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Short Cruise Report
RV Maria S. Merian MSM 32

Bremen – Southampton – Cádiz
25.09.2013 - 30.10.2013
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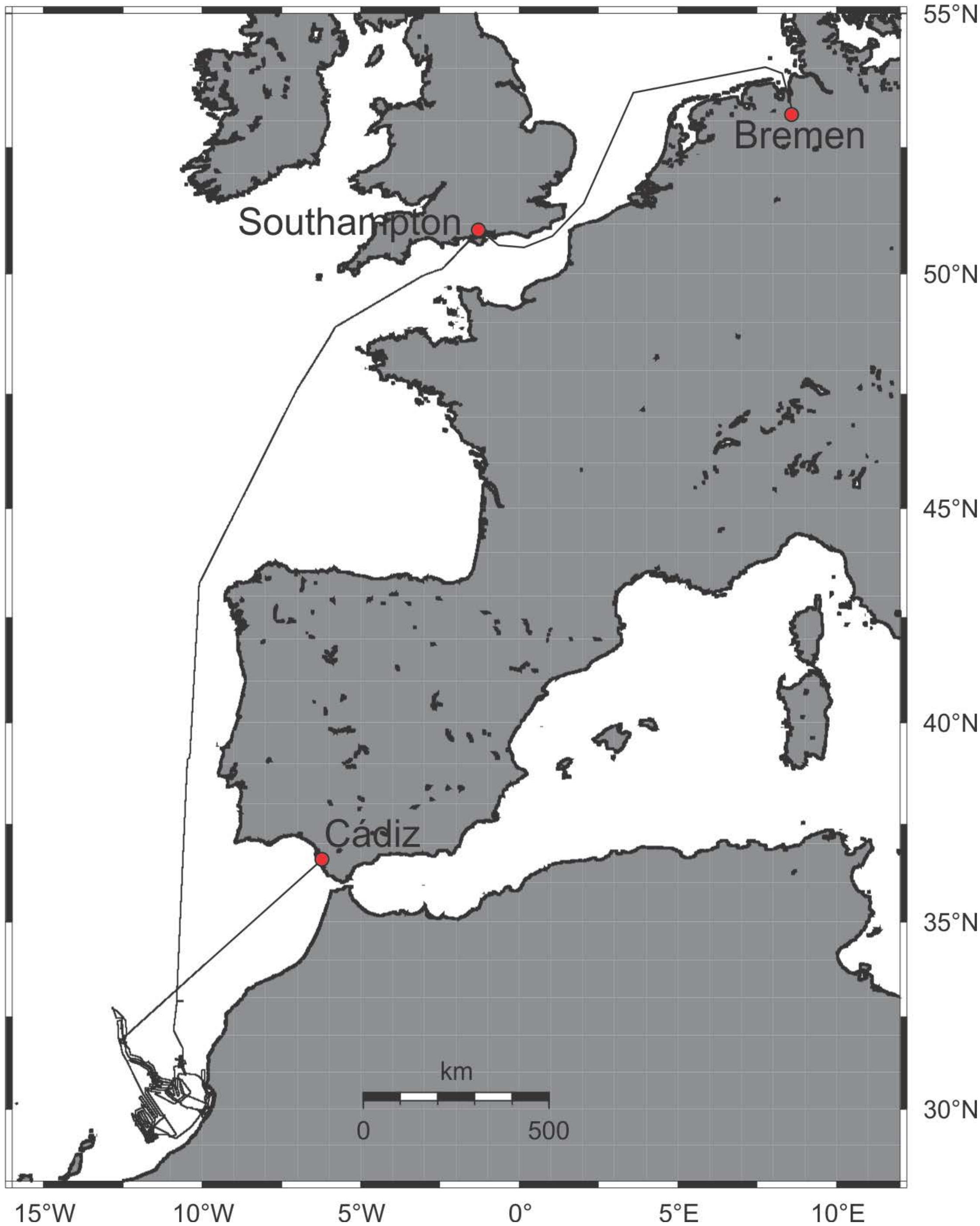

Fig 1: Track chart Cruise MSM32 (Bremen-Southampton-Cádiz).

