CR Haiti-TWiST Science Cruise, Leg 1

=== Part I ===

Thursday, 30 May 2024

Arrival of the OBS team on board of the *R/V Pourquoi pas?* in the morning. Nice surprise: the three containers that transported our ocean bottom seismometers (OBS) and associated equipment, as well as the materials needed for the sediment core activities during Leg 2 of the cruise, are already on board. They had left Brest earlier this month and made the journey from Le Havre to Kingston, Jamaica on board a container ship. Michael, Pascal and Pierre are assisted by Jean-Frederique Lebrun. Their task is to empty the containers and distribute the equipment in the different laboratories on board. Only two of the containers will stay on board; they will be loaded with the OBS instruments and the sediment cores, before being shipped back to Brest at the end of July.

Friday, 31 May 2024

The rest of the scientific team boards the *R/V Pourquoi pas?* along with Andrea Prada Bianchi, a freelance journalist for Le Monde. Regretfully, the installation of the seismic system (14 containers to be installed) is behind schedule. It would seem that the Maritime Agent appointed by Genavir has underestimated the significance of the task and thus far only a few containers have found their place on the ship's decks. Our departure, initially planned this Friday at 18h00 has to be delayed; the captain indicates that departure is more likely postponed until Sunday morning June 2nd, at 07h00. In this CR, all times refer to local time on board the ship, i.e., UTC-5h.

Immigration regulations are very strict in Jamaica. Before entering the country, all visitors are obliged to fill out the on-line *Official Electronic Immigration and Customs Declaration Card* (called C5 by PICA, https://enterjamaica.com/). One of the critical questions asked is the purpose of the visit: Choices include Tourism, Work, Meetings, and Transit. The difficulty is that the first leg of the Haiti-TWiST cruise lasts longer than the 30 days that French citizens are allowed to stay in Jamaica without a Visa. Hence, most participants indicated "*transit*" as the purpose for coming to Jamaica. Bad surprise, with *"transit to the R/V Pourquoi pas?"* marked below the official entry stamp in our passports, we can no longer go onshore once we have boarded the vessel. For the port call after the first leg of the cruise, and for those arriving for the second leg we will need to find out how to arrange for the correct entry, enabling us to visit Kingston, if only for an afternoon.

His Excellency Olivier Guyonvarch, ambassador of France in Jamaica and permanent representative of France at the International Seabed Authority, an international organization that manages the seabed of the Area under the UN Convention on the Law of the Sea, expressed the wish to visit the research vessel before departure. A short visit of the *Pourquoi pas?* is organized in the afternoon for the Ambassador, his wife and members of his team. This is also an opportunity for the chief scientists of the Haiti-TWiST cruise to thank the Ambassador for his efforts to obtain the authorization from the Jamaican authorities to perform marine scientific research in the waters under their jurisdiction.

After dinner, most people find their cabin for a first night of sleep on the ship, after the long journey from France. However, at around 22h30 we are all woken up by the announcement that the science staff is needed on the bridge to finalize the immigration formalities before departure. The two immigration officers were apparently told that the *Pourquoi pas?* was leaving Kingston early on Saturday morning, which was no longer the case. Anyway, we all showed up, had our passports checked, handed them over, and tried to go back to sleep.

Saturday, 1 June 2024

Today marks the birthday of the Chief Scientist, but the party will have to wait. The vessel will not leave the port until tomorrow, and so beer and wine remain under custom seal until we leave the territorial sea. With no possibility to visit Kingston, preparations for the cruise advance, and people are getting used to the vessel, which is huge, even compared to the *R/V L'Atalante* that many of us know well.

Sunday, 2 June 2024

It is morning, and everybody is ready for the departure at 7h00, but not before having enjoyed a freshly baked croissant or a *pain-au-chocolat*, a Sunday morning tradition on the Genavir ships. However, a huge autoliner, the *Höegh Beijing*, has priority and we need to wait until it clears the way. Finally, at around 7h30, the *R/V Pourquoi pas?* leaves the Freeport Harbor of Kingston. After a short transit through the channel, the Pilot leaves the vessel at 08h00 local time, and our adventure starts for real. The weather is not bad, a bit grey and humid.

Sunday lunch is very special, not only is the meal exceptional, but we also have the right to a glass of white and of red wine during the meal. After that, a little siesta is in order.

The Safety Instruction meeting takes place at 16h00 in the Conference Room of the vessel. Antoine explains the safety features of the ship, the different alarms, and what we should do in case such an alarm is given. A demonstration is also given on how to put on the survival suit in case we have to abandon ship. Safety drills will happen regularly, so that we know where to meet, and what to do in case of a general alarm, a fire, or the need to abandon ship. The science team meets right after the safety instruction, to revisit the objectives of the mission and organize the watches in the Scientific Control Room as well as the preparation, launching and recovery of the OBS.

The transit to the first study area, in the windward passage between Haiti and Cuba takes about 24 hours. During this time, multibeam bathymetry and sub-bottom profiler data are collected.

Monday, 3 June 2024

The seismic equipment is deployed as soon as there is daylight. The magnetometer is put in the water and will be towed behind the tail-buoy that marks the far end of the 3-km solid state seismic streamer that we use during the high-resolution seismic acquisition. After an initial false start when deploying the air gun array, shooting finally starts at 14h30. Not long after, multiple alarms alert the seismic operators of a malfunctioning of the system. After several hours, the equipment is repaired, deployed again, and the seismic acquisition restarts at 20h30. Instead of the five originally planned high resolution seismic profiles, we decide to acquire only four, in order to catch up somewhat on the time lost due to the late departure and also to avoid a one-way traffic corridor offshore Cuba. Unfortunately, during the work to repair the malfunctioning system, it was forgotten to record the magnetometer readings. So, we lost 1 day of magnetometer readings along two of the profiles, although we may be able to recuperate one registered magnetic measurement per shot.

