025	**10-3**	**GC-04**	11:20		33° 54.083'	24° 16.143'	1709
13.11.2025	**10-4**	**GC-05**	12:59		33° 54.084'	24° 16.144'	1701
13.11.2025	**11-1**	**CTD-04**	15:08		33° 54.233'	24° 16.140'	1706
13.11.2025	**12-1**	**AUV-116**	18:39	03:51	33° 53.233'	24° 33.982'	1760
14.11.2025	**13-1**	**PZ-01**	08:39		33° 54.116'	24° 16.143'	1639
14.11.2025	**14-1**	**HF-02-01**	11:29	11:48	34° 5.162'	24° 19.292'	1907
14.11.2025	**14-2**	**HF-02-02**	13:04	13:12	34° 4.924'	24° 19.111'	1886
14.11.2025	**14-3**	**HF-02-03**	13:55	14:03	34° 4.681'	24° 18.932'	1869
14.11.2025	**14-4**	**HF-02-04**	14:42	14:50	34° 4.436'	24° 18.744'	1826
14.11.2025	**14-5**	**HF-02-05**	15:28	15:36	34° 4.203'	24° 18.565'	1769
14.11.2025	**14-6**	**HF-02-06**	16:11	16:27	34° 3.968'	24° 18.382'	1732
14.11.2025	**14-7**	**HF-02-07**	17:04	17:21	34° 3.721'	24° 18.193'	1755
14.11.2025	**14-8**	**HF-02-08**	17:49	17:57	34° 3.489'	24° 18.020'	1793
14.11.2025	**14-9**	**HF-02-09**	18:38	18:46	34° 3.287'	24° 17.818'	1838
14.11.2025	**14-10**	**HF-02-10**	19:26	19:43	34° 3.279'	24° 17.520'	1853
14.11.2025	**14-11**	**HF-02-11**	20:28	20:46	34° 3.267'	24° 17.220'	1857
14.11.2025	**14-12**	**HF-02-12**	21:28	21:45	34° 3.254'	24° 16.924'	1877
14.11.2025	**14-13**	**HF-02-13**	22:23	22:39	34° 3.244'	24° 16.622'	1847
15.11.2025	**15-1**	**CTD-05**	06:48		33° 54.164'	24° 16.132'	1690
15.11.2025	**16-1**	**MIC-01**	08:58		33° 54.132'	24° 16.178'	1702
15.11.2025	**16-2**	**GC-06**	11:11		33° 54.132'	24° 16.183'	1705
15.11.2025	**17-1**	**GC-07**	12:50		33° 54.175'	24° 16.157'	1698
15.11.2025	**18-1**	**GC-08**	14:32		33° 54.136'	24° 16.188'	1697
15.11.2025	**19-1**	**CTD-06**	16:33		33° 54.157'	24° 16.234'	1710
16.11.2025	**20-1**	**AUV-117**	06:42	13:05	33° 55.350'	24° 7.402'	1829
17.11.2025	**21-1**	**HF-03-01**	07:00	07:17	34° 4.685'	24° 18.931'	1868
17.11.2025	**21-2**	**HF-03-02**	07:53	08:01	34° 4.446'	24° 18.749'	1825
17.11.2025	**21-3**	**HF-03-03**	08:36	08:44	34° 4.210'	24° 18.546'	1767
17.11.2025	**21-4**	**HF-03-04**	09:20	09:37	34° 3.970'	24° 18.383'	1729
17.11.2025	**21-5**	**HF-03-05**	10:11	10:19	34° 3.731'	24° 18.204'	1757
17.11.2025	**21-6**	**HF-03-06**	10:54	11:02	34° 3.491'	24° 18.024'	1789

17.11.2025	**21-7**	**HF-03-07**	11:35	11:42	34° 3.292'	24° 17.823'	1838
17.11.2025	**21-8**	**HF-03-08**	12:19	12:26	34° 3.275'	24° 17.530'	1851
17.11.2025	**21-9**	**HF-03-09**	13:00	13:16	34° 3.267'	24° 17.222'	1749
17.11.2025	**21-10**	**HF-03-10**	13:53	14:10	34° 3.256'	24° 16.923'	1880
17.11.2025	**21-11**	**HF-03-11**	14:44	15:01	34° 3.242'	24° 16.625'	1846
17.11.2025	**22-1**	**AUV-118**	18:18	06:10	33° 55.191′	24° 7.475′	1900
