PROCEED

EXPANDING FRONTIERS OF SCIENTIFIC OCEAN DRILLING

A Magellan Plus Workshop

Austrian Academy of Sciences, Vienna (Austria)

6 -7 April 2019

Workshop Report

PROCEED Scientific Committee:

Co-chairs: Rosalind Coggon (University of Southampton, UK)
Michael Strasser (University of Innsbruck, Austria)

Chiara Boschi (Institute of Geosciences and Earth Resources, Pisa, Italy), Adélie Delacour (Université Jean Monnet, Saint-Étienne, France), Tom Dunkley Jones (University of Birmingham, UK), Matthias Forwick (UiT The Arctic University of Norway, Tromsø, Norway), Marguerite Godard (Université de Montpellier, France), Patrick Grunert (University of Cologne, Germany), Michelle Harris (University of Plymouth, UK), Verena Heuer (MARUM, Germany), Helga Kleiven (University of Bergen, Norway), Walter Kurz (University of Graz, Austria) Andrew McCaig (University of Leeds, UK), Juliane Mueller (AWI, Germany), Usidean Nicholson (Heriot-Watt University, UK), Matt O'Regan (Stockholm University, Sweden), Appy Sluijs (Utrecht University, Netherlands)

PROCEED Organising Committee:

Gilbert Camoin (CEREGE/EMA)
Nadine Hallmann (CEREGE/EMA)
David McInroy (BGS/ESO)
Antony Morris (University of Plymouth/ESSAC)
Werner Piller (University of Graz/ESSAC)
Bernhard Plunger (Austrian Academy of Sciences/ECORD Council)
Gabriele Uenzelmann-Neben (AWI Bremerhaven/EFB)

1. Introduction

2018 marked 50 years since Deep Sea Drilling Project (DSDP; 1968 to 1983) Leg 1 drilled 7 sites in the Gulf of Mexico and Atlantic Ocean, initiating 5 decades of international co-operation in scientific ocean drilling – arguably, the most successful and enduring international science collaboration. The scientific ocean drilling endeavours of DSDP's successor programs (the Ocean Drilling Program; 1983-2003, the Integrated Ocean Drilling Program; 2003-2013, and, since 2013, the International Ocean Discovery Program) have all been guided by scientific planning documents, including the current IODP Science Plan 2013-2023: *Illuminating Earth's Past, Present and Future*. Given the length of time required for the preparation of these documents, it is already time to plan for a potential new scientific ocean drilling program beyond 2023. To respond to the significant challenges of building a successor programme to IODP, ECORD decided to organise a workshop aimed at defining the new goals for a future international scientific ocean drilling program beyond 2023, with special emphasis on new science frontiers and technological developments in a multiple drilling platform approach. In summer 2018 ECORD therefore formed an organising committee tasked with convening the PROCEED (Ex**P**anding F**RO**ntiers of S**C**i**E**ntific Oc**E**an **D**rilling) workshop. The organising committee nominated a group of 16 ECORD scientists to join a PROCEED Scientific Committee, to develop the workshop agenda and convene the meeting. This group was selected to span the membership of ECORD and breadth of IODP science, with a particular focus on encouraging the next generation of IODP scientists to take the lead in this effort.

The PROCEED workshop was held at the Austrian Academy of Sciences, Vienna (Austria), on 6-7 April 2019. The location and timing of this workshop were selected to coincide with the European Geosciences Union 2019 meeting, to allow workshop participants to combine travel for the two meetings. The objective of PROCEED was to produce a White Paper summarising the scientific, technological and programmatic goals for ECORD beyond 2023. This document will constitute the foundation for interactions between ECORD and our IODP partners, who are also convening planning workshops at their national/consortium level during 2019.

Applications to attend the meeting were encouraged from both ECORD scientists and those from other IODP partners. Applications were received from 137 scientists from 21 countries (14 ECORD member countries, 5 IODP partners and 2 non-IODP member countries), with all applications accepted. There was a good balance of career level amongst the participants (see Appendix A), comprising 42% senior scientists, 34% mid-career researchers, and 26% early career researchers (<8 years post-PhD and not holding a permanent position) (4% - career level not given). The gender balance amongst participants was also good (36% female).

The PROCEED scientific committee prepared an online pre-meeting survey, which all participants were asked to complete. The purpose of the survey, which questioned what the scientific and technological challenges of scientific ocean drilling beyond 2023 are, was to help shape the workshop agenda, collecting initial ideas from the community, establishing where there was already consensus and which issues required further debate, and to collect people's breakout group preferences. To ensure that the ECORD plan for continued scientific ocean drilling beyond 2023 was as well-considered as possible, the widest possible input was sought, with the invitation to complete the pre-meeting survey extended to members of the ECORD scientific community, regardless of whether they were attending PROCEED, or indeed had any previous direct involvement with IODP. The results of the pre-meeting survey are summarised in Appendix B.

PROCEED was funded by ECORD through the MagellanPlus Workshop Series Programme and benefitted from the generous provision of facilities by the Austrian Academy of Sciences.

PROCEED workshop participants (Photocredit ÖAW).

Festsaal (plenary hall) of the Austrian Academy of Sciences (ÖAW) during the PROCEED workshop plenary session (Photocredit ÖAW).

2. Workshop program

The PROCEED workshop program (Table 1) comprised a combination of invited keynote presentations, panel sessions, and breakout and plenary discussions. Throughout the meeting feedback was collected via Pigeonhole, an online 'real time' platform, through which the audience were able to participate in polls, ask questions and submit comments, with up-voting to indicate popularity of the questions/support for the ideas submitted. The Pigeonhole polls and input are summarised in Appendix C.

To define the scientific goals of scientific ocean drilling beyond 2023 we need to assess the progress IODP has made towards addressing the 14 scientific challenges of the current Science Plan, and the extent to which the Science Plan needs to be revised to accommodate new and emerging challenges. We also need to ensure that the IODP infrastructure is appropriate to address these future scientific challenges. Day 1 of PROCEED therefore focused on assessing our progress towards the challenges of the current science plan and establishing what new scientific ideas IODP should address beyond 2023.

Table 1a: PROCEED Program workshop – Day 1 (April 6)

8h15	Registration
8h45	**Introduction to PROCEED** – *Gilbert Camoin, Michi Strasser, Roz Coggon*
9h00	**Plenary Session: Our progress towards achieving the Challenges of the Science Plan**
	- Climate and Ocean Change: *Heiko Pälike (MARUM, Bremen)*
	- Earth Connections: *Chris MacLeod (Cardiff University)*
10h00	**Breakout Session A** (Part 1): Climate and Ocean Change/Earth Connections
10h45	*Coffee break*
11h15	**Breakout Session A** (Part 2): Climate and Ocean Change/Earth Connections
12h00	Report - 30 min
12h30	*Lunch*
13h45	**Plenary Session: Our progress towards achieving the Challenges of the Science Plan**
	- Biosphere Frontiers: *Verena Heuer (MARUM, Bremen)*
	- Earth in Motion: *Lisa McNeill (University of Southampton)*
14h30	**Breakout session B:** Biosphere Frontiers/Earth in Motion
16h00	*Coffee break*
16h30	Report - 30 min
17h00	**Plenary Session: Introduction to Day 2 - Future platforms, technology, opportunities & IODP management** - SOD+23: A potential New US facility beyond 2023: *Anthony Koppers (Oregon State University)* and *Jim Wright (Rutgers University)* - J-DESC PROCEED Workshop Summary report: *Masataka Kinoshita (University of Tokyo)* - MSP opportunities beyond 2023: *Dave McInroy (BGS)* - IODP China opportunities beyond 2023: *Shouting Tuo (Tongji University)*
18h00	Reception (Aula)

The first part of day 2 focussed on the technological needs (including platforms, shipboard analytical tools, and data handling) and programmatic issues associated with building a new scientific drilling program. The final sessions of day 2 focused on defining the architecture of the new science plan, and the future role of ECORD in IODP.

Table 1b: PROCEED Program workshop – Day 2 (April 7)

9h00	**Wrap Up Session:** Day 1 summary and introduction to Day 2 - Future platforms, technology, opportunities & IODP management – *Michi Strasser and Roz Coggon*
9h30	**Plenary Session: Technologies and opportunities to expand IODP Science** *Achim Kopf (MARUM, Bremen)*
10h00	**Panel Session: Future technologies, techniques, methods, and opportunities:** **Panellists:** ICDP - Ulrich Harms Paleoclimate/IPCC - Tina van de Flierdt JPI Oceans - Angelo Camerlenghi Minerals/Resources - Sabina Strmic Hydrocarbon Exploration Insights from IODP - Andrew Davies
10h45	*Coffee break*
11h15	**Breakout Session C: Future technologies, techniques, methods and opportunities:** C1 – Amphibious Drilling C2 – Programmatic Issues C3 – Early Career Discussions C4 – Infrastructure C5 – Inter-program Links
12h00	Report 30 min
12h30	*Lunch*
13h45	**Breakout Session D:** Expanding the Frontiers of IODP – what should the architecture of the new Science Plan be? What is the future role of ECORD?
14h30	**Plenary Discussion:** Report, Wider group discussion - what should the design of the new Science Plan be? What is the future role of ECORD
15h30	*Coffee*
16h30	**Plenary Session:** summary of the PROCEED survey and open scientific questions, comments, ideas & wrap up – *Roz Coggon and Antony Morris*
17h00	Workshop close

3. Science Plan content

3.1 Introduction

The primary focus of PROCEED Day 1 discussions was the science of IODP, including evaluating our progress towards achieving the current challenges of the Science Plan, and how these challenges should be developed or added to in the future. The 14 Challenges of the 2013-2023 Science Plan are grouped into four themes:

- **Climate and Ocean Change** – Reading the past, informing the future.
- **Biosphere Frontiers** – Deep Life and environmental forcing of evolution.
- **Earth Connections** – Deep processes and their impact on Earth's surface environment.
- **Earth in Motion** – Processes and hazards on human time scales.

To foster the interdisciplinary links within IODP science the PROCEED Science Committee divided the discussion of the current four Science Plan themes into two sessions, with parallel discussions of two themes at a time allowing workshop participants to discuss two themes. The themes were paired on the basis of workshop participants preferred themes (submitted in the pre-workshop survey) to allow the majority of participants to attend their top two choices (Appendix B). As an introduction to each theme, an invited keynote speaker gave their perspective on our progress towards achieving the current science plan challenges of that theme.

Science Plan Theme Keynote Speakers:

- Climate and Ocean Change: Heiko Pälike (MARUM, Bremen)
- Earth Connections: Chris MacLeod (Cardiff University)
- Biosphere Frontiers: Verena Heuer (MARUM, Bremen)
- Earth in Motion: Lisa McNeill (University of Southampton)

All theme breakout groups were asked to respond to the same four Science Plan theme discussion questions to nurture the discussion:

i) Are the challenges of this theme still relevant to scientific ocean drilling?

ii) Do any of these challenges need to be expanded or modified? How?

iii) What new scientific challenges should be formulated in this theme (or with links to other themes)?

iv) What new scientific challenges should be formulated in this theme (or with links to other themes)?

3.2 Current science plan theme breakout discussions

A1. Ocean and Climate Change

Three separate breakout groups (Groups A1a, A1b, A1c) discussed the Ocean and Climate Change theme of the existing IODP Science Plan. A summary of the discussions between the members of the groups is presented below.

i) Are the challenges of this theme still relevant to scientific ocean drilling?

The current scientific challenges addressed by the *Ocean and Climate Change* theme are as follows:

1. ***How does Earth's Climate system respond to elevated levels of atmospheric CO_2?***
2. ***How do ice sheets and sea level respond to a warming climate?***
3. ***What controls regional patterns of precipitation, such as those associated with monsoons or El Niño?***
4. ***How resilient is the ocean to chemical perturbations?***

There was a consensus amongst the groups that all four scientific challenges are still relevant. The challenges, in particular challenges 1 and 4, have not been fully/sufficiently addressed in the first 5 years since the inception of the current program. There was a consensus that despite their relevance, the challenges should be more interconnected and need some expansion/modifications.

ii) Do any of these challenges need to be expanded or modified? How?

All groups agreed that the strong compartmentalisation of challenges/themes in the current science plan should be avoided. A new science plan should aim for better interconnections and integration of any maintained, modified or new challenges and themes. More specific remarks on the expansion and/or modification of the existing challenges were as follows:

How does Earth's Climate system respond to elevated levels of atmospheric CO_2?
This challenge should be expanded to address not just the response of the system, but also the triggers and drivers thereby establishing links to other themes. In a new science plan, this challenge should go beyond the focus on climate sensitivity. Tipping points of the climate system should be at the centre of a modified challenge.

How do ice sheets and sea level respond to a warming climate?
This challenge should be expanded/modified to include the entire cryosphere (e.g., "How does the cryosphere respond to a warmer/warming climate?"). While Antarctica is well covered in the current science plan, proposals regarding the Arctic are felt to be discouraged by the current phrasing of the challenge ("ice sheets", "sea level"). At the moment, climate models still struggle with polar amplification, nutrient cycling and geo-dynamics of the Arctic. Furthermore, high-latitude river discharge to the Atlantic Ocean and its impact on onset of sea ice cover remains poorly understood. Finally, an increased number of high-latitude records from the Arctic will constrain meridional thermal gradients more reliably. High-latitude records from the Arctic, capitalizing on newly developed proxy methods, are thus crucial for climate models aiming to quantify ocean-ice-land-atmosphere feedbacks. A modified challenge addressing the entire cryosphere, or more broadly constituted around polar environments, should encourage an

increasing number of proposals targeting the Arctic, and implementation of those that are already in the system.

What controls regional patterns of precipitation, such as those associated with monsoons or El Niño?
This challenge should be expanded/re-focused towards deep-time records, which are still largely missing, e.g. regarding the onset of the monsoon. Another focus should be placed on monsoon behaviour in high-CO_2 worlds to improve model predictions. A mission approach including multiple expeditions addressing complementary themes is considered a viable approach for this challenge.

How resilient is the ocean to chemical perturbations?
This challenge should be expanded/re-formulated to include ecosystem sensitivity and the consequences for biodiversity and nutrient cycling. Furthermore, the challenge should not only focus on the perturbations but also the recovery from such perturbations. Links to other themes (e.g., "Earth Connections" – LIPs) should be highlighted.

iii) What new scientific challenges should be formulated in this theme (or with links to other themes)?

There was a broad agreement that the advent of new technologies and proxy methods (e.g., ancient DNA, biomarkers) since the inception of the current science plan provides an opportunity for the formulation of new challenges within the theme. All of the new challenges provide links to other challenges/themes through "key-connectors" (e.g., ecosystems/ biomineralization/biological pump, tectonics/ocean circulation) and opportunities for amphibious drilling proposals.

- "*How does ecosystem evolution force and respond to environmental change through time?*"

There was a general consensus amongst all groups that ecosystems and biodiversity should play a central role to the theme in a new science plan. The new challenge partly ties into the current challenge "*How sensitive are ecosystems and biodiversity to environmental change?*" of the "Biosphere Frontiers" theme; however, it was pointed out that currently the focus is almost exclusively limited to the deep biosphere. The newly formulated challenge should target a more comprehensive view encompassing all marine ecosystems and their role not only as responders but also drivers of ocean and climate change. A new science plan should thus encourage proposals regarding topics such as the evolution of ecosystems, biomineralization pathways, photosynthetic communities, and the carbon/biological pump. The new challenge offers a considerable potential for amphibious drilling proposals in partnership with ICDP, e.g. in order to understand nutrient fluxes and cycling.

