Comprehensive Cruise Report – M66-4a

20.11. – 12.12.05 Corinto, Nicaragua – Guayaquil, Ecuador

RV METEOR docked in the port of Corinto Nicaragua on 19th Nov. 2005 when Cruise M66-3b terminated. Two containers with research equipment were unloaded, while a container of the seismic group was returned from stowage area to the vessel. Unfortunately the deep-sea cable, which was replaced 10 days ago in Caldera was broken during the previous leg at 4000 m length and needed to be replaced during this port call again. The intensive support of the crew ensured replacement without time delay.

The majority of the scientists arrived in time at Managua airport, despite a group of three members. These people are from non-European countries and had chosen to fly across Caracas avoiding visa problems during the few hour transit that would have been necessary if they flew across the USA. As their arrival was announced for 24 hours delay departure of the vessel was not shifted to an earlier time as previously hoped. Nevertheless it turned out that the carrier Air France did not guaranteed the continued travel of the persons and hence they had to stay in Caracas another day. Due to the dense time schedule METEOR left the port of Corinto on the 21st Nov. 08:20. As the next working area of the cruise is located close to Corinto it was decided to try later for a meeting between a shuttle boat and METEOR, once the scientist had arrived in Managua.

Crew members of cruise M66-4a

METEOR used the time to deploy 7 OBH/S along the planed profile 1. The instruments were positioned between long term recording hydrophones and seismometers deployed during leg M66-2a, seven weeks ago. Further on, time was used to start picking up instruments that were not planed to record active seismic profiling later on. During 22nd Nov. we received message that our missing colleagues arrived in Managua and could welcome them in the evening onboard. After a few hours transit we reached the starting point of our first airgun profile. After 14 hours of airgun shots we recovered all instruments from this line.

A second profile was deployed parallel to the trench on the outer rise on 24th Nov. All airguns worked without problems during the 65 nm long line. During OBH/S recovery two close by instruments from the seismology network were picked up as well.

In the morning of the 26th Nov. we started the deployment of line 3. Together with 5 instruments from the seismology network 13 additional OBH/S covered this NE-SW striking profile over a length of 75 N.M. Airgun shooting was completed on 27th Nov. 12:00 without any complications.

After recovery of all instruments METEOR set course towards the first DeepTow area at 12° N on the slope of the Nicaragua continental margin. At 13:40 hrs local time Sidescan and Depressor were lowered to the water. At 14:00 hrs the telemetry system showed unusual amplitudes in the electric current consumption, followed by a power break down. The winch was stopped immediately, and as a restart showed abnormal high currents the system was switched off again. The winch was asked to retrieve the system onboard when a sudden drop in weight measure of the winch indicated that we had lost at least the 2 tons depressor weight. Immediately emergency release of the Sidescan indicated that the instrument sank to bottom (2300 m depth) with the depressor. Exact positioning of the instrument showed that the system must be

DeepTow Streamer and Sidescan with 2 tons depressor weight

floating 30 m above ground. Consequently we started to dredge for the system using the 18 mm deep sea working wire of METEOR. Two attempts using up to 7500 m of cable failed.

Following on METEOR headed for some swath mapping courses in order to complete the existing map in the regions of the upper terminations of the observed canyons cutting into the slope. This course reached up to 12°19' N.

In the afternoon of Dec. 1st we returned to the ground position of the Sidescan and prepared for another attempt to dredge the system. This time 9500 m of cable were used to circle the estimated position. About 5000 m of cable had been dragged in when a flash light and the radio signal verified the release and return to surface of the tow fish.

After recovery of the Sidescan we continued our program with deployment of profiles 4 & 5 in the morning hours of 2nd Dec. These lines were dedicated to resolve high resolution data and deeper structure of Mound Baula Massive. Two perpendicular profiles were occupied by 22 instruments, which recorded shots from a 250 cinch GI gun and a 2080 cinch G-gun array of two clusters. Besides one OBH all instruments were recovered until 4th Dec. As the remaining unit rests at 1014 m depth it was decided to try another dredge attempt. As the release replies clearly verified internal motion of the motor drive it was assumed that the hook axis was not turned simultaneously. This assumption was derived from a unit kept onboard with the same malfunction. Unfortunately this dredge did not result in a recovery and due to time limits no further attempts for recovery were undertaken.

Rescue operation

During the night hours of 4th and 5th Dec. a short wide angle profile was shot crossing a ridge structure identified by Sidescan sonar and deep towed streamer during cruise SO173-1.

