

Workshop Report to ESF, October 20, 2008
by Maria Ask and Achim Kopf, with contributions from the workshop participants

Workshop on Marine Research Drilling (MAGELLAN WORKSHOP SERIES)
OCEAN DRILLING FOR SEISMIC HAZARD IN EUROPEAN GEOSYSTEMS

CONVENERS:

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SCIENTIFIC COMMITTEE:

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Photo of participants of the ESF and VR supported workshop “*Ocean Drilling for Seismic Hazard in European Geosystems*”, held August 18-20, 2008, Luleå University of Technology, Luleå, Sweden.

Main sponsor of the workshop



Life, Earth and Environmental Sciences (LESC)

Co-sponsor of the workshop



1. SUMMARY (UP TO 1 PAGE)

Submarine seismic geohazards are some of the most devastating natural events in terms of lives lost and economic impact. Earthquakes pose a big threat to society and infrastructure because of their episodicity, while tsunamis are known for their potential of striking coastlines world-wide. However, the governing processes and recurrence intervals of geohazards are still poorly understood. The European scientific community has a strong focus on geohazards along European and nearby continental margins. For example, the Mediterranean is highly vulnerable with respect to submarine geohazards because of its densely-populated coastline that is the World's leading holiday destination with up to 30% of the global tourism, and its seafloor that is criss-crossed by hydrocarbon pipelines and telecommunication cables. Examples include earthquakes along the active tectonic margins of the Mediterranean and Sea of Marmara, landslides on active and passive margins, tsunamis, and tsunamites and seismites in the sedimentary record that suggest a long history of similar events.

The Magellan Workshop sponsored by the European Science Foundation and the Swedish research council entitled "*Ocean drilling for seismic hazard in European geosystems*" was recently held in Luleå, Sweden, 18-20 August, 2008. The workshop objectives were to: (1) address scientific questions and goals on a European scale; (2) combine European expertise in research related to seismogenesis, and (3) coordinate and strengthen Europe's role within large-scale international projects (e.g. IODP [Integrated ocean drilling program] and ICDP [International continental scientific drilling program]). A total of 19 dedicated scientists participated at the workshop, from nine European countries and USA (see Section 4). The expertise of the group spans over a wide scientific spectrum within geosciences. In addition, several of the participants have been (or are) leaders of scientific drilling expeditions, lead proponents of IODP and ICDP proposals, members of the IODP science advisory structure, and/or leaders of ongoing EU projects.

About half of the workshop was devoted to presentations about the IODP and ICDP structures, active and future drilling proposals related to the topic of the workshop, report from the IODP workshop on geohazards, technology needed (stress measurements, observatories, ship status, new site survey sources), funding, as well as various aspects of seismic hazard (landslide triggers and slope response, earthquake modeling, and tsunamis). The second half of the workshop was devoted to discussions in the entire group as well as in break-out working groups. The first group focused on existing and new drilling- and engineering development proposals. Much of the discussion regarded proposals for which MSPs (mission specific platforms) could be used. The second group concentrated on proaction to increase the recognition of ocean drilling for geohazards within individual member countries, EU and IODP.

The deliverables of the workshop, stated in the application, are already fulfilled: (1) a summary article to the ECORD newsletter (October 15, 2008); and (2) a new proposal, 738-APL "*Ancillary Project Letter: Nankai Trough Submarine LandSLIDE history (NanTroSLIDE)*" to IODP (October 1, 2008) by Michael Strasser (lead proponent) and Angelo Camerlenghi among other co-proponents.

Additional post-workshop activities include submission of an abstract to the AGU fall workshop in San Francisco in December 2008 by the group of workshop participants (*Ask et al., 2008*), and two presentations on geohazards and scientific drilling, given as a follow-up of the workshop, at the 2nd EURO-MEDITERRANEAN Symposium by Angelo Camerlenghi, and for Statoil executives by Maarten Venneste. We are planning talks on geohazards at EGU General Assembly in April 2009, and IODP INVEST meeting in Bremen in September 2009. Further progress regarding proposals include (1) several existing IODP proposals are planned to be resubmitted on April 1, 2009 (685-full [*Pierre Henry et al.*] and one complex drilling proposal, CDP, 715-full [*Angelo Camerlenghi et al.*] and October 1, 2009 (710-pre2 [*Lisa McNeill et al.*] that will be adapted for MSP drilling, and 704-full2 by [*Chris Goldfinger et al.*]); (2) one engineering drilling proposal will be submitted to IODP on April 15, 2009, for development of in situ stress measurements by Francois Cornet, Pierre Henry, and Achim Kopf; and (3) one pre-proposal on riser or riser-less drilling is planned to be submitted during year 2009, by Jean-Yves Collot. Another result of the workshop is the contention that ocean scientific drilling of geohazards needs more attention in the EU framework programs. The two workshop organizers try to respond to this shortcoming by leading a proposal for a coordination action on subseafloor sampling (formerly Deep-Sea Frontier Initiative; Achim Kopf) and for submission of a Marie Curie RTN (initial training network; Maria Ask) proposal in early 2009. The workshop also recognizes the need for industry cooperations, and a small group lead by Maarten Venneste, was formed.