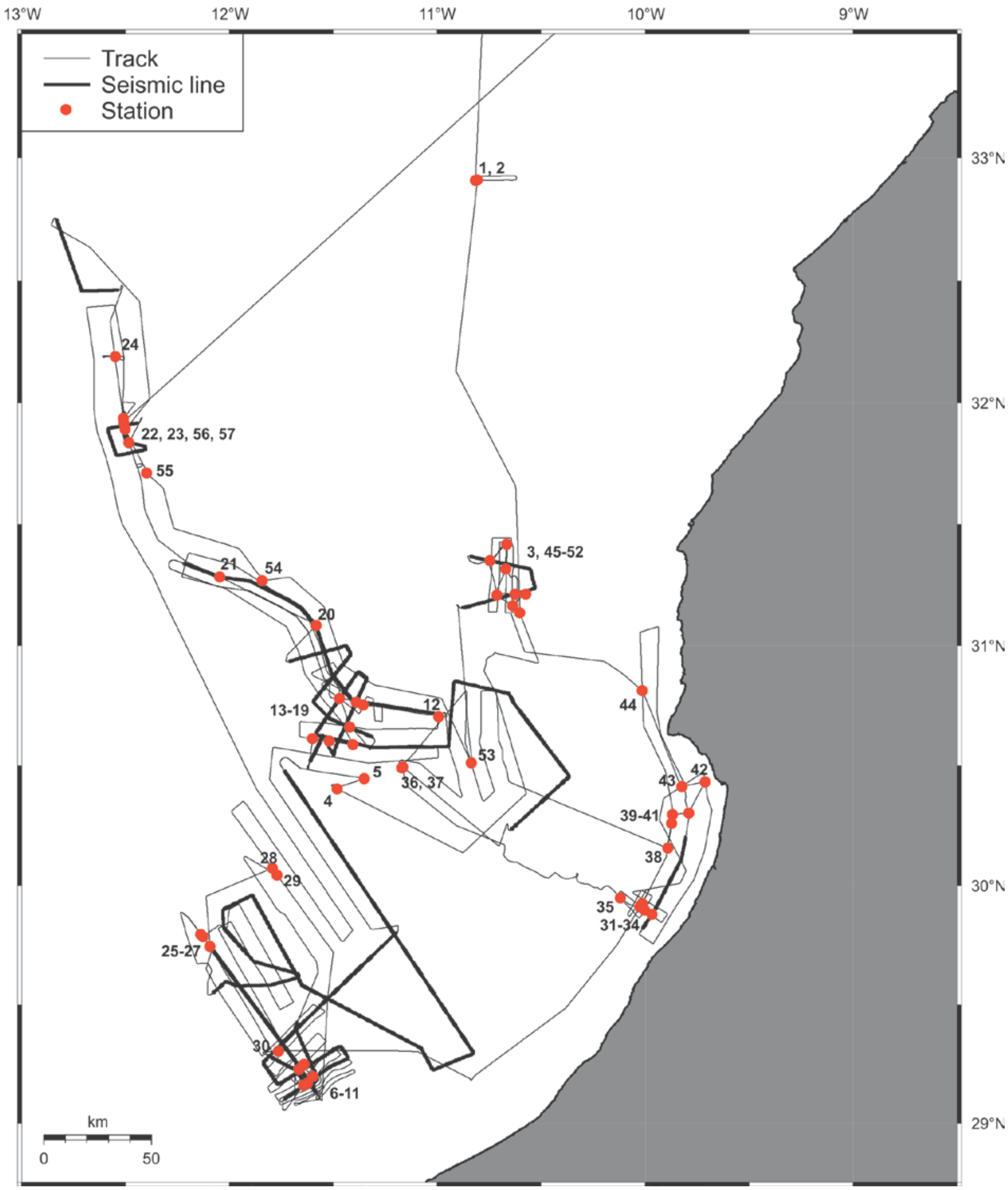

Fig 2: Detailed track chart of the MSM32 working area.

Objectives

Agadir Canyon is one of the largest submarine canyons in the World, and is 450 km long, up to 30 km wide and 1250 m deep. It incises the Moroccan Shelf at 200 m water depth and terminates on the floor of the Agadir Basin at 4300 m water depth. The upper canyon has two shelf-incising tributaries that merge at a depth of 2200 m; below this the canyon forms a single conduit that curves around a series of volcanic seamounts on the lower slope. The Agadir Canyon supplies the World's largest submarine sediment-gravity flows (>100 km^3 volume and up to 2000 km run-out) to Agadir Basin and the wider Moroccan Turbidite System. However, there are currently very few data from the upper 400 km of this canyon, which was the main working area of Cruise MSM32. Outstanding questions addressed during the cruise include:

1) What are the location, size and character of the giant landslides scars that represent the source areas of the World's largest sediment-gravity flows? Is there evidence for retrogressive failure? Why do certain landslides transform into turbidity currents and how does this process work?

2) Why does the canyon floor have areas of sandy fill (representing high-energy flows) interspersed with stacked thick (20 m) muddy debris flows, i.e. why do some landslides fully disintegrate while others do not?

3) Why did the devastating 1731 and 1960 Agadir earthquakes not generate a significant landslide or turbidity current in Agadir Canyon?

4) How are huge volumes of material transferred from the Atlas Mountains and Sous River onto the Morocco Shelf and then on-wards to upper Agadir Canyon?

5) Can active salt diapirism be identified using onlap relationships of dated debris-flow deposits? How are salt diapirs and debris flows related?

6) Do the large-scale (~500 m wide and ~15 m high) carbonate mounds at ~700 m water depth adjacent to upper Agadir Canyon represent living cold-water coral communities? Cold-water corals are well studied in northeast Atlantic waters, and are a conservation priority.

The main methods used during Cruise MSM32 were imaging by means of the TOBI deep tow sidescan sonar, a high-resolution 2D seismic system consisting of a 150m-long 88 channel digital streamer and a standard GI-Gun, and the hydroacoustic systems of RV MARIA S. MERIAN. Geological sampling was carried out using a gravity corer and a giant box corer. In addition, we collected CTD data and water samples.

Work was carried out in four areas. The focus of the working area south of Agadir Canyon was the investigation of the location, size, and character of giant landslides scars. Work along the canyon axis investigated sediment transport processes through the canyon. Cold-water corals were investigated north of Agadir Canyon. Work in the head region of Agadir Canyon and on the shelf focused on sediment transfer from the Atlas Mountains and Sous River onto the Moroccan Shelf and then onwards to upper Agadir Canyon..

Narrative

The majority of the scientific party arrived in Bremen on September 24th and directly boarded RV Maria S. MERIAN. Containers were unloaded and MERIAN left the port of Bremen heading to Southampton on September 25th at 08:00h local time. RV MARIA S. MERIAN arrived in Southampton at the pier of the National Oceanography Centre (NOCS) on September 27th at 08:30h. The main aim of this short port call was to load the deep-towed side scan sonar TOBI and to embark additional scientists.