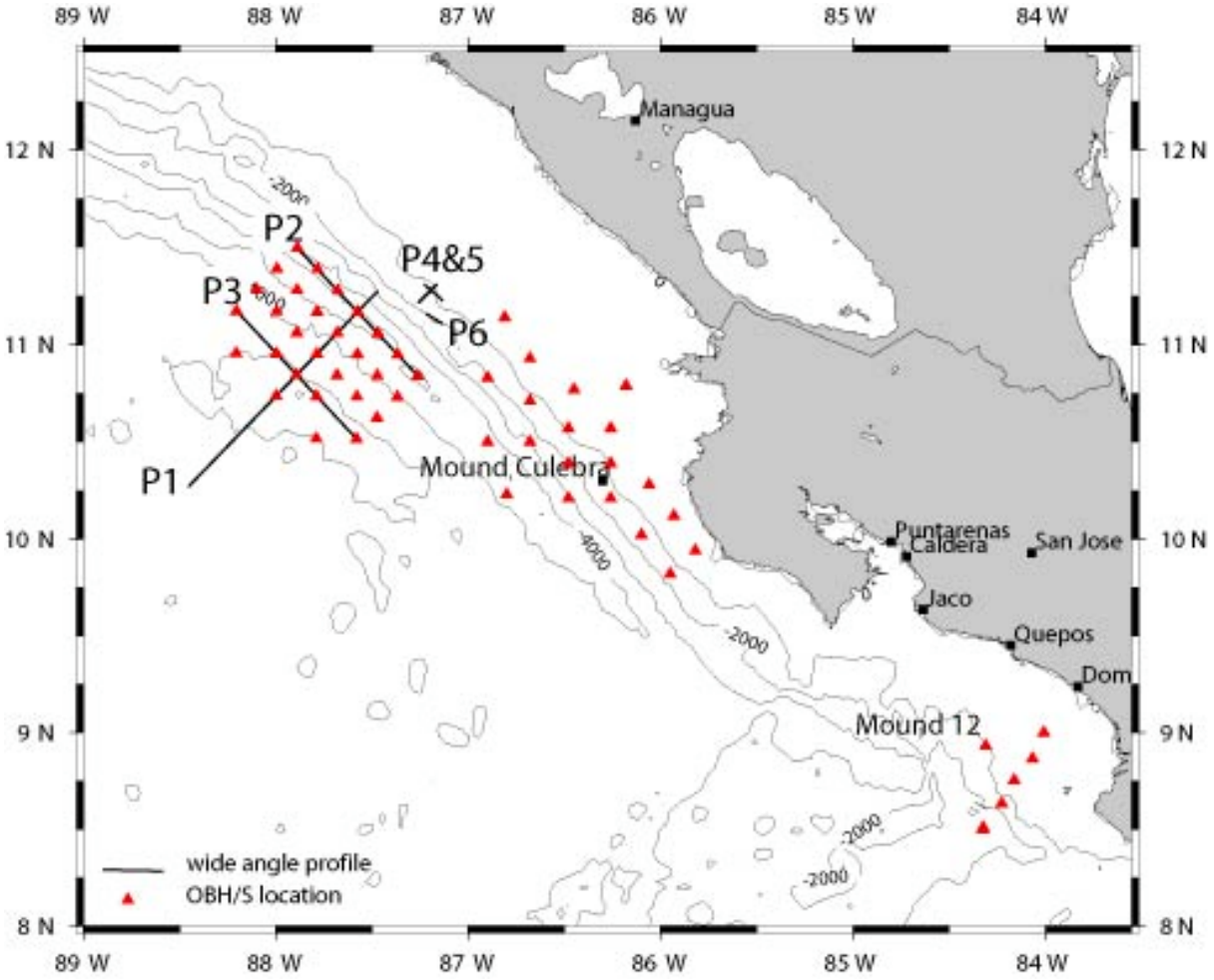
In the afternoon of 5th Dec. we started deployment of 20 instruments for long time seismological observations off Nicaragua and Costa Rica in the vicinity of Nicoya peninsula.

In between a short Parasound profile was recorded crossing the Hermosa slide. Upon transit to Mound 11&12 another Parasound profile was recorded above the Lira slide. In the morning of the 7th Dec. we deployed one Tiltmeter station, an OBH and an OBS on Mound 12. Positions were chosen close to the locations of long-term water samplers deployed by US colleagues.

The afternoon hours were used for the deployment of four additional seismometers off Osa peninsula. These instruments were equipped with broadband seismometers and form the marine prolongation of a land traverse across Costa Rica.

During preparations for deployments of a final high resolution seismic line a fishing boat approach METEOR and reported about a small fishing boat which was about to sink some 20 N.M. away. Of course research activities were stopped immediately and METEOR headed towards the given location. The helpless fishing boat was found drifting on its side completely washed over while a second boat in standby rescued the crew. After two hours METEOR succeeded to move the boat in upright position again and pumps were installed to empty the boat. At about 20:00 hrs the fishing boat depart from METEOR towed by a supporting colleague.

As the remaining work time did not allow any seismic work METEOR left southwards for Hydrosweep mapping courses, before transit to Guayaquil started in the morning of 08th Dec.