- "*Reconstruction of a 4D-paleo-ocean*"

The lack of spatial and temporal coverage, in particular for pre-Quaternary time intervals, has been identified as problematic by all groups. These gaps severely limit our ability to capture the full spatial and temporal variability of (paleo)climatic change. The reconstruction of a "4D-paleo-ocean" (comprehensive identification of changes through space and time) for under-sampled stratigraphic intervals (e.g., Cretaceous, Miocene) or discrete time slices (e.g., PlioMap, DeepMiP, Miocene), is thus regarded as a central new challenge in the next science plan. The drilling of longitudinal and latitudinal (depth) transects over several (potentially amphibious) expeditions will be particularly important. The new challenge should also address state-of-the-art modelling capabilities; through integration of modellers in early stages of the science plan and planned expeditions the successful use of IODP data in the genuine improvement and testing of ocean and atmosphere models should be ensured. Higher spatial coverage will

further allow a significant refinement of biostratigraphic correlation, the backbone of any age model, beyond the low latitudes.

In this context, the importance of the accessibility and usability of existing data was highlighted. To make better use of existing ocean drilling data, to easily access and integrate them and to identify spatial and temporal gaps in preparation for 4D-proposals, experts for big data and database management should be involved in the new program. Workshop participants strongly encourage the development of community-led or IODP supported database efforts that would make expedition *and* post-expedition geochemical, biotic and sedimentological data easily accessible, including adaptive age models that could provide the data on a common timescale.

- *Ultra high-resolution paleoclimatic records*

The acquisition of ultra-high-resolution (decadal to centennial time-scales) paleoclimatic records on timescales relevant to climate and weather dynamics (e.g., ENSO, PDO) has been identified as an important challenge across all groups. These records may come from archives such as corals, drift deposits and epicontinental seas. Many of these archives are best accessible through amphibious drilling proposals in partnership with ICDP. As above, strong engagement with the modelling community should be undertaken through proposal development and with post-expedition science.

- "*(Gateway) Tectonics and Climate*"

The workshop identified a potential new challenge to better constrain the influence of tectonic and paleogeographic controls, on the long-term evolution of ocean circulation, ecosystem evolution and internal climate dynamics. Understanding the long-term evolution of these boundary conditions – independent of greenhouse gas forcing - is important to better inform the predictive capability of paleoclimate time-slices as future climate analogues. Addressing this challenge will rely on strong engagement with the solid Earth community, and links to other challenges/themes such as "*Earth in Motion*".

iv) What could 'land to sea' drilling transects bring to the science of this theme?

All groups agreed that amphibious drilling proposals (ADP) offer unique research opportunities and should play a more prominent role in the planning of future expeditions. The combination of marine and terrestrial archives through land-sea transects will enable more comprehensive views on and linkages between the challenges identified for the theme as well as across themes including precipitation patterns (ENSO, monsoon), sea-level change, gateway tectonics and ocean circulation, nutrient fluxes, source-to-sink processes, and the role of high-latitude areas (permafrost & CO_2; high-latitude continental shelves). Furthermore, land-ocean drilling will give access to key-areas of exceptionally high sedimentation rates such as epicontinental seas. The participants also agreed that a pre-requisite for such integrated drilling initiatives is a closer partnership with ICDP and in particular a well-integrated and easily accessible proposal system.

Johannessaal of the Austrian Academy of Sciences (ÖAW) during the PROCEED Breakout session (Photocredit ÖAW)

A2. Earth Connections

The *Earth Connection* theme was discussed by two separate breakout groups (A2a, A2b). A summary of the discussions between the members of the two groups is presented below.

i) Are the challenges of this theme still relevant to scientific ocean drilling?

The current scientific challenges addressed by the *Earth Connections* theme are as follows:

> 8. ***What are the composition, structure, and dynamics of Earth's upper mantle?***
> 9. ***How are seafloor spreading and mantle melting linked to ocean crustal architecture?***
> 10. ***What are the mechanisms, magnitude, and history of chemical exchanges between the oceanic crust and seawater?***
> 11. ***How do subduction zones initiate, cycle volatiles, and generate continental crust?***

Discussions of the two breakout groups reached a consensus that the four challenges are still scientifically relevant, as some long-term projects are still on going and some challenges were not fully addressed during the last five years of the program (MOHOLE project for instance). However, both breakout groups were concerned that the theme name, "Earth Connections", is not relevant anymore, as it does not properly represent the scientific content of the challenges and significant overlaps occur between the *Earth Connections* and the *Earth in Motion* themes, with the unclear distinction between the two resulting in confusion. Several keywords that could be included in the future theme title were proposed: geodynamic, tectonic, subseafloor ocean, habitability, biosphere, resources.

Both breakout groups highlighted the fact that links and connections between the four themes of the current Science Plan (if this structure is preserved) need to be strengthened, and integrated projects in areas with common interests across multiple themes should be developed to foster frequent drilling. Connections to astrobiology, societal issues, and planetary habitability should also be reinforced in the next version of the Science Plan. It was also suggested that the new Science Plan could be organized as challenges and hot topics, with the overall number of challenges reduced.

Discussions of both breakout groups led to a similar conclusion that the four challenges need to be either modified or expanded. During the discussion, members of the two groups proposed possible modifications and changes. Breakout group members raised the fact that the title of Challenge 8 may be too restrictive and specific, leading to a possible misinterpretation of the content of the challenge and its objectives to focus only on drilling of mantle rocks (MOHOLE project). A reformulation of this challenge, still including deep drilling into mantle rocks, may thus be necessary. Similarly, breakout group members suggested the slight modification of challenge 10 to "What are the mechanisms, magnitude, and history of chemical exchanges between the *solid earth* and seawater? *How do they affect the evolution of the oceans?* This expands challenge 10 to include the effect of the fluid-rock interactions across on the *entire* crust and their consequences for the chemical evolution of seawater.

In addition, several topics/ideas that should be included in the next version of the science plan were suggested, listed below as keywords:

- Mantle dynamics.
- LIPs: architecture, links to anoxic events (use of amphibious drilling)
- Structure of the oceanic lithosphere at ultraslow-spreading ridge and/or in amagmatic ridges, structure and composition of the lower crust and of the hanging wall of oceanic core complexes.
- Monitoring of dynamic processes.
- Tectonic structures: transform faults, strike-slip faults.
- Rifting (via amphibious drilling).
- Processes and exchanges in the entire crust.
- Serpentinization and origin of life/astrobiology/prebiotic molecules.
- Resources: ore deposits/energy/water/life.
- Links from deep to shallow (and vice and versa).

iii) What new scientific challenges should be formulated in this theme (or with links to other themes)?

Breakout discussions evoked several other challenges that were not addressed in the current version of the Science Plan, which could be included in the next version in association with the keywords above:

- Far field tectonic processes: effect on the evolution of the seafloor/subduction.
- Life cycle of the plates from continental breakout and rifting to subduction at different scales, long-term and short time scales (life, geohazards): architecture of the crust; interaction of the crust with oceans as it ages (organic and inorganic interactions), and effects on sediments, biosphere, climate.
- Planetary hazards: connections between biosphere/climate and earth, links between the water in crust, serpentinization, origin & evolution of life, and planet habitability.
- Climate and Earth Connection? (Arctic processes & rifting/MOR, tectonics & gateways, volcanism, LIPs).

iv) What could 'land to sea' drilling transects bring to the science of this theme?

Several projects are already in the IODP-ICDP evaluation system and a few other project/ideas are at the writing stage. Another dedicated breakout discussion was planned during the PROCEED workshop to discuss specifically this topic.

Dachpavillon of the Austrian Academy of Sciences (ÖAW) during the PROCEED Breakout session (Photocredit ÖAW)

B1. Biosphere Frontiers

The *Biosphere Frontiers* theme was discussed by two separate breakout groups (B1a, B1b). Note that the ECORD biosphere community represented at PROCEED was relatively small, as such there were no microbiologists in group B1b, which comprised predominantly paleoceanographers, micropaleontologists, and organic geochemists. A summary of the discussions between the members of the two groups is presented below.

i) Are the challenges of this theme still relevant to scientific ocean drilling?

The current scientific challenges addressed by the *Biosphere Frontiers* theme are as follows:

5. ***What are the origin, composition, and global significance of deep subseafloor communities?***
6. ***What are the limits of life in subseafloor realm?***
7. ***How sensitive are ecosystems and biodiversity to environmental change?***

There was general consensus between both groups that these challenges are still relevant to scientific ocean drilling. Challenges 5 and 6 have received more attention during this phase of ocean drilling resulting in fundamental paradigm-shifting discoveries, although potential still remains to tweak to expand them. In contrast, challenge 7 remains largely unaddressed, and should be re-imagined.

ii) Do any of these challenges need to be expanded or modified? How?

There was discussion of the definition of the 'biosphere' with regards to these challenges. To date the IODP research focus has been on microbial life, however it was concluded that these challenges should be expanded to explicitly include all subseafloor records of marine life, and to improve connection across all science plan themes. IODP has made great advances in our understanding of the subseafloor microbial biosphere; the science plan challenges should be expanded to (i) build on this knowledge and (ii) capitalize on newly available analytical techniques (e.g. new methods in organic geochemistry), using fresh material. The revised biosphere theme challenges should include:

- What are the fundamental *biological* limits to the concept of life – longevity of microbial cells – as well as the environmental limits to life – on Earth and other planets.
- Deep biosphere, diversity and metabolic pathways and biogeochemical processes
- Ecosystem functioning.
- Biogeography of microbial communities - what are the controls on deep subseafloor communities.
- Exploring conditions that may be analogous to or informative of, questions around the origins of life and astrobiology.

The groups noted that these topics would present both technological challenges (e.g. high pressure incubations post-coring) and challenges for human resources (size of the deep-biosphere community). However, the development of expertise in microbiological sample processing, associated with IODP, is stimulating other communities - for example, as happened in the Deep Carbon Observatory community.

iii) What new scientific challenges should be formulated in this theme (or with links to other themes)?

As noted above, emphasis should be placed on the broadest conception of the biosphere, to encompass all subseafloor marine life, resulting in significant overlap with the current ocean and climate change theme. Looking beyond the current IODP science plan, areas of interest for this 'expanded' biosphere theme should include:

- Flow of energy & matter from the surface to deep ocean, and then within seafloor sediments; biotic and abiotic pathways for subseafloor reactions; early diagenesis and its impact on proxies; mineral authigenesis.
- Links to seawater chemistry; pore water chemistry; hydrothermal systems; and the potential for anthropogenic impacts on the system.
- Links to astrobiology – understanding the fundamental building blocks and limits of life; other ocean worlds; origins of life.
- Scoping ecosystem sensitivity, thresholds and dynamics (forcings and responses).
- The effect of microbiological processes (e.g. biomineralization) on paleoceanographic proxies (linking to ocean and climate change theme).
- Microbial life at plate boundaries (links to *Earth in Motion*).
- Ancient DNA (fresh material) as a new frontier.

iv) What could 'land to sea' drilling transects bring to the science of this theme?

Land to sea transects would allow investigation of:

- Nutrient cycling (source to sink).
- Links between the terrestrial and marine deep biosphere.
- Offshore extension of fresh deep aquifers – life across salinity gradients.
- Transitions between geothermal and hydrothermal systems.
- Aquatic ecosystems
- Shallow water microbial ecosystems.
- The first impacts of global change (using Arctic land to sea transects)
- Hot sediments and methane – hydrates.

Sitzungssaal of the Austrian Academy of Sciences (ÖAW) during the PROCEED Breakout session (Photocredit ÖAW)

B2. Earth in Motion

Three separate breakout groups (Groups B2a, B2b, B2c) discussed the Earth in Motion theme of the existing IODP Science Plan. A summary of the discussions between the members of the groups is presented below.

i) Are the challenges of this theme still relevant to scientific ocean drilling?

The current scientific challenges addressed by the *Earth in Motion* theme are as follows:

> ***12. What mechanisms control the occurrence of destructive earthquakes, landslides, and tsunami?***
>
> ***13. What properties and processes govern the flow and storage of carbon in the subseafloor?***
>
> ***14. How do fluids link subseafloor tectonic, thermal, and biogeochemical processes?***

There was a general consensus between all the groups that all the scientific challenges are still relevant and in progress. Most of the challenges have not been fully/sufficiently addressed in the first 5 years since the inception of the new science plan.

As with many other thematic breakout groups, there was a consensus that the theme itself may be a barrier to cross-disciplinary proposals. In particular, the 'human time scales' referred to in the theme subheading may preclude proponents addressing some important hazards that occur at much lower frequencies, including, for example, bolide impacts and large-volume submarine landslides. Suggestions included changing the name of the theme to something broader, such as *Planetary Hazards*, or removing the theme structure entirely and reframing the challenges ("grand challenges"?), with a stronger emphasis on societal relevance.

Another issue that affects this theme is that many of the objectives require the installation of seafloor or subsea monitoring/instrumentation, which comes at a significant extra cost and is not funded through the standard proposal process. This results in proportionally fewer proposals that address the *Earth in Motion* theme. Could the proposal systems or links to other programs/funding sources be expanded/facilitated in the next science plan? A further issue is that the questions addressed require multiple expeditions, as shown by NanTroSEIZE and Hikurangi in particular. Future developments in this theme will likely require a critical mass of scientists working together to build complimentary expeditions and access additional funds.

ii) Do any of these challenges need to be expanded or modified? How?

The challenges could be expanded by making explicit reference to key earth hazards that are not currently included (although these are mentioned in the text). The most obvious ones to include are volcanic eruptions and bolide impacts (building on the success of Chicxulub in particular), but could also include other hazards such as catastrophic ice-sheet collapse and sea-level rise, methane release, and fluctuations in the geodynamo (affecting the strength of the magnetic field).

In addition, the challenges focus on 'mechanisms'; it would be good to expand this with a stronger focus on frequency, magnitudes, and impacts of hazards. This would allow a more compelling case to be made for the societal relevance of the science plan in particular.

With respect to challenge 13 in particular, the carbon cycle could take a more central role in a new science plan, either as a theme or "Grand challenge" (or equivalent). This is obviously a very integrated topic, linking the biosphere, hazards, climate and oceans, and even the deep Earth. Similarly, fluids (challenge 14) also link multiple different challenges and themes and may be better as an overarching theme.

It is also important to consider how questions addressed by other themes affect geohazards. For example, how do changes in climate impact seismicity or landslide frequency via processes including isostatic rebound or hydrate dissolution? This more integrated 'Earth Systems' approach will be critical to the new science plan.

iii) What new scientific challenges should be formulated in this theme (or with links to other themes)?

Numerous other challenges were proposed, including more focus on resources such as water in aquifers, a focus on faults other than subduction zones (e.g. strike-slip systems), large landslides on passive margins and rifted margins, Mediterranean subduction zones (or other highly vulnerable regions), and release of carbon from the subsurface environment.

iv) What could 'land to sea' drilling transects bring to the science of this theme?