Temperatures during the day are very elevated, but at night the temperature drops and we see impressive thunderstorms with frequent lightning.

Tuesday, 4 June 2024

Shooting continues, and the different watch teams are finding their marks. The marine mammal observers do their watch. After a sperm whale observed just after leaving Kingston, no marine mammals have been seen, nor detected by the acoustic monitoring system, thus far. There is very little maritime traffic in the area. However, several tree trunks are floating in the water as well as plastic debris.

Some scientific team members processed quickly high-resolution seismic recordings from the previous day, and we receive our first profile results. There is excitement in the Science Control Room when we look over the data together and offer our different interpretations. We decide to hold scientific discussions about operations, problems, and results/data every day at 15h45 for 15-30 minutes.

Wednesday, 5 June 2024

Shooting of the high-resolution seismic profiles continues until about noon, followed by the recovery of the air gun array and the streamer. In the early afternoon, we set course towards the start of the deep seismic profile, just south of the Exclusive Economic Zone of the Bahamas. Regretfully, we did not get the authorization to conduct marine scientific research in the area under their jurisdiction.

The OBS team has been working hard to prepare the launching of 65 OBS. At 18h00 the first OBS is deployed, and at a rate of about one per half hour, 42 OBSs are set overboard, before we reach the north coast of the southern peninsula of Haiti.

Thursday, 6 June 2024

At 11h00, the last OBS of the northern segment of profile 1 is deployed and we commence the transit around the southern peninsula, which takes about 9 hours.

In the afternoon, Dinis, a marine mammal observer (MMO), presents to the crew and scientific team, the MMO protocol related to marine mammals when shooting seismics. In our case, the high-resolution seismics used during the first days of the cruise does not require specific mitigation measures. However, for the deep seismic acquisition, using an air gun array of around 4000 in^3, there is an exclusion zone of 500 m around the air guns; as soon as a whale is spotted within this range, seismic shooting must stop immediately. The talk of Dinis is followed by a presentation by co-chef scientists, Walter and Chastity. The objectives of the cruise, and the operations are presented to the crew.

Friday, 7 June 2024

In the morning, the last OBS (number 65) is deployed some 100 km south of the southern peninsula of Haiti. After a few hours of transit, the deployment of the full multi-channel seismic system (6 km streamer and two air gun arrays) can finally start at around 11h00. In addition to the streamer that will record the seismic shots, the Passive Acoustic Monitoring (PAM) system is deployed as well. A specialized MMO will use this system when seismic shooting day and night and during low visibility conditions, to detect the presence of marine mammals in the vicinity of the vessel. During the day, visual observations by 2 MMOs will complement the PAM. Ramp-up of the air guns, a procedure that is supposed to alert marine mammals present in the area and incite them to distance themselves from the air gun array before full power shooting should have started at around 17h00. A technical problem delays the start of shooting, and finally it is around 19h30 that the acquisition along the first deep seismic profile starts.

Saturday, 8 June 2024

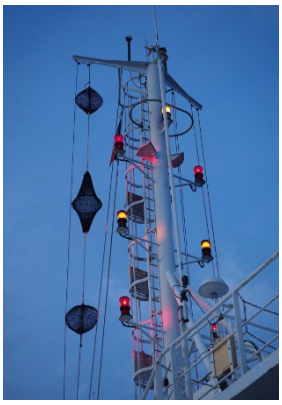
During the night the PAM operator monitored for the presence of marine mammals, and besides a few clicks/whistles coming from a distance that could not be determined, no activity was noted. Three air guns failed during the operations, but we are still at around 80% of the nominal power of the air gun array. It is decided to finish the southern part of profile TWIOBS01 before bringing the air guns on board for repair. They will be repaired and serviced during the transit around the southern peninsula. The weather is nice, but the wind is picking up. This means that we will have to recover the air guns going east. As we are going in the opposite direction of our transit this causes further delays, but *c'est la vie*.

This evening we have a little welcome drink at the front deck, celebrating the start of the cruise, as well as a birthday, while circumnavigating the southern peninsula of Haiti. Regretfully, visibility is not ideal, and we can barely see the impressive relief of Haiti rising out of the sea due to the haze.

Sunday, 9 June 2024

We finish our transit to the start of the second part of the first deep seismic profile. The weather is calm, and along the north coast of the southern peninsula, several small boats are fishing as the sun comes up. Luckily, they are prudent and distance themselves of the research vessel and the streamer we are towing behind us. The watch officer rests on his *qui-vive* to avoid any incident. A bit later, floating wood is worrying the captain, and the ship has to deviate a little from its track to avoid damage to the gear we tow behind the ship. The north coast of the southern peninsula is now clearly visible, the early morning haze has disappeared. The pre-watch for marine mammals started at around 9h20, and the ramp-up of the air guns at 10h20.

The first whale sighting during shooting is around 14h30, several pilot whales are on the portside of the vessel, at around 800 m distance. The MMOs alert the bridge and the seismic engineers to be prepared for a shut-down, in case the animals enter the exclusion zone of 500 m around the guns.



Luckily, the whales continue their journey without changing course and a few minutes later they have left the alert area. There had been no need to interrupt the seismic acquisition. No detection was made on the PAM system, but pilot whales are not always very vocal according to Luis, one of the MMOs.

The watch in the Scientific Control Room continues, bathymetric and sub-bottom profiler data are collected along with the seismic data. Gravity measurements are made all along. Magnetic data is also acquired with a sensor (SeaSpy) towed 50 m behind the tail buoy of the streamer. Shooting will continue all night.