2. DESCRIPTION OF THE SCIENTIFIC CONTENT OF AND DISCUSSION AT THE EVENT (UP TO 4 PAGES)

Scientific Presentations

The scientific program is presented in Section 4, and the scientific presentations are reviewed below.

Report from IODP International Workshop on Geohazards, 26 – 30 August 2007, Portland, Oregon, USA

The IODP workshop was organized by two conveners (Julia Morgan and Eli Silver) and a steering committee (Angelo Camerlenghi, Brandon Dugan, Steve Kirby, Kiyoshi Suyehiro, and Craig Shipp). It gathered 89 participants from 18 countries, and was the first of its kind within IODP. The full report from the workshop is available online (<http://www.iodp.org/geohazards>).

Six key questions that require ocean drilling of submarine geohazards were identified at the workshop: (1) What are the sizes and frequency of hazardous events? What factors control them? (2) Can the tsunamigenic potential of past and future events be assessed? (3) Do precursory phenomena exist and can be recognized? (4) Can we monitor seafloor movements? (5) What makes up weak layers to localize slip? (6) What triggers rapid seafloor deformation? Four consensus items were formulated: (1) Scientific drilling is a unique tool that provides ground truth like no other approach; (2) Coordinated efforts are needed to study geohazards in ocean setting; (3) Mandate to include geohazards in the updated ISP (initial science plan) of IODP; and (4) The IODP geohazards component complement those of other research entities, including NSF MARGINS Program and national hazards programs.

The workshop participants agreed that the IODP workshop defined the broad framework for studying geohazards through ocean drilling, the background knowledge, and the community structure.

Scientific Drilling Programs and Their Proposals

The overall structure of IODP was presented, followed by a summary of active proposals. As of April 10, 2008, there are 112 active proposals on the IODP system, of which three are CDP proposals (complex drilling project proposals). ECORD scientists are very active proponents, e.g., over 40% of the proponents are from ECORD countries, compared to USA and Japan that contribute with 34% and 14% of proponents, respectively. Most proposals need a non-riser drilling platform, (76%), but 9% need a MSP (mission specific platform).

ICDP differs from IODP regarding funding structure, equipment pool, and scientific advisory structure. Individual drilling programs are mainly financed by the host country, while ICDP offers partial financial and operational support. The drilling platform is defined for each drilling project. ICDP organizes a workshop for approved pre-proposals, after which a full proposal is submitted. Since the establishment in 1993, ICDP has received 201 proposals, organized 45 workshops and supported 22 projects. Further information is available on <http://www.icdp-online.org/>.

Engineering development proposals are needed by IODP to fulfill goals of the ISP. Examples of near-term engineering development needs are refined core barrels and logging tools, improved core quality and quantity, and standards between platforms, observatories and procedures. There are three types of engineering development proposals, depending on project cost (Class A and B, respectively) or solicited IODP need (Class C). For further details, see <http://www.iodp.org/eng/>.

EU – Project Funding, Collaborations and Links to Ongoing European Activities

Much research on submarine geohazards could be funded by EU through: (1) Collaborative research (theme Environment). However, the calls are often aimed within such a narrow field, IODP research is often excluded; (2) ERC (European Research Council); and (3) Marie Curie actions. Lobbying is required to develop calls more directed to IODP specific research. Networking activities such as the ECORD ERA Net are important area for lobbying, and it is also important to maintain a tight link to the Deep Sea Frontier initiative, which has not succeed within ocean drilling yet, and perhaps participate in a continuation of ECORD Net. Because Mediterranean is unique within European geosystems, additional networking initiatives specifically targeted at Mediterranean submarine geohazards are desirable, within Marie Curie Training Network and/or Industry-academia pathways and partnerships.