Amphibious drilling proposals will have a particularly important role to play in expeditions (or multiple expeditions) that address the *Earth in Motion* theme, or equivalent. This is particularly true for fault systems that extend from land to sea, where it is critical to link observations in both settings to understand the whole system. Lake drilling could also provide important constraints on tsunami run-up and frequency for example, linked to observations from the ocean that address tsunamigenesis. Observatory systems may be considerably cheaper to deploy onshore or in shallow water, than in deep water settings, allowing more effective monitoring. Despite the importance of amphibious proposals, there is only one such proposal in the IODP/ICDP system at the moment, which aims to understand the strike-slip fault system in Haiti. This is partly due to the independent, and out-of-sync, nature of the two proposal systems, and there was some consensus that a linked proposal system might be of great benefit to scientists seeking to address this theme in particular.

Other scientific issues in this theme that could uniquely be addressed by 'land to sea' transects include proposals aiming to understand and quantify sediment flux, aquifer systems, near-shore processes, anthropogenic perturbations (e.g. dam construction on delta subsidence), and high-resolution records of sea-level changes.

In addition to these points, MSPs clearly have an important role to play in many geohazards, particularly for drilling in areas with shallow water, as highlighted by the recent Chicxulub expedition. Other examples where MSPs might play an important role will be in quantifying glacial run-off during periods of rapid sea-level rise, Arctic shallow-water permafrost dissociation and methane release.

4. Future IODP Opportunities

4.1 Introduction

The first part of PROCEED Day 2 focussed on future opportunities for IODP. This section of the program comprised: an introductory Keynote Talk by Achim Kopf (MARUM, Bremen) entitled '**Technologies and opportunities to expand IODP Science**'; a Panel session comprising panellists with a range of expertise on potential future opportunities for IODP; and breakout discussions. For the breakout session workshop participants were given a choice from five different groups:

C1 – Amphibious Drilling
C2 – Programmatic Issues
C3 – Early Career Discussions
C4 – Infrastructure
C5 – Inter-program Links

The introductory Keynote Talk by Achim Kopf (MARUM, Bremen) highlighted (i) the need for, and opportunities of, borehole observatories and (ii) new arising technologies for drilling and in situ measurements. Monitoring is essential to acquire time series data and samples to measure and characterize key processes that are episodic and/or non-linear. These are particularly relevant for advancing our understanding of Geohazards, subsurface biology and fluid flow, by providing real 4D data for holistic system characterization (e.g. Subduction zone 4D Initiative (SZ4D)). Among the ~ 3880 boreholes drilled since the beginning of scientific ocean drilling, only ~ 30 holes are equipped with monitoring observatories. Opportunities exist to use cased legacy holes for future monitoring installations and/or to deploy seafloor drilling systems available in academia and industry for cost-efficient installation of new observatories, in addition to drilling new holes and CORK/LTBMS installation from IODP drilling vessels. Furthermore, technological innovations for new sensors or instruments with lower power consumption (e.g. in hole CPT, APTs, fibre optic sensing) push new frontiers for seafloor and sub-seafloor in situ measurements and monitoring. These are certainly technological challenges bearing great potential opportunities, but need imagination, endurance and lobbying for securing funding from sources outside ECORD/IODP (e.g. EU calls for research and development linking academia and maritime industry or Belmont Forum thematic international collaborative calls involving social sciences and stakeholder, also see 4.2 "opportunities for joint programming" below).

4.2 Technology/opportunities Panel Session

To facilitate discussion of IODP beyond 2023 an invited panel of six experts were asked to provide their insights on future opportunities and technologies and take questions from the floor. The panel comprised:

Dr Ulrich Harms (GFZ-Potsdam) – Head of the ICDP Operational Support Group
Prof Tina van de Flierdt (Imperial College London) – Paleoclimatology/IPCC
Prof Angelo Camerlenghi (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale) – JPI Oceans
Dr Sabina Strmic Palinkas (UiT The Arctic University of Norway) – Mineralogy and Resources
Dr Andrew Davies (Halliburton) – Exploration & industry-IODP links
Prof Dr Achim Kopf (MARUM, Bremen) – Technology and Observatories

The panellists' presentations and responses to questions are summarised below by topic:

Opportunities for joint programming:
Joint programming allows us to define, develop and implement common research agendas to improve the efficiency of public funding with the aim of addressing major societal challenges. ECORD is well suited to this and an example of best practice in European joint programming. Securing further funding would be challenging, but there are several joint programing opportunities that could be explored, including via the European Marine Board (EMB; the leading European think tank in marine science policy, providing a platform to advance marine research and to bridge the gap between science and policy) or JPI-Oceans (an intergovernmental initiative to enable cooperation in marine and maritime research, launched as one of ten Joint Programming Initiatives by the Council of the European Union in 2011). Several European funding instruments are also potentially available (including ERA Net co-fund (Article 185 initiatives), Research and Innovation Actions, European Joint Programme Cofund (EJP Cofund) and Coordination and Support Actions (CSA). The G7 Groups of Senior Officials (GSO) on global Research Infrastructures (G7) conduct research case studies. The Japanese government included *Chikyu* from the beginning as a global Research Infrastructure. Moving forward, we should ask for a case study on scientific drilling.

Joint IODP-ICDP opportunities:
The overarching science objectives for IODP and ICDP are similar, and the same is true for future needs and technologies (e.g. monitoring networks). The only real difference is ICDP's investment in high temperature (>900°C) operations (drilling, stabilisation and in-situ measurements/monitoring). The opportunity for IODP and ICDP to work more closely was identified years ago, but the first significant progress on that issue was the development of amphibious drilling proposals (ADP) initiated by ECORD at the first meeting of the IODP Forum in 2014. However, the progress of ADPs through the review system is slow. This is in part because the ADP proposal system can be confusing, with different timelines for IODP and ICDP – IODP having two submission rounds per year whereas ICDP has only one. Streamlining the joint proposal process would encourage the submission for ADPs. Our ability to cooperate is limited by bureaucracy; we need co-working rather than collaboration. Since it is science that needs to be supported, any joint IODP-ICDP efforts need to be bottom up and flexible. The possibility of an umbrella organisation to oversee both IODP and ICDP has previously been suggested, but it would present management difficulties. The IODP Forum is a good example of a light touch umbrella approach.

IODP's future contributions to the IPCC:
IODP has made significant contributions to the scientific basis of the IPCC reports. The recent announcement that there would no longer be a dedicated paleoclimate chapter in future IPCC reports therefore initially caused concern amongst the paleoclimate community. However, paleoclimate will actually now feature throughout the IPCC, increasing its profile, ensuring IODP will continue to have an important role. A large number of paleoclimate scientists contribute to the IPCC, with good representation of IODP scientists among the report authorship. We should continue to encourage the community to be proactive and respond to the 'open consultation' or contact authors directly (the authorship is listed on the IPCC website). Looking forward, we should continue to encourage colleagues to apply to be part of the next IPCC, although time consuming, this a worthwhile high profile activity. IODP should consider additional areas in which it could contribute to the IPCC, including continued focus on the cryosphere, where a special report is due soon, and improved understanding of climate dynamics from high-resolution records.

Mineral Resources:
Recent hydrothermal activity along Mid Ocean Ridges is a source of key mineral resources and an analogue for ancient volcanogenic massive sulfide (VMS) ore deposits. These deposits are an important source of traditional metals (Cu, Zn, Au) and critical commodities (Co, V, Sb) for green-shift and high technologies. They are also a potential source of toxic compounds (Tl, As, Hg). Investigations of these systems are also important for understanding interactions between hydrothermal (geochemical) and biological processes. To date expeditions 139, 169, 158, 193 and 331 have investigated hydrothermal mineral deposits. The slow spreading Gakkel Ridge in the Arctic is a key area of interest, as an analogue for VMS deposits. Knowledge gained through future scientific ocean drilling of submarine hydrothermal mineral deposits is key to both understanding mineral resources now accessible on land and for the sustainable and environmentally responsible exploration and exploitation of deep-sea deposits.

Links with industry:
IODP has revolutionised our view of Earth history, but it has also influenced industry. Yet, despite its potential benefits, engagement between IODP and industry is underutilised – primarily because there is not enough dialogue between communities that would enhance both groups. IODP and industry engagement could be improved via enhanced data sharing, knowledge exchange (both scientific and technological), and through co-funding. Both IODP scientists and industry would benefit from greater data and knowledge exchange – IODP data de-risks frontier areas (directly and indirectly), whereas industry can provide site survey data. There are significant research overlaps between IODP and industry, with joint interests including turbidites, contourites, carbonates, source to sink and links with ICDP. Industry is developing new techniques and technologies including: machine learning/log interpretation capabilities; downhole tools (e.g. geochemical tools); and the drill rigs themselves.

There are two main barriers to enhancing IODP's links with industry: (i) IODP works in an open data environment, whereas activities in the commercial sector are inherently proprietary; (ii) there are obvious conflicts between enhanced industrial links and IODP's work in sensitive environments with a clear need to avoid a public perception that IODP is used to find oil or new mineral resources. In response to the former problem, Dr Davies noted that industry recognises the benefits of interaction with IODP and the need to collaborate and reported that although industry data will never be open access, there is an appetite to share data provided there is a specific goal.

Comments from the floor noted that there is in fact a long history of engagement between IODP and industry; industry colleagues have contributed to key review processes that were critical to getting drilling ships and subsequently assessing their performance; industry representatives contribute their time and expertise to the Environmental Protection and Safety Panel (EPSP) and technological reviews (e.g., Deep Crustal Drilling Engineering Working Group; College Station, October 2017); as president of IODP-MI Manik Talwani (himself from industry) hired Jamie Austin to engage with industry; and industry representatives sat on the ECORD Industry Liaison Panel (ECORD ILP) created in 2013, which was originally developed as a UK-IODP initiative. This panel, which was built on the concept of data sharing, did work well for a few years, before being reclassified as an ad-hoc committee in 2015. One difficulty is to determine at what level we should engage with industry (management vs scientists). More rapid staff turnover at higher (management) levels in industry compared to academia can make it difficult to build lasting relationships. Re-energization of the ECORD ILP, focused at a science level, presents a good way to re-establish and strengthen links with industry.

The opportunities for direct collaboration on specific drilling projects were also discussed – with scientists requesting industry cores from deep holes/intervals that industry is 'washing through'. This would likely be difficult, but could be considered on a case-by-case basis when goals really overlap. ICDP does have experience of adding coring to industrial projects (e.g., Iceland geothermal wells). Even if joint coring efforts are not an option, industry cores are stored internationally (e.g. by the BGS in the UK) and those repositories are open to everyone. Similarly industry cores and data from continental settings (e.g., Norway and New Zealand) are also available.

Data Storage and Management:
All IODP data is currently openly available, but may not be in the best possible format. IODP could learn from other programs (e.g., GeoTraces) when developing future databases. Consideration should be given to how to handle the large IODP-related datasets not collected during IODP expeditions (e.g. observatory data) that consequently are not currently included in the IODP databases.

Museumszimmer of the Austrian Academy of Sciences (ÖAW) during the PROCEED Breakout session (Photocredit ÖAW)

4.3 Future IODP Opportunities discussions

C1. Amphibious Drilling

Three topics were addressed during this breakout discussion:

i) Do we have, in terms of science, new challenges that can be addressed only by amphibious drilling?

Amphibious Drilling Proposals are defined as "those for which full achievement of the scientific objectives requires scientific drilling at both onshore and offshore sites" (Proposal submission Guidelines IODP Science Evaluation Panel; May 15, 2018).

The discussion focussed on several processes for which doing Amphibious Transects would provide invaluable elements to better understand the driving mechanisms and their impacts:

Pending / future projects:

- Permafrost & thawing: Ancient groundwater & permafrost, thawing, destabilization & landslides, which links Climate Changes with Geohazards, Hydrogeology, Resources – (links science and industry).
- Faults onshore/offshore and seismicity: Faulting and geohazards (the HaitiDRILL project).
- Obduction, serpentinization and the carbon cycle (New Caledonia project): subduction initiation & dynamics of Zealandia; serpentinization and the deep biosphere (e.g., role of fluids in reaction paths); formation of the carbonate shelf and sea level changes during the Oligocene; impact on ore formation, hydrogen production and CO_2 storage (links science and industry)
- Balancing Ice masses with respect to sea-level rise: Along transect transport from major outlet glacier regions; Drilling through ice into glacial sediment (ICDP) / Ancient glacial shield (transect); sea-level reconstructions.
- Coastal aquifers & Hydrological Cycles: occurrence of offshore fresh water aquifers (e.g., East coast USA); impact on deep biosphere.
- Hydrothermalism, Ore Forming and Volcanic Processes (Campi Flegrei).

Other science questions to be addressed by ADP:

- Forearc basin in subduction zones that evolve from marine to terrestrial basins.
- Formation of LIPs - areas to be targeted: Bermuda-Bermuda Rise; Caribbean LIP (in situ submarine and obducted subaerial); Etendeka (subaerial)-Walvis Ridge (submarine); Karoo/Ferrar (subaerial) – SDRs (e.g., Explora Wedge); Kerguelen Islands- Kerguelen Plateau; Ontong Java (submarine) – Solomon Islands (obducted); Parana (subaerial) – Sao Paulo Plateau/Rio Grande Rise (submarine).

Note. Some of these scientific questions could also be addressed by combining two separate projects, one for ICDP and one for IODP. Several participants asked what would be the best strategy providing the best chance of success in terms of funding. This highlights a fundamental insecurity within the IODP community concerning the practicalities and uncertainties of the current ADP proposal route.

ii) Do we have, in terms of science, new challenges that can better be addressed by collaborating across Program boundaries

There is significant overlap between the IODP and ICDP Science Plans, which include many of the same or similar science questions/challenges. Close collaboration would enhance our ability to meet these challenges.

The break-out group recognised that it is not just land-ocean transects that are important - other scientific topics are closely linked between IODP and ICDP, but are not necessarily targets for ADP's:

- Terrestrial and marine records (e.g. monsoon, climate, paleo-environment, sea level, geohazards, perturbations).
- Rifting (initiation and evolution).

Also, as noted previously, it is unclear whether an ADP is always the best strategy for funding.

Scientists are already collaborating across Program boundaries, so the important question is: *How can we improve the structures and make best use of scientist expertise across communities?*

iii) How could we improve collaboration between IODP and ICDP?

One question was whether ADPs need to be forced into the new science plan? Discussions around this topic conceded that ADPs are already possible. Successful examples need to be drilled to pave the way for future proposals, and practical aspects of the proposal system need to be improved.

On what level can we improve IODP/ICDP collaboration?

- ADP, laboratory, data share?
- SEP together? Ad-hoc committee? Ideally: Science would be proposed first, then implementation should follow up.
- Science Plan: Science Plans have different levels: "Big Topics", "themes", and "Challenges". "Big Topics" and "themes" could be combined into "Big Questions addressed by scientific drilling" to improve visibility toward funding agencies, decision makers and general public.
- Would having more communality between ICDP and IODP Science Plans be beneficial for funding agencies? (Avoiding duplication for funding agencies).
- We need a structure that allows for looking beyond the Science Plan for 2023.

C2. Programmatic Issues

During this breakout discussion, various issues related to the program were discussed, such as funding of the program, expedition, and post-cruise research, promotion of the program either to the public or to the financers, and the success of the future New Science Plan.