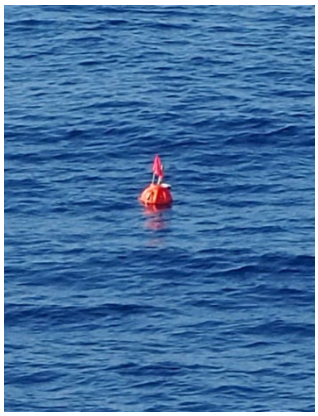
Monday, 10 June 2024

The weather is calm; the end of the first seismic profile is just after sunrise. The seismic team is ready to recover the air gun arrays and the streamer. Everything has worked perfectly fine. Some dolphins are sighted: they play a bit with the bow of the vessel and continue their journey.

At around 14h, we will start the recovery of the OBSs. An acoustic signal is sent several nautical miles before the point where the instrument was deployed last week. This will allow the OBS to release its deadweight and come up. After an ascent at a velocity of about one meter per second, the instrument will arrive at the sea surface just when the *Pourquoi pas?* approaches. The instruments are often spotted visually, due to their bright orange color and the little flag. In addition, they transmit a radio signal that will allow the bridge to determine the direction in which the OBS is located. At night, a flashing light mounted on the OBS helps in finding it rapidly. Once spotted, the delicate recovery maneuver with the ship begins, which involves approaching the instrument at slow speed and retrieving it with a long rod, a bit like how children fish ducks at a Fair. But here, failure is more annoying, as the ship must then turn around for another try. By mid-night, 10 OBSs have already been recovered and the first data downloaded. Exciting to see the first graphs with the recorded signals of the air gun shots. All instruments will have to be reconditioned, their batteries charged and a new deadweight attached, before they will be deployed again for the second profile. The OBS team is very occupied to be ready in time for the second long profile, acquisition of which will be in a few days.

The entire day we have been accompanied by a US Coast Guard cutter, a white ship with a diagonal red colored stripe on its hull. The vessel does not have its IAS activated, making it impossible to identify. They are keeping an eye on us from a safe distance of more than 7 nautical miles.

Tuesday, 11 June 2024



Once the early morning haze is gone, the contours of Haiti are visible on the port side of the vessel. The OBS resurface one by one, and the bridge is getting faster and faster in their recovery. The latest best time is less than 8 minutes between the signal "*OBS at surface*" and the moment it is captured with the rod. The watches in the Science Control Room continue, as well as the quality control of the OBS data, as soon as the instruments are recovered. The sea is calm, and there is almost no wind but in the sun the temperature is almost unbearable during the day.

In the meantime, the reflection seismic processing team has performed the quality control and initial processing of the first deep seismic profile.

After 33 successful recoveries, tonight we have no luck. It is already dark when OBS34 is supposed to arrive at the surface, but we have no flashlight nor radio signals to find it… Both Michael and Mathilde see the instrument floating-alongside, but too late to launch the recovery. Trying to keep a small OBS in sight at night is almost impossible, and by the time the ship maneuvers in place again, there is no longer a visual contact. This starts a long 2-hour visual search with many people mobilized on the bridge to look for indications. The three large spotlights of the ship are searching the sea surface for any sign of the instrument. Many false alarms result from the light reflecting off plastic and other garbage floating on the ocean. Did the OBS really surface? During the search, we are all particularly shocked by the quantity of debris we see in the spot lights. After several turns and a search pattern that takes into account the potential drift of the instrument, we have to give in to the obvious: we will not be able to find the instrument tonight. Two hours behind schedule, we finally set course to the next OBS location: the show must go on!

Wednesday, 12 June 2024

The last OBS of the northern segment of our profile is recovered at around 7h15.

"*La nuit porte conseil*" and, hence, we decide to go back to the site where we lost the OBS34 last night: It seems worth the try. We will send the release signal to the OBS in question, just in case that did not work yesterday. A review of the bathymetry where OBS34 was dropped indicates that it was deployed on a slope. Some scientists pontificate that maybe the OBS did not surface at all, that maybe the OBS fell on its side and that the hydrophone is unable to 'hear' our calls. In any case, we will call for it again and also follow the estimated drift trajectory, for a visual search. It will be all eyes on deck. Let's keep our fingers crossed.

=== Part II ===

Regretfully, no luck, after sending the release signal several times again, no OBS arrives at the surface. We follow the predicted drift direction for 7 miles, and despite all eyes on deck, no sign of our instrument. I have never seen so many people on the bridge in absolute silence. We conclude that the instrument will not be found today and go back to business, but not for long.

Something that all mariners fear, bad news from home, arrives early in the afternoon. The mother of one of the scientists on board has passed away. With the Captain, we analyze the situation, and decide to set direction to Kington, hence postponing the recovery of the 23 OBSs that are still on the seafloor. The postponement offers some positives – the passive seismologists on board aim to use the extra one and a half days of 'quiet recording times' for detecting earthquakes. Quite a few have already been identified.

Thursday, 13 June 2024

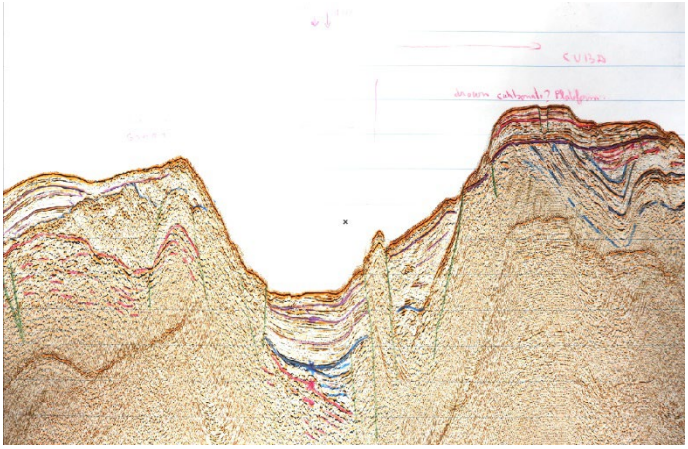
At 6h00, the pilot boat comes along side of the *Pourquoi pas?* and our colleague starts the journey back to France. We all know that she needs to be home now with her family and close ones, but she will be terribly missed on board. We discuss how to reorganize the work to assume the tasks she was

doing. The transit back to the study area takes about 15 hours, and at 23h00 we start recovering our seafloor instruments, who have been patiently waiting.