Loading activities were finished early afternoon and RV MARIA S. MERIAN left the port of Southampton on September 27th at 16:00h. The scientific crew included 11 scientists from the

Christian-Albrechts-Universität zu Kiel, 3 scientist from the Helmholtz Centre for Ocean Research Kiel (GEOMAR), 5 scientists from the National Oceanography Centre in Southampton (NOCS) and 1 scientist from Leeds University. Weather during the transit to the Moroccan margin was reasonable with some scattered showers but calm sea state. September 30th was used for short successful test deployments of the TOBI vehicle and the seismic streamer. We entered Moroccan waters around 09:00h on October 1st, which was the start of the scientific program by switching on the hydroacoustic systems. We reached our first station at the distal El Hadiba Canyon early afternoon the same day. A CTD (Station MSM32-1) down to 4200 m was taken for measuring a sound velocity profile for the multibeam systems. Two short hydroacoustic profiles were recorded in order to define potential locations of distal turbidites in the Seine abyssal plane. The PARASOUND showed a promising location (Station MSM32-2) but heavily consolidated sediments resulted in a bended core barrel. The night was used for a transit to an area north of Agadir canyon, where old sediment echo sounder data indicated the presence of carbonate mounds. The new multibeam data clearly show abundant mounds in water depths between ~650 m and 850 m. This area was selected for a first full TOBI deployment on October 2nd at 09:30h. The TOBI data show clear variations in backscatter between individual mounds suggesting that some mounds are active while others are partly covered by sediments. Based on these results, we selected one mound for taking a giant box corer (Station MSM32-3). The box corer sampled both dead and living *Lophelia pertuba* and was therefore a full success. Water samples and a CTD profile were taken at the location of the box corer. The night was used for hydroacoustic surveying of the Agadir Canyon head region. We reached Station MSM32-4 south of Agadir Canyon at 06:00h on October 3rd. This station was targeting landslide deposits identified on available hydroacoustic data. We recovered a giant box corer and a 7.70 m-long sediment core from this location. The core does not show typical landslide deposits suggesting that landslide deposits are covered by a significant drape or that blocks with an intact internal structure were cored. The next station (MSM32-5) was supposed to be in background sediments but sediment recovery was only ~3 m. In the following, we collected two long seismic profiles reaching from ~3000 m depth to the shelf break. These profiles show abundant near surface and buried mass transport deposits. Smaller landslides originate at the flanks of widespread diapirs. The seismic and hydroacoustic also indicate one main fairway for sediment transport into the Agadir Canyon. We started a systematic hydroacoustic survey on October 5th in order to identify the source area of the fairway. We crossed the headwall area for the first time in the morning of October 6th. Individual scarps are up to 100 m high; the complex pattern suggest a multiple stage failure and close interaction of landslide and canyon processes. The data were used to locate three gravity cores (MSM32-06 – 08) in order to sample landslide deposits and the potential glide plane. Especially Core MSM32-08 shows nice debrite deposits and a potential glide plane in about 7 m subsurface depth. The following night was used for additional hydroacoustic surveying of the headwall area. A TOBI deployment covering the headwall area was scheduled for the morning of October 7th. The CTD mounted on TOBI, however, failed and TOBI was recovered again. A software failure was identified as most likely problem and after fixing this bug, TOBI was deployed again in the afternoon. The same behavior was observed and additional instruments failed. TOBI was recovered again and a small leak in one of the pressure bottles was identified as reason for the cascading-type of failure. As parts of the electronics and the pressure bottle needed severe maintenance, we continued the hydroacoustic mapping during the night. Three successful up to 5 m long gravity cores (MSM32-09 - 11) were taken the next morning (07.10). The aim was to sample different levels of potential glide planes. All cores except for one show clear indications for sediment transport features and potential glide planes. Coring was followed by a seismic survey of the headwall area. The seismic data image a complex interplay between diapirism, canyon processes and mass wasting. As TOBI repairs were still ongoing, we decided to leave the headwall area in order to map the main mass transport fairway entering the deep Agadir Canyon. This attempt was interrupted by a successful test of the damaged pressure TOBI bottle. The new hydroacoustic data allowed to locate three coring locations (MSM32-13 – 15) targeting undisturbed background sediments and different landslide facies; up to 8 m-long gravity were recovered at the these locations on October 10th. The first core was taken in the axis of a small channel in the fairway and shows clear landslide deposits at its base. The second core shows the same deposits overlain by a ~30 cm thick turbidite. The third core was a reference core outside the landslide deposits.

Coring was followed by the next TOBI-deployment in the afternoon of October 10th. All instruments worked fine but the noise level increased significantly with dive depth indicating another malfunctioning. TOBI was brought back on deck and a partly broken cable in the umbilical was quickly identified as reason for the high noise level. As several hours were needed to replace the cable, seismic profiles across Agadir Canyon were collected in the night. The data show that the main transport fairway for landslides to Agadir canyon has been active for a long period of time. Reflection seismic profiling was continued until the morning of October 12th. The umbilical was replaced in the meantime and TOBI deployment started after lunch. This time TOBI worked without any problems and we collected two adjacent profiles (down and upslope) of the thalweg of Agadir Canyon. The TOBI-data show a sandy thalweg and widespread debrite deposits of varying fabric. Numerous slides are entering the canyon from the canyon flanks. TOBI operations had to be stopped on October 14th in the evening due to strong winds form the NE (Beaufort 7-8). The night was used to collect hydroacoustic profiles across Agadir Canyon. The next day (15.10) was an intense and very successful coring day. We started with a boxer core and a gravity core of the sandy thalweg; we recovered thick turbidites and coarse gravel at the base of the gravity core (Station MSM32-16). The following stations aimed in coring debrite deposits, which entered the canyon from the fairway (MSM32-16 to 19). All cores recovered the debrite; the drape on top of the debrite is much thinner in Agadir Canyon compared to the fairway. The debrite shows clear signs of erosion at its top. Seismic profiles across the canyon were collected during the night. October 16th was used to collect a set of cores down the Agadir Canyon (MSM32-20 - 22) in order to investigate the behavior of the debrite when moving downslope inside the canyon. Surprisingly the debrite shows a very consistent appearance down to ~31°53'N, 12°30'W where hydroacoustic data image a change of the acoustic facies. The final core was taken in the evening of October 16th (MSM32-22) at this location. This core bounced but we recovered a ~2 m long intact section showing a brownish drape overlying a debrite with almost vertically aligned clasts. This may be the edge of a freezing debrite. The night was used for additional seismic imaging of the debrite in the lower Agadir Canyon. Two more cores were taken until early afternoon on October 17th. The first core (MSM32-23) shows very clear signs of flow transformation. The second core (MSM32-24) was taken further downslope and brought no recovery indicating a hard sandy canyon floor at this location.