More specifically, the talk presented excerpts from the –then upcoming – text of the call for proposals (launched Sept. 2, 2008) in order to trigger discussion and possibly identify opportunities where the participants could submit their research ideas. As a matter of fact, both a Coordinating action call and a

Integrated project call show significant overlap with drilling/subseafloor sampling and also seismic hazard borehole monitoring (see below).

Technology Needs

EMSO (European Multidisciplinary Seafloor Observation) deep sea-floor observatories are deployed on specific sites offshore European coastline to allow continuous monitoring for environment and security. EMSO build on other seafloor observation programs (GMES, global monitoring for environment and security, and ESONET, European seafloor observatory network), and has the main objectives to (1) establish an entity for the EMSO infrastructure for long-term deep water observations and investigations; (2) enable deployment of the infrastructure and its long-term management; and (3) promote the catalytic process and synergic effort at EU and national levels, coordinating and harmonizing all available resources observatories.

Knowledge of in situ stress is critical for understanding faulting and earthquake generation. However, it is difficult to conduct in situ stress measurements of good quality and do valid interpretations. The full stress tensor requires definition of six components defined in a reference frame, but often simplifying hypotheses can be made. Several techniques exist for boreholes, however, most of them only determine parts of the stress tensor and the results may be difficult to interpret. Best results are achieved by integrating different stress methods, e.g. hydraulic fracturing and hydraulic fracturing of pre-existing fractures, and to follow quality assurance routines.

IODP and Other European Drilling Proposals on Seismic Hazard

The status of IODP and ICDP proposals on seismic hazard were presented, namely:

IODP 685-Pre	Installation of Borehole Observatories on the Ligurian Margin (<i>P. Henry, et al.</i>)
ICDP	Cold seeps associated with the North Anatolian Fault zone in the Sea of Marmara (<i>G. Dresen et al.</i>)
IODP 710-Pre2	Early Rift Development: Gulf of Corinth (<i>L. McNeill, et al.</i>)
ICDP	Deep Geodynamic Laboratory - Gulf of Corinth (<i>F. Cornet et al.</i>)
IODP 555-Full3	Backstop hydrogeology of a wide accretionary complex south of Crete, Eastern Mediterranean Sea (<i>A. Kopf, et al.</i>)
ICDP	SAFOD (San Andreas fault zone observatory at depth), GONAF (geophysical observatory of the North Anatolian fault), MOLE (multidisciplinary observatory and laboratory of experiments along a drilling in central Italy), NELSAM / DAFSAM (Natural earthquake laboratory in South African mines / Drilling active faults in South African mines), DFDP (deep fault drilling project), and Drilling along the Nankai Trough, and Crete / Hellenic subduction zone drilling.

Status of Drill Ships and Tools

No IODP expeditions are currently ongoing. Budget restrictions reduce yearly operation time to max. 7-8 months per year for the *SODV* (scientific ocean drilling vessel) and *Chikyu*. The *SODV* is scheduled to leave Singapore for Darwin on 11 October 2008. Maintenance, preservation of machinery and equipment is ongoing on *Chikyu*, which will be followed by preparation work and research activities in the laboratory area. Two MSP expeditions are scheduled for 2009, New Jersey and Great Barrier Reef.

NantroSEIZE: Nankai Trough Seismogenic Zone Experiment

The IODP Stage 1 drilling expeditions 314 – 316 has been completed. Coring results include successful penetration of mega-splay branches and active fault zones in Holes C0001 and C0004. Evidence for mass wasting processes have been found in Holes C0004 and C0008, and fault zones at the toe of the accretionary prism has been characterized in Holes C0006 and C0007. The results show: (1) evidence of complex deformation patterns; (2) high degree of deformation (totally fragmented claystones) and intrinsically low friction along mega-splay branches; (3) recovery of altered gouge material in fault zones at the splay and at the toe of the accretionary prism; (4) mass wasting plays a more prominent role than anticipated; and (5) riser drilling is needed to core fault zones and sample underlying strata, and also to increase overall core recovery.