Friday, 14 June 2024

The sea is a bit agitated by the increased winds, but strangely enough, this helps in recovering the OBSs. Once the instrument has passed the bow of the ship, it is protected from the wind, and the ship is pushed towards it. Things are going smoothly until the late afternoon, when another stubborn instrument does not want to appear on the sea surface at the expected time. Did it come up, without radio signal? Hard to tell, but unlikely because this particular model is also equipped with an Iridium link, and should, in theory, communicate its GPS position by satellite once at the surface.

Andrea, our journalist, is having fun trying his drone, initially at very short range, but gradually he is gaining confidence and he already has taken pictures of our vessel from 50 m high and at distances up to 200 m. The potential of such “toys” is incredible.



The multi-channel data are processed with the Solid-QC and REVEAL. Luckily, Simon and Laure already have experience with the ins and outs of this new software package. Color pencils come out for the first interpretations of the plate boundary.

Saturday, 15 June 2024

The last OBS is recovered at 2h30 and after a short transit, we start deploying them again, along the second profile.

This evening we have a little “pot” on the front deck, after a bit more than 2 weeks on board, we are approaching the middle of our journey, and experience shows that time accelerates from here on. Also, the logistics for those leaving after the first leg, and those arriving for the second leg have to be put in place. Arranging for the ground transportation, ensuring that all relevant information for those boarding for the second leg is communicated to the bridge, etc. The last flights are booked, and others have to be modified, as Air France cancelled some flights between Paris and Atlanta.

Sunday, 16 June 2024

At around 4h00 the lost OBS should surface if the time release worked: that is the ultimate security that will have the OBS releasing at a predetermined time. If so, it will result in an email message sent to Pascal and his team. Regretfully, no message, no sign!

Its Sunday, and Father’s Day: some of us dads receive messages wishing us a happy day. This morning we drop the last OBSs along profile 2, and deployment of the streamer and air gun arrays will start early afternoon after a transit of several hours.

The multi-beam echosounder is not cooperating: only very weak reflections from the seafloor are detected on the center beams. The operators and electricians task themselves with the appropriate measurements in order to identify the problem, and hopefully repair it before we start shooting. Acquiring reliable bathymetric data along the seismic profile is essential.

At 13h00, the deployment of the seismic equipment starts, the vessel sets course into the wind, and the magnetometer is the first instrument to dip in the water, followed by the streamer. Protected from the wind, it gets very hot on the ship's working deck, making the deployment all the more exhausting for the team. Around 17h45, after deploying the 6 km seismic streamer and the PAM system, the MMOs start their pre-watch, while the air gun arrays are being deployed. We also discover that the magnetometer at the end of the streamer is recording erroneous values and we don't know why. The entire day, no single marine mammal was observed; let's hope that this remains the case until the end of shooting.

The southern coast of Cuba is very impressive, a mountain chain rising out of the water, north of the Oriente Fault Zone. Regretfully, it is quite hazy and the pictures taken are not great. In this area, Cuba reaches altitudes of 1800 m. Hard to imagine that we are looking at a mountain as high as Mount Everest, when measured from the seafloor of the Cayman Trough which reaches depths of 7000 m here! The multi-beam echo sounder is having trouble with such a steep slope.

Monday, 17 June 2024

At 3h00, an unfamiliar sound wakes me up. It takes a little moment before I realize where I am and that someone is calling me on the phone. Marine mammals have been detected by the PAM operator, and shooting may have to stop. Indeed, Andrea (one of the MMOs, not the journalist!) detects whistles and clicks of marine mammals with the passive monitoring system. At first, they are sporadic, but after about 10 minutes, the signal is more intense and repetitive. Although the species cannot be identified, the mammals must be at close range, as we detect their highest frequency clicks (up to 120 MHz, way beyond what humans can hear) that do not propagate over long distances. The precautionary principle obliges us to stop the shooting, but there is quite a bit of discussion after. Some colleagues consider that in the absence of species identification and without a reliable distance determination, shooting should be allowed to continue. It is also not easy for the MMOs, who realize that significant delays jeopardize some of the future operations. We will surely provide feedback after the cruise, and investigate if modifications to the marine mammal protocol of Ifremer are needed and/or possible.

For the moment, we need to decide what to do, turn around or continue our course and leaving a gap in the data. We decide to circle back, as the data are important in this area that marks the transition between the crust of the oceanic Cayman Trough and that of the Caribbean Large Igneous Province (CLIP). Before doing so, the watch officer wakes up the captain, as the maneuver is quite delicate with all the gear we are towing behind the vessel. The vessel can only turn at the rate of 2 degrees per minute, so it will take 90 minutes before we head north again, parallel to the original ship track. There are no other ships in the vicinity and no shallow areas, so the captain validates the 5 hour long elongated loop, during which, luckily, no more animals are detected. At around 8h00, after air gun ramp-up, we are back in business. Later in

the day around 16h, the magnetometer miraculously began to record accurate values again. No one understands why. We attribute it having been in the “Cuba Triangle.”

As we were happily shooting along profile 2, we are approaching a very shallow area, Formigas Bank, with water depths at 40 m or less. At around 22h00, Andrea again detects whistles and clicks of marine mammals. Unlike further north, it is very well possible that the cetaceans remain near this bank for long periods, and it is likely that we would meet them again in the same spot. Hence, rather than making a loop, this time we decide to continue our trajectory, but at reduced speed so as to limit the data gap. No detections are made in the following hour, and at around 23h00 we are allowed to start the 20-minute ramp-up of air gun power.