18.11.2025	**23-1**	**GC-09**	08:32		33° 56.594'	24° 7.068'	1735
18.11.2025	**23-2**	**MUC-06**	10:12		33° 56.595'	24° 7.066'	1735
18.11.2025	**24-1**	**MUC-07**	11:38		33° 56.174'	24° 6.965'	1716
18.11.2025	**24-2**	**GC-10**	15:22		33° 56.180'	24° 6.968'	1718
18.11.2025	**25-1**	**AUV-119**					
18.11.2025	**26-1**	**HF-04-01**	22:17	22:37	33° 54.635'	24° 16.559'	1799
18.11.2025	**26-2**	**HF-04-02**	23:10	23:18	33° 54.452'	24° 16.450'	1772
18.11.2025	**26-3**	**HF-04-03**	23:43	23:51	33° 54.288'	24° 16.370'	1747
19.11.2025	**26-4**	**HF-04-04**	00:22	00:43	33° 54.115'	24° 16.277'	1719
19.11.2025	**26-5**	**HF-04-05**	01:09	01:16	33° 53.982'	24° 16.203'	1730
19.11.2025	**26-6**	**HF-04-06**	01:44	01:52	33° 53.792'	24° 16.103'	1756
19.11.2025	**26-7**	**HF-04-07**	02:21	02:41	33° 53.595'	24° 15.998'	1777
19.11.2025	**26-8**	**HF-04-08**	03:21	03:28	33° 53.940'	24° 15.865'	1750
19.11.2025	**26-9**	**HF-04-09**	04:09	04:29	33° 54.308'	24° 15.711'	1763
19.11.2025	**26-10**	**HF-04-10**	05:05	05:12	33° 54.203'	24° 16.056'	1713
19.11.2025	**26-11**	**HF-04-11**	05:40	06:01	33° 54.121'	24° 16.277'	1729
19.11.2025	**27-1**	**GC-11**	07:29		33° 54.203'	24° 16.168'	1699
19.11.2025	**27-2**	**MUC-08**	10:09		33° 54.193'	24° 16.156'	1695
19.11.2025	**28-1**	**MUC-09**	12:10		33° 56.204'	24° 6.911'	1715
19.11.2025	**28-2**	**GC-12**	13:34		33° 56.199'	24° 6.918'	1717
19.11.2025	**29-1**	**GC-13**	15:53		33° 57.150'	24° 16.057'	1847
20.11.2025	**30-1**	**CTD-07**	15:26		33° 44.170'	24° 44.452'	2059
20.11.2025	**31-1**	**AUV-120**					
20.11.2025	**32-1**	**HF-05-01**	20:44	21:01	33° 44.733'	24° 47.108'	2046
20.11.2025	**32-2**	**HF-05-02**	21:46	21:53	33° 44.491'	24° 46.931'	1991
20.11.2025	**32-3**	**HF-05-03**	22:23	22:31	33° 44.372'	24° 46.842'	1970
20.11.2025	**32-4**	**HF-05-04**	22:58	23:05	33° 44.286'	24° 46.768'	1965
20.11.2025	**32-5**	**HF-05-05**	23:40	23:48	33° 44.164'	24° 46.677'	1968
21.11.2025	**32-6**	**HF-05-06**	00:17	00:34	33° 44.049'	24° 46.591'	1965
21.11.2025	**32-7**	**HF-05-07**	01:06	01:14	33° 43.911'	24° 46.488'	1964
21.11.2025	**32-8**	**HF-05-08**	01:42	01:49	33° 43.773'	24° 46.385'	2007
21.11.2025	**32-9**	**HF-05-09**	02:36	02:52	33° 43.652'	24° 46.679'	1987
21.11.2025	**32-10**	**HF-05-10**	03:34	03:42	33° 43.838'	24° 46.641'	1964
21.11.2025	**32-11**	**HF-05-11**	04:14	04:22	33° 44.045'	24° 46.598'	1966
21.11.2025	**32-12**	**HF-05-12**	04:54	05:02	33° 44.223'	24° 46.565'	1976
21.11.2025	**32-13**	**HF-05-13**	05:38	05:57	33° 44.480'	24° 46.516'	2005
04.12.2025	**33-1**	**CTD-08**	15:30		35° 46.424'	20° 49.175'	2776
04.12.2025	**33-2**	**GC-14**	18:04		35° 46.402'	20° 49.204'	2794
04.12.2025	**34-1**	**GC-15**	21:11		35° 50.871'	20° 48.030'	2892
04.12.2025	**35-1**	**GC-16**	00:15		35° 51.484'	20° 51.443'	3229
05.12.2025	**36-1**	**GC-17**	03:06		35° 55.168'	20° 52.765'	2802
05.12.2025	**37-1**	**ROV-1**	08:19	13:40	35°58.036'	20°47.179'	2761

05.12.2025	**38-10**	**HF-06-10**	23:46	23:54	35° 58.163'	20° 47.132'	2762
06.12.2025	**38-11**	**HF-06-11**	00:13	00:21	35° 58.144'	20° 47.148'	2762
06.12.2025	**38-12**	**HF-06-12**	00:38	00:56	35° 58.127'	20° 47.156'	2762
06.12.2025	**38-13**	**HF-06-13**	01:17	01:24	35° 58.113'	20° 47.164'	2762
06.12.2025	**38-14**	**HF-06-14**	01:45	01:54	35° 58.097'	20° 47.181'	2762
06.12.2025	**38-15**	**HF-06-15**	02:11	02:19	35° 58.086'	20° 47.195'	2760
06.12.2025	**38-16**	**HF-06-16**	02:33	02:42	35° 58.075'	20° 47.170'	2761
06.12.2025	**39-1**	**ROV-2**	06:20	12:09	35° 57.401’	20° 47.857'	2918
06.12.2025	**40-1**	**GC-18**	14:52		35° 57.395'	20° 47.821'	2913
06.12.2025	**41-1**	**GC-19**	18:37		36° 9.766'	20° 41.040'	2880
07.12.2025	**42-1**	**CTD-09**	14:53		34° 44.251'	21° 56.885'	3086
08.12.2025	**43-1**	**ROV-3**	07:43	13:03	34°40.815’	22°08.983’	3135
09.12.2025	**44-1**	**HF-07-01**	02:47	03:08	35° 58.126'	20° 47.179'	2764
09.12.2025	**44-2**	**HF-07-02**	03:19	03:39	35° 58.127'	20° 47.176'	2761
09.12.2025	**44-3**	**HF-07-03**	03:51	04:11	35° 58.128'	20° 47.177'	2763
09.12.2025	**44-4**	**HF-07-04**	04:23	04:39	35° 58.132'	20° 47.177'	2762
09.12.2025	**45-1**	**ROV-4**	08:02	15:02	35°57.602’	20°47.785’	2841
10.12.2025	**48-1**	**GC-21**	15:29		34° 41.020'	22° 15.079'	3102
10.12.2025	**49-1**	**GC-22**	17:58		34° 43.238'	22° 13.521'	3403
10.12.2025	**50-1**	**GC-23**	21:24		34° 40.273'	22° 8.858'	3403
10.12.2025	**50-2**	**MUC-10**	23:39		34° 40.272'	22° 8.856'	3401
11.12.2025	**51-1**	**HF-08-01**	01:47	02:04	34° 41.493'	22° 08.914'	3180
11.12.2025	**51-2**	**HF-08-02**	02:35	02:42	34° 41.342'	22° 08.997'	3182
11.12.2025	**51-3**	**HF-08-03**	04:24	04:30	34° 40.490'	22° 09.356'	3362
11.12.2025	**51-4**	**HF-08-04**	05:12	05:29	34° 40.268'	22° 09.475'	3375
11.12.2025	**51-5**	**HF-08-05**	06:13	06:20	34° 40.000'	22° 09.608'	3376
11.12.2025	**51-6**	**HF-08-06**	08:10	08:26	34° 38.846'	22° 10.154'	3051
11.12.2025	**51-7**	**HF-08-07**	09:53	10:00	34° 38.561'	22° 11.287'	2888
11.12.2025	**51-8**	**HF-08-08**	10:31	10:38	34° 38.565'	22° 11.606'	2866
11.12.2025	**51-9**	**HF-08-09**	11:16	11:33	34° 38.624'	22° 11.998'	2850

AUV: 5 dives with MARUM AUV SEAL 5000
ROV: 5 ROV dives with GEOMAR ROV KIEL 6000
GC: 23 gravity core stations
MUC: 9 Multicorer stations
MIC: 1 Minicorer station
CTD: 9 stations CTD with hydro-casts
HF: 8 stations for heat flow mesurements
Ca. 1440 nm of multibeam and Parasound mapping