Aspects of Seismic Hazard

Numerical simulations can be used to explore controlling factors of (oceanic) geohazards, e.g., (1) How internal deformation transfers to seafloor deformation; (2) How instability develops; and (3) Where failure or deformation will occur. The DEM (discrete element method) works very well, and provides important insights into structural evolution and mechanical controls. DEM modeling of faults and structures allows capture of structural characteristics of unstable geologic systems, and potentially predict factors such as size and frequency. However, constraints on material properties are needed.

Submarine slides can initiate on relatively gentle slopes. When triggered, these slides typically involve large volumes of soil/sediments. Mechanism of movement is a combination of debris flow and turbidity current which results in very long run-out distances. At risk are seabed facilities, both by slide and tsunami generation. Earthquake is a major triggering mechanism for initiation of submarine slides, which can occur immediately after the earthquake, delayed, up to years after. Failure mechanisms may differ among soil types, but some mechanisms are independent of soil type.

There is a need to understand the relative importance of earthquakes as triggers of submarine landslides. Preconditioning factors favoring submarine slope stability and instability depend on the sediment characteristics and stress history. These factors can only be calculated if: (1) samples and in situ measurements are available below, at and above the detachment surface; (2) the sedimentary history of the continental slope is known. Scientific drilling (including site survey data) is mandatory for calculating the preconditioning factors. The Mediterranean is a suitable area for studying landslides in a non-glaciated setting.

The NEA (North East Atlantic) region has been the focus of major investigation in the last decade: bathymetry, tomography, seismic profiles, and other surveys. Seismic risk assessment in this area is based on a short period of historical and even shorter instrumental period. Tsunamis in the NEA region may be generated by seismicity, landslides, and volcanic eruptions, from local or far field events. Paleoseismic and -tsunami investigation of the deep sea sedimentary record can be the tool to identify seismic recurrence for the NEA region.

Integrating P- and S-waves are important for characterization, geohazard assessment and excess pore pressure evaluation. Spectral analysis of surface wave yields detailed shear wave velocity profiles of the shallow sub-surface used for geotechnical characterization. The methodology relies on rock physical models/effective medium theory to relate seismic response to quantification and characterization. NGI (Norwegian Geotechnical Institute) has developed and successfully deployed a dual-mode shear wave source prototype. NGI has also developed a forward modeling tool, LaySac5, which is crucial for modelling and interpretation of the results from the prototype.

Open Session on Future Drilling Projects on Seismic Hazard/Related Geohazards

Six presentations of future IODP and ICDP drilling projects were given:

- (1) EQ-triggered subaquatic landslides, paleo-seismology and seismic hazard in the Swiss Alps. In this study on seismic hazard in central Europe and alpine tectonics, it is proposed that closed basins can provide high-resolution archives for paleo-earthquakes;
- (2) Paleoseismology of South-Central Chile. Structures in Chilean lacustrine sediment cores correlate to past giant earthquakes. Potentially, it may be a good amphibibic ICDP-IODP project;
- (3) MSP proposal Nice airport. New results propose that a sensitive clay layer, fresh water, excess pore pressure and overloading lead to failure at Nice airport; new questions are generated;
- (4) The Ecuador Margin: a potential IODP target (linked to the SEIZE initiative). New MCS data identify five drilling targets to study the seismogenic zone and splay fault, subduction erosion processes, sediment transformation, and shear localization;
- (5) Sumatra Sunda subduction zone - Future drilling and related activities. A site survey in 2008 collected seismic refraction data for the IODP proposal 704-Full (C. Goldfinger, et al.); and
- (6) Cenozoic mud volcano activity along the Indus Fan – offshore Pakistan. Seismic reflection data show several generations of mud volcanoes: Are mud volcanoes a potential geohazard?

The participants agree that several of these talks are likely to develop into drilling proposals, and that it would be desirable to develop amphibibic drilling projects, i.e. combined IODP and ICDP projects.

