



European Marine Board Expert Working Group

Marine Geohazards and the Blue Economy

Terms of Reference

August 2019

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1. Background and Rationale

A geohazard (or geological hazard) is a geological condition which represents - or has the potential to develop into - a situation leading to damage or uncontrolled risk (Vanneste *et al.* 2014). The major marine geohazards (Fig. 1) are coastal erosion, seawater intrusion, earthquakes, submarine landslides, subsidence, tsunamis, natural gas hydrate dissociation, seabed sand waves, shallow gas, overpressure strata, gas chimneys, mud volcanoes and mud diapirism (Jia *et al.* 2016).

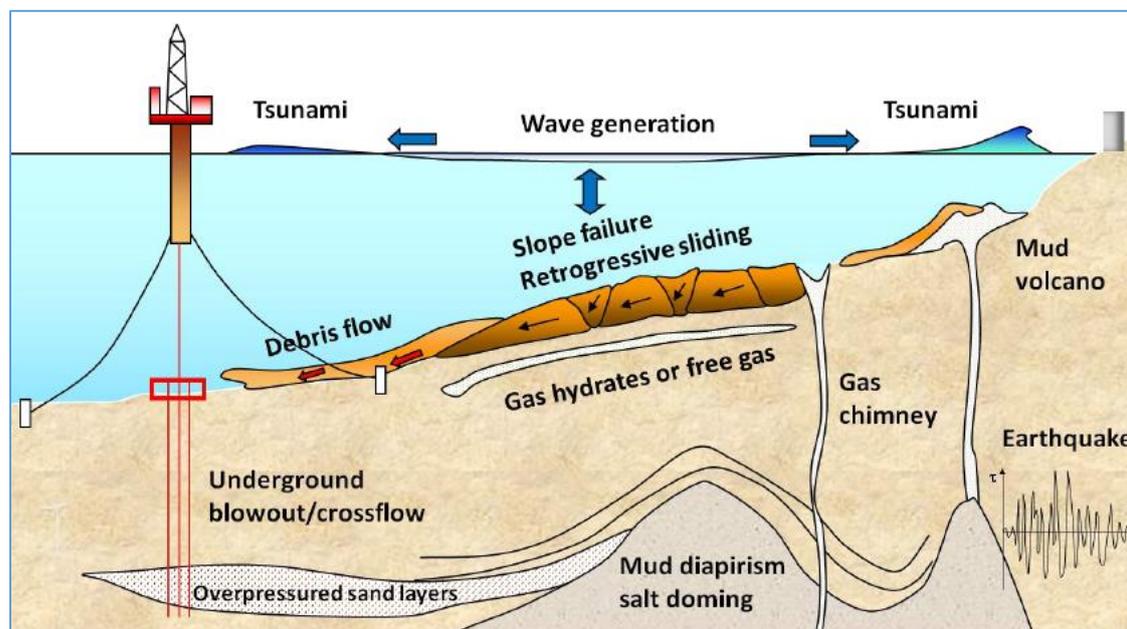


Fig. 1: Sketch map of major submarine instabilities and deformation features (Vanneste *et al.* 2014)

The advancement of deep-water exploration activities, the uncertainties of the consequences of climate change, the latest catastrophic global events (e.g. the 2004 India Ocean and 2011 Japan tsunamis), and the increasing human population densities in the world's coastal regions are responsible for the increased importance and awareness related to marine geohazard research (Camargo *et al.* 2019). This is well illustrated by the selection of “a safe ocean” as one of the six societal objectives of the United Nations Decade of Ocean Science for Sustainable Development (2021-2030). In addition, “A Protective Europe” is one of the five future policy priorities for the European Union. The strategic planning of the Horizon Europe programme (2021-2027) also noted that impacts are expected from research and innovation activities to “*improve disaster risk and societal resilience through better understanding of natural and man-made disasters and by the development of novel concepts and technologies to counter these risks*”¹.