We left the lower Agadir Canyon around 16:00h on October 17th and started a transit to the headwall area mapped earlier in order to collect TOBI data of this region. TOBI and the airgun seismics were successfully deployed in the evening of October 18th at very calm seas. The seismic data show an interesting step like pattern in the headwall region. The TOBI data show relative homogeneous low-back scatter data as the slide deposits are covered by a thick hemipelagic drape. TOBI was recovered after one long downslope-run in the evening of October 19th. Additional seismic data across the mass transport deposits were collected in the night. The seismic data show a clear relationship between slide thickness and flow behavior on one side and diapirs on the other hand. Slide material moved around the diapirs and left only thin deposits on their tops. October 20th was a successful coring day. We started with three cores (MSM32-25 – 27) about 40 km downslope of the main headwall across the boundary of a debrite. These cores show a very interesting transition from debritic deposits over slightly deformed deposits to undisturbed deposits outside the slide. Afterwards two additional cores were taken in the depositional part of the debrite (MSM32–28 and 29). The night was used for collecting additional seismic data across the headwall area. The data indicate that sediment waves play an important role in controlling the locations of individual failures. A last core (MSM32-30) targeting the glide plane of the slide was successfully taken in the morning of October 21st. Afterwards we started a hydroacoustic survey of the shelf around the mouth of the Sous river and the head region of Agadir Canyon. Surprisingly no indications for incised valleys were identified in the data. Several features indicate that the sediment freight of the Sous River is transported to the north though the shelf region around Agadir Canyon itself is presently sediment starved. A tributary canyon approximately 100 km south of the head region of Agadir Canyon cuts into the shelf. Several box cores were taken in the head region of this tributary canyon; fine sand is the dominant material in this area. A core in the thalweg of this canyon in ~800 m water depth shows about 80 cm hemipelagic sediment on top of an immature turbidite. The night was used for mapping the tributary canyon; the course of the canyon is strongly controlled by diapirs. Two cores were taken late evening on October 23rd. A giant box corer was taken from the thalweg of the tributary canyon about ~120 km off the shelf break while a gravity core targeted a terrace in direct vicinity. The terrace is about 90 m higher than the thalweg. Core recovery was just a bit more than one meter because the sandy base of a turbidite prevented further penetration of the gravity corer. This shows that turbidity currents were large enough for depositing significant sand layers about 90 m above the thalweg. October 24th was used for additional coring on the shelf. Different facies were samples by the giant box corer and gravity corer. Fine sand is the dominant sediment on the shelf but a small mud belt was identified off Agadir in a mid-shelf position.

After finishing the shelf work in the late evening of October 24th, we headed to the coral area identified at the beginning of the cruise. Additional mapping showed that an area of about 400 km^2 between 650 m and 850 m water depth is covered with abundant mounds. We sampled six of these mounds distributed across the entire area and in different water depth by means of the giant box corer (Stations MSM32-45 - 50). Dead *lophelia pertuba* and some other species were found in all box cores. Living corals were found in two box cores in the southern part of the mound field. One of these stations was chosen for a 13-hour yo-yo CTD covering a full tidal cycle (MSM32-51). CTD profiles of all other box corer stations and one additional background station (MSM32-52) were collected on October 26th in order to investigate differences in the oceanographic setting between living and dead coral sites. The coral work was completed by two seismic profiles crossing different parts of the field. October 27th was used to collect additional cores of Agadir Canyon. The first core (MSM32-53) was taken high above the canyon thalweg in order to check whether major turbidity currents occurred in the upper Agadir Canyon in the past. The core contains only one single turbidite with coarse pebbles at its base suggesting that it was a very energetic and large flow, possibly representing Bed 5 identified in the Moroccan turbidite system. Three additional cores (MSM32-54 – 56) taken on October 27th; these cores recovered different debris flow facies from distal Agadir Canyon. The research

program was completed by a small seismic survey of distal Agadir Canyon and one final core (MSM32-57). We started our transit to Cádiz at 21:30h on October 28th; we arrived at the port of Cádiz as scheduled on October 30th at 08:30h.
RV MARIA S. MERIAN-Cruise MSM32 was a great success. We collected about 1500 km of seismic 2D-lines in exceptional quality. We had three successful TOBI deployments covering an area of about 1000 km^2. We collected about 186 m of cores at 40 stations. In addition, we took 22 giant box cores. CTD casts were collected at 9 stations including one 13 hour Yo-yo CTD. Hydroacoustic data were collected during designated surveys as well as along all seismic profiles and transits. The new data will allow an in depth investigation of the morphology, processes and geohazards of giant landslides in and around Agadir Canyon.