Discussions

Working Group 1: Development of Proposals

The focus on the discussions of this working group was strategic changes to existing proposals and their potential role in upcoming EU FP7 call on seismic borehole observatory science, and new proposals. The following actions were discussed for proposals:

- IODP 685-Pre2** is most likely to be submitted as a MSP full proposal on April 1, 2009 (*P. Henry et al.*)
- IODP 704-Full** is to be submitted as a Full2 proposal on Oct. 1, 2009 (*C. Goldfinger, L. McNeill, et al.*)
- IODP 710-Pre2** is most likely to be submitted as a MSP full proposal on April or Oct. 1, 2009 (*L. McNeill et al.*)
- IODP 715-Full** is most likely to be submitted as a CDP on April 1, 2009 (*A. Camerlenghi et al.*)
- New IODP APL** A new APL proposal, Nankai Trough Submarine Landslide history (NanTroSLIDE) was submitted Oct. 1, 2008 (*M. Strasser, et al.*; **IODP APL-738**)
- New IODP APL** A new APL proposal, Nankai-Kumano Basin mud volcanoes is to be submitted on Oct. 1, 2009 (*J. Ashi, A. Kopf, et al.*)
- New IODP Pre** A new pre-proposal on Seismic forearc drilling in Ecuador is planned to be submitted in 2009 (*J-Y Collot et al.*)
- New IODP ED** A new ED proposal for stress measurements is to be submitted on April 15, 2009 (*F. Cornet, P. Henry, A. Kopf, et al.*)
- New IODP** A pre-proposal, Paleoseismology in Swiss lakes is pre-planned for 2010 (*F. Anselmetti, M. Strasser, D. Giardini, et al.*)

Working Group 2: Proaction to Increase the Recognition of Ocean Drilling for Geohazards

Discussions focused on funding and proactive steps to increase recognition of ocean drilling for geohazards within individual member countries, EU and IODP.

A first aspect of funding is the European membership level to IODP. While IODP statistics show that ECORD scientists are committed and make a substantial contribution to IODP, we are not equally financially committed. The next phase of IODP is an opportunity to step-up to full membership. ECORD scientists must inform EU and ECORD executives and policy makers about the importance of ocean drilling for geohazards, because the effect of geohazards is a concern to all Europeans. Good opportunities to inform EU and ECORD executives and policy makers are the upcoming EGU meeting in Vienna, April 2009 and the IODP INVEST Bremen meeting in September, 2009. A power point presentation on geohazards should be made that allow individual scientists to inform appropriate representatives in their respective country.

A second aspect of funding is the ability of individual scientists to attract ESF and EU funding for IODP related research. We aim at responding to ESF calls in 2009 and explore the three FP7 environments Industry-academia, Marie Curie, and Training networks. It is also important to lobby for formulation of calls within our field of research. There are two important steps that should be considered: First, communicate with the DSF steering committee that the observatory part has been implemented; now the need is to go on with drilling and geohazards. Second, unite around the scope of geohazards, i.e. define the focus, or mission statement (collect samples, measure in-situ, observe long-term), set-up an acronym, design a logo, and set-up a low maintenance and up-to-date web site.

The two funding aspects above help to increase the recognition of ocean drilling for geohazards. In addition, it is important to present talks and posters at upcoming meetings, for example at the EURO-MEDITERRANEAN Symposium and AGU fall meeting in 2008, and the EGU and IODP INVEST meetings in 2009. For the latter meeting, a white paper on geohazards should be compiled, which stress the importance of scientific drilling to solve the open problems. The white paper should be based on the existing documents from the IODP Portland workshop¹ and the DSF report². Marine geohazards should be included in the next science plan of IODP and in the EU FP work plans. We see that geohazards has the potential to improve the visibility of the entire IODP program, because it is a concern to almost all EU citizens, at home or on vacation.

¹ <http://www.iodp.org/geohazards>

² <http://ec.europa.eu/research/environment/pdf/deepseefrontier.pdf>

3. ASSESSMENT OF THE RESULTS AND IMPACT OF THE EVENT ON THE FUTURE DIRECTION OF THE FIELD (UP TO 2 PAGES)

In order to place the results of the workshop into the context of larger initiatives and recognition of the expert group that met in Luleå, we want to stress a few points. Naturally, the largest impact of the workshop on “*Ocean drilling for seismic hazard in European geosystems*” is to be anticipated for the IODP. This was achieved directly by the gathering of people with active drilling proposals (A. Camerlenghi, L. McNeill, P. Henry, A. Kopf as lead proponents of 715-Full, 710-Pre2, 685-Pre2, 555-Full3, respectively) in the Mediterranean Sea, but also by inviting experts in continental drilling and the ICDP community. The latter group teamed up with marine scientists and in case of the Gulf of Corinth, tries to link the continental CRL site (F. Cornet) with marine proposals (L. McNeill, 710-Pre2) by responding to the recent EU call for seismic borehole observatory science (ENV.2009.4.1.1.1 Contribution to observing systems for seismogenic hazards). This type of amphibic approach triggers cross-fertilization and interdisciplinary research across boundaries between different communities. A third approach of the workshop to widen the scope was the invitation of experts in seismic hazards with research interests inside, but also outside of Europe. Those researchers were equally responsive to calls for proposals and submitted innovative drilling strategies for Japan (M. Strasser, 738-APL), or made plans to do so for Ecuador (J-Y Collot) and Liguria (P. Henry, S. Stegmann, N. Sultan, A. Kopf) in the near future. In summary, three main thrusts of activities, including a number of action items, were put forward to set the stage for an increased recognition and impact of European scientists in the field of hazard drilling:

I – IODP Proposals

Both the updates of existing proposals and the submission of new proposals from a strong group of European experts represent a crucial signal and guiding light to the marine scientific drilling community and their funding agencies. This seems to be of particular importance at times where

- (1) the flag ship IODP platforms (*SODV, Chikyu*) operate rather discontinuously while ECORD mission specific operations suffer from tremendous demand by industry (and hence postponed platform availability for several legs);
- (2) we approach the end of the current IODP phase with difficulties in funding; and
- (3) where it is vital to develop exciting scientific ideas and hypotheses to be solved by drilling and to complement them by intelligent drilling strategies and technologies, especially with the INVEST meeting ahead (Bremen, September 2009) where the new science plan for the post-2013 phase has to emerge.

The latter aspect was further addresses in the workshop by the commitment of a group of participants to submit an ED (engineering development) proposal on state-of-the-art borehole stress measurements to IODP in 2009 (F. Cornet, P. Henry, A. Kopf). With this, we serve all varieties in the IODP proposal system, i.e. a CDP, Pre- and Full-proposals, an APL and an ED proposal. Hence, the participants represent ECORD science and European leadership in several fields related to the abovementioned geohazard science.

II – Geohazard MSP Opportunities

The second main thrust of the workshop was to define a “mission” of European researchers involved in a field which, historically, is occupied by US scientists (who more recently have been flanked by Japanese scientists). This dominance is reflected by the nationalities of the NanTroSEIZE PMT (project management team). No European scientists are represented in the core PMT, and only one European is a member of the wider PMT team (A. Kopf). Another result of this dominance is the large number of American and Japanese co-chiefs formerly invited to convergent margins legs in ODP and IODP. So far, the traditional research fields of mission specific drilling funded by the “European leg of the IODP stool” have been devoted to climate change and most recent geological records in Earth history. The workshop has tried to develop a number of mission-specific targets in the field of geodynamics, and more specifically geohazards, whose prerequisites include the inability to use either *SODV* or *Chikyu*. Examples include the Gulf of Corinth (a new bridge hinders either drill ships to enter the Gulf) or the Ligurian margin (the slope failures south of the city of Nice occurred in only 12-15 m water depth). More loosely related, drilling for submarine landslides often calls for geotechnical drilling, for instance by deploying CPTU probes (cone penetration tests with pore pressure monitoring). Such drilling, as

proposed by Camerlenghi in proposal 715-full, cannot be performed with the regular IODP platforms, and hence requires a MSP. A number of quality drilling proposals addressing the MSP component of IODP will enhance the recognition of European scientists in fields other than climate change.

III – European Proposals

Third, the workshop participants consulted colleagues with a wealth of experience in EU funding schemes. Starting from a presentation on this topic, a fruitful discussion and brain storming evolved. For the time being, this culminated in two break-out groups which developed future strategies for EU proposals. Similar to the proposals addressed to IODP (see first point above), the EU approach serves a variety of funding mechanisms. These include:

- (1) Submission of proposal on Geohazard drilling and related topics to obtain Marie Curie research & training network. Maria Ask is the leader for submitting a Marie Curie network proposal in early 2009;
- (2) Nurturing and/or establishment of industry cooperations, for which a small group lead by Maarten Venneste was formed;
- (3) Submission of a proposal for a coordination action on subseafloor sampling in response to the recent EU call. This represents the continuation of the Deep-Sea Frontiers (DSF) initiative which was founded by the ECORD Council and is underway to gain new momentum. Achim Kopf got appointed the new coordinator of the DSF successor proposal by the steering committee; and
- (4) Submission of a proposal for a large-scale Integrated Project on drilling and borehole installations to understand seismic hazards. Here, a number of proponents compile an amphibic project on onshore (CRL Phase 2 drilling into the Aigeon fault, Gulf of Corinth) and offshore (with seafloor drill-rig MeBo from University Bremen, Germany) holes to shed light on fault mechanics and earthquake hazard. The proposal is led by Francois Cornet and accompanied by Achim Kopf and Lisa McNeill.