Tuesday, 18 June 2024

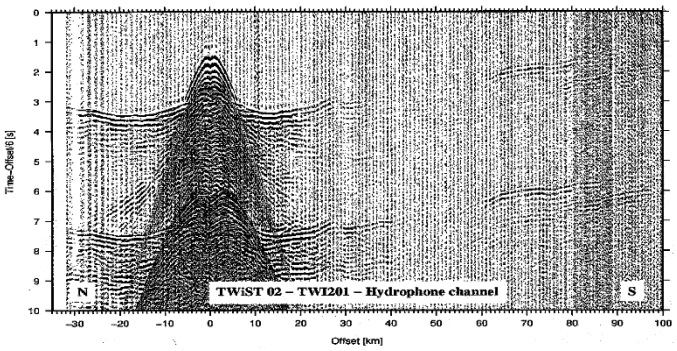
Strangely, one can hear and feel that the air gun shots are different than before… an air leak on the starboard gun array surely affects the air pressure at the guns. We need to repair it, before reaching the Hess Escarpment, an important morphological boundary between the Lower Nicaragua Rise and the Caribbean Basin that we do not want to miss in order to characterize the crustal blocks on either side. After a short break to recover the damages array, the seismic team manages to do the repairs on the starboard air guns while continuing shooting with the port array, albeit at lower power. Hence, there is no need for the one-hour pre-watch. Following the repairs, which were done in record time, the repaired array is redeployed. After a short ramp-up sequence, all is well.

This afternoon, the second science talk takes place in the conference room: this time it is Chastity, who talks about the impact of earthquakes on the carbon budget. Her work with Romain Jatiault of the University of Perpignan shows a potential link between the activity of natural hydrocarbon seeps and earthquakes. They studied earthquakes in the eastern Mediterranean. Members of the science team and the crew attended the talk, and Chastity was very pedagogic in her explanations, making the topic accessible to all.

Late in the evening, we reach the end of deep seismic profile 2. Once the shooting finished, the seismic team starts recovery of the equipment, a task that is finished just before 4h00 the next morning.

Wednesday, 19 June 2024

No more shooting, it is very calm on the vessel this morning, as we start the recovery of the OBSs. We all rush to the bridge when the appearance of several sperm whales is announced! It is quite spectacular to see five of them at less than 200 m from the vessel. The show lasts about 15 minutes before they disappear. Regretfully, we are not towing the PAM streamer, as this would have been a great opportunity to calibrate some of the acoustic observations. However, OBS recovery operations require the ship to be agile in all directions, which is incompatible with towing such a streamer.



The ocean bottom instruments will pop-up one by one, during the next two and half days. The OBS team is extremely busy, downloading the data, verifying the quality, and preparing the instruments for the last profile. The OBS data appear to be of excellent quality, as illustrated by the diagram to the left, showing that shots at offsets of up to 100 km are registered.

This afternoon, the ship's store carrying *Pourquoi pas?* T-shirts and other memorabilia is open. Regretfully, the selection is limited, and only a few sizes are available. No luck this time, but a new supply of goods is expected to arrive in Kingston.

=== Part III ===

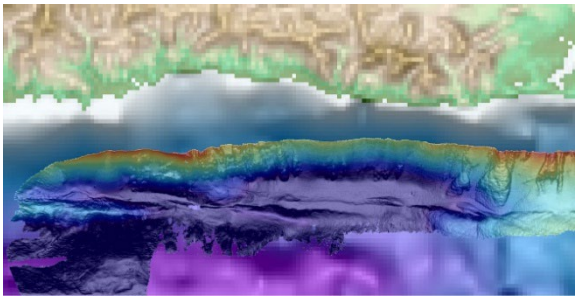
Thursday, 20 June 2024

Despite being far away from France, the legislative elections announced by Macron have occupied many on board over the last week and a half. As early as ten days ago, we started interrogating different authorities about the way to delegate votes while on a vessel. The problem is that even when using the on-line procedure, the identity of the person that delegates his or her vote still needs to be confirmed in person. Both the Captain and the PI use their contacts to get information on how to overcome this hurdle. Partial responses come from the Ambassador in Kingston, the Consul of France in Panama (in charge of the Caribbean region), the Prefecture Maritime in Brest, as well as the ship operator, Genavir. Logically, we are not alone in this quest. New instructions from the Ministry of Internal Affairs arrive at all Embassies, and they take into account the fact that the captain of a French vessel represents the authority of the French State on board and performs the duties of Registrar and Judicial Police Officer. Although this seems to be a simple solution, each person wanting to delegate a vote has to contact their City Hall, before transmitting by email the relevant form, certified by a stamp and signature of the captain. As of this week, several persons have already received confirmation that their request had been taken into account.

The third science talk is given by Bladimir, our Cuban colleague, this afternoon. The topic is seismic noise tomography in the Caribbean. Using ambient noise, Vladimir and his co- authors of the study, recently published in the *Bulletin of the Seismological Society of America*, constructed a 3D shear velocity model for the crust–uppermost mantle structure beneath the Caribbean region from the surface down to 150 km depth. Amongst the interesting results is the determination of thin crust, likely oceanic in the area of the San Andreas Rift. As expected, the structure of the Caribbean plate is very complex and heterogeneous.

In the meantime, the OBS recovery continues during most of the night. Regretfully, two more instruments are not at the RDV. Impossible to know whether the instruments remained at the sea bottom, or came up at the estimated time without flashlight nor radio signal. This evening, the PI offers an *apero* at the front deck: it is the first day of summer.

Friday, 21 June 2024



After recovery of the last OBS for profile 2, at around noon, we set course to the start of the third profile. Rather than taking the shortest route, it is decided to map part of the Oriente Fault located to the west of our next profile. There is no reliable multi beam bathymetric data along this segment. Although the Reson multi-beam echosounder still seems to underperform, with a relatively low signal to noise level, we obtain a pretty map of the fault trace.