Acknowledgements
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NOCS	National Oceanography Centre Southampton, UK
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MSM32-Station List

Station No.		Date	Gear	Time	Latitude	Longitude	Water Depth	Remarks/Recovery
MERIAN	CAU	2013		[UTC]	[°N]	[°W]	[m]	
MSM32/ 589-1	MSM32- 1-1	01.10.	ROS/CTD	13:53	32°54.40	10°49.06	4183.8	24 water samples recovered
MSM32/ 590-1	MSM32- 2-1	01.10.	GC	20:14	32°54.46	10°48.44	4248.7	12m barrel, USBL at SL 30m, bend barrel, recovery: 159cm
MSM32/ 591-1	MSM32 _RUN#1	02.10.	TOBI	08:26	31°07.72	10°36.13	736.4	deep tow sidescan sonar, 495m SL max, test run
MSM32/ 592-1	MSM32- 3-1	02.10.	GKG	15:06	31°08.06	10°36.23	719.1	USBL at SL 30m, living and dead Lophelia pertusa recovered
MSM32/ 592-2	MSM32- 3-2	02.10.	ROS/CTD	16:39	31°08.06	10°36.25	718.4	21 water samples recovered
MSM32/ 593-1		02.10.	MB+PS	17:51	31°08.08	10°36.27	732.1	mapping with various course
MSM32/ 594-1	MSM32- 4-1	03.10.	GKG	05:05	30°24.25	11°29.02	2324.5	box corer did not release, no recovery
MSM32/ 594-2	MSM32- 4-2	03.10.	GC	07:39	30°24.25	11°29.02	2326.0	5m barrel, recovery: >500cm, overpenetrated
MSM32/ 594-3	MSM32- 4-3	03.10.	GKG	09:01	32°24.25	11°29.03	2326.0	recovery: 38cm
MSM32/ 594-4	MSM32- 4-4	03.10.	GC	11:26	30°24.25	11°29.02	2327.2	10m barrel, recovery: 758cm
MSM32/ 595-1	MSM32- 5-1	03.10.	GC	13:59	30°26.72	11°21.21	2272.0	10m barrel, core catcher broken, no recovery
MSM32/ 595-2	MSM32- 5-2	03.10.	GC	15:34	30°26.71	11°21.22	2271.7	10m barrel, recovery: 336cm
MSM32/ 596-1	MSM32- 001-007	03.10.	SEISREFL	19:07	30°30.58	11°41.30	2224.9	several profiles, see separate list
MSM32/ 597-1		05.10.	MB+PS	10:53	29°54.89	11°56.96	2039.2	mapping with various course
MSM32/ 598-1	MSM32- 6-1	06.10.	GC	13:50	29°14.96	11°38.47	1211.1	5m barrel, recovery: 485cm
MSM32/ 598-2	MSM32- 7-1	06.10.	GC	15:03	29°14.69	11°38.76	1183.5	5m barrel, recovery: >500cm, overpenetrated
MSM32/ 598-3	MSM32- 8-1	06.10.	GC	16:14	29°13.60	11°39.96	1125.3	5m barrel, recovery: ~580cm, overpenetrated
MSM32/ 598-4	MSM32- 8-2	06.10.	GC	17:29	29°13.62	11°39.94	1119.6	10m barrel, recovery: 757cm
MSM32/ 599-1		06.10.	MB+PS	18:07	29°13.62	11°39.94	1121.2	mapping with various course
MSM32/ 600-1	MSM32 _RUN#2	07.10.	TOBI	07:17	29°06.02	11°34.19	3320.8	stopped due to technical problems
MSM32/ 600-2		07.10.	MB+PS	12:00	29°05.12	11°40.42	236.1	mapping with various course
MSM32/ 601-1	MSM32 _RUN#3	07.10.	TOBI	15:30	29°06.15	11°35.00	144.9	stopped due to technical problems
MSM32/ 602-1	MSM32- 9-1	07.10.	GC	18:02	29°11.81	11°35.96	680.8	5m barrel, recovery: 488cm
MSM32/ 603-1	MSM32- 10-1	07.10.	GC	18:52	29°10.12	11°37.60	633.0	5m barrel, recovery: 487cm
MSM32/ 604-1	MSM32- 11-1	07.10.	GC	19:44	29°09.61	11°38.62	810.9	5m barrel, recovery: 417cm
MSM32/ 605-1	MSM32- 008-013	07.10.	SEISREFL	21:11	29°03.49	11°44.64	412.6	several profiles, see separate list
MSM32/ 606-1		08.10.	MB+PS	19:30	29°48.96	11°19.03	1878.4	mapping with various course
MSM32/ 607-1	MSM32- 12-1	09.10.	ROS/CTD	13:20	30°42.24	10°59.71	2680.0	24 water samples recovered, below ~1900m noise signal, upcast significant offset from downcast until ~800m
MSM32/ 608-1		09.10.	MB+PS	15:55	30°42.33	10°59.84	2676.7	mapping with various course
MSM32/	MSM32-	10.10	GC	07:20	30°35.31	11°24.38	2499.2	5m barrel, recovery: >500cm,