Marine geohazards are slowly gaining political attention at European level. With an increased number of human activities being conducted offshore, there are risks of altering the conditions of the ocean floor including gas hydrates² resulting in potential hazards for seabed structures. In 2017 MEPs Gesine Meissner and Ricardo Serrão Santos hosted a “Gas Hydrates and Offshore Geohazards” event at the European Parliament, which concluded that offshore geohazards impede the development of Blue Economy and pose threats to ecosystem functioning³. Marine geohazards may also hamper the effective implementation of policies such as the Maritime Spatial Planning (MSP) and Integrated Coastal Zone Management (ICZM), and in regions like the Mediterranean, marine geohazards can jeopardize economic activities and civil infrastructures.

¹ https://ec.europa.eu/research/pdf/horizon-europe/ec_rtd_orientations-towards-the-strategic-planning.pdf

² Gas hydrates are an ice-like form of water that has cavities containing gas — usually methane. (Nature)

³ <http://www.searica.eu/documents/category/31-documents-of-the-event-22-june-2017>

Seafloor integrity to ensure ecosystem functioning is measured through [Descriptor 6](#) of the EU Marine Strategy Framework Directive (MSFD), for which Member States aim to achieve and maintain Good Environmental Status (GES) of EU marine waters. Changes in sediment regimes would also affect protected ecosystems like cold water corals; and the recolonization of such areas, once affected by a landslide, is not fully understood.

Specific threats to society from marine geohazards are the disappearance of valuable land near the shorelines, devastation of coastal areas by landslide-generated tsunamis and the destruction of seafloor installations (e.g. communication cables, pipelines) (Vanneste *et al.* 2014). There is a need to increase our understanding and wider awareness of marine geohazards, in the context of other extreme events, such as meteotsunamis, as explained in European Marine Board's Navigating the Future V⁴.

It is essential to improve the knowledge and tools for identifying risks and set out a strategy for hazard mitigation. Throughout the upcoming decade, the expansion and improvement of seafloor observatories' networks (such as [EMSO-ERIC](#)), integration of data at a European scale (such as [EPOS](#) and [EMODnet Geology](#)), assessment of hazards (such as [TSUMAPS NEAM](#)), early warning systems (such as [IOC Tsunami Programme](#)), disaster risk management systems (such as [Copernicus Emergency Management Service](#)), and mitigation plans are the main challenges. Hazardous marine geological events may occur at any time and the scientific community, marine industry, and governmental agencies must cooperate to better understand and monitor the processes involved in order to mitigate the resulting unpredictable damages (Camargo *et al.* 2019).

Submarine landslides: an example of marine geohazards

As land masses rise after ice sheets on top melt due to global warming⁵ (in places like Greenland) the relative sea level around the continental shelf reduces, removing the weight and thus pressure of the sea water on the marine sediment. In some cases, pressure removal may be a more efficient way of destabilizing gas hydrates than temperature increases and hence there is a potential risk of slumping on the continental shelf around Greenland, which could lead to submarine landslides producing tsunamis (Maslin *et al.* 2010). Submarine landslides are one of the most critical marine geohazards (Vanneste *et al.* 2014). For instance, the Storegga landslide off the coast of Norway, dated to have occurred at around 8.20 ± 0.25 ka (tens of thousands of years) ago, is considered to be amongst the largest known landslides, producing a tsunami with a suspected elevation of up to 12 metres (Kopf *et al.* 2015; Bondevik *et al.* 2003). In low risk seismic regions, like U.S. Atlantic coast, submarine landslide tsunamis likely constitute the biggest tsunami hazard to the coast (Brink *et al.* 2014).

Rationale for Working Group

Sedimentary stability and geohazards have been on the agenda of past EMB Plenary meetings as a proposal for a new EMB activity, but the scope of this proposal has varied, from the fundamental understanding of sedimentary processes, to geohazard related to gas hydrate dissociation as a result of climate change. Geohazards is a broad and complex topic and the Board has been exploring its policy relevance.