In the early evening, we navigate along the south coast of Cuba in the area of Santiago de Cuba. Regretfully, it is pretty hazy and clouds cover the slopes of the island. There is no activity whatsoever on the water, which is surprising at the entrance of such a big port city. Deploying of OBSs along the third deep seismic profile starts and will last for more than a day. It is *la Fête de la Musique*, and several people gather in the lounge area to play music on the instruments that are available on the ship, which include several guitars, an electric piano and a drum set.

Saturday, 22 June 2024

The deployment of OBS for our third profile has continued all night and things are going according to plan. As we are trying to figure out why some of the seafloor instruments were not recovered, we notice that the estimated depth at deployment noted in our records was not always correct. Discrepancies between the depths recorded at the time of launching and the true depth of the seafloor occasionally caused differences of up to 30 minutes between the estimated time lapse needed for the instrument to ascend in the water column and the observed time. This difference cannot be attributed to human error, as our electronic log book, Casino, also occasionally records depths that are in error.

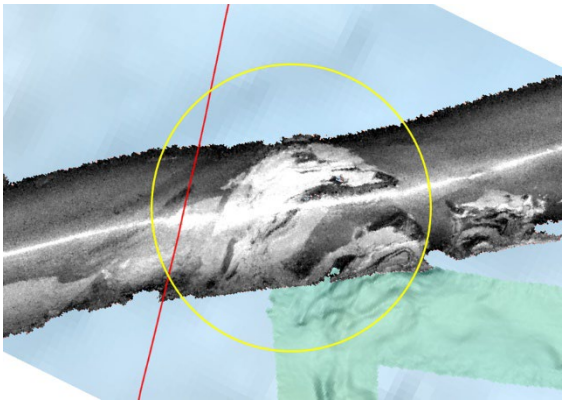
In fact, when deploying and recovering the seafloor instruments, no multi-beam bathymetry data is acquired, as the ship operations involve frequent changes in speed and course making those data difficult to exploit. During these operations, the water depth is measured with the single beam EA600 system. However, occasionally tests were carried out with the Reson multi-beam echosounder to determine why the signal to noise ratio appears abnormally low, causing many soundings to be rejected. It is concluded that the interference between the two acoustic systems, which both operate at 12 kHz, causes errors in the depths registered and displayed by the TECHSAS software. No harm done, but we will need to be more vigilant to ensure that the depths at which the OBSs are deployed are registered correctly.

Sunday, 23 June 2024

Early this morning we reached the point where the seismic equipment needs to be deployed in order to start shooting at the beginning of the third deep seismic profile. After less than five hours, including an hour of pre-watch for marine mammals, luckily without any detection, shooting wakes me up at 6h00 sharp. We are on time!

It’s Sunday and the kitchen is already working at full speed to prepare lunch when the smell of fresh croissants and *pains au chocolat* attracts us all to the cafeteria. After such a treat, things are looking good; even the skies show some blue after several days of grey weather and evening thunderstorms.

A first air gun fails around 10h00, and a second a bit later on the other air gun array: we are currently operating the air guns at 84% of the planned power. 80% is our cut-off: below that we will be forced to recover both air gun arrays and do the necessary repairs. But, let's not anticipate.



It is time to find out why we have been unable to display the acoustic backscatter imagery collected by the multi-beam echosounder. Apparently, Jean-Fred had already encountered this problem during a previous cruise on the *Pourquoi pas?,* SUPER-MOUV. This type of data, which informs us about the character of the seafloor, is not a priority for the first leg of Haiti-TWiST, but it is definitively needed for the second leg during which we will be taking sediment cores. After some back and forth with different people on board, the problem is identified. Without going into detail, it turns out that the GLOBE software that we use to process the multi-beam data has been evolving over time, and the file format we are acquainted with is no longer supported. Although the depth data can still be processed, some other parameters, such as the acoustic backscatter, are no longer included. The problem is solved by changing to the new file format from now on. Regretfully, this requires additional work on all data files already produced. We use the occasion to replace the older version of GLOBE that was installed on the dedicated computer on board with a newer release, improving some of the functionalities. Surprise: a seafloor structure visible on one of the first processed acoustic images looks a lot like the Ifremer dolphin (but it is 12 km long)!

Monday, 24 June 2024

Luckily, the air gun array held the entire night, and no marine mammals were detected with the PAM system. Shooting continues at the rhythm of one shot per minute and should end before mid-night this evening. The OBS team is analyzing the technical issues with two OBSs that malfunctioned and, therefore, are no longer deployed. The current profile has 59 OBSs along it. We keep our fingers crossed that the guns keep functioning and no mammals are detected.

Tuesday, 25 June 2024

We had used the transit between the end of profile 2 and the start of profile 3 to map the Oriente Fault along the southwest coast of southern Cuba. This night we want to do some additional bathymetry profiles to cover the fault zone and its potential splays further east.

Just after midnight, we start recovering the air guns in a westerly direction, against the currents, and then we set course to the east to recover the streamer. By 6h00 all the seismic equipment is back on board, and we start the mapping of the Oriente Fault Zone. Our track will have us pass in front of

Guantanamo Bay military base, which has a 3 nautical mile restricted access area around it. We pass at 5 nautical miles and map the northern flank of the valley associated with the fault. Yesterday, a US helicopter had paid a visit to the vessel: they first circled around the ship and then checked out the tail buoy, that is 6 km behind us. Surely, they must have detected our seismic shots with seismometers on land. Our colleagues at CENAIS in Santiago reported that our shots, fired at a distance of more than 200 km further south, were recorded on their land station.

The fourth science presentation is at 16h15, and concerns the French national program EXTRAPLAC. This program was initiated to determine the outer limits of the French continental shelf in accordance with Article 76 of the UN Convention on the Law of the Sea. Those outer limits, as proposed by coastal States worldwide, need to be examined by the Commission on the Limits of the Continental Shelf (CLCS), at the UN Headquarters in New York. France, which has one of the largest Exclusive Economic Zones in the world, hopes to extend its jurisdiction over the continental shelf offshore the Hexagon and offshore its overseas territories. It has already concluded the examination process for several of these territories, but other areas are still waiting to be considered, as the CLCS has a long waiting list.