Funding of expedition and post-cruise research is a challenge for researchers of EU countries. A possible solution would be to have an ECORD grant that could facilitate post cruise research and analyses. This would be particularly beneficial for projects that require setting up ocean monitoring and observation systems. Suggestions were made to explore opportunities to leverage extra funding from partners. More effective communication of the IODP program was discussed in detail. In particular, how to effectively communicate the value of IODP Science, either to the public or to the decision makers, in a more simplistic way. This is critical in a changing political landscape within some of the main IODP partners (e.g. the USA and Brazil). Outreach and marketing is deemed to be critical, including more effective web resources, and full-time staff employed for this role. Finally, in the production of a new science plan, it is critical that sufficient support is provided to the science team, including illustrators, web designers, and writers, from the inception of the process.

Johannessaal of the Austrian Academy of Sciences (ÖAW) during the PROCEED Breakout session (Photocredit ÖAW)

C3. Early Career Researchers' discussions

This discussion group was convened to allow the early career researchers at the meeting to discuss IODP issues of importance to them in the absence of more senior scientists. The PROCEED science committee asked those ECRs who were interested in joining this discussion to chair it and report back to the wider meeting themselves. This session lead to productive discussions, and both the PROCEED committees were pleased to see all the ECR group members on stage to present their thoughts.

The issues raised in the ECR discussions focussed on mechanisms to increase/facilitate ECR participation in IODP; ways to make IODP more accessible; and improvements to IODP education and outreach:

- It was suggested that an ECORD-wide ECR network be established to allow ECRs to share their IODP experiences, information to assist participation, science ideas etc. An ECR delegate could sit as an observer on the IODP review (SEP) panels, to better understand this process and report back to the ECR network.
- Education and outreach are an important aspect of IODP science, and should have a stronger representation in the IODP Science Plan.
- Given the revised berthing situation that will include outreach JR berths within national quotas it is likely that ECORD outreach berths on the JR will be negligible – new options for co-ordinating and implementing outreach within ECORD should be explored, for example there could be an ECORD outreach liaison in each country. ECORD could develop a suite of ready-made teaching/output materials to facilitate scientist's efforts to conduct outreach.
- Given the restricted number of berths, could more shore-based scientists be included in cruises? This would increase accessibility for those unable to spend two months at sea (e.g. single parents, those with health restrictions). To ensure full participation such participation should come with obligations to participate in shipboard discussions/science meetings (via Skype/FaceTime etc).
- Efforts should be made to expand membership of ECORD. Scientists should advertise IODP to other scientific communities (e.g. access to IODP databases and core repositories), and other institutes in their countries not currently involved to yet uninvolved, this could be achieved using the distinguished lecturer program.
- An improved ECORD-wide scheme for post-cruise funding would be welcomed!

C4. Infrastructure

Infrastructure discussions largely centered on the unique challenges of sampling fault zones and deep basement. It is an area of scientific interest that engages a large contingent of the IODP scientific community. It is a technological challenge that has not been met outside of *Chikyu* drilling on the Pacific rim. Improving the capacity to succeed in this area requires continued development, adoption and deployment of new drilling bits and sea-bed drilling technologies. There is considerable scope for mission specific platforms and alternate drilling strategies to contribute to this area of research. For example, it was noted that drilling into basement is often easier than recovering basement rocks. One approach to overcome this is to adopt a proven drilling technology and pair this with side borehole coring. Development of side borehole coring would also generate opportunities to re-sample legacy holes. The unique challenges related to drilling deep into basement or through complex lithologies are best met with careful coordination and management from the employed technology to utilising the most experienced staff.

Continued development of borehole instrumentation and observatories should be emphasized in the new science plan. Development of more energy efficient, non-cabled observatory systems, and more sophisticated geochemical sensors were two areas explicitly discussed. There is also a need to ensure that the engineering expertise for development and maintenance of instruments and observatories is properly integrated into planning for the future of IODP.

Shipboard facilities were also discussed – these are routinely reviewed for JR expeditions in the end-of-expedition surveys, in which the two most common requests are a CT-scanner and an XRF-scanner.

Entrance hall of the Austrian Academy of Sciences (ÖAW) during the PROCEED coffee break (Photocredit ÖAW)

C5. Inter-program Links

Two main topics were addressed during this breakout discussion, with a particular focus on links to the International Continental Scientific Drilling Program (ICDP):

i) What opportunities are there to link IODP science with other scientific programs/entities to enhance our science? How could such links be structured?

ii) Would it be good to have a science foundation serving as an umbrella under which the different science programs can get together?

Links between IODP and ICDP:
IODP and ICDP basically deliver the same products: scientific drilling samples and data. However, IODP and ICDP are distinct due to significant operational and organizational differences. For example, there are different protocols regarding public accessibility of data and core curation, and in ICDP PIs are responsible for sourcing funding for operations. The possibility of merging these two programs was discussed.

There is overlap between both programs, and it might be good to go forward and develop one program for "Earth Systems Drilling & Monitoring". Conflicting arguments for and against this option were discussed. For example, the implications for funding: a larger (combined) program might be able to apply for more funding, leverage extra funding, or to dig into strategic funding, that the smaller individual programs might struggle to access. Equally, merging the programs might jeopardise funding opportunities for those who use both proposal streams, with a risk that the amount of total funding would decrease. Currently, given the different operational procedures of the two programs, it would be difficult to merge them. The discussion group concluded that both the separate programs are good as they are and should be kept. Funding agencies need to be made aware that these are two separate programs.

Given the synergies between the two programs, and their importance to the jointly operated amphibious projects, the two science programs should be coordinated properly. It would be beneficial to have one umbrella organization for communication to funding agencies and the public – providing a stronger common voice. In IODP, it is possible to submit complex drilling proposal for a series of riser and riserless operations, requiring co-ordination between the different IODP operators and facility boards. The same approach could be used as a model for IODP-ICDP coordination for amphibious projects. There is already good experience in IODP with the integration of platforms – there have been bumps in the road between platform providers, but IODP has managed to cope with these internal differences to develop a good approach to handling integrated proposals. Established internal IODP procedures might therefore be used to nurture links with ICDP. An umbrella science organization would facilitate proposal submission for amphibious projects, with proposals submitted into one bucket, from where decisions will be made regarding operations. The group concluded that strengthening the links between IODP and ICDP would be beneficial, but that science must be the driver, to avoid two programs with different priorities.

Links with other programs:
With regards links with other programs, again science needs to define joint goals and targets - this will further define what tools are needed. One approach could be to lobby for a common big research project in a certain region of interest. COST Actions (European Cooperation in Science & Technology), for example, are a useful and efficient facility for that. Within that, other programs need to be considered, for example geothermal drilling, GEOTRACES and BIOGEOSCAPES as interfaces of biology and chemistry in the ocean.

5. Architecture of a New Science Plan and the future Role of ECORD

The workshop participants were randomly divided into four groups (D1-4), with an additional fifth group (D5) designated as an (optional) ECR only group, to discuss the architecture of the new science plan and the role of ECORD in IODP beyond 2023. All groups considered the same three questions:

Looking beyond 2023:

i) What new big ideas should be in the New Science Plan?

ii) What should the architecture of the New Science Plan be? (Outline with examples)

iii) What should the role of ECORD be in a new Drilling program?

The results of the breakout discussions and subsequent plenary are combined below.

5.1 What new big ideas should be in the New Science Plan?

The breakout discussion and subsequent plenary generated lots of suggestions of ideas to include in the new science plan, with many similarities. These suggestions are compiled and summarized below:

- **Life cycle of plate**: from rifting to subduction initiation, including: continental break-up, rifting initiation, plume influence, crustal architecture, evolution and aging of the oceanic lithosphere; geochemical cycles and the role of the biosphere/impact on life; resources; initiation of subduction; and ophiolite emplacement. This could also be linked to the formation and structure of passive margins and shelf processes.
- **Resources**: to include water and mineral resources, being careful to avoid explicit support of the hydrocarbon industry (although that could appeal to governments). Resources should be considered in the broadest possible sense, for example including fisheries (linking to shallow water habitability), with an emphasis on their environmental importance and the sustainable use of resources, and links between resources and the biosphere.
- **Follow the Water**: water is a topic that links multiple areas of IODP research, including resources (freshwater potential of the continental shelf), biogeochemical cycling, ocean circulation, hydrology and climate, and the biosphere.
- **Habitability:** building and maintaining a habitable planet is of crucial societal relevance.
- **The Anthropocene record.**
- **Monitoring,** including a link to ocean observatory systems. The ultimate goal should be a 4D approach for key intervals.
- **Societal problems we can solve:** for example, CO_2 storage, earthquake prediction.
- **Tectonics, oceanography and climate sensitivity:** a new focus for climate studies could be the feedback links between tectonic processes and ocean and/or climate change.
- **Crises - and resilience:** causes and impacts of crises events (e.g. volcanism, tectonic gateways, extinction events).
- **Timescales & rates of change:** all timescales should be considered, from human to geological timescales.
- **Planetary Hazards:** the concept of hazards could be broadened to encompass a processes occurring over a wider range of timescales, and to include climate change as a hazard.
- **Perturbations:** this could include climate sensitivity, tipping points, feedbacks on short timescales, documenting changes using high resolution records, and links between deep Earth and surface processes.
- **The cryosphere:** with a particular emphasis on the Arctic, given the current IODP focus on Antarctic Ice Sheets.

- **Ocean circulation:** with a focus on Oligocene to recent records when the continental arrangement and circulation patterns were similar.
- **The origin of life:** linking planetary dynamics and geochemical processes to habitability.
- **Fluxes, including the Carbon Cycle.**
- **Biosphere and plastics:** the impact of human activity on the health of the oceans.
- **Evaporitic basins:** Drilling salt basins (Mediterranean).
- **Future evolution of life:** the co-evolution of the geo- and biosphere, and the future evolution of the biosphere.
- **Astrobiology:** investigating inner and extra-terrestrial life/exobiology – with opportunities to link to other major research programs (e.g. NASA).
- **Linking land-ocean records:** multiple topics could be advanced with land-sea drilling transects (see day 1 discussions).

New ideas for the way we conduct our science were also considered:
- **Data:** the science challenges should include a focus on data driven science, including big data and AI.
- Following **a UN Sustainable Development Goal approach** – in terms of opening up opportunities for target countries, to allow their scientific communities to develop.

5.2 What should the architecture of the New Science Plan be?

A clear theme that came out of the Day 1 discussions of the current science plan themes was that although many of the current science plan challenges remain relevant the new science plan should have a different structure that emphasises cross-disciplinary links. This was supported by the results of pigeonhole polls that asked: Is the scientific content of the Science Plan still relevant? Do we need a new architecture for the Science Plan? (Yes: 94% and 93%, respectively).

Purpose of a new science plan:
The breakout and subsequent plenary sessions included discussions of the need for, purpose, and target audience of a new IODP science plan, since these issues affect the content and architecture of the plan:

- It was agreed that a new science plan is needed beyond 2023, to make clear that this is a new program.
- There are multiple audiences for the science plan (Funding agencies, the public, scientists).
- It is important to identify the purpose/impact of the science plan, which depends on the audience.
- Funding agencies require a solid document that explains what important science IODP can address, and why it should be funded. Given that many of the challenges in the current science plan remain relevant it is important to highlight past successes, emphasizing the exceptional achievements already made by IODP – including IODPs record of answering questions we didn't even know to ask. The excellent legacy of scientific ocean drilling to date should also be emphasized – for example, its record of training multiple generations of scientists, and the diversity of countries and institutions involved.
- The public needs a document that clearly explains why ocean drilling is important, emphasizing the societal relevance of the scientific questions in the plan.
- The 'top-down' nature of a program science plan is somewhat at odds with 'bottom-up' proposal-driven nature of IODP, which is a clear strength of the program. Scientists therefore require a broad science plan to attract the excellent proposals required.

- The science plan could include a strategic plan and a list of goals (e.g., for science support and mentoring, outreach and education).
- Given the different needs of these different audiences, several different versions/formats of the science plan may be required. We could develop 'Teasers' (for public) and 'Challenges' (for peers).
- The need for a printed version of the science plan was questioned. Any printed version would need to be a 'linear' document, whereas a digital version could be non-linear with hyperlinks. The executive summary should be linear with clear infographics (highlighting links between scientific ideas) for communication of ideas to a broad audience.

Architecture:
The breakout groups were tasked with suggesting a new architecture for the science plan (although they were not asked to provide all the details, just illustrating any suggestions with examples). It was agreed that a new structure was required to make clear the science plan beyond 2023 is a new plan. The new structure should include replacing the current four themes, as maintaining these would prevent the plan ever looking new. There was a consensus that the new science plan should be interdisciplinary, with a focus on the links between the science questions. It was suggested that in designing the new architecture the following should be considered:

- The terminology (currently themes and challenges) of the plan should be revised. Themes could be replaced with 'Grand Challenges' or 'Overarching Questions' at the highest hierarchical level (similar to the UN Sustainable Development Goals approach).
- The number of science questions (currently challenges) should be reduced from 14 to 5-10. These questions need to be clear and intelligible, but also need to be broad enough to encapsulate the ideas of the whole scientific community (perhaps wider than at present?)
- The questions should be important for humankind – in formulating them we should consider what we can only achieve by (ocean) drilling? What are the new frontiers?
- There should be a balance between achievable topics and aspirational goals. The plan needs to include achievable goals, so that we can demonstrate success to the public and funding agencies. However, the current plan includes long-term projects that would never be complete within a 10-year cycle of the program (e.g. Project MoHole), given technological developments required and the depth of drilling needed. Even more straightforward projects may take more than 10 years if they require multiple JR expeditions, given the JR's 10-year circumnavigations of the world's oceans. Given the requirement for a new science plan every 10 years, such long-term projects are still on-going, which makes it hard to sell the science plan as 'new'. To counter this, the aspirational nature of such projects should be highlighted up front. The plan could include challenges that would be achievable in 5 years, 10 years, and 15+ years.
- If the plan included challenges with different time frames, it could be 'fluid' with reviews and revisions every 5 years.
- The serendipitous nature of IODP expeditions should be highlighted - emphasizing that we always learn new things.
- A section on technology should be included up front, highlighting new capabilities.
- Links with other communities (e.g. ICDP, planetary science) should be emphasized.
- The science plan could include a mission statement summarising what we will do and how we are going to do it.

Several possible specific architectures were suggested:

- The scientific challenges could be grouped into 4 multidisciplinary '**planetary**' topics/grand challenges: Planetary Hazards (on various timescales; including climate change); Planetary Habitability; Planetary Evolution (e.g. life cycle of a plate); Planetary Resources (including water)/Sustainability.
- The scientific challenges could be grouped by either the timescales of the processes of the processes involved, or from shallow to deep processes.
- The science plan could focus on several keywords or ideas e.g. life cycle of a plate; following the water.
- Planet Earth could feature at the centre of the plan (or the infographic summary), allowing scope to link with the other worlds.

The title of the new science plan was also considered during the plenary session, with suggestions including 'Our Dynamic Earth'. A title that encompasses the 'whole-planet' perspective of IODP research may broaden the relevance of scientific ocean drilling and foster greater collaboration with ICDP. However, the contrasting point that marine science needs to be reflected in the title was also made - we live on an ocean planet, and the oceans contain more than 200 Myr of Earth history; the oceans are where the record is and that should be emphasized.