Three (related) suggestions for new activities fed into a Terms of Reference for a Working Group on marine geohazards, approved by the Board in October 2017 (Fig. 2):

- “Seafloor sedimentary processes” (suggested by Alessandro Crise - OGS, in Split, October 2015)

⁴ <http://www.marineboard.eu/navigating-future-v>

⁵ Isostatic rebound

- A suggested collaboration with the COST action MIGRATE “Marine gas hydrate - an indigenous resource of natural gas for Europe” (suggested by Jan-Stefan Fritz - KDM, in Glasgow, October 2016)
- “Climate change and geo-hazards, including slope stability” (suggested by Gilles Lericolais - IFREMER, in Glasgow, October 2016)

The launch of the Working Group was postponed until after the launch of the EMB flagship publication ‘Navigating the Future V’ (European Marine Board 2019), which includes a chapter on Science of Surprises describing dynamic seafloor processes and natural hazards.

The Open Session of the [EMB Plenary Meeting](#) in Trieste in October 2018 was dedicated to geohazards and brought more insight of marine geohazards to the EMB members and reiterated its importance. Following the launch of Navigating the Future V it was suggested to broaden the scope of the working group to include impacts of marine geohazards on the Blue Economy.

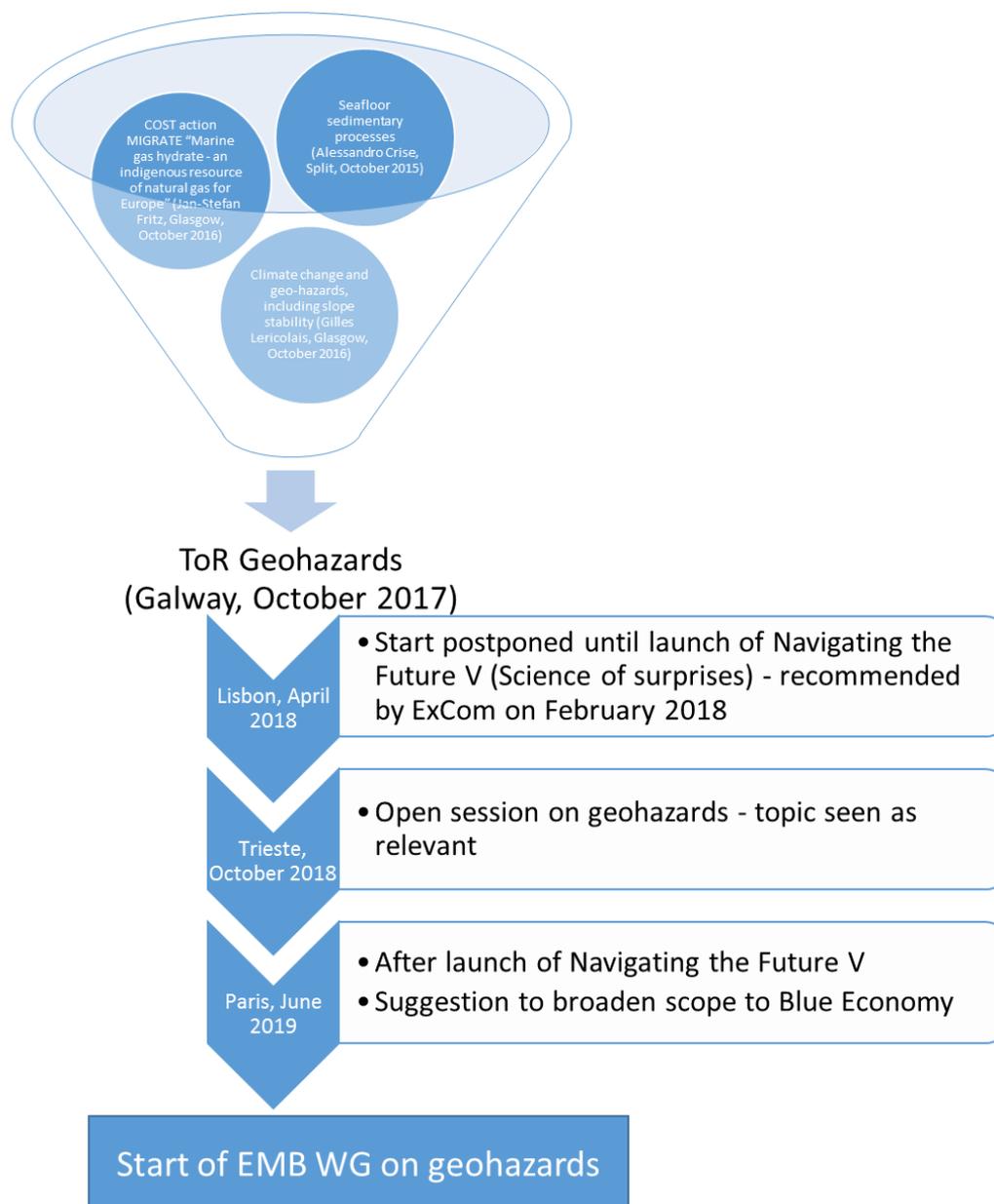


Fig. 2: Graphical representation of the history and decisions of the EMB activity on geohazards.

2. Working Group Objectives

Marine geohazards have not been on the policy landscape in the past, and the EMB proposes an expert working group to produce a Future Science Brief (FSB) that can provide a state-of-the-art within this broad research field, identifying the key issues, and illustrating some examples of how research in this area can improve the assessment of risks to the Blue Economy.

The FSB should focus on marine geohazards, and include reference to coastal interactions. It should highlight the need for marine scientific research and further understanding of marine geohazards, how these impact the Blue Economy and how they may be influenced by climate change and the wider earth system. It should make specific recommendations, on what can be done to cope with this issue, for scientists, European and national policymakers, offshore industry representatives, research funders and centres, international and European efforts, and NGOs.

Specific objectives

- Define the state-of-the art in European research in this area;
- Draft the main R&D needs to increase understanding and European capability of this topic;
