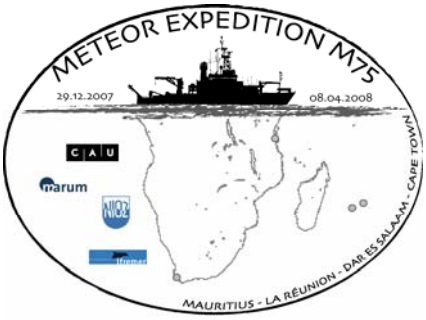
Expedition Meteor M75/1 – ERODER 2



1. Wochenbericht: 29-12 - 30.12.2007

The Leg M 75/1a is one of the 2 foreign legs involved in the M75 campaign via the European ship barter. This is an unprecedented situation that could become more frequent in the next future as european fleet intercollaboration increases. The M75/1, which is the the first leg of the RV Meteor M75 campaign, is **also named** ERODER 2, as it is part of a more complete geological program named ERODER: a high resolution study focused on the submarine slopes of La Réunion Island (Indian Ocean).
This cruise has 3 main objectives:
(1) to better understand the geological structure of the volcanic island (the emerged part is only 1/30th of the total),
(2) its evolution through time and
(3) the current dynamics of material transfer processes to the deep-sea.
Two cruises had been performed in 2006 around the island with french oceanographic vessels: FOREVER and ERODER 1 ; they led to the discovery of volcanodetritic deep sea fans and new volcanic structures around La Réunion Island.
The main goal of the ERODER 2 cruise is to collect more detailed bathymetric, backscatter and mud-penetrator data on these fans to understand their origin and evolution and to study their present activity. A large number of new seamounts have been mapped during the recent cruises. Some of them must be sampled to understand their origin and ages.
The French scientific team arrived on board the RV Meteor in Port Louis (Mauritius Island) on December 28th. It has the support of german technicians and engineers, who will participate to the cruise and will help the team to collect data with the sophisticated echosounders hull-mounted on board the RV Meteor.
The Vessel left Mauritius island on Friday 29th, just before lunch time.
After several hours of transit towards La Réunion Island, scientific operations started by around 4000 m water depth by dredging on a flank of a submarine volcano discovered in 2006. Two small lava debris were catched. They will help to determine the age of lavas and their origin.
Then one long geophysical profile has been acquired towards La Reunion island using the EM120 swath bathymetric device, a magnetometer and the parasound

subbottom profiler. This first profile will be used to define the best acquisition parameters for deep-sea exploration in such a volcanodetritic environment.
The island of La Réunion sensu stricto consists of two juxtaposed volcanic massifs: Piton des Neiges, which is a dormant volcano and Piton de La Fournaise, which is a highly active basaltic shield volcano, that has grown continuously since at least 0.527 Ma. It is currently one of the most active volcanoes in the world. The recent volcanic activity is mainly concentrated inside a caldera that formed less than 5000 years ago. However, outside the caldera, two broad topographic ridges are interpreted as volcanic rift-zone, or preferential pathways for the magma. The present activity in mainly controlled by a magma reservoir located near or just below sea level. From this reservoir, magma injects into the rift-zones and travels from the central part of the volcano to the distal flanks.
Although eruptions along these structures outside of the main caldera of the volcano are not frequent, averaging two or three per century, they are long-lived structures. In the submarine part of the Piton de la Fournaise volcano, these zones depart noticeably in morphology from the other submarine terrains. They are observed near to the coast, have rugged topography and steep slopes at the base but rather smoother morphologies at the top.
Sunday 30th has been focused on dredging operations of these submarine rift zones. Strong and unstable surface oceanic currents make dredging operations difficult and longer than expected by the scientific team. The first dredge collected old and alterated lavas (see photo).

The cruise is just starting, the weather is sunny and the sea quite calm. Hoping that these good conditions will continue for next weeks.