5.3 What should the role of ECORD be in a new Drilling program?

ECORD, which currently comprises 14 European countries and Canada, has two key roles within IODP:

- ECORD is one of three IODP platform providers along with the USA, who operates the multipurpose riserless vessel *JOIDES Resolution,* and Japan, who operates the riser vessel *Chikyu*. ECORD is currently responsible for funding (including securing the necessary in kind contributions) and implementing mission-specific platform (MSP) expeditions.
- The ECORD Science Committee, ESSAC, is one of the eight Program Member Offices (PMOs) that manage and fund the participation of researchers working in member countries or consortia in IODP activities. As such, ESSAC is responsible for nominating scientists from ECORD countries to participate in IODP expeditions and to serve on IODP boards and panels. ECORD also engages in activities to broaden national interest and participation in IODP research opportunities within ECORD countries.

The consensus amongst workshop participants was that the current ECORD structure works well and should be maintained. The scientific progress as a result of the versatile MSP expeditions, which can operate in areas inaccessible to the JR or *Chikyu*, was emphasized – with the majority of participants (75% via pigeonhole poll) ranking the importance of MSPs to future IODP science as high or critical. The strength of ECORD scientists' contributions to IODP research, including leadership of proposals, was commended. ECORD's education (e.g. through ECORD Summer Schools) and outreach efforts were also praised and ideas to even better co-ordinate such activities (e.g. coordinating individual efforts by each ECORD members countries) have been discussed. The current bottom up, peer-review system is a key strength of IODP and should also be maintained. To maintain ECORD's position within IODP further funding sources should be sought (see also section 4.2 "Opportunities for joint programming"), and efforts should continue to grow membership of ECORD.

ESO Science Manager David McInroy presenting in the Festssaal of Austrian Academy of Sciences (ÖAW) during the PROCEED plenary session (Photocredit ÖAW).

The PROCEED organising and scientific committees (Photocredit ÖAW).

6. Workshop Summary

6.1 Wrap up

The PROCEED workshop discussions lead to the following consensus on the future of scientific ocean drilling beyond 2023.

ECORD views on the science plan:

- The content of the Science Plan is still relevant.
- The architecture needs changing to better reflect the interdisciplinary nature of our science AND to excite funding agencies.
- The meeting identified many exciting new/emerging topics.
- It is clear that are key questions that can ONLY be addressed with land to sea transects, e.g. aquifers, permafrost, source2sink, basin evolution (see section 4.3 – C1 above).
- A closer link with ICDP (and other entities) should be explored.

The future role of ECORD in IODP

- ECORD must continue to be an IODP partner.
- The ECORD science community is very healthy, and must continue to participate in all aspects of IODP globally, using and supporting all facilities (e.g., proposing and participating in expeditions, conducting research using IODP samples and data, and supporting outreach activities).
- ECORD must continue to be a (MSP) platform provider.
- The ECORD community should explore and advertise the versatility of MSPs.
- ECORD needs to explore ways to leverage more funding in order to meet the challenges of the new program.

6.2 Outcomes & Future actions

- The Pigeonhole and online workshop surveys were kept open for a further month following the workshop, providing a further opportunity for people to contribute to workshop discussions. These additional comments have been incorporated into the Appendix B and C of this report.
- All the workshop presentations will be made available on online.
- The science committee will write a workshop report, to be published online.
- The report will be presented to IODP Forum in September.
- The committee will report back to the group following the Forum.

6.3 Acknowledgements

The PROCEED organising and scientific committees would like to thank ECORD for funding this workshop, via the MagellanPlus Workshop Series Programme, and the Austrian Academy of Sciences for their generous provision of facilities.

7. Appendices

7.1 Appendix A: Participant lists

Table 2: PROCEED Organization Committee

Last Name	First Name	E-mail address	Institution	Country
Camoin	Gilbert	camoin@cerege.fr	CEREGE	France
Hallmann	Nadine	hallmann@cerege.fr	CEREGE	France
McInroy	David	dbm@bgs.ac.uk	British Geological Survey	UK
Morris	Antony	a.morris@plymouth.ac.uk	University of Plymouth	UK
Piller	Werner	werner.piller@uni-graz.at	University of Graz	Austria
Plunger	Bernhard	Bernhard.Plunger@oeaw.ac.at	Austrian Academy of Sciences	Austria
Uenzelmann-Neben	Gabi	gabriele.uenzelmann-neben@awi.de	AWI, Bremerhaven	Germany

Table 3: PROCEED Science Committee *(*co-chairs of committee)*

Last Name	First Name	E-mail address	Institution	Country
Boschi	Chiara	chiara.boschi@igg.cnr.it	Inst. Geosciences&EarthResources	Italy
*Coggon	Rosalind	R.M.Coggon@soton.ac.uk	University of Southampton	UK
Delacour	Adélie	adelie.delacour@univ-st-etienne.fr	Univ. Jean Monnet Saint-Etienne	France
Dunkley Jones	Tom	t.dunkleyjones@bham.ac.uk	University of Birmingham	UK
Forwick	Matthias	Matthias.Forwick@uit.no	Arctic Univ. of Norway Tromsø	Norway
Godard	Marguerite	Marguerite.Godard@umontpellier.fr	Université de Montpellier	France
Grunert	Patrick	pgrunert@uni-koeln.de	University of Cologne	Germany
Harris	Michelle	michelle.harris@plymouth.ac.uk	University of Plymouth	UK
Heuer	Verena	vheuer@marum.de	MARUM, University of Bremen	Germany
Kleiven	Helga (Kiki)	kikki@uib.no	University of Bergen	Norway
Kurz	Walter	walter.kurz@uni-graz.at	University of Graz	Austria
McCaig	Andrew	A.M.McCaig@leeds.ac.uk	University of Leeds	UK
Mueller	Juliane	Juliane.Mueller@awi.de	AWI, Bremerhaven	Germany
Nicholson	Uisdean	u.nicholson@hw.ac.uk	Heriot-Watt University	UK
ORegan	Matt	matt.oregan@geo.su.se	Stockholm University	Sweden
Sluijs	Appy	a.sluijs@uu.nl	Utrecht University	Netherland
*Strasser	Michi	michael.strasser@uibk.ac.at	University of Innsbruck	Austria

Table 4: PROCEED Participants *(*Early career as self-indicated upon registration)*

Last Name	First Name	E-mail address	Institution	Country
Aiken	Chastity	chastity.aiken@gmail.com	Ifremer	France
Allan	Jamie	jallan@nsf.gov	NSF	USA
Aloisi	Vanni	aloisi@ipgp.fr	Institut de Physique de Globe de Paris	France
Ando	Sergio	sergio.ando@unimib.it	University of Milano-Bicocca	Italy
Argani	Andrea	andrea.argnani@ismar.cnr.it	Istituto delle Scienze Marine (CNR)	Italy
*Auer	Gerald	gerald.auer@jamstec.go.jp	JAMSTEC	Japan
*Barilaro	Federica	federica.barilaro@uninsubria.it	Uninsubria	Italy
*Bednarz	Malgo	bednarz@cerege.fr	CEREGE	France
Behrmann	Jan	jbehrmann@geomar.de	GEOMAR	Germany
Beier	Christoph	christoph.beier@helsinki.fi	University of Helsinki	Finland
*Bialik	Or	obialik@campus.haifa.ac.il	University of Haifa	Israel
Bornemann	André	andre.bornemann@bgr.de	BGR Hannover	Germany
Böttcher	Michael	michael.boettcher@io-warnemuende.de	Leibniz Institute for Baltic Sea Research	Germany
*Brandl	Philipp	pbrandl@geomar.de	GEOMAR	Germany
Brenner	Carl	cbrenner@LDEO.columbia.edu	Columbia University	USA
Briais	Anne	anne.briais@cnrs.fr	CNRS Geoscience Environment Toulouse	France
*Brunet	Morgan	morganebrunet@hotmail.com	IODP France	France
Camerlenghi	Angelo	acamerlenghi@inogs.it	OGS	Italy
Ceuleneer	Georges	georges.ceuleneer@get.omp.eu	CNRS - Université Paul Sabatier	France
Christeson	Gail	gail@ig.utexas.edu	UTIG	USA
Clift	Peter	pclift@lsu.edu	Louisiana State University	USA
Coffin	Mike	mike.coffin@utas.edu.au	University of Tasmania	Australia
Cotterill	Carol	cjcott@bgs.ac.uk	British Geological Survey	UK
Cuven	Stéphanie	phaniecuven@gmail.com	Géosciences Environnement Toulouse	France
Davies	Andrew	andrew.davies@halliburton.com	Halliburton	UK
De Santis	Laura	ldesantis@inogs.it	OGS	Italy
*Di Capua	Andrea	andrea.dicapua@idpa.cnr.it	CNR - IDPA	Italy

Table 4 continued: PROCEED Participants *(*Early career as self-indicated upon registration)*

Last Name	First Name	E-mail address	Institution	Country
Donnadieu	Yannick	donnadieu@cerege.fr	CEREGE	France
*Drury	Anna Joy	ajdrury@marum.de	MARUM, University of Bremen	Germany
Egger	Lisa	lisa.egger@bgr.de	BGR Hannover	Germany
Erbacher	Jochen	jochen.erbacher@bgr.de	BGR Hannover	Germany
Escutia	Carlota	cescutia@ugr.es	Research Council of Spain - IACT	Spain
Ferré	Eric	eric.ferre@louisiana.edu	University of Louisiana at Lafayette	USA
Fiorentino	Andrea	andrea.fiorentino@isprambiente.it	Geological Survey of Italy - ISPRA	Italy
Flores	José-Abel	flores@usal.es	Universidad de Salamanca	Spain
Ford	Heather	h.ford@qmul.ac.uk	Queen Mary University of London	UK
Fulton	Patrick	pfulton@cornell.edu	Cornell University	USA
Gaina	Carmen	carmen.gaina@geo.uio.no	University of Oslo	Norway
*Gales	Jenny	jenny.gales@plymouth.ac.uk	University of Plymouth	UK
Gebhardt	Catalina	catalina.gebhardt@awi.de	AWI Bremerhaven	Germany
Glombitza	Clemens	clemens.glombitza@gmail.com	ETH Zurich	Switzerland
Gohl	Karsten	karsten.gohl@awi.de	AWI Bremerhaven	Germany
*Greve	Annika	greveanni@gmail.com	JAMSTEC	Japan
Gruetzner	Jens	Jens.Gruetzner@awi.de	AWI, Bremerhaven	Germany
*Gürer	Derya	derya.guerer@gmail.com	University of Queensland	Australia
Gutscher	MarkAndré	gutscher@univ-brest.fr.	University of Brest	France
Hall	Ian	Hall@cardiff.ac.uk	Cardiff University	UK
*Azami	Seyed	sazami@umass.edu	University of Massachusetts Amherst	USA
Harms	Ulrich	ulrich.harms@gfz-potsdam.de	GFZ Potsdam	Germany
*Haymann	Stephanie	stephanie.hayman@unifr.ch	University of Fribourg	Switzerland
Heeschen	Katja	katja.heeschen@gfz-potsdam.de	GFZ	Germany
Henderiks	Jorijntje	jorijntje.henderiks@geo.uu.se	Uppsala University	Sweden
*Hochmuth	Katharina	kh355@leicester.ac.uk	University of Leicester	UK
Holtz	Francois	f.holtz@mineralogie.uni-hannover.de	Leibniz Universität Hannover	Germany

Table 4 continued: PROCEED Participants *(*Early career as self-indicated upon registration)*

Last Name	First Name	E-mail address	Institution	Country
*Huang	Jyh-Jaan	huang.jyhjaan@gmail.com	University of Innsbruck	Austria
Iadanza	Annalisa	annalisa.iadanza@cnr.it	CNR	Italy
Ildefonse	Benoit	benoit.ildefonse@umontpellier.fr	University of Montpellier, CNRS	France
Jovane	Luigi	jovane@usp.br	University of São Paulo	Brazil
Kallmeyer	Jens	kallm@gfz-potsdam.de	GFZ Potsdam	Germany
Kanamatsu	Toshiya	toshiyak@jamstec.go.jp	JAMSTEC	Japan
Kinkel	Hanno	hanno.kinkel@plymouth.ac.uk	University Plymouth	UK
Kinoshita	Masataka	masa@eri.u-tokyo.ac.jp	University of Tokyo	Japan
Koeberl	Christian	christian.koeberl@univie.ac.at	University of Vienna	Austria
Kopf	Achim	akopf@marum.de	MARUM, University of Bremen	Germany
Koppers	Anthony	akoppers@ceoas.oregonstate.edu	Oregon State University	USA
Kroon	Dick	dick.kroon@ed.ac.uk	University of Edingburgh	UK
Kutterolf	Steffen	skutterolf@geomar.de	GEOMAR	Germany
*Le Ber	Erwan	elb51@le.ac.uk	ESO - University of Leicester	UK
*Lee	Eun Young	eun.y.leeee@gmail.com	Chonnam National University	South Korea
*Lembke-Jene	Lester	lester.lembke-jene@awi.de	AWI, Bremerhaven	Germany
*Limonta	Mara	mara.limonta@unimib.it	University of Milano-Bicocca	Italy
Lourens	Luc	l.j.lourens@uu.nl	Utrecht University	Netherland
Lovell	Mike	mtl@le.ac.uk	Leicester University	UK
Lüniger	Guido	Guido.Lueniger@dfg.de	DFG	Germany
Mac Namara	David	david.d.mcnamara@nuigalway.ie	National University of Ireland	Ireland
Malone	Mitch	malone@iodp.tamu.edu	IODP-TAMU	USA
*Martinez	Mathieu	mth.martinez@gmail.com	University of Rennes	France
Mazzini	Adriano	adriano.mazzini@geo.uio.no	University of Oslo	Norway
McLoed	Chris	Macleod@cardiff.ac.uk	Cardiff University	UK

Table 4 continued: PROCEED Participants *(*Early career as self-indicated upon registration)*

Last Name	First Name	E-mail address	Institution	Country
McNeill	Lisa	lcmn@noc.soton.ac.uk	University of Southampton	UK
Meyzen	Christine	christine.meyzen@unipd.it	University of Padova	Italy
Monnin	Christophe	christophe.monnin@get.omp.eu	CNRS - Université Paul Sabatier	France
Pälike	Heiko	hpaelike@marum.de	MARUM, University of Bremen	Germany
*Petersen	Jassin	jassin.petersen@uni-koeln.de	University of Cologne	Germany
Prytulak	Julie	julie.prytulak@durham.ac.uk	University of Durham	UK
Pucéat	Emanuelle	Emmanuelle.Puceat@u-bourgogne.fr	University of Burgundy	France
Rebesco	Michele	mrebesco@inogs.it	OGS	Italy
Reijmer	John J.G.	Reijmer@kfupm.edu.sa	KFUPM - CPG	Saudi Arabia
Robinson	Stuart	stuart.robinson@earth.ox.ac.uk	University of Oxford	UK
Röhl	Ulla	uroehl@marum.de	MARUM, University of Bremen	Germany
*Rydningen	Tom Arne	tom.a.rydningen@uit.no	The Arctic University of Norway Tromsø	Norway
Satolli	Sara	s.satolli@unich.it	Università di Chieti-Pescara	Italy
Schwarzenbach	Esther	esther.schwarzenbach@fu-berlin.de	Freie Universität Berlin	Germany
Simmons	Michael	Mike.Simmons@halliburton.com	Halliburton	UK
Slagle	Angela	aslagle@ldeo.columbia.edu	Columbia University	USA
Sonntag	Iris	iris.sonntag@dfg.de	DFG	Germany
Spezzaferri	Silvia	silvia.spezzaferri@unifr.ch	University of Fribourg	Switzerland
Spiess	Volkhard	vspiess@uni-bremen.de	University of Bremen	Germany
*Srikumar	Roy	srikumar.roy@icrag-centre.org	Irish c. f. research in applied geosciences	Ireland
St John	Kristen	stjohnke@jmu.edu	James Madison University	USA
Stein	Ruediger	Ruediger.Stein@awi.de	AWI Bremerhaven	Germany
St-Onge	Guillaume	Guillaume_St-Onge@uqar.ca	Université du Québec à Rimouski	Canada
Strmic Palinkas	Sabina	sabina.s.palinkas@uit.no	UiT The Arctic University of Norway	Norway
Suyehiro	Kiyoshi	suyehiro@jamstec.go.jp	JAMSTEC	Japan
*Tamborrino	Leonardo	ltamborrino@marum.de	MARUM-University of Bremen	Germany
Teagle	Damon	damon.teagle@southampton.ac.uk	University of Southampton	UK