- Highlight scientific research and knowledge on marine geohazards, impacts on the Blue Economy, and connection with climate change and the wider earth system;
- Build interdisciplinary relationships between geology and other relevant fields of research (offshore structural engineering, benthic biology, climate change, etc.).

3. Deliverables

The Working Group will deliver a Future Science Brief (36 pages), addressing the above topic by September 2020.

A peer review process with a minimum of two external reviewers will be organized by the EMB Secretariat. In accordance with the EMB procedures, the Future Science Brief will require approval by the EMB Member Organizations prior to finalization and publication.

The impact of the publication will be achieved via a targeted dissemination strategy (see point 4). Working Group members will be required to make suggestions on how to reach end-user contacts and to contribute to the dissemination. Promotion of the Future Science Brief may include dedicated presentations at stakeholder events. Working Group members will also be asked to notify the Secretariat of any dissemination activities or observed uptake or impact of the messages in the publication, for up to two years following publication, for future impact reporting.

4. Target Audience and Expected Impact

The Working Groups are the primary foresight and priority-setting tools of the European Marine Board. The expected outcome is that the recommendations of the resulting policy document influence future research strategies and programmes at both national and European level. Therefore, the EMB policy document target audience is in the first instance those who determine and set research agendas, including research funding organisations, programme managers and science policy advisors/developers both at the national and European level. To some extent, and depending on the subject, the expected outcome is also intended to strengthen the particular research domain by stimulating networking and developing common positions between expert scientists, potentially leading to new collaborative projects. The recommendations and perspectives delivered through EMB policy documents can also influence and drive broader marine and maritime policies, beyond the research realm. This publication could also bring the

risks of marine geohazards to the attention of offshore industry representatives, international efforts (e.g. IOC Tsunami Programme), and NGOs.

5. Working Group Composition and Operation

Working Group Chair and co-Chair

A lead Chair and co-Chair will be selected to represent the Working Group and take responsibility for its deliverables.