Around 17h00, we reach the position of the first OBS, and the recovery of the 59 instruments starts. An hour later, we have a little celebration on the front deck for all birthdays happening this week. This evening, the view of the south coast of Cuba is spectacular. By 21h00, just before the moon comes up, the sky is magic: no single cloud, and in the pitch-dark sky we observe the stars, but that's not all we can see. Starlink is also visible with the naked eye.

Wednesday, 26 June 2024

The OBSs are recovered one by one. At the northern end of the profile water depths exceed 5000 m and it takes almost an hour and a half for the instruments to reach the sea surface. An OBS recently named '*Guardian of the Depths*' is deployed at the deepest point along this profile, 5500 m!

The wind is picking up, and it gets harder and harder to visually distinguish the instruments in the swell, but fortunately the radio signal is loud and clear as soon as they pop up.

Both magnetometers on board were tested to ensure that acquisition problems we noted earlier will not happen again. Both instruments are working correctly. However, when analyzing the magnetic data that were collected during the third seismic profile – the magnetometer is only deployed during seismic acquisition, when it is towed behind the tail buoy – we discover data gaps. Starts another quest to find out the origin of this problem: is it a problem of acquisition, of data transmission from the tail buoy to the ship using a wire in the streamer, or an error at the receiving side, on the vessel. Inquiring minds want to know!

=== Part IV ===

Thursday, 27 June 2024

A tropical storm is developing in the Equatorial Atlantic. Its trajectory and its force are still very uncertain, but the captain monitors the situation. Already, it seems likely that we need to change plans in the coming days, but for the moment we continue with the scheduled operations.

Today, the last OBS is recovered at 17h00, and this means that we finished the deep multi-channel seismic acquisition (with the 6 km seismic streamer) as well as the wide angle seismics using the OBS. Miraculously, the last profile had no interruptions. No marine mammals were observed during the seismic shooting, there was no need to repair air guns and, finally, all 59 seafloor instruments that were deployed during the previous days were recovered! A "*sans faute*" as they say in French. Time to celebrate with a toast in the dry lab where all the equipment is now safely stored and the data are being downloaded before arranging the OBS in two containers that will leave for France at the end of the cruise.

Friday, 28 June 2024

This afternoon, the doctor on board proposed a first aid course, teaching some of us the basics of the actions to take when confronted with a person in difficulty. The first aid approach has been simplified in recent years. For example, it is no longer recommended to find the person's pulse as it is sometimes hard to find, and one could lose precious minutes to search for it, during which time one could already call for help and put the person in a secure position. We also learned the basics of the application of a defibrillator. I had not participated in any first aid training since I was 18 years old, what a shame!

In the evening, we have the traditional barbecue on the front deck to mark the end of the first leg of the science cruise. The kitchen prepared a whole suite of great appetizers from mini pizzas to sausage rolls and salmon spread. Besides lamb and sausages, the highlight was surely the tuna steak marinated with ginger and lemon. On the hot grill, less than two minutes on each side and it is perfectly cooked!

This event was also the occasion to declare the winners of the art contest that was launched at the beginning of our journey. All members of the crew and the science team were invited to submit a work of art, using the graphic materials that were made available or any other medium they chose. The contest was a big success, with 11 works submitted, and a total of 55 people on board expressing their vote for the podium of three winners and a "*Coup de Coeur*". It is definitively worth repeating this experience on the next leg, if there is time!

Saturday, 29 June 2024

We are collecting High-Resolution seismics when another sad message arrives: The mother of another colleague has brutally passed away this afternoon. We prepare a return to Kingston, but this time it is more complicated to make the right decisions, as the tropical storm previously announced is now a full category 4 Hurricane with the name *Beryl* and it is heading for Jamaica. Several consultation meetings are held, taking into account the data acquisition operations planned, the arriving storm and the human factor. At 18h, a brief meeting is held in the conference room for all scientists on board. Given the fact that the storm will likely impact the flights of people returning home after the first leg, we decide to also disembark those members of the science team that were supposed to leave Kingston on the 3rd or the 4th of July by plane. Luckily, we are able to advance their flights to the first of July without too much trouble. In total 9 members of the scientific team will leave the *Pourquoi pas?* tomorrow in the late afternoon with the same launch boat used a few weeks ago. It will turn out to be

the right decision from many perspectives. As we set course to Kingston, we try to comfort our bereaved colleague.

Sunday, 30 June 2024

The RDV with the launch boat is at 18h00 sharp, and although the wind has somewhat died down, it is quite tricky to make the jump from the stable *Pourquoi pas?* to the up-and-down moving boat. A few minutes later, all persons are on board with their luggage, and safely seated inside the cabin. As the launch boat returns to the port of Kingston, one of our departing colleagues takes this picture of the *Pourquoi pas?* As last time, all leaving colleagues will be missed on the vessel, but a special thought concerns our colleague who has lost her dear mother.

We cannot stay in the Kingston Harbor, as it will be in the eye of the storm on Wednesday and the Captain decides to direct the vessel towards the Gulf of Gonâve, where we can find shelter. There is no immediate rush, so we design a ship track that allows us to fill some gaps in the existing bathymetry, as well as to map the deformation front south of Cuba.