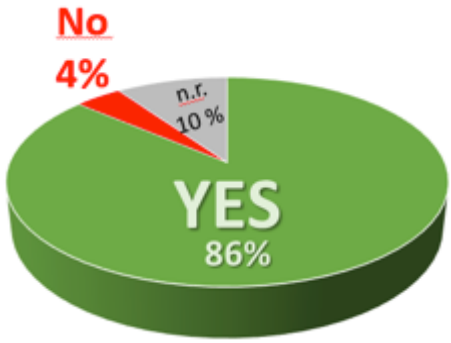
Table 4 continued: PROCEED Participants *(*Early career as self-indicated upon registration)*

Last Name	First Name	E-mail address	Institution	Country
Tejada	Maria Luisa	mtejada@jamstec.go.jp	JAMSTEC	Japan
Toczko	Sean	sean@jamstec.go.jp	JAMSTEC	Japan
Tuo	Shouting	shouting@tongji.edu.cn	Tongji University	China
Urgeles	Roger	urgeles@icm.csic.es	Instituto de Ciencias del Mar, CSIC	Spain
van de Flierdt	Tina	tina.vandeflierdt@imperial.ac.uk	Imperial College London	UK
Vannucchi	Paola	paola.vannucchi@rhul.ac.uk	Royal Holloway University of London	UK
Villinger	Heinrich	vill@uni-bremen.de	University of Bremen	Germany
Virtasalo	Joonas	joonas.virtasalo@gtk.fi	Geological Survey of Finland	Finland
Voelker	Antje	antje.voelker@ipma.pt	IPMA & CCMAR	Portugal
Wagreich	Michael	michael.wagreich@univie.ac.at	University of Vienna	Austria
Wefer	Gerold	gwefer@marum.de	MARUM	Germany
*Wolfgring	Erik	erik.wolfgring@univie.ac.at	University of Vienna	Austria
*Woodhouse	Adam	eeadw@leeds.ac.uk	University of Leeds	UK
Wright	Jim	jdwright@eps.rutgers.edu	Rutgers University	USA
Yamada	Yasuhiro	yyamada@jamstec.go.jp	JAMSTEC	Japan

7.2 Appendix B: PROCEED Pre-meeting survey summary

The pre-meeting survey was completed by 138 individuals, of which 107 were attending the workshop. 42% of the survey respondents were senior scientists, 37% were mid-career, and 21% were early career scientists (<8 years post-PhD and not holding a permanent position). The responses to the survey questions are summarised below. In addition to gathering participant's data (see Appendix A) and answers to open-text questions (see below), there were three specific pre-meeting polls on key questions regarding the current science plan, the role of MSPs and interest in amphibious drilling, as input to the PROCEED scientific committee for efficient workshop program planning.

Q: Is the current IODP Science Plan for 2013-2023 still appropriate to guide scientific ocean drilling beyond 2023?

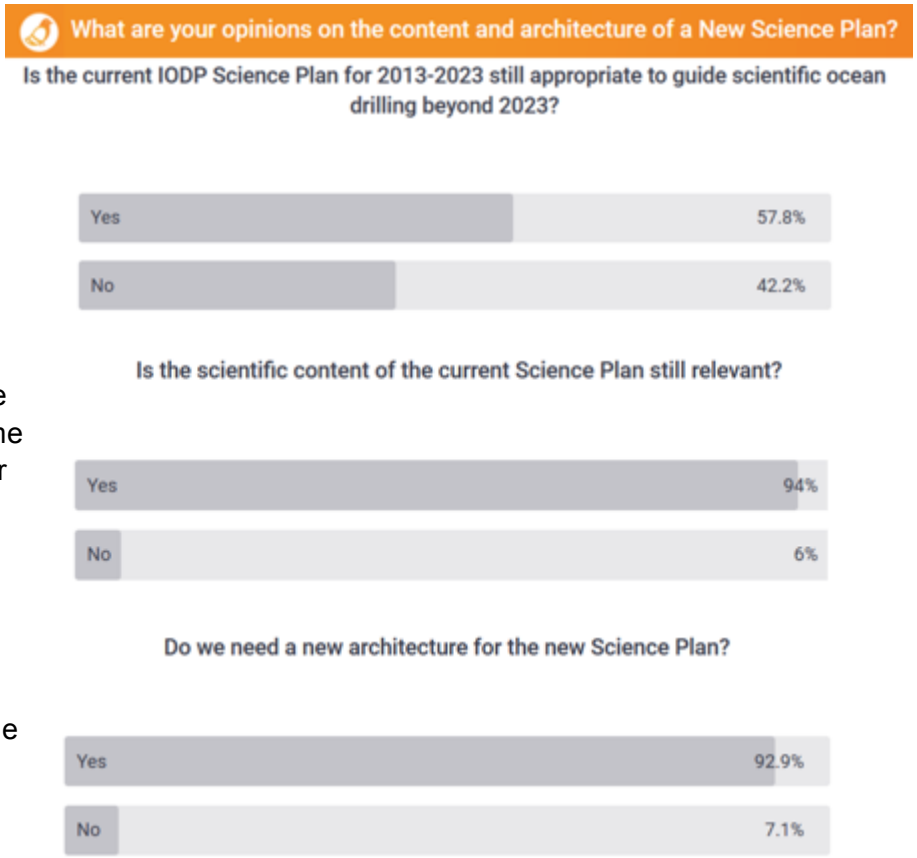


86% YES: the challenges of the IODP 2013-2023 Science Plan are still relevant, and should form the basis of the Science Plan beyond

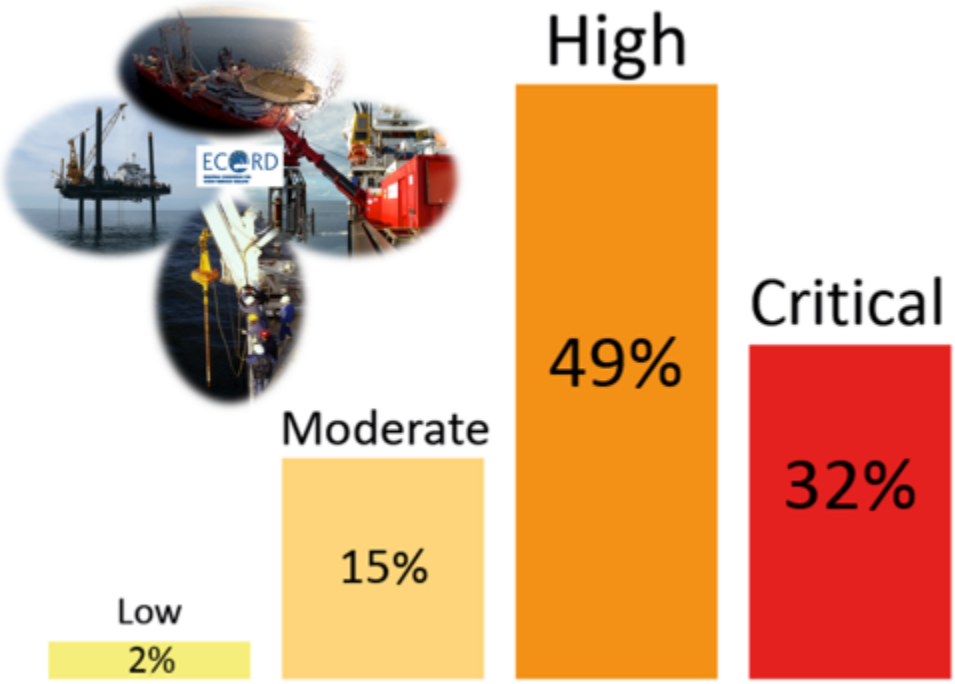
4% NO: the majority of the challenges of the 2013-2023 Science Plan have been addressed and a completely new plan is required beyond 2023.

n = 123

Although the pre-meeting survey indicates a clear consensus on whether the current Science Plan is appropriate to guide scientific ocean drilling beyond 2023, this position shifted through the PROCEED day 1 discussions of the progress we have made towards addressing the scientific challenges of the current Science Plan for 2013-2023, and it became clear that the question of whether the current Science Plan is still suitable is more complex. The same question was therefore re-evaluated at the beginning of PROCEED day 2, with two subsequent questions regarding the content and architecture of the New Science Plan, using the Pigeonhole tool.

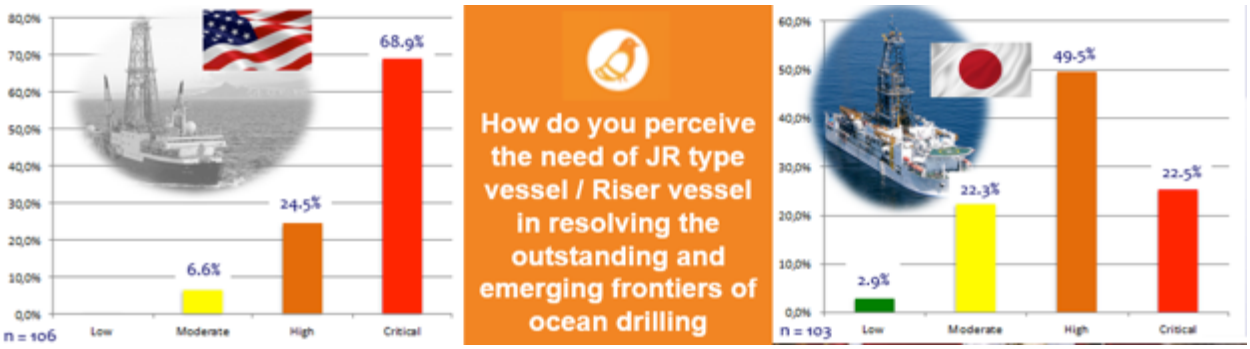


Q: How do you perceive the need for MSP's in resolving the outstanding or emerging challenges in scientific ocean drilling?

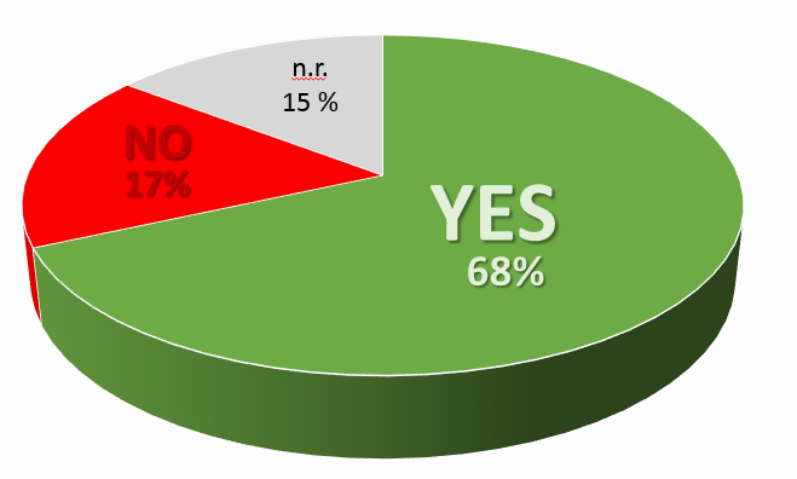


n = 123

During the PROCEED workshop it became clear that ECORD must continue to participate in all aspects of IODP globally, using and supporting all facilities. A Pigeonhole poll on perceived importance of both a JR-type non-riser platform and Chikyu-type riser vessel revealed the following results:

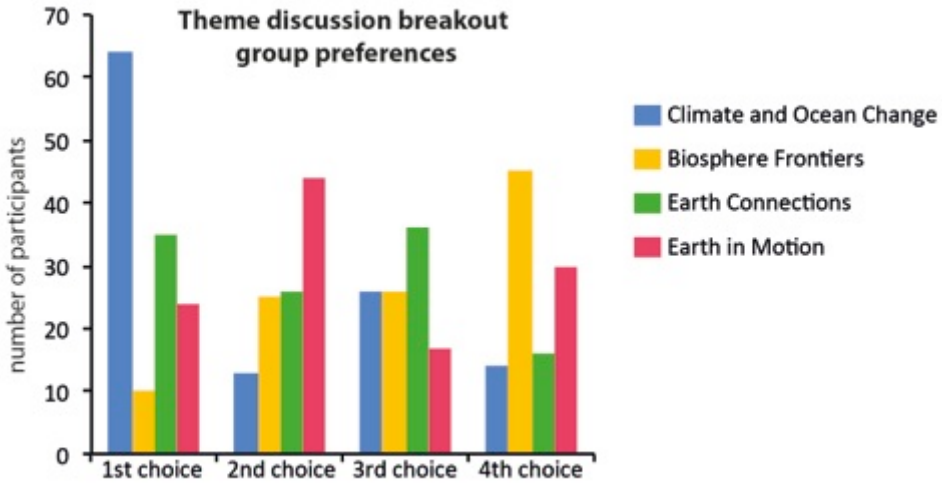


Q: Would you be interested in joining a breakout group focused on the future role and implementation of land-to-sea (amphibious drilling) transects in IODP?



n = 123

The pre-meeting online survey was also used to gather input on the workshop participants preferred breakout group selections – the break down of these choices gives an indication of the scientific interests of the workshop participants:



The remainder of the questions allowed for free text responses. In the summary below some responses are quoted at length or verbatim, others are integrated where multiple responses highlight the same issue. Where several respondents have made the same point, this is also indicated. The responses have been integrated into paragraphs for ease of reading, but, as individual statements within paragraphs can come from multiple individuals, they are not necessarily consistent with each other, and may make contrary points. However, the paragraphs are ordered broadly by “theme” so that responses on a similar theme are grouped together. Responses are grouped into themes, and where appropriate are further split into the individual challenges. Finally, there is a bias towards respondents who wrote more substantial and coherent replies. These may or may not represent the wider views of the community, and should be used with care, **they are in no way the agreed position from those attending the PROCEED workshop!**

Q. Beyond 2023, which current IODP SP challenges need to be modified or expanded?

There was a strong call for an emphasis on societal relevance and social responsibility for our environment for challenges in all themes, associated with the need to communicate the value and importance of IODP science to the public and policy-makers at all levels. Challenges need to be framed in an accessible way to the general public and stakeholders. The societal relevance of each theme should be explicitly spelled out. This will also help individual IODP scientists communicate the relevance and importance of scientific ocean drilling. For example, the climate theme should go beyond documenting "*what has happened*" and move into contributing solutions through improving understandings that relate to the current state of the world. Water, life, minerals as resource are currently an important side product of IODP research but could play a larger role in explaining the reasons for this science.