Profile

The Working Group (WG) Chairs should be experienced marine scientists or technologists in the field of marine geohazards. It is important that the Chair and co-Chair have a big picture approach to ensure a focus on the full spectrum of marine geohazards, the influence of climate change, impacts on the marine environment, human livelihoods and the Blue Economy.

Selection process

The Working Group (WG) Chair and co-Chair will be selected based on a call for WG member nominations issued by the EMB Secretariat to EMB Member Organizations. A WG Chair can be directly proposed by member organization(s) or working group member(s), on the basis of her/his recognized expertise and leading role in the field, at European or international levels. The European Marine Board Secretariat facilitates the Chair and co-Chair selection, liaising with the European Marine Board Executive Committee and member organizations and, as required.

The EMB Secretariat will work together with the Chair/co-Chair to select the WG members and ensure an appropriate balance of expertise and experience within the working group.

Roles and responsibilities of WG Chair

The WG Chair and co-Chair are responsible for ensuring the scientific quality of the Working Group outputs and its timely delivery according to the WG Terms of Reference and as agreed at the kick-off meeting. The WG Chairs provide scientific leadership and motivation and drive the WG activities with the support of a dedicated European Marine Board Science Officer who acts in the capacity of WG facilitator.

The WG Chairs (lead Chair primarily and co-Chair when the lead Chair is not available):

- Chair WG meetings,
- Coordinate the scientific contributions to the document draft according to the objectives defined at the kick-off meeting,
- Maintain an overview of the content and quality of the various inputs and requests additional expertise if necessary,
- Ensure timely delivery of the WG document, and
- Enhance the document's strategic impact by promoting WG activities and the output.

The meeting Chairs will be crucial to effectively moderate discussions and deliver meeting outputs.

Working Group Members

The Working Group will be made up of a maximum of 12 experts comprising European scientists and technologists who are participating in leading networks and/or research groups across different research domains (slope stability, gas hydrates, tsunamis -including early warning, earthquakes, benthic biology, volcanism, structural engineering, offshore structure deployment, tectonics, research infrastructures, coastal protection, climate change scenarios, etc.). During the

process of selection of experts, connections with International and European initiatives will be ensured through membership of the WG. The group will be led by a Chair and co-Chair and facilitated by the EMB Secretariat.

Profile and selection process

WG Members may be drawn *inter alia* from EMB member organizations, national research institutes and universities as well as relevant European projects and initiatives, industry and non-profit organizations. A call for nominations will be issued by the EMB Secretariat to EMB Member Organizations. WG Members are selected from the resulting pool of experts by the WG Chair(s), supported by the EMB Secretariat. Decisions on the composition of the Working Group are guided by achieving the correct balance of expertise required to comprehensively address the topic at hand as well as ensuring a wide geographic and gender distribution. Non-selection of some nominated candidates is therefore normal, and bears no relation to the scientific excellence of those candidates not selected.

Roles and responsibilities of WG Members

WG Members are responsible for ensuring the scientific quality of their inputs and their timely delivery according to the WG Terms of Reference.

WG Members:

- Prepare for and attend the WG meetings,
- Submit written contributions in a timely manner as agreed at the kick-off meeting,
- Guide and adhere to the high-level strategic objectives of the publication,
- Promote the resulting brief at national level and European levels, and
- Feedback information on dissemination activities and opportunities, impact and uptake to the EMB Secretariat.

Engaging the wider community

During the course of the WG, members may invite a selection of stakeholders or observers from the wider community including science, industry, policy makers and funders.

EMB Facilitation of the Working Group

The EMB Executive Director is the *ex officio* WG manager. She nominates one or two Secretariat officers to support and facilitate the Working Group.

The EMB Secretariat will coordinate this activity with the Chair and co-Chair. A dedicated EMB Science Officer will act in the capacity of facilitator and other EMB Secretariat staff may be involved depending on the specific topic for each Working Group activity.