Map of OBH/S deployments and wide angle seismic profiles aquired during M66-4a

METEOR Leg M66-4

11.12.2005 Guayaquil (Ecuador) – 22.12.2005 Talcahuano (Chile)

Introduction and scientific rationale

Leg M66-4 was dedicated entirely to testing a new CPT (cone penetration testing) free fall lance. The overall objective when studying active convergent margins is to unravel the complex fluid processes and their ramifications for natural hazards such as submarine landslides and earthquakes. The understanding of such processes may be severely deepened if the crucial controlling parameters are measured *in situ*. For that purpose, a free fall-CPT lance has been built (Fig. 1). This device allows a time- and cost-effective characterization of both pore pressure and sediment strength in the uppermost ocean floor sediments. CPTmeasurements are usually carried out with a cylindrical lance, either motor-driven or as free fall instrument. Penetration depth is controlled by sediment composition/grain size as well as the weight of the lance. In our case, it is a few meters. During penetration, frictional forces at the tip and along the sleeve of the lance are measured. The amount of frictional resistance allows for a classification of the sediment. In addition to these first order strength measurements, a piezometric cell is measuring pore pressure in the sediment. The RCOM free fall CPT is a seagoing modification of a standard industrial CPT tip (Geomil, NL). Pore pressure is measured in u1 and u3 position.

During earlier research cruises, landslide scars and sedimentary trench successions with abundant turbidites have been found off Chile. As a result of these cruises, wide areas along the Chilean continental margin are geophysically well characterized. These data, namely the bathymetric charts, have allowed researchers to measure in situ-heat flow along three profiles using the Chilean vessel *Vidal Gormaz* in 2003 (Fig. 2). Along the northernmost of these profiles, CPT experiments measuring sediment physical properties such as strength, pore pressure, as well as tilt of the probe were conducted with the new device during Leg M66/4b.

Work programme and Results

The CPT measurements at the Chilean continental slope focused on the northernmost profile to complement the earlier heat flow transects (Fig. 2). A total of 8 individual tests were carried out along the transect. The range of water depths was 1018 – 1824 meters below sea level. Initial results indicate two things:

1) The sediments along this section of the Chilean margin are well indurated, because the lance penetrated the sediment only by up to 1-2 meters. In some cases, repeated attempts were required to penetrate at all since the instrument fell on its side upon seafloor contact.
2) Despite the difficulties to penetrate the seafloor, pore pressure signals showed nice peaks upon impact, and a rapid decay. Measured t_{50}-parameters ranged between 10 and 40 minutes.

Figure 1: Picture of the instrument during deployment from RV *METEOR*.

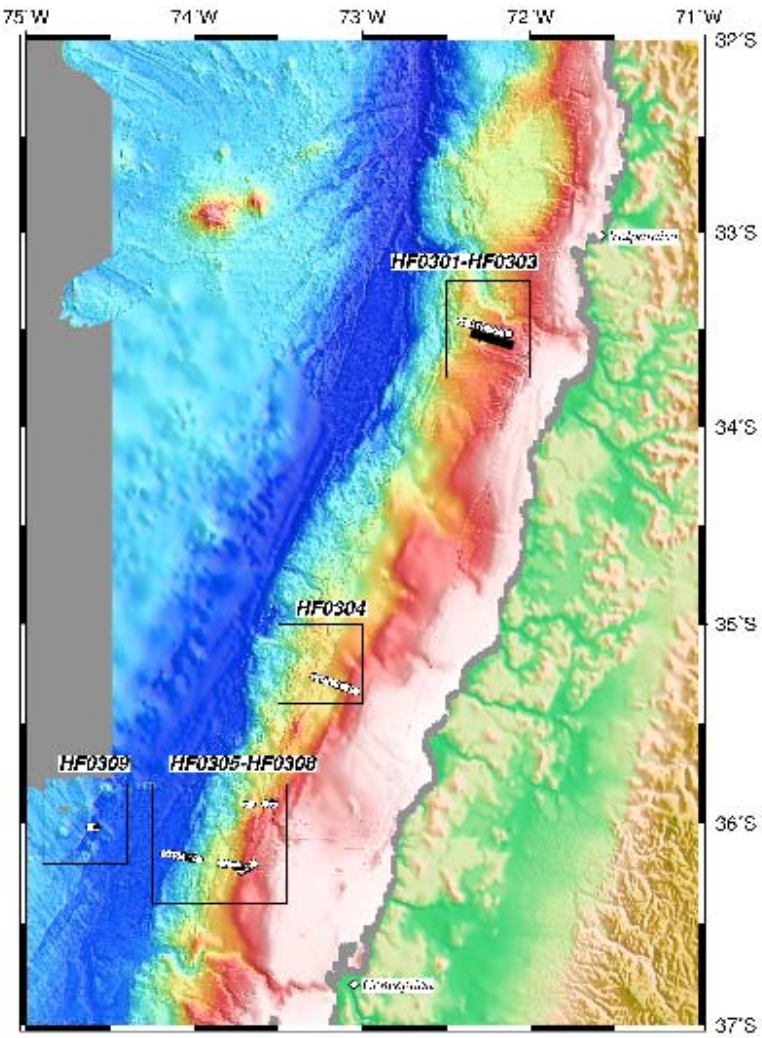


Figure 2: Bathymetric map of the study area off Chile including heat flow and CPT locations.