A future revision of the science plan should include the "state of play" towards meeting current SP challenges and any expansion to the challenges should refer back to this status report. In general, the long-term nature of the challenges make them still highly relevant, with many requiring future operations in various regions and environments. For instance, Arctic drilling that is absolutely essential for addressing all challenges of theme 1. In terms of structure, there was a desire for better integration across the themes, highlighting interconnected challenges throughout the science plan.

The importance of real-time continuous observation of sub-sea floor conditions and environments was noted.

Climate and Ocean Change

Deep ocean cores are the most important and continuous archive of Earth's climate history. Sediments recovered allow us to reconstruct biogeochemical cycles, fluxes, and interactions among the biosphere, hydrosphere, atmosphere, cryosphere and solid earth. A detailed temporal and spatial arrays of paleoenvironmental data can be developed and reveal our planet's dynamic climate system over a range of climate states and time periods. Reconstruction of different past climates allows the scientists to improve the physics and chemistry represented in numerical climate simulation and to predict the response of the climate system to human-induced perturbation versus natural climate variability. More sophisticated techniques revolutionize our ability to reconstruct past environmental conditions and to reduce uncertainties associated with these reconstructions.

A number of respondents emphasized the importance of integrated 4D-ocean reconstructions of water mass distributions and current intensities especially for Pre-Quaternary time intervals. Whereas the current science plan is mainly written in a way that focuses on specific climatic events, propose a direct statement to advance the generation of longer high-resolution records. The aim would be a better understanding of how changes in tectonic configuration, ice volume/sea-level and pCO_2 may have 'preconditioned' the Earth for these events to occur and to provide the context within which to fully understand their implications; especially in regard to future climate change. In addition to maintaining the other areas of the science plan, more emphasis could be made of: Greenland ice sheet history; oxygen minimum zones; role of subduction zones in biogeochemical cycling; tropical climate in past warm house worlds.

1. Elevated CO_2

This challenge needs to be broadened in its focus; CO_2 isn't the only climate forcing that requires research - it's more important to understand how CO_2, temperature, the cryosphere, weathering, tectonics and other aspects of the Earth's system interact together to control

climate. A broader focus on how Earth's climate system responded in warmer time periods in particular will be more valuable to understanding how our climate system works, than focussing on CO_2 alone. A number of respondents highlighted the need for improved spatial coverage of future analogue climate states, recovering the quality and detail of records necessary to characterise baseline conditions and internal climate variability for the Pliocene, Miocene and older warm climate intervals, in order to test the vulnerability of ocean circulation, biosphere and other components of the Earth System and to scan for tipping points and non-linear transitions.

Several commented that this Challenge should be modified so it isn't just about CO_2- or even included as one part of Challenge 4 – certainly broadened to include CH_4 from the permafrost and O_2 in the oceans. How does Earth's climate and ocean ecosystem respond to rapidly changing levels of greenhouse gases? How is the transition to a Hothouse Earth manifested in the changes to physical, chemical, and biological systems?

2. Ice Sheets and Sea level

Records of ice sheet dynamics under elevated levels of CO_2 and a warming climate and their impact in sea level are still needed. Paleoenvironmental records obtained around Antarctica are still limited in their geographical coverage and do not provide a basis for comprehensive understanding for ocean-ice sheet-atmospheric interactions to understand how different sectors of Antarctica respond to climate perturbations. Subglacial records, not included in the previous science plan are needed to be included in amphibious subglacial-ice-proximal-ice-distal transects at sensitive locations of both the West and the East Antarctic ice sheet.

Albeit challenging from a logistical point of view, recent preliminary results from Expedition 374 show the large approximations in the interpretation of ice sheet dynamics that were done in previous DSDP sites in Antarctica and of ANDRILL cores. New results from Expedition 379 in the Amundsen Sea should also reveal new aspects of the West Antarctic Ice Sheet. But we need more, for example in the challenging Weddell sea. The Greenland area is also challenging, however, this area is definitely poor in deep drilling sites and hampers a proper understanding of the climate evolution over the last 34 Ma. Lack of information from this area also prevents an understanding of the bipolar linkages between the two ice sheets and the other components of the climate system, as well as the role of teleconnections at different timescales.

3. Precipitation, monsoons and El Nino

This challenge targets one of the society's most pressing question - what factors control the global hydrological cycle - and discuss the importance of preserve water resources. It is fundamental to expand the study of the continental margin sediments and open-ocean sites to obtain new data on both continental and oceanic change and to recognize the role that tectonic-climate interaction played in Earth system history. Petrographic, mineralogical and geochemical compositions of core sediments allow us to reconstruct the characteristics of the source rocks but also the hydraulic regime during transport and the burial conditions. These data allow us to identify when and where different tectonic domains of source rocks have generated detritus next transported and deposited in the deep sea, to link observed changes in geological sources and environmental conditions with accumulation rates in the basin, to extract new information on the paleodrainage evolution of the major river systems of the area of study in parallel with the tectonic evolution, also providing information on the evolution of climate. The study of the progressive changes in mineralogical, geochemical and textural features in sediments from different facies along the sedimentary system, from their source to their depositional sink, under the effects of weathering, transport, deposition and diagenesis can be considered. The

comparison between petrographic, mineralogical and geochemical data from recent turbiditic sediments with data from modern river sediments and sediment of the shelf highlights how physical and chemical processes can selectively remove less durable minerals and segregate different sediment fractions in different sub-environments. Changes in petrographic, mineralogical and geochemical composition of sediment samples collected at different depth of the same core allow us to detect and possibly quantify the relative dissolution rates of less stable minerals during burial diagenesis.

The Indian Ocean monsoon campaign was a good start but we still know next to nothing about the Paleogene and the immediate aftermath of India-Asia collision. This needs to be linked to testing of the Raymo uplift hypothesis as a driver of global cooling.

This challenge could also be broadened to other regional to global processes of climate variability. How do variations in precipitation affect ecological and biogeochemical processes from millennial-scale to multi-million-year secular trends? Similarly, El Nino is just one of the interannual processes, but what about changes in for example North Atlantic Oscillation (NAO) or Indian Ocean Dipole (IOD)?

4. How resilient is the ocean to chemical perturbations?

This has been hardly addressed and may need to be refocused to be more specific on ocean acidification and dead zones and/or be redrafted to link to life and biogeochemical cycles. The combination of “ocean” and “resilient” is difficult to understand and “chemical perturbations” are too restricted. “How does the marine ecosystem respond to climate perturbations and how does it contribute to climate feedback processes?” Targets could include the detailed causes, history, and consequences of oceanic anoxic events, arguably the most significant environmental events in the past 200 million years.

Biosphere Frontiers

All of the themes and challenges formulated in theme B Biosphere Frontiers are still valid and far away from being completely understood. Our efforts here should certainly continue. However, we need to focus more strongly on the impact of a changing climate and concomitantly a changing environment for the subsurface biosphere and its feedback to the surface world. Theme B already considers the impact of the changing climate on ecosystems, formulated under the challenge 7 (How sensitive are ecosystems and biodiversity to environmental change?). This should be extended and become one of the central challenges of a new program. There are a number of changes that we observe and we currently do not understand enough about the impact they have on the subsurface biosphere and its response. Rapid changes of the environment will cause new imbalances and the biosphere will adapt and modify the environment in turn. We need to identify systems that already undergo changes in response to anthropogenic environmental changes and systems that are likely to change in the near future. These changes should consider more conditions than increased CO_2 levels of the ocean and related changes in pH For example increasing temperature might modify current equilibria in sediment chemistry and zonation may shift. Melting ice might change solved ion composition in certain locations. Established regimes of run-off from land or input from melting glaciers might change sediment conditions and trigger changes in the subsurface biosphere. Warming seawater and increased ice-free sea surface will alter primary productivity and sedimentation with resulting changes of the sediment biosphere, etc. Additionally, we also realize the widespread effects of plastic pollution in the sea, leading to microplastics, particles and toxic chemicals accumulating not only in macrofauna but also in smaller organisms and

ultimately accumulating in the sediments, where they may also impact the microbial subsurface biosphere with completely unknown effects. All such changes will alter the environment for the subsurface biosphere and need to be understood and the feedback in response has to be investigated and we will need to estimate the impact of a changing subsurface biosphere on the surface world.

The role of past ecosystems and the evolution of organisms in climatic and oceanic changes should be more strongly emphasized. The term "biosphere" should not be understood as synonymous with "deep biosphere" but apply to all organismic groups. An expansion to the Biosphere Frontiers could include the life cycles of the deep subsurface biota and links to astrobiology in Challenge 6 to explore how microbiology in the ocean crust environment has contributed to the existence of life on Earth and other planets.

Biosphere Frontiers needs to be rewritten in a way to show how the field has evolved. It is the youngest of the four research themes and most research proposals were rather exploratory. Due to the massive gain in knowledge over the last decade we can now move towards hypothesis-driven research, which was not possible before due to lack of basic data.

Deep Biosphere gave a new twist in the current program, but it should be integrated into ocean biosphere in general, since this would cover a much larger area and address the oceanic biota as well and their role in the carbon cycle. Potentially testing the sustainable limits of life on various scales.

7. How sensitive are ecosystems and biodiversity to environmental change?

Multiple respondents commented on the importance of Challenge 7 and the relative failure to address this in the current program. Comments included the need for a new focus on the evolution of life and biosensitivity through integration with ecologists and biologists as well as use of new methods to reconstruct acidification events or Oxygen Minimum Zones (OMZ). Characterising the sensitivity of ecosystems and biodiversity to environmental change could include a focus on shallow (reefs, mangrove, coastal) and polar environments because these environments are most at risk under current anthropogenic environmental changes, including floods, pollution, acidification, sea ice retreat, freshening and warming.

The 2013-23 Science Plan ('SP') describes the importance of understanding this question but offers relatively little about how it might be achieved. Critically, very little has been done in IODP Leg planning or post-cruise research support to achieve this goal, and we are still very far away from the understanding we need. In addition, the explicit scientific goal of studying biologic evolution in its own right, although clearly stated in both the COSOD and COMPLEX reports, has been dropped from the SP. It should be re-instated. The data needs for both goals are very similar; only the analyses are slightly different, significantly extending the scientific opportunities at very little incremental cost. Study of diversity dynamics is a very well-established field in paleontology and has standard methodologies which, with some modification, can be used to implement Challenge 7. These are exemplified by successful initiatives such as the Paleobiology Database ('PBDB'). A new SP should define these methodologies, as appropriate, as central to achieving Challenge 7. These include a global approach to the collection and analysis of marine microfossil diversity data and explicit support for collection of full diversity data from samples, instead of the mostly biostratigraphic marker data that is currently standard. These methods can only be achieved if the underlying tools and information needed for data collection and synthesis are developed. These include: 1) a global framework of sections with good microfossil preservation and accurate age models covering all major biotic provinces for at least the Cenozoic; 2) reasonably complete, standardized taxonomies for the major marine

microfossil groups; 3) AI-based methods to efficiently collect species occurrence data in samples; 4) online platforms for data access, synthesis and analysis similar to established tools such as the PBDB; 5) better links to the rapidly developing fields of marine plankton ecology and molecular biology. Community development of some of this infrastructure has begun, e.g. occurrence and age model databases like NSB/Neptune and the taxonomic catalog Mikrotax. New initiatives such as the Digital Deep Earth program offer opportunities for development of these and integration to IODP's own efforts, explicitly in support of Challenge 7 science goals. IODP, or the agencies that support it, must in addition alter the *modus operendi* to include larger, longer-term data collection and management efforts that are not directly linked to individual Legs. It must also reach out to the marine plankton biology community for their input and co-sharing of research planning and support.

Earth Connections

Several respondents suggested an expansion of Earth Connections themes to investigate ocean lithosphere architecture and relationships between lithosphere-ocean chemical exchanges and the biosphere and/or the impact of mantle processes (such as Large Igneous Provinces formation) on the environment (not just limited to ecosystems as in Challenge 7). Deep Earth connections should be updated with respect to the current findings of the Izu-Bonin expeditions and extending the ability to drill in areas of ultraslow spreading or active subduction zones should be implemented. Oceanic basin initiation processes and hotspot (LIPs and OIBs)-related mechanisms of crust formation are also missing.

Regarding blue-sky goals the Earth Connection is too focused on MOR or processes directly linked to MORs. The full cycle of oceanic crust/lithosphere is not addressed properly, i.e. serpentinization processes, for example. Continental break-up is not mentioned, as well as transform faults and fracture zone systems. The latter, in particular, are the "last" tectonic frontiers, but DSDP, ODP and IODP has not encouraged their study (in fact only ODP Leg 159 has been dedicated to FZs, transform faults are even less known). In Earth Connection, subduction zones have been only mentioned in relation to SZ's initiation, while fundamental characteristics regarding their processes are still not known, and come out of serendipity in the quest for megathrust. For example, processes related to bending (bend fault serpentinization, petit spots), processes related to forearc deformation (serpentinite diapirs, seamount subduction, etc...) are not mentioned. In the societal relevance there is mention of pollution and in particular how plastic is affecting sedimentation and therefore the sub-seafloor and seafloor stability in particular close to big rivers.

There was also a suggestion for a challenge to understand the time evolution of the geomagnetic field and how it can be used to improve our sense of time in the Earth System. IODP has a long history of contributing to our understanding of paleo- and geomagnetism. Current expeditions (e.g. 382) and hopefully future expeditions (Antarctic Peninsula Sediment Drifts) that are paleoceanographic focused in regions with limited carbonate preservation are dependent on high resolution magnetic stratigraphy, largely based on results from prior IODP drilling (e.g. 177, 202, 303). Yet, our understanding of the drivers and timescales of geomagnetic change are still limited.

8. What are the composition, structure, and dynamics of earth's upper mantle?

The fast spreading rate crust Mohole remains a key challenge but is largely unanswered unless we drill deeper than 1 km into ocean crust in multiple environments including oceanic plateaus and seamounts. Perhaps this challenge should be broader, beyond the Moho.

9. How are seafloor spreading and mantle melting linked to ocean crustal architecture?

Some stated that Challenge 9 needs more attention as not many Expeditions targeted this challenge, others suggest that it has been largely addressed, not only through drilling, but also through conventional geophysical and sampling cruises. The remaining aspect of this challenge is the structure and evolution of mid-ocean ridges with very low magma budget. Recent investigations of the Earth mantle's composition and dynamics have revealed complexities in the structure and flow of mantle reservoirs, and complex interactions between mantle circulation and lithosphere. For example, recent studies in the Australia-Antarctica area suggest that the mantle producing the melts at the South-East Indian ridge is neither typically from a Pacific domain nor from an Indian domain (Hanan et al., 2017; Park et al., 2019). Tackling these problems requires collecting samples of mantle or derived basalts close to mid-ocean ridge axes, but also off-axis in locations most often covered by sediments, where drilling is necessary. Hanan, B., et al. (2017), Geochemical and isotopic variations along the Southeast Indian Ridge (126°-140°E) related to mantle flow originating from beneath Antarctica (abstract), paper presented at AGU Fall meeting, New Orleans. Park, S.-H., C. H. Langmuir, K. W. W. Sims, J. Blichert-Toft, S.-S. Kim, S. R. Scott, J. Lin, H. Choi, Y.-S. Yang, and P. J. Michael (2019), An isotopically distinct Zealandia-Antarctic mantle domain in the Southern Ocean, Nature Geoscience, doi: 10.1038/s41561-018-0292-4.