For this WG the facilitator is: Ángel Muñoz Piniella, EMB Science Officer

General Data Protection Regulation (GDPR) policy for EMB WGs

Personal data for EMB working group members and those involved in other EMB core activities is used for internal communication with the activity as well as external communication of the EMB activity via publications, the EMB website and EMB social media outlets.

For any new EMB activities, consent is sought at the kick-off of the activity to cover all relevant use and storage of personal data. It is anticipated that the subjects would also be added to the EMB mailing list, and thus their data would continue to be stored and used beyond the end of the activity, unless consent is later withdrawn. A template consent form can be found in Annex 1. After a period of 2 years, unless requested otherwise, we will keep it in our database for future roles.

Reviewers are also contacted within the context of EMB activities. The template email they receive already clearly outlines their right to act that their input remains anonymous, in which case the reviewer would simply be listed as “Anonymous”. The reviewer will be informed of how and where their personal data will be stored. The consent of the reviewer will also be specifically sought for their personal data to be used outside of any activities directly relating to their role as reviewer, using the template text included in this document.

The EMB [privacy policy contains](#) information about our compliance with GDPR (data protection law). In this document you can find how to send us a request to let you access your data that we have collected, request us to delete your data, correct any inaccuracies or restrict our processing of your data. You have the right to lodge a complaint about the way we handle your data with [Belgian Data Protection Authority](#) or you can contact us at info@marineboard.eu for more information or concerns.

6. Mode of Operation

The establishment of a Working Group is for a limited duration and the group will be disbanded by the Board when it has fulfilled its mandate. EMB Working Groups are facilitated by the EMB Secretariat but they are not financially supported by the EMB (unless an extraordinary contribution is secured by one or more EMB Member Organizations).

The work programme for the Working Group will consist of:

- One meeting (remote meetings via video conference may be considered);
- Writing assignments;
- Regular email interactions;
- Facilitation of the WG by the European Marine Board Secretariat;
- External peer review;
- Coordination of the report writing to publication standards by the WG Chair/co-Chair; and
- Final editing of the report in preparation of the publication by the EMB Secretariat and the WG Chair and co-Chair.

Support from the European Marine Board:

- The EMB will arrange meetings and provide organizational support for WG meetings;
- The EMB will cover the costs of all catering associated with WG meetings, including a WG dinner. Travel costs for WG participants are not covered by the EMB secretariat, but normally covered by the nominating EMB Member Organization or by the participant’s own institution (if these are different);
- The EMB will cover the costs of publication and dissemination (to relevant stakeholders) of the Policy Brief;
- Members of the EMB Secretariat will attend each meeting, write and disseminate meeting minutes, and will maintain regular dialogue with the WG Chair and co-Chair to ensure timely delivery of the policy brief.

7. Indicative Timetable

The kick-off meeting of the WG is foreseen in November 2019 with WG activities continuing for approximately 12 months from launch, including 2-3 meetings (Kick-Off meeting followed by tele-meetings) and including 3 months for internal and external review, design and remote approval. Publication of the final document is foreseen in September 2020, before the fourth tsunami exercise from the North Eastern Atlantic, the Mediterranean and Connected Seas Tsunami Warning System (NEAMWave20).

Tasks (2019-2020)	2019								2020											
	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	
Approval of updated ToR by EMB member organizations	█	█	█																	
Nominations and expert selection		█	█	█																
Appointment of WG co-Chairs				█	█															
WG member list confirmed, invitations and planning for kick-off meeting				█	█	█														
Kick-off meeting <ul style="list-style-type: none"> ▪ discussion of ToR ▪ objectives and scope of the WG ▪ table of contents and work plan ▪ confirm expertise, allocate writing assignments ▪ communication plan, foresight tools and brainstorming on recommendations 						█														
Drafting of content (with remote meetings between EMB SEC, Chair and co-authors as necessary)						█	█	█	█											
Meeting 2 <ul style="list-style-type: none"> ▪ review of the draft ▪ finalize the structure of the document ▪ identify illustration & image needs 								█												
Finalize (text and illustrations)								█	█	█	█									
Approval of publication by WG members										█	█	█								
External review and revisions											█	█	█							
Design and Remote Approval by EMB delegates											█	█	█	█						
Publication and press release, followed by dissemination and uptake/impact tracking																█	█	█	█	