609-1	13-1	.						overpenetrated
MSM32/609-2	MSM32-13-2	10.10.	GC	09:02	30°35.30	11°24.34	2494.6	10m barrel, recovery: 841cm
MSM32/610-1	MSM32-14-1	10.10.	GC	11:09	30°36.16	11°31.32	2450.0	10m barrel, recovery: 783cm
MSM32/611-1	MSM32-15-1	10.10.	GC	13:00	30°36.74	11°36.11	2254.5	10m barrel, recovery: 934cm
MSM32/612-1	MSM32_RUN#4	10.10.	TOBI	15:11	30°28.98	11°37.32	2324.3	stopped due to technical problems
MSM32/612-2	MSM32-014	10.10.	SEISREFL	16:08	30°30.39	11°37.08	2298.7	stopped due to TOBI problems
MSM32/613-1	MSM32-015-023	10.10.	SEISREFL	20:29	30°32.86	11°29.88	2434.5	several profiles, see separate list
MSM32/614-1		12.10.	MB+PS	05:04	30°09.98	10°42.42	1831.1	mapping with various course
MSM32/615-1	MSM32-RUN#5	12.10.	TOBI	11:36	30°41.93	10°57.62	2647.4	towed ca. 500m above seabed with various course, stopped due to weather
MSM32/615-2	MSM32-024-028	12.10.	SEISREFL	12:04	30°42.53	10°57.43	2647.5	several profiles, see separate list
MSM32/616-1		15.10.	MB+PS	00:46	30°53.53	11°35.41	2854.3	mapping with various course
MSM32/617-1	MSM32-16-1	15.10.	GKG	06:12	30°45.10	11°21.44	2869.6	USBL at SL 30m, recovery: 39cm
MSM32/617-2	MSM32-16-2	15.10.	GC	08:43	30°45.16	11°21.45	2869.9	5m barrel, USBL at SL 30m, recovery: 171cm, barrel bounced
MSM32/618-1	MSM32-17-1	15.10.	GC	10:50	30°45.86	11°23.43	2869.7	5m barrel, recovery: 383cm
MSM32/619-1	MSM32-18-1	15.10.	GC	13:10	30°46.74	11°28.25	2841.5	10m barrel, recovery: 563cm
MSM32/620-1	MSM32-19-1	15.10.	GC	15:37	30°39.74	11°25.27	2609.4	10m barrel, recovery: 800cm
MSM32/621-1	MSM32-29-32	15.10.	SEISREFL	17:56	30°34.64	11°19.10	2396.2	several profiles, see separate list
MSM32/622-1	MSM32-20-1	16.10.	GC	07:35	31°04.99	11°34.85	3072.7	10m barrel, recovery: 559cm
MSM32/623-1	MSM32-21-1	16.10.	GC	11:39	31°17.01	12°02.93	3383.5	10m barrel, recovery: 281cm
MSM32/624-1		16.10.	MB+PS	13:32	31°17.13	12°03.19	3384.6	mapping with various course
MSM32/625-1	MSM32-22-1	16.10.	GC	20:44	31°56.06	12°30.68	3938.0	5m barrel, recovery: 320cm, hit seabed two times
MSM32/626-1	MSM32-33-38	16.10.	SEISREFL	22:45	31°56.24	12°30.57	3938.0	several profiles, see separate list
MSM32/627-1	MSM32-23-1	17.10.	GC	07:46	31°50.18	12°29.08	3888.3	5m barrel, recovery: 420cm
MSM32/628-1		17.10.	MB+PS	09:51	31°50.54	12°29.20	3891.3	mapping with various course
MSM32/629-1	MSM32-24-1	17.10.	GC	12:47	32°11.36	12°32.97	4074.3	5m barrel, no recovery
MSM32/630-1		17.10.	MB+PS	15:06	32°11.04	12°30.46	4067.9	mapping with various course
MSM32/631-1	MSM32-RUN#6	18.10.	TOBI	17:34	29°05.66	11°33.38	127.0	towed ca. 500m above seabed with various course
MSM32/631-2	MSM32-39	18.10.	SEISREFL	18:41	29°07.23	11°34.64	158.7	several profile, see separate list
MSM32/632-1		19.10.	MB+PS	18:14	29°48.10	12°12.59	1943.8	mapping with various course
MSM32/632-2	MSM32-40-45	19.10.	SEISREFL	20:31	29°32.58	12°05.33	1775.4	several profiles, see separate list
MSM32/633-1	MSM32-25-1	20.10.	GC	07:13	29°47.13	12°07.74	1938.5	10m barrel, recovery: 673cm, may have bounced
MSM32/634-1	MSM32-26-1	20.10.	GC	08:40	29°47.75	12°08.30	1953.1	10m barrel, recovery: 890cm, may have bounced
MSM32/	MSM32-	20.10	GC	10:58	29°44.67	12°05.64	1937.7	10m barrel, recovery: 669cm