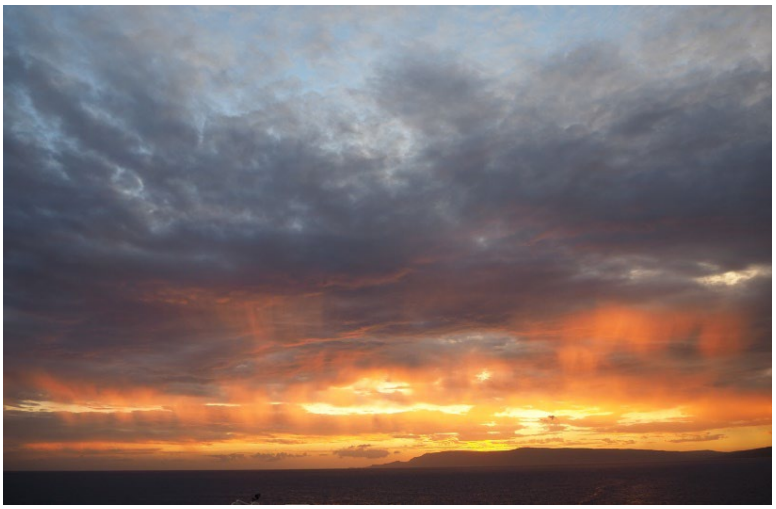
Monday, 1 July 2024

The Kingston Harbor will be officially closed tomorrow, and all ships are requested to leave the port as soon as possible to seek shelter elsewhere. The captain confirms that it is not at all a good idea to be in a port when winds with gusts of up to 220 km/h hit, as ship moorings can break and drifting vessels may cause severe damage to the port infrastructures, not to mention human victims.

Several large container vessels have the same idea as we, and are heading towards the Gulf of Gonâve for calmer waters. We plan a new track for the vessel that will map the areas close to Haiti, while staying at a save distance from the shore. Although this is not part of our primary objectives, we will surely discover some interesting seafloor features here, and complete existing seafloor mapping that has significant data gaps.

In other news: first catch by our fervent fishermen: whenever we are not towing seismic equipment behind the vessel and we are not moving at maximum speed, the crew puts out a few lines to catch a fish or two. This morning a fantastic Mahi-Mahi (*Dorade coryphène*) mistook the hook and attached bait for a delicious meal. I hope it will be served later this week, but first the chief cook cleans the fish and decides to freeze it for several days, in order to eliminate any possible parasites.

Tuesday, 2 July 2024

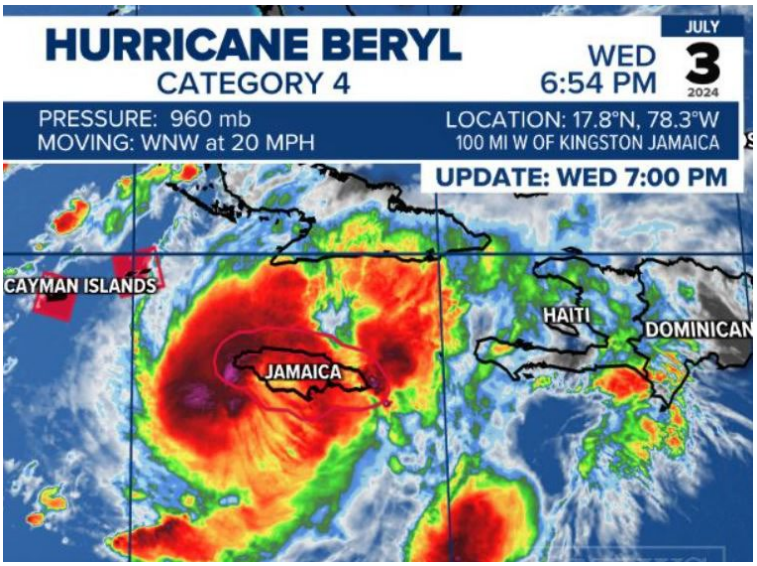


The Gulf of Gonâve seems to be a heaven of peace today: the water is like a lake, and beautiful clouds paint the sky. During the day, dolphins visit the vessel and play with its bow. The data are beautiful, sure, but nature seems also at its best. At sunset, we are close to the south coast of the northwest department of Haiti and experience the amazing views of the land, as the sun sets. The cafeteria feels pretty empty when the remaining 5 members of the science team that are not on watch eat at the first service.

Wednesday, 3 July 2024

Hurricane Beryl finally hits Kingston in the morning of Wednesday the 3rd. We are in contact with the French Ambassador, who indicates that there is severe damage along the north coast of Jamaica, and west of Kingston, but it would seem that the city itself is relatively OK. However, there are many areas without power and drinking water.

After a calm night, this morning the sky is grey, and the air feels heavy and humid. We are all somewhat worried about how we will end this first leg of the science cruise. When will the Kingston Harbor and Kingston's International Airport open again?



Thursday, 4 July 2024

This morning, the French Ambassador in Jamaica informs of the fact that the airport will open on Friday morning at 5h00. This means, if all goes well that the flights of the 35 researchers and students on their way from Europe, will likely be maintained. Since their arrivals from London and Atlanta are scheduled in the late afternoon, it is likely that they will be able to land in Kingston. We keep our fingers crossed.

Although we do not know when the Kingston Harbor will be accessible again, the captain, after consultations, decides to direct the vessel towards Kingston. The idea is to be ready in front of the channel and have access to the Pilot amongst the first vessels that will be allowed to enter the harbor early Friday morning. A last bathymetry profile is acquired to complement existing data in the region, and then we use the currents to reach speeds of up to 12 knots in the direction of Kingston.

Friday, 5 July 2024

Our gamble worked out, the RDV with the pilot boat is at 8h00 this morning and the *Pourquoi pas?* is among the first vessels to enter the deserted harbor. The environment is quite eerie: the water is brown in color and a lot of three trunks and other debris are floating in the sea. On top of that, the awful smell we perceive, once docked in the harbor, leaves little imagination as to what could have happened to the Kingston sewer system during the heavy rains that followed the passage of Beryl. However, we are docked, and operations on the deck commence. Our containers are rearranged on the deck, to make them accessible, and all OBSs are loaded before they return home. The end of the first leg of Haiti-TWiST is here.

Chastity, Walter and the entire Haiti-TWiST Team