

Merian Expedition MSM04/2 (TRAIL)

Fort de France – Fort de France

03.01. – 19.01.2007

Chief Scientist: Prof. Dr. Ernst R. Flueh (IFM-GEOMAR)

Altogether 21 scientists from IFM-GEOMAR, University of Bergen, IPG-Paris and GeoAzur, Nice comprised the scientific team that set out to study the Antilles subduction zone between Martinique and Guadeloupe. The cruise MSM04/2 is part of an international EU-funded programme called THALES, and was followed by an expedition of RV Atalante in February 2007 and RV Antea in Mai 2007.

During the cruise MSM04/2 two long seismic wide-angle profiles from the deformation front across the Island arc were successfully acquired. In addition, a seismological network with almost 50 ocean bottom seismic stations was installed and/or maintained. This network was further augmented by additional stations during the follow up cruises. Furthermore, a newly developed pore pressure device was successfully tested and finally deployed for a long term deployment. Throughout most of the cruise the Simrad EM120 system collected bathymetric data.

This project presents a scientific measurement approach for the detection of new types of seismic signals, as well as deep structural images that are relevant to the problem, being possible heralds of mega-thrust earthquakes. This will be applied in the Lesser Antilles Arc, that may be prone for $M > 8$ earthquakes as it shares characters of the Sumatra-Andaman case. These water-related phenomena, deep seismic tremor and silent earthquake, were recently discovered in Japan and NW US subduction zones, where advanced technologies and methods have been applied. They were reported to have their source region close to the interplate subduction boundary, the mega-thrust fault plane, where possible water content has been revealed by deep structural seismic images. Importantly, these transient signals are observed in advance of the major $M > 8$ earthquakes expected there. They might in case be considered as possible silent heralds of megathrust earthquakes and monitored. This scientific measurement approach, for detection of signs of place and time of major subduction earthquakes may open the way to monitoring evolution, with high-yield/high-risk possible societal impact for hazard preparedness and mitigation.

With active seismic measurements (wide angle data on RV Merian, near vertical data on RV Atalante) the structural inventory of the subduction zone shall be mapped. Of special interest are the location of the plate boundary, the extend and thickness of the upper plate basement and the young sedimentary basin. Knowledge about these features is essential to later interpret the seismological data.

A device for in-situ pore pressure measurements (PWPL) has been developed as part of the SFB 574 subproject B2. It is configured to collect long-term records of minute pore pressure changes in the shallow sediment subsurface in areas of

enhanced fluid flow. These measurements are especially important in the vicinity of vent sites and in areas of slope instability and slumping. The device is rigged to a standard IFM-GEOMAR BCL (benthic chamber) lander system and is able to measure pore pressure fluctuations in the upper 1.5m for time periods of several month, which will enable us to compare these variations to other parameters like seismicity. The PWPL was deployed during MSM04/02 on an unstable flank off E Martinique in an area with numerous slides and high local seismicity. The PWPL instrument will be recovered in June 2007.

A second device currently under development (CPP) was successfully tested at 10 stations during the cruise. This device combines spot measurements of dynamic in situ parameters such as pore pressure (determined by approximation of decay curves) with a sampling tool for the sediment interval probed.

The cruise track of MSM04/2 is shown below.