In addition to the immediate response to the EU call launched in early September 2008 (i.e. immediately after the Magellan workshop in Luleå), the two workshop coordinators are planning to put together a proposal for an ESF EuroCores topic related to geohazard research. This could be either a second phase of the ongoing EuroMARC programme, then possibly with targets further away from climate and ecosystem research, but along the same drilling-related line, or alternatively a new approach complementing the DSF successor and ECORD activities. Both paths may be suitable to strengthen the role of European researchers in IODP, well beyond the field of “*Ocean drilling for seismic hazard in European geosystems*”.

Impact of the Event

Camerlenghi, A., 2008. Scientific Drilling to Address Submarine Geohazards in the Mediterranean Sea. 2nd EURO-MEDITERRANEAN Symposium. A pan-Mediterranean strategy Hotel Hilton, 11th – 12th September 2008, Portorosa - Furnari (ME)

Ask, M., A. Camerlenghi, A. Kopf, J.K. Morgan, and participants of the 2008 ESF Magellan workshop “Ocean Drilling for Seismic Hazard in European Geosystems”, 2008. Scientific Ocean Drilling to Assess Submarine Geohazards along European Margins. AGU Fall workshop, *submitted*.

Strasser, M., G. F. Moore, J. Ashi, A. Camerlenghi, B Dugan, K. Huhn, K. Kawamura, B.G. McAdoo, G. Panieri, G. A. Pini, R. Urgeles., 2008. APL-738. Ancillary Project Letter: Nankai Trough Submarine Landslide history (NanTroSLIDE). Submitted to IODP on October 1, 2008.

Kopf, A., 2008. Ocean Drilling for Geohazards. Deep Sea Frontier steering committee workshop, Barcelona, Spain, 6 October, 2008.

4. FINAL PROGRAM OF THE WORKSHOP AND WORKSHOP PARTICIPANTS

Final Program

DAY/TIME	TITLE	SPEAKER
<u>Monday, 18 August</u>		
9.00 – 10.00	Opening and welcome Introduction to workshop goals and ocean drilling	Maria ASK (SE), Achim KOPF (DE)
10.00 – 10.30	Coffee (Centrumrestaurangen Amica)	
10.30 – 11.15	Report from IODP International Workshop on Geohazards	Julia MORGAN (USA)
11.15 – 12.00	Scientific Drilling Programs and their proposals IODP and ICDP Drilling Proposals and Statistics IODP Engineering development proposals	Achim KOPF (DE) Maria ASK (SE)
12.00 – 13.00	Lunch (Wibergsgården)	
13.00 – 14.00	Funding EU – Project funding, Collaborations and links to ongoing European activities	Angelo CAMERLENGHI (SP)
14.00 – 15.00	Technology EMSO: European Multidisciplinary Seafloor Observation In Situ Stress Measurements and Regional Stress Field Determination	Miguel MIRANDA (PT) François CORNET (FR)
15.00 – 15.30	Coffee (Centrumrestaurangen Amica)	
15.30 – 17.00	IODP and other European drilling proposals on seismic hazard Ligurian Sea Cold seeps associated with the North Anatolian Fault zone in the Sea of Marmara Gulf of Corinth, Greece: Geohazards and Drilling Potential New results and challenges for the Corinth Rift Laboratory	Pierre HENRY (FR) Pierre HENRY (FR) Lisa MCNEILL (UK) François CORNET (FR)
17.00 – 17.15	Coffee (Hoppe-salen)	
17.15 – 18.00	<i>Continue</i> IODP and other European drilling proposals on seismic hazard Eastern Mediterranean Sea: Drilling proposal 555-full3 International Continental Scientific Drilling Program and proposals on seismic hazard	Achim KOPF (DE) Achim KOPF (DE)
18.00 – 18.15	Status of drillships and tools	Maria ASK (SE)