635-1	27-1	.						
MSM32/ 636-1		20.10 .	MB+PS	12:16	29°45.61	12°05.77	1942.8	mapping with various course
MSM32/ 637-1	MSM32- 28-1	20.10 .	GC	15:19	30°04.35	11°47.69	2175.8	10m barrel, recovery: 806cm
MSM32/ 638-1	MSM32- 29-1	20.10 .	GC	17:24	30°02.63	11°46.26	2193.4	10m barrel, recovery: 794cm
MSM32/ 639-1		20.10 .	MB+PS	18:46	30°02.56	11°46.12	2182.8	mapping with various course
MSM32/ 639-2	MSM32- 46-50	20.10 .	SEISREF L	23:34	29°26.43	11°39.99	1540.3	several profiles, see separate list
MSM32/ 640-1	MSM32- 30-1	21.10 .	GC	07:11	29°18.20	11°45.95	1458.9	10m barrel, recovery: 151cm
MSM32/ 641-1		21.10 .	MB+PS	13:04	29°12.24	10°48.94	95.8	mapping with various course
MSM32/ 641-2	MSM32- 51	22.10 .	SEISREF L	08:56	30°12.79	09°48.18	98.7	several profiles, see separate list
MSM32/ 642-1	MSM32- 31-1	23.10 .	GKG	07:16	29°55.49	10°00.94	137.7	recovery: 18cm
MSM32/ 642-2	MSM32- 31-2	23.10 .	GC	07:42	29°55.49	10°00.95	136.4	5m barrel, no recovery
MSM32/ 643-1		23.10 .	MB+PS	08:16	29°56.04	10°00.15	126.7	mapping with various course
MSM32/ 644-1	MSM32- 32-1	23.10 .	GKG	08:57	29°54.68	10°01.50	149.3	recovery: 25cm
MSM32/ 645-1	MSM32- 33-1	23.10 .	GKG	09:35	29°53.80	10°00.20	122.9	no recovery, corer did not close
MSM32/ 645-2	MSM32- 33-2	23.10 .	GKG	10:01	29°53.80	10°00.20	123.8	recovery: 20.5cm
MSM32/ 645-3	MSM32- 33-3	23.10 .	GC	10:20	29°53.80	10°00.21	124.3	5m barrel, liner empty
MSM32/ 646-1	MSM32- 34-1	23.10 .	GKG	11:12	29°52.76	09°58.09	109.4	recovery: 21cm
MSM32/ 647-1		23.10 .	MB+PS	11:27	29°52.76	09°58.09	108.3	mapping with various course
MSM32/ 648-1	MSM32- 35-1	23.10 .	GKG	12:33	29°56.88	10°07.16	653.2	SVP beacon at SL 30m, recovery: 41cm
MSM32/ 648-2	MSM32- 35-2	23.10 .	GC	13:16	29°56.88	10°07.16	627.0	5m barrel, recovery: 100cm, bend barrel
MSM32/ 649-1		23.10 .	MB+PS	13:54	29°57.46	10°07.77	477.5	mapping upper canyon with various course
MSM32/ 650-1	MSM32- 36-1	23.10 .	GKG	20:43	30°29.49	11°10.28	2619.1	USBL at SL 30m, recovery: 25cm
MSM32/ 651-1	MSM32- 37-1	23.10 .	GC	23:06	30°29.66	11°10.03	2600.8	10m barrel, recovery: 201cm
MSM32/ 652-1		24.10 .	MB+PS	02:40	30°48.33	10°51.56	2065.9	mapping with various course
MSM32/ 653-1	MSM32- 38-1	24.10 .	GKG	13:14	30°09.34	09°53.55	133.5	recovery: 27.5cm
MSM32/ 654-1	MSM32- 39-1	24.10 .	GKG	14:15	30°15.52	09°52.37	123.8	recovery: 27cm
MSM32/ 655-1	MSM32- 40-1	24.10 .	GKG	14:51	30°17.76	09°52.12	114.9	box corer empty
MSM32/ 655-2	MSM32- 40-2	24.10 .	GKG	15:04	30°17.76	09°52.12	114.8	box corer empty
MSM32/ 655-3	MSM32- 40-3	24.10 .	BP	15:29	30°17.76	09°52.12	115.6	recovery: ~5cm
MSM32/ 656-1	MSM32- 41-1	24.10 .	CTD/ROS	16:09	30°18.17	09°47.44	96.9	no samples taken
MSM32/ 656-2	MSM32- 41-2	24.10 .	GKG	16:27	30°18.17	09°47.45	93.6	recovery: 40cm
MSM32/ 656-3	MSM32- 41-3	24.10 .	GC	16:41	30°18.17	09°47.45	97.0	5m barrel, recovery: 150cm
MSM32/ 657-1	MSM32- 42-1	24.10 .	GKG	16:56	30°26.00	09°42.73	46.2	recovery: 43cm
MSM32/	MSM32-	24.10	GC	18:03	30°26.00	09°42.72	46.7	5m barrel, recovery: 106cm

657-2	42-2	.						
MSM32/ 658-1	MSM32-43-1	24.10.	GKG	18:50	30°24.78	09°49.52	96.9	recovery: 39cm
MSM32/ 658-2	MSM32-43-2	24.10.	GC	19:11	30°24.79	09°49.52	96.0	5m barrel, recovery: 143cm
MSM32/ 659-1	MSM32-44-1	24.10.	GKG	21:43	30°48.72	10°00.87	93.4	recovery: 42cm
MSM32/ 660-1		24.10.	MB+PS	21:52	30°48.72	10°00.87	93.7	mapping with various course
MSM32/ 661-1	MSM32-45-1	25.10.	GKG	07:55	31°18.94	10°40.29	701.4	USBL at SL 30m, recovery: 21cm
MSM32/ 662-1	MSM32-46-1	25.10.	GKG	09:32	31°25.09	10°40.06	801.7	USBL at SL 17m, recovery: 35cm
MSM32/ 663-1	MSM32-47-1	25.10.	GKG	11:00	31°21.02	10°44.79	834.9	USBL at SL 20m, recovery: 70cm
MSM32/ 664-1	MSM32-48-1	25.10.	GKG	12:55	31°12.47	10°42.85	863.8	USBL at SL 20m, recovery: 24cm
MSM32/ 665-1	MSM32-49-1	25.10.	GKG	14:19	31°12.74	10°37.53	676.7	USBL at SL 14m, no recovery, box corer turned to side, wire tangled around framework
MSM32/ 665-2	MSM32-49-2	25.10.	GKG	15:08	31°12.74	10°37.54	678.2	USBL at SL 14m, recovery: 45cm
MSM32/ 666-1	MSM32-50-1	25.10.	GKG	16:20	31°09.79	10°38.23	782.3	USBL at SL 20m, no recovery
MSM32/ 666-2	MSM32-50-2	25.10.	GKG	17:18	31°09.78	10°38.25	788.2	USBL at SL 17m, recovery: 27.5cm
MSM32/ 667-1	MSM32-51-1	25.10.	ROS/CTD	18:37	31°12.74	10°37.53	685.4	JoJo-CTD: count 1 14 water samples recovered, data recording did not work, to be repeated
MSM32/ 667-2	MSM32-51-2	25.10.	ROS/CTD	19:52	31°12.74	10°37.53	683.5	JoJo-CTD: count 2 14 water samples recovered
MSM32/ 667-3	MSM32-51-3	25.10.	ROS/CTD	21:38	31°12.75	10°37.53	699.0	JoJo-CTD: count 3 2 bottom water samples: 665m
MSM32/ 667-4	MSM32-51-4	25.10.	ROS/CTD	22:25	31°12.75	10°37.53	681.8	JoJo-CTD: count 4 2 bottom water samples: 670m
MSM32/ 667-5	MSM32-51-5	25.10.	ROS/CTD	23:17	31°12.75	10°37.53	681.1	JoJo-CTD: count 5 2 bottom water samples: 672m
MSM32/ 667-6	MSM32-51-6	26.10.	ROS/CTD	00:05	31°12.75	10°37.53	679.3	JoJo-CTD: count 6 2 bottom water samples: 675m
MSM32/ 667-7	MSM32-51-7	26.10.	ROS/CTD	00:46	31°12.75	10°37.53	678.0	JoJo-CTD: count 7 2 bottom water samples: 676m
MSM32/ 667-8	MSM32-51-8	26.10.	ROS/CTD	01:28	31°12.74	10°37.53	676.8	JoJo-CTD: count 8 2 bottom water samples: 676m
MSM32/ 667-9	MSM32-51-9	26.10.	ROS/CTD	02:07	31°12.74	10°37.53	678.2	JoJo-CTD: count 9 2 bottom water samples: 676m
MSM32/ 667-10	MSM32-51-10	26.10.	ROS/CTD	02:49	31°12.75	10°37.53	684.5	JoJo-CTD: count 10 2 bottom water samples: 677m
MSM32/ 667-11	MSM32-51-11	26.10.	ROS/CTD	04:32	31°12.75	10°37.54	689.7	JoJo-CTD: count 11 2 bottom water samples: 677m
MSM32/ 667-12	MSM32-51-12	26.10.	ROS/CTD	05:21	31°12.75	10°37.54	687.7	JoJo-CTD: count 12 2 bottom water samples: 677m
MSM32/ 667-13	MSM32-51-13	26.10.	ROS/CTD	06:05	31°12.75	10°37.53	682.8	JoJo-CTD: count 13 2 bottom water samples: 675m
MSM32/ 667-14	MSM32-51-14	26.10.	ROS/CTD	06:49	31°12.75	10°37.53	681.1	JoJo-CTD: count 14 2 bottom water samples: 673m
MSM32/ 667-15	MSM32-51-15	26.10.	ROS/CTD	07:45	31°12.75	10°37.53	683.8	JoJo-CTD: count 15 8 water samples recovered
MSM32/ 668-1	MSM32-52-1	26.10.	ROS/CTD	09:39	31°12.73	10°34.49	623.8	8 water samples recovered
MSM32/ 669-1	MSM32-50-3	26.10.	ROS/CTD	11:02	31°09.78	10°38.24	785.2	8 water samples recovered
MSM32/ 670-1	MSM32-48-2	26.10.	ROS/CTD	12:38	31°12.47	10°42.85	934.4	8 water samples recovered
MSM32/ 671-1	MSM32-45-2	26.10.	ROS/CTD	14:37	31°18.95	10°40.32	702.5	8 water samples recovered

MSM32/ 672-1	MSM32- 46-2	26.10 .	ROS/CTD	16:17	31°25.09	10°40.06	793.9	8 water samples recovered
MSM32/ 673-1	MSM32- 47-2	26.10 .	ROS/CTD	17:55	31°21.02	10°44.79	835.3	8 water samples recovered
MSM32/ 674-1	MSM32- 52-54	26.10 .	SEISREF L	19:27	31°20.58	10°49.77	994.5	several profiles, see separate list
MSM32/ 675-1	MSM32- 53-1	27.10 .	GC	08:13	30°30.70	10°50.26	2099.0	10m barrel, recovery: 802cm
MSM32/ 676-1		27.10 .	MB+PS	10:56	30°46.73	10°58.79	2156.5	mapping with various course
MSM32/ 677-1	MSM32- 54-1	27.10 .	GC	16:22	31°16.03	10°50.56	3185.0	10m barrel, recovery: 531cm
MSM32/ 678-1		27.10 .	MB+PS	19:04	31°24.50	11°58.98	2806.1	mapping with various course
MSM32/ 679-1	MSM32- 55-1	27.10 .	GC	22:03	31°42.69	12°23.99	3804.5	5m barrel, recovery: 187cm
MSM32/ 680-1	MSM32- 56-1	28.10 .	GC	01:12	31°53.43	12°30.18	3910.7	5m barrel, recovery: 238cm
MSM32/ 681-1		28.10 .	MB+PS	03:08	31°53.46	12°30.00	3914.7	mapping with various course
MSM32/ 682-1	MSM32- 55-56	28.10 .	SEISREF L	08:45	32°44.51	12°51.00	3527.4	several profiles, see separate list
MSM32/ 683-1	MSM32- 57-1	28.10 .	GC	18:36	31°55.14	12°30.49	3929.4	5m barrel, recovery: 157cm