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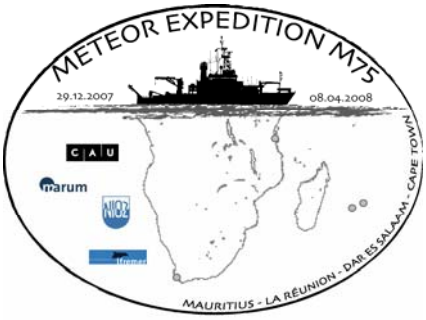


2. Wochenbericht: 30.12.2007 – 6.01.2008

The M75/1 is **also named** ERODER 2, as it is part of a more complete geological program named ERODER: a high resolution study focused on the submarine slopes of La Réunion Island (Indian Ocean).

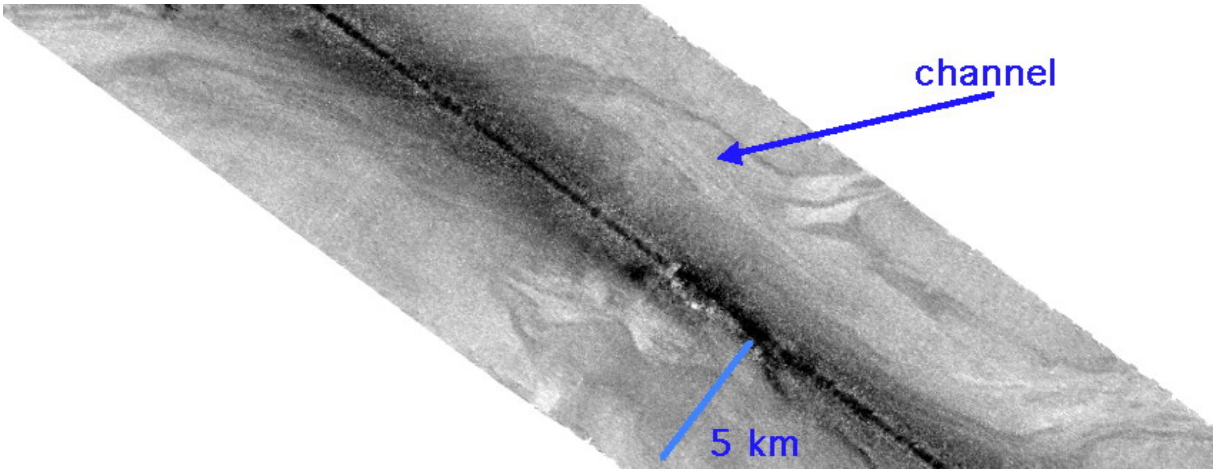
Two cruises: FOREVER and ERODER 1, performed in 2006, led to the discovery of volcanodetritic deep sea fans and new volcanic structures around La Réunion Island.

The main goal of the ERODER 2 cruise is to collect more detailed bathymetric, backscatter, mud-penetrator data and cores on these fans and seamounts to understand their origin and evolution and to study their present activity.

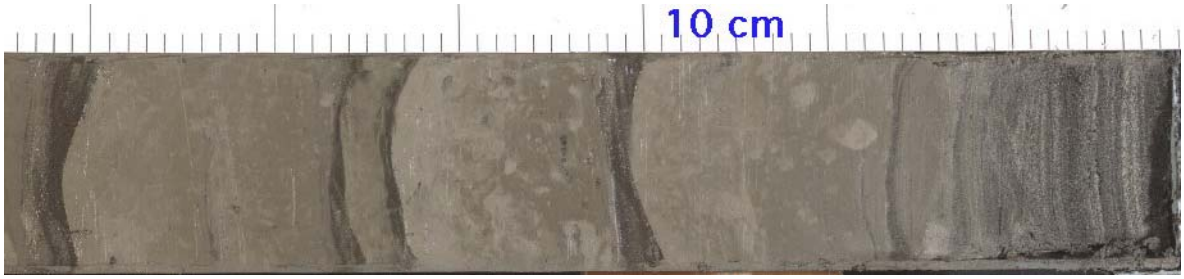
Last Sunday, the cruise was just starting, the weather was sunny and the sea quite calm. Unfortunately, the past week was more rainy and windy. The sea became rough (swell up to 3.5 m). However, we worked every day, even if some acoustic data are relatively noisy. Since the beginning of the cruise, we acquired a large amount of geophysical data (1583 kms of profile) at 7.5 knots, we did 7 coring and 5 dredging stations (6 collected cores and 2 successful dredges).