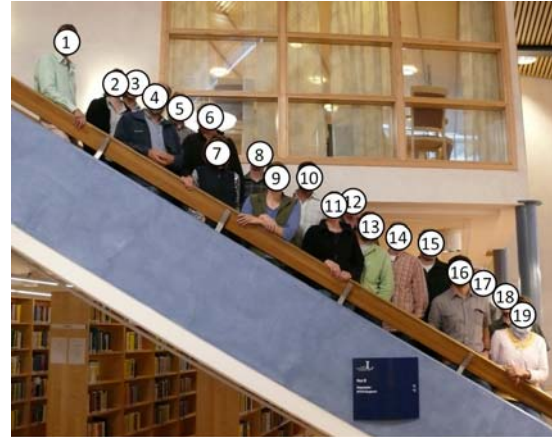
18.15 – 18.45	NantroSEIZE: Nankai Trough Seismogenic Zone Experiment	Achim KOPF (DE)
18.45 – 19.00	Wrap-up of day 1	Achim KOPF (DE)
<u>Tuesday, 19 August</u>		
8.30 – 10.00	Aspects of Seismic Hazard	
	Particle Dynamics Models of Faulting and Structural Evolution: Applications to Geohazards	Julia MORGAN (USA)
	Earthquake modeling	
	Earthquake response of submarine slopes	
	Tsunami hazards in the North East Atlantic (NEA) region	Amir KAYNIA (NO) Maria Ana BAPTISTA (PT)
10.00 – 10.30	Coffee (Centrumrestaurangen Amica)	
10.30 – 11.00	Seismic hazard: Geotechnical stuff, modelling and mitigation	
	Submarine landslides, earthquakes, and the Mediterranean case	Angelo CAMERLENGHI (SP)
	Seabed Mapping with surface and shear Waves for Geohazards	Maarten VANNESTE (NO)
11.00 – 12.00	Open session on future IODP drilling projects on seismic hazard/related geohazards	
	EQ-triggered subaquatic landslides, paleoseismology and seismic hazard in the Swiss Alps	Michi STRASSER (DE) Marc De Batist (BE)
	Paleoseismology of South-Central Chile	Nabil SULTAN (FR)
	MSP proposal Nice airport	
12.00 – 13.00	Lunch (Wibergsgården)	
13.00 – 14.00	<i>Continue</i> Open session on future IODP drilling projects on seismic hazard/related geohazards	
	The Ecuador Margin: a potential IODP target (linked to the Seize initiative)	Jean-Yves COLLOT (FR)
	Sumatra Sunda subduction zone - Future drilling and related activities	Lisa MCNEILL (UK)
	Cenozoic mud volcano activity along the Indus Fan – offshore Pakistan	Gerome (CALVES)
14.00 – 15.00	Plenary discussion of European role in IODP and potential drilling targets	
	Set up of the two working groups on Proposals (existing and new ones) and Proactive working group on increasing the recognition of geohazards	
15.00 – 15.30	Coffee (Centrumrestaurangen Amica)	
15.30 – 17.00	Discussion in the two working groups on the development of active and planned drilling proposals (and engineering development proposals)	
17.00 – 17.15	Coffee (Hoppe-salen)	

17.15 – 17.45	Continuation of discussion in working groups on the development of active and planned drilling proposals (and engineering development proposals)	
17.45 – 18.30	Report from working groups on the development of active and planned drilling proposals (and engineering development proposals), and plenary discussion	
18.30 – 18.45	Wrap-up of day 2	Achim KOPF (DE)
18.45	Bus departs to Gammelstad (Location D in MAP 3)	
19.00 –	Tour in Church Village of Gammelstad, UNESCO World Heritage	
19.30 –	Social dinner at Margaretas Vårdshus, Gammelstad	
22.30 –	Bus departs to hotel	

Wednesday 20 August

9.00 – 10.00	Working group reports, plenary discussion	
10.00 – 10.30	Coffee (Centrumrestaurangen Amica)	
10.30 – 12.30	Discussion and writing of pre-proposal drafts in working groups or sub-groups	
12.30 – 13.30	Lunch (Wibergsgården)	
13.30 – 14.45	Discussion of upcoming SEIZE Portland workshop (Nov. 2008) and IODP Bremen workshop (Sept. 2009) and future activities/milestones Geohazards Scope Final plenary discussion.	
14.45 – 15.00	Wrap-up of day 3 and workshop	Achim KOPF (DE), Maria Ask (SE)
15.00	End of workshop Coffee (Centrumrestaurangen Amica)	

Workshop Participants



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