Appendix 1: Reference list to related activities

- Bondevik, Stein, Sue Dawson, Alastair Dawson, and Øystein Lohne. 2003. "Record-Breaking Height for 8000-Year-Old Tsunami in the North Atlantic." *EOS* 84 (31): 2001–3. <https://doi.org/10.1029/2003EO310001>.
- Brink, U.S. ten, J.D. Chaytor, E.L. Geist, D.S. Brothers, and B.D. Andrews. 2014. "Assessment of Tsunami Hazard to the U.S. Atlantic Margin." *Marine Geology* 353 (July): 31–54. <https://doi.org/10.1016/j.margeo.2014.02.011>.
- Camargo, João, Marcos Silva, Antônio Ferreira Júnior, and Tereza Araújo. 2019. "Marine Geohazards: A Bibliometric-Based Review." *Geosciences* 9 (2): 100. <https://doi.org/10.3390/geosciences9020100>.
- European Marine Board. 2019. "Navigating the Future V: Marine Science for a Sustainable Future." *EMB Position Paper 24*. Ostend, Belgium. <https://doi.org/10.5281/zenodo.2809392>.
- Jia, Yonggang, Chaoqi Zhu, Liping Liu, and Dong Wang. 2016. "Marine Geohazards : Review and Future Perspective." *Acta Geologica Sinica* 90 n4 (August): 1455–70. <https://doi.org/10.1111/1755-6724.12779>.
- Kopf, Anna, Mesude Bicak, Renzo Kottmann, Julia Schnetzer, Ivaylo Kostadinov, Katja Lehmann, Antonio Fernandez-Guerra, et al. 2015. "The Ocean Sampling Day Consortium." *GigaScience* 27 (4). <https://doi.org/10.1186/s13742-015-0066-5>.
- Maslin, Mark, Matthew Owen, Richard Betts, Simon Day, Tom Dunkley Jones, and Andrew Ridgwell. 2010. "Gas Hydrates: Past and Future Geohazard?" *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 368 (1919): 2369–93. <https://doi.org/10.1098/rsta.2010.0065>.
- Vanneste, Maarten, Nabil Sultan, Sebastian Garziglia, Carl Fredrik Forsberg, and Jean-Sebastien L'Heureux. 2014. "Seafloor Instabilities and Sediment Deformation Processes: The Need for Integrated, Multi-Disciplinary Investigations." *Marine Geology* 352 (June): 183–214. <https://doi.org/10.1016/j.margeo.2014.01.005>.

Annex 1: Consent form for Core Activities

EMB holds personal data for anyone involved in core EMB activities, including Working Groups.

The following personal data may be held by the EMB Secretariat:

- Name
- Title
- Job title
- Areas of expertise and research interests
- Previously held roles
- Institute
- Country
- Institutional email address
- Institutional postal address
- Institutional telephone number
- Photographs
- Video

This information is stored in a secure spreadsheet and folder locations, and only EMB Secretariat staff have access to this.

EMB may:

- Contact you regarding the EMB activity that you are directly involved with
- Contact you regarding other EMB activities
- Add you to the EMB stakeholder mailing list
- Make your name, institution and country publically available on the EMB website, in EMB communications, e.g. presentations regarding the activity you are involved in, and in EMB publications
- Take your photograph during EMB activities and use these pictures in publications, on the EMB website and on EMB social media outlets
- Take video footage during EMB activities and use these pictures in publications, on the EMB website and on EMB social media outlets

The data held may be reviewed and revised by the subject, and consent for any or all of the above may be withdrawn at any time.

Please tick this box to confirm that you understand the above, and that you give EMB permission to obtain, use and store your personal data as outlined above.

Name:

Date: