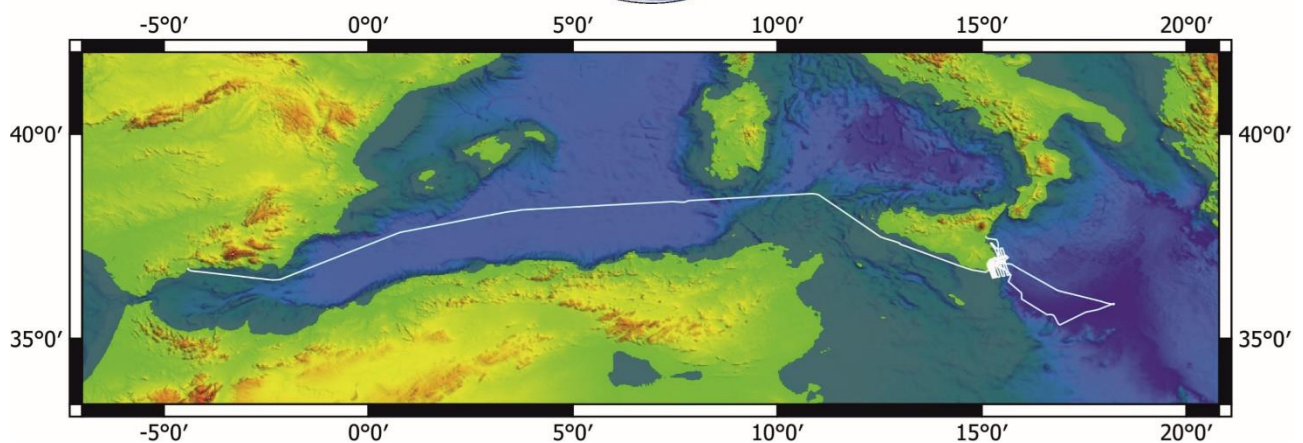


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Short Cruise Report R/V METEOR M199

Catania (Italy) – Malaga (Spain)
25th February - 11th March 2024

Chief Scientist: Prof. Dr. Christian Hübscher
Captain: Marc Petrikowski



Objectives

The DELUGE cruise aims to acquire a set of high-resolution multichannel seismic reflection profiles that will enable us to detect and characterize buried erosional and depositional signatures to validate the scenario for the Zanclean megaflood during its passage from the western to the eastern Mediterranean Basins and reconstruct its evolutionary stages.

The specific objectives of the cruise are the following:

- Objective 1: To infer the route of the Zanclean megaflood and quantify its discharge rate.
- Related working hypothesis: The megaflood flow direction was from west to east, originating from SE Sicily (near Noto), and reaching a discharge rate of 140 Sv.
- Approach: The location, geometry, and dimensions of the large erosional channel upslope of Noto Canyon, as well as other buried erosional and depositional structures, will be derived from interpretations of the seismic reflection profiles from across the shelf. Froude number and Manning equations will be used to estimate the discharge of the megaflood.

- Objective 2: To reconstruct the key phases in the evolution of the Zanclean megaflood.
- Related working hypothesis: The megaflood involved a fast, advancing, and primarily erosional first phase, followed by a slower, retreating, and predominantly depositional second phase.
- Approach: The location, dimensions, internal geometry and relative age of erosional and depositional structures representative of megaflood events (e.g. channels, megabars, clinoforms, distal lobes) will be derived from interpretations of seismic reflection profiles from the base of the Malta Escarpment.

- Objective 3: To obtain a unified seismic stratigraphic framework across the western Ionian Sea.
- Approach: Establish a high-resolution seismic stratigraphic tie among existing and proposed wells.

The aims of the cooperation with the Istituto Nazionale di Fisica Nucleare (INFN), the German Research Centre for Geosciences – Potsdam (GFZ) and the University of Malta are:

- Source signal estimation of the sparker source.
- Acoustic numerical modeling of the propagating sparker source.
- Acoustic model validation and evaluation of marine mammal response before, during, and after sparker emissions during the M199 seismic reflection survey.

Narrative

Shortly after the RV METEOR arrived at the port of Catania in Sicily on February 22, 2024, a small group of scientists from the University of Hamburg boarded to discuss the planning of port activities with the ship's crew. With the scientific equipment truck already arrived, the METEOR crew brought the winches and pallets with lifting tools on deck. This allowed the main Hamburg group, which had also arrived in Catania by then, to install the scientific instruments in the laboratories on February 23. Due to the refueling of gas oil for the ship, activities on the working deck were not possible. Therefore, the installation of the streamer winches and the laying of deck cables took place the following day. In the evening, a Meet and Greet of the full scientific team of Expedition M199 took place in Catania at a location named after the Irish writer James Joyce. On February 24, the 23-member group of scientists from Germany, Italy, Malta, and the UK officially boarded the ship, warmly welcomed by Captain Petrikowski and his crew. The day passed quickly with further installations and scientific discussions. We received news that NATO planned a submarine maneuver in large areas of our working area starting from February 25 and no measurements were to take place in about one-third of our working area. This would have substantially reduced the expected research results, leading to various changes in the route planning on the same day. Nevertheless, preparations continued, and by evening, the deck and laboratories were ready for departure.

At 9 a.m. on February 25, RV METEOR departed from the port of Catania. Due to the military exercises, the transit to the working area did not follow a direct route, already consuming some time. The measurement of a velocity-depth profile in deep water was conducted in the early afternoon. The data were processed by the always helpful Scientific and Technical Service team into the multibeam system, significantly improving the quality of seabed mapping. Due to strong winds and high swell, we decided to postpone the commencement of seismic measurements. Instead, we surveyed the northern Malta Plateau using hydroacoustic systems. On the morning of February 26, with calmer winds and seas, the seismic team began deploying the digital streamers. The Marine Mammal Observers (MMOs) commenced visual scans of the water surface for marine mammals and acoustic monitoring of deep water to exclude vocalizing marine mammals in the vicinity of the ship. In the late morning, reflection seismic measurements began with a soft start after the MMOs confirmed the absence of marine mammals. By midday, profile measurements in the Gulf of Noto had commenced. In the afternoon, NATO lifted its restrictions on our operations, much to our relief.

By late evening on February 27, winds and waves steadily increased, slightly affecting the quality of the measurements, a situation that persisted until February 28. On this day, the crew involved the scientists on board in a fire drill. The weather had calmed further by March 29, which was favorable for data quality. With very calm sea conditions, we continued the profile surveys in east-west and north-south directions close to the coast at Fontane Bianchi. Throughout the afternoon, we had to maneuver multiple times and perform full circles as fishing vessels did not adhere to the collision avoidance rules. Later in the evening, a profile had to be continued with a full circle as the sparker and the PAM had momentarily tangled. On March 1, with very calm sea conditions, we continued the

profile surveys in east-west and north-south directions close to the coast at Fontane Bianchi. The following day, the profile surveys in the Gulf of Noto and close to the coast were completed, and in the late afternoon, we set out approximately 150 nautical miles southeast into the Ionian Sea to conduct geophysical profiles for planned drilling as part of the International Ocean Drilling Program IODP3. After 36 hours, on March 4, all towed equipment was brought on deck, hydroacoustic systems were switched off, and the transit back to the Gulf of Noto began. The approach to the working area against the increasingly strong wind was a bit uncomfortable due to the growing wave height and took longer than hoped.

We reached the working area at 02:20 on March 5 and redeployed the sea-seismic instruments. The MMOs immediately started hydroacoustic monitoring of the sea and after 60 minutes of monitoring, gave us the green light to start our seismic measurements. Over 24 minutes, we gradually increased the emitted signal strength, and at 03:36, we began our profile survey with seismic, PARASOUND, and Multibeam. Since the forecasts from the helpful team at the German Weather Service (DWD) indicated strong westerly winds for the transit to Malaga in the latter half of the journey, we ended scientific measurements in the late afternoon at 18:00. The disassembling of towed equipment continued until approximately 20:30, and METEOR set sail for Malaga. Initially, the route followed close to the southern coast of Sicily, offering a beautiful view of the island's mountains as we entered the Tyrrhenian Sea on March 6. During the day, equipment and cable installations on the deck were cleaned, packed, and secured.

On March 7, the route passed along the southern coast of Sardinia. The day was used to further process and visualize data and to develop initial thoughts on interpretation. Additionally, various departments worked on different reports. Data processing, visualization, and discussion continued during the transit, which led south of the Balearic Islands on March 8 and into the Alboran Sea on March 9. On March 10, we arrived in Malaga, concluding Expedition M199 DELUGE.

Acknowledgments

We like to thank Captain Marc Petrikowski and the professional crew of the RV METEOR for their enthusiastic support during the entire cruise that enabled us to complete our working program in a good atmosphere on board.

Cruise participants

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Station list

Station Number M199-2_	MCS Profile HH24-	Start Date	Start Time (UTC)	Start Latitude (°N)	Start Longitude (°E)	End Date	End Time (UTC)	End Latitude (°N)	End Longitude (°E)	Length (km)
2	01	26/02/24	10:54	36°48,8'	15°08,3'	26/02/24	16:39	36°29,3'	15°17,2'	39,3
2	02	26/02/24	16:39	36°29,3'	15°17,2'	26/02/24	22:30	36°52,7'	15°10,0'	42,5
2	03	26/02/24	22:30	36°52,7'	15°10,0'	27/02/24	05:00	36°30,0'	15°20,5'	47,9
2	04	27/02/24	05:00	36°30,0'	15°20,5'	27/02/24	11:51	36°55,8'	15°12,9'	49,0
2	05	27/02/24	11:51	36°55,8'	15°12,9'	27/02/24	19:21	36°31,1'	15°26,3'	51,1
2	06	27/02/24	19:21	36°31,1'	15°26,3'	28/02/24	02:56	36°58,7'	15°20,0'	52,1
2	07	28/02/24	02:56	36°58,7'	15°20,0'	28/02/24	10:34	36°32,2'	15°33,4'	58,3
2	08	28/02/24	10:34	36°32,2'	15°33,4'	29/02/24	23:39	37°19,9'	15°14,9'	96,6
2	09	29/02/24	23:39	37°19,9'	15°14,9'	29/02/24	12:54	36°33,8'	15°40,2'	99,8
2	10	29/02/24	12:54	36°33,8'	15°40,2'	29/02/24	23:39	37°12,1'	15°30,3'	60,1
2	11	29/02/24	23:39	37°12,1'	15°30,3'	01/03/24	03:09	37°01,7'	15°35,2'	29,6
2	12	01/03/24	03:09	37°01,7'	15°35,2'	01/03/24	09:16	36°53,0'	15°10,7'	43,5
2	13	01/03/24	09:16	36°53,0'	15°10,7'	01/03/24	14:55	36°58,6'	15°38,3'	45,4
2	14	01/03/24	14:55	36°58,6'	15°38,3'	01/03/24	23:23	36°39,6'	15°12,6'	61,1
2	15	01/03/24	23:23	36°39,6'	15°12,6'	02/03/24	01:57	36°50,6'	15°10,1'	24,2
2	16	02/03/24	01:57	36°50,6'	15°10,1'	02/03/24	04:30	36°40,1'	15°15,7'	15,7
2	17	02/03/24	04:30	36°40,1'	15°15,7'	02/03/24	07:52	36°55,1'	15°12,3'	31,1
2	18	02/03/24	07:52	36°55,1'	15°12,3'	02/03/24	12:14	36°41,5'	15°19,3'	31,1
2	19	02/03/24	12:14	36°41,5'	15°19,3'	02/03/24	14:44	36°55,8'	15°13,1'	32,6
2	20	02/03/24	14:44	36°55,8'	15°13,1'	02/03/24	21:21	36°33,1'	15°42,6'	61,4
2	21	02/03/24	21:21	36°33,1'	15°42,6'	03/03/24	05:41	36°57,8'	15°58,8'	77,5
2	22	03/03/24	05:41	36°57,8'	15°58,8'	03/03/24	15:07	35°33,3'	16°46,0'	88,9
2	23	03/03/24	15:07	35°33,3'	16°46,0'	04/03/24	01:14	35°38,8'	17°32,5'	99,2
2	24	04/03/24	01:14	35°38,8'	17°32,5'	04/03/24	04:15	35°42,6'	17°50,6'	31,7
2	25	04/03/24	04:15	35°42,6'	17°50,6'	05/03/24	03:22	36°49,8'	15°35,6'	39,6
3	26	05/03/24	03:22	36°49,8'	15°35,6'	05/03/24	07:47	36°50,7'	15°17,8'	38,3
3	27	05/03/24	07:47	36°50,7'	15°17,8'	05/03/24	09:47	36°54,0'	15°33,7'	27,7
3	28	05/03/24	09:47	36°54,0'	15°33,7'	05/03/24	11:37	36°54,2'	15°22,4'	17,3
3	29	05/03/24	11:37	36°54,2'	15°22,4'	05/03/24	14:41	36°41,8'	15°11,4'	27,9
3	30	05/03/24	14:41	36°41,8'	15°11,4'	05/03/24	16:47	36°51,2'	15°08,1'	20,3