A group of seamounts rising above the oceanic plate was identified during the FOREVER campaign in April 2006, located off the west coast of La Réunion, near the Mahanoro trench. The geometry of these seamounts suggests that they were volcanic constructions. The easternmost of the group was the target for two dredges. It shows a relatively complex morphology with an oval general shape with ridges respectively orientated to the SW and to the E. Its summit was mapped during the week with a minimum depth of 1800 m. Dredges were respectively realized at the depth of 3111 m and 2750 m on its western flank. The first dredge sampled a small piece of basalt and a bigger composite block (40 x 30 x 20 cm) of made of a felsic rock (quartz + feldspar + a non-identified brown mineral) coated with sediments and with a Fe–Mn crust. This mineralogical composition suggests a continental origin of this rock. We hope to get more samples on these seamounts before the end of the cruise.

Recent studies carried out off north western Africa showed that the presence of volcanic islands along the Morocco and Mauritanian passive continental margins increased the complexity of deep-sea sedimentary facies distribution. The growth and the dismantling of these volcanoes modified the pre-existing seafloor topography and produced numerous submarine avalanches. However in spite of the numerous studies led around volcanic archipelagos like Canary and Hawaii. No true volcanodetritic deep sea fan similar to the ones observed in continental context has been observed in these areas. Most of the last week nights were devoted to the high resolution mapping of the Cilaos deep-sea fan discovered in 2006. All the data have been processed on board. The first backcatter images are very impressive (see below). They indicate that the fan is still very active and that submarine avalanches are able to transport sand down to 4400 m water depth at a distance of more than 300 kms from La Reunion island coasts.



We are still tracking the distal end of the submarine channels belonging to the Cilaos fan.



Several cores were collected within channels or on outerbanks. All cores have been opened and described on board by sedimentologists (see above). They show a series of “turbidite” beds, some of them containing medium to coarse sands. We collected massive sand beds which are a few tens of centimeters thick.

We are going to continue our exploration of the distal Cilaos fan over the next few days as well as coring and dredging operations.

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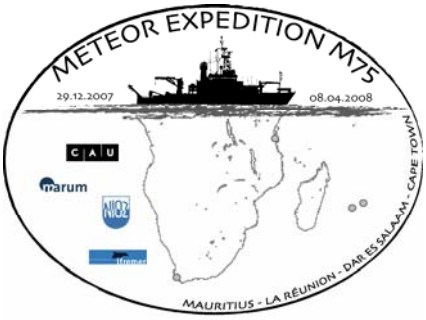
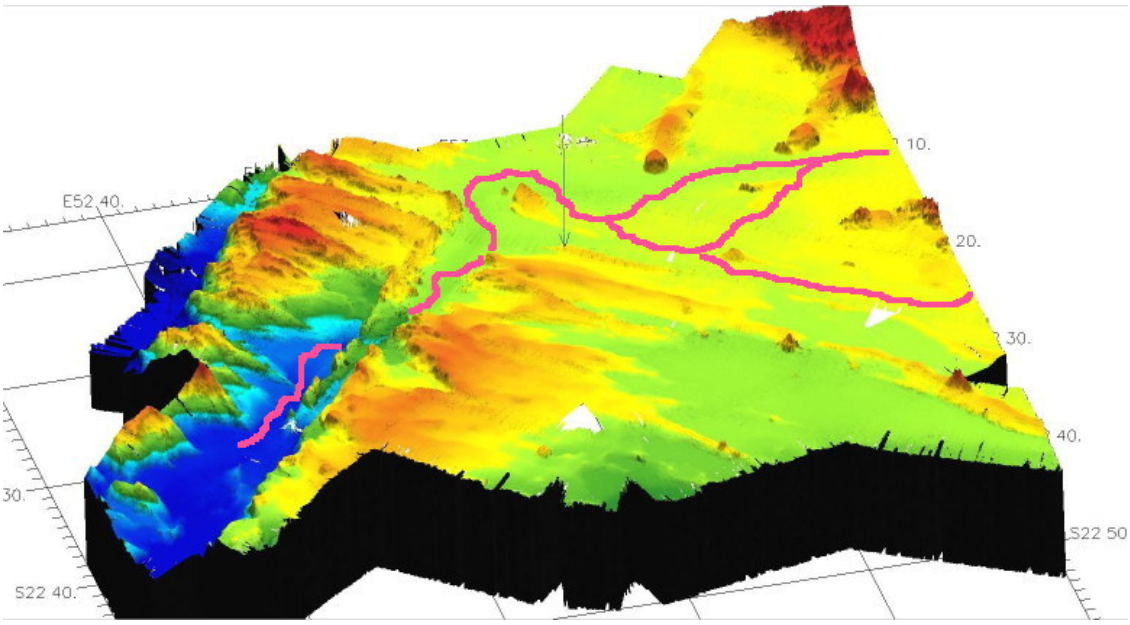


3. Wochenbericht: 7.01.2008 – 13.01.2008

The M75/1 is **also named** ERODER 2, as it is part of a more complete geological program named ERODER. The main goal of the ERODER 2 cruise is to collect more detailed bathymetric, backscatter, mud-penetrator data and cores on deep-sea fans and seamounts which were discovered in 2006 around La Réunion Island.

Last Sunday, we reported that the cruise had to deal with changing weather and sea conditions. We experimented the same conditions during the past week. We started with 4-5 Beaufort and swell between 2 and 3 meters. At that time, we were exploring the distal part of the Cilaos deep-sea fan between 4000 m and 4500 m water depth. The fan covers an area of more than 15000 km^2, 6 times the island area (2500 km^2) and 40 times its source area on island. Elongated volcanic ridges divide the turbidite system into three parts: western, axial and eastern. The lower western fan, our target, is confined between a volcanic ridge and a submarine volcano massif. It is characterized by one major straight channel branched out downstream. Data collected in 2006 indicated that the main channel was continuing its course beyond the surveyed area. Our goal was to track the path of the channel down to its end. This part of the survey was very exciting, as the course of the channel is largely controlled by pre-existing morphology, the channel changes several times its main course and because we were exploring a “blank area” (no data at all). We successfully tracked the channel to its distal end, which is located at more than 5000 m water-depth in a complex fracture zone linked to the history of the oceanic plate. Our channel hunt pushed us far southward the previous survey, delivering very interesting information on the oceanic structures in the area. Acoustic data suggest that the Cilaos turbidite system is quite sandy. This is confirmed by several cores collected and described on board last week.

Last thursday and friday, we left our main working area to go closer to the southern coast of La Réunion Island. A deep low pressure system, located westward the island, generated a tough north flux.



3D view of part of the survey area, showing relief alignments related to the oceanic plate history and the complex interaction between the pre-existing morphology and the today present active Cilaos channel (in pink).

The wind increased up to 8 Beaufort, before we left the area. Protected by the volcanic island, we found very good working conditions and used for the first time a circular dredge brought with us form France.

Two dredges were realized in the south-western flanks of La Réunion edifices on the co-called “Ride de l’Etang Salé”. This submarine ridge, about 15 km long and a few kilometers wide has an elongated shape radial to the island and was previously interpreted as an ancient rift-zone of Piton des Neiges volcano. Samples of rocks were collected during both dredges. Three other dredges were operated on the Piton de la Fournaise rift-zones. Two dredges were realized on the southern ridge of the NE rift-zone (Ride des Anniversaires), one near the base (many good samples) and one near the top (successful but only two samples). The target of the third dredge was the northern part of the SE rift-zone. In spite of difficult conditions, two samples were collected. On Sunday 13 January, two other dredging operations were successfully conducted on huge seamounts located 170 km westward La Reunion, one seamount already dredged on January 3rd (henceforth called « Lasso ») and the “Moustik” seamount, which is 3200 m high !

It is our last sunday at sea on the R.V. Meteor and therefore the last sunday message of the M75/1a cruise.