10. What are the mechanisms, magnitude, and history of chemical exchanges between the oceanic crust and seawater?

Challenge 10 should be more systematically approached via multiple transects along tectonic flow lines, including monitoring. Legacy transects like DSDP Leg 3 should become established in other ocean basins, allowing future expeditions to be carried out to expand on the work and knowledge, including repeat visits of sites to provide longer-term and more in depth knowledge of those systems. Hydrothermal systems are highly important but we know rather little about the deep expression of their roots (stockwork). Drilling fossil systems would help quantify rock-fluid interactions and contribute to the discussion of marine resources. We still do not understand: 1) the driving forces for fluid flow in oceanic crust (basalts or peridotites), and, 2) the geometry of fluid circulation, including the penetration depth of hydrothermal fluids in the crust. This challenge could be expanded to include the chemical exchange between seawater and mantle peridotite, not only between seawater and the crustal rock.

11. How do subduction zones initiate, cycle volatiles, and generate continental crust?

Subduction zone initiation needs to be modified, emphasis should be put on processes rather than settings. In future, this could include the drilling of offshore and onshore components of ancient and modern examples, the dynamics and composition of upper mantle (requires drilling deeper), volatile cycling, carbon cycling, forearc deformation and earthquakes with focus on new regions (outside IBM).

Earth in Motion

The science challenges within the "Earth in Motion" theme are good, but some of them are far from implementation because the structure doesn't really support the development of long-term proposals related to long hard rock holes i.e. into the IBM crust, or the Mohole project, which can only be implemented by riser drilling and an enormous community effort. It is difficult to write proposals for these given the severe limitations of the JR for this type of drilling. As a result, Earth in Motion proposals have been somewhat limited to a number of key areas, particularly megathrust earthquakes at convergent margins. Strike-slip/transform margins have largely been neglected [emphasized by several respondents], as have passive margin hazards.

Recommend developing a strategy that will allow direct access to the lithospheric mantle based on experience from expeditions located in the IBM area.

There is potential to significantly widen the scope of this theme, including more processes and hazards on human time scales, *but not only limited to these timescales*. Argument for understanding (sampling and monitoring) processes and rates spanning a wide range of (dynamic) timescales from millions of years (sampling archives of past extreme events) to seconds (monitoring). Hazard and sustainable resource aspects should be in the forefront of the science plan in order to "sell" our research to society at large. These might include tsunami potential, slope failure, real-time and short-term monitoring of dynamic systems for hazard prediction (e.g. earthquakes/deformation, carbon storage challenges, gas hydrate systems in the Arctic).

This theme also needs to include destructive volcanism. Hazards arising from volcanic eruptions are often tsunamis and landslides and maybe even be triggered by one of the other hazard producing processes, e.g. earthquakes triggering volcanic eruptions.

Challenge 13 is strictly interconnected with the other research themes but is poorly covered in IODP#2 – this is so societally relevant that it has to be part of our portfolio.

7.3 Appendix C: Pigeonhole summary

Open-text Poll

PROCEED Workshop General Discussion Board

06 Apr 2019, 08:45 - 08 Apr 2019, 06:51

92	26	8
Participants	Total votes	Answers
39	9	8 / 0
Interactions*	Highest vote	Allowed / Blocked

* Interactions include the total number of questions, votes, comments and answer ratings

Answer status breakdown:

Q: Do you have any comments that do not fall within the other interactive sessions on the agenda? Please interact with the agenda items as far as possible. Participants are free to respond to comments.

8 Answers Allowed

9 VOTES

Volkhard Spiess • 06 Apr 2019 10:07

I feel that there is a potential for a more strategic approach of facing osme of the global challenges, e.g. by better linking IODO and ICDP initiatives (e.g. through strategic workshop).

1 Comments:

Jochen Erbacher • Allowed on 06 Apr 2019, 14:05 • Allowed

Absolutely - but joint workshops won't be enough. It's time for a true cooperation of both programs

0 Upvotes | 0 Downvotes

7
VOTES

Jochen Erbacher • 06 Apr 2019 14:12

A new program should closely cooperate with ICDP. This should be visible in our (and ICDP's) new science plan and in the new structure. A "Scientific Deep Drilling Forum" would be great!

3 Comments:

Lucas Lourens • Allowed on 06 Apr 2019, 14:53 • Allowed

I would even propose to develop one science plan for an integrated scientific drilling program that would cover both IODP and ICDP themes and challenges. This would make it clearer for the outside world, both public and policy makers, to understand the relevance of our field for society and its challenges (eg UN SD goals)

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 15:52 • Allowed

Perhaps have a section that is common to each of the IODP and ICDP Science Plans? Combining programmes into one Science Plan would be difficult given the very different ways that these programmes operate (e.g. in terms of funding, repositories, databases etc).

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 10:14 • Allowed

IODP will be gone after 2023, giving way for new organizational ideas. This is a good opportunity to show fundling agencies that the drilling community has a long term vision. Don't expect funding agencies to put money in „more of the same".

0 Upvotes | 0 Downvotes

4
VOTES

Anonymous • 06 Apr 2019 17:07

Is there going to be a post survey for the workshop? In the initial survey, 90% said no change to the science plan in the beginning but after all the discussions maybe we have changed our minds?

3
VOTES

Anonymous • 06 Apr 2019 16:36

The existing science plan is too linear and causes unnecessary separation of interconnected questions and challenges

---

1
VOTES

Anonymous • 07 Apr 2019 14:48

Important to remember who the audience is of the Science Plan - funding agencies, non-experts and general public. "Easy access", key catch phrases - avoid expert jargon in this document.

1
VOTES

Anonymous • 06 Apr 2019 09:05 • Hidden

Yes

1
VOTES

Anthony Koppers • 06 Apr 2019 12:43

Special Volume on 50 years of scientific ocean drilling available at https://tos.org/oceanography/issue/volume-32-issue-01

1 Comments:

Anonymous • Allowed on 08 Apr 2019, 00:29 • Allowed

Great paper, thanks for sharing!

0 Upvotes | 0 Downvotes

0
VOTES

Anonymous • 06 Apr 2019 09:04 • Hidden

No

Poll (Multiple Choice)

Using Pigeonhole: Practice Poll

06 Apr 2019, 09:04 - 07 Apr 2019, 23:00

102	82	75
Participants	Total votes	Highest votes

Questions

Q1: Have you read the IODP Science Plan 2013-2023?

82 Participants

Yes	91.5%	75 Votes
No	8.5%	7 Votes

1 Comment

Anonymous • 06 Apr 2019 09:05 • Allowed • Voted for: Yes

Many times ...

Q&A

Plenary Session - Our Progress Towards Achieving the Challenges of the Science Plan: Climate and Ocean Change, Heiko Pälike

06 Apr 2019, 09:00 - 08 Apr 2019, 06:51

93 Participants	49 Total votes	5 Questions	0 Questions answered
64 Interactions*	19 Highest vote	5 Allowed / 0 Blocked	0 Ratings / None Top rating

* Interactions include the total number of questions, votes, comments and answer ratings

5 Questions Allowed

19
VOTES

Anonymous • 06 Apr 2019 09:34

How can we best strengthen scientific links between O&C and the other themes in the current Science Plan?

5 Comments:

Anonymous • Allowed on 06 Apr 2019, 09:55 • Allowed

There are already links to Biosphere Frontiers in regard to microfossil related studies. This linkage could be strengthened in new science plan because it relates to current focus on biodiversity.

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 09:58 • Allowed

Stronger links could be built to earth in motion/earth connections by exploring challenges that focus on the interplay between climate and tectonics. It might encourage proposals that look at these two aspects together, rather than in isolation (currently more common).

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 10:09 • Allowed

Another link between climate and biosphere frontiers could be the effect of organic matter flux/energy flux from surface productivity to the benthic (microbial) biosphere. Could also provide a link to societal issues such as ocean eutrophication.

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 11:42 • Allowed

Come up with overarching science topics/questions that cut across all themes, rather than splitting up the science plan in four thremes

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 12:13 • Allowed

I second the opinion to highlight the overarching science topics - a broad, open umbrella structure that can encompass specific missions / themes able to address multiple challenges within current (perceived) "separate" Science Themes

0 Upvotes | 0 Downvotes

17
VOTES

Anonymous • 06 Apr 2019 09:30

Is the mission approach the most effective way forward in implementing future IODP science?

4 Comments:

Anonymous • Allowed on 06 Apr 2019, 09:32 • Allowed

Define « mission » ?

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 09:39 • Allowed

I think that understanding what we achieved with past/current expeditions is a fundamental starting point for the new plan.

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 09:55 • Allowed

Moving from a single expedition to a mission approach requires a much stronger planning infrastructure that is currently not in place. If missions become more common, individual expeditions should still be possible to encourage agile new developments.

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 09:59 • Allowed

What exactly is meant with mission? A mission to Mars can be done with different space crafts. A mission to target for instance the KT boundary has been done by different drilling platforms both on land and sea. So I would say that in principle all scientific drilling expeditions used within the IODP and ICDP can be seen as a mission approach.

2 Upvotes | 0 Downvotes

11
VOTES

Anonymous • 06 Apr 2019 09:53

Many of the expedition in the recent phase have also primarily targeted reconstruction of ocean circulation patterns, but this is not explicit in the current science plan. Should it be included?

2
VOTES

Anonymous • 06 Apr 2019 10:09

How can we achieve both: more complete spatio-temporal coverage and ultra-high resolution efforts? What are the trade offs to consider?

1 Comments:

Anonymous • Allowed on 06 Apr 2019, 12:35 • Allowed

I think so. To be societally relevant high resolution records are key to get at rates of change and tipping points.

0 Upvotes | 0 Downvotes

0
VOTES

Anonymous • 06 Apr 2019 09:13 • Hidden

Feel free to post questions here!

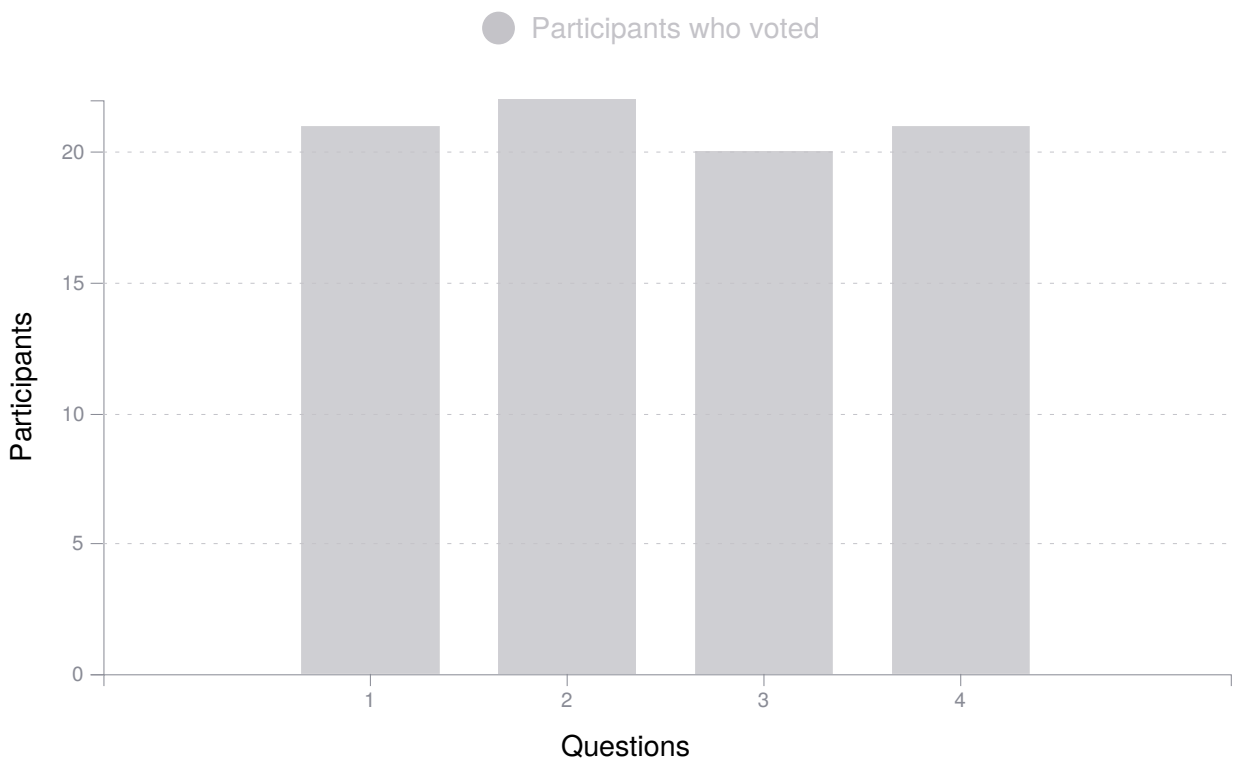
Poll (Multiple Choice)

In your opinion, how far have we progressed each of the Challenges under the Climate and Ocean Change Theme? (enter poll to rate each Challenge)

06 Apr 2019, 09:20 - 08 Apr 2019, 06:55

38	84
Participants	Total votes

Questions



Q1: How does Earth's climate system respond to elevated levels of atmospheric CO2?

21 Participants

Little progress — 19.0% — 4 Votes

Significant progress, but work still to be done

76.2% 16 Votes

Challenge well progressed

4.8% 1 Vote

Q2: How do ice sheets and sea level respond to a warming climate?

22 Participants

Little progress made

27.3% 6 Votes

Significant progress, but work still to be done

50.0% 11 Votes

Challenge well progressed

22.7% 5 Votes

Q3: What controls regional patterns of precipitation, such as those associated with monsoons or El Niño?

20 Participants

Little progress made

10.0% 2 Votes

Significant progress, but work still to be done

35.0% 7 Votes

Challenge well progressed

55.0% 11 Votes

Q4: How resilient is the ocean to chemical perturbations?

21 Participants

Little progress made

71.4% 15 Votes

Significant progress, but work still to be done

23.8% 5 Votes

Challenge well progressed

4.8% 1 Vote

Open-text Poll

What new Challenges should be added under the Climate and Ocean Change Theme?

06 Apr 2019, 09:20 - 08 Apr 2019, 06:55

31	15	4
Participants	Total votes	Answers
20	8	4 / 0
Interactions*	Highest vote	Allowed / Blocked

* Interactions include the total number of questions, votes, comments and answer ratings

Answer status breakdown:

Q: What new Challenges should be added under the Climate and Ocean Change Theme?

4 Answers Allowed

8 VOTES

Anonymous • 06 Apr 2019 09:34

Need more emphasis on deep time. Neogene is getting well constrained but Paleocene records remain poor, e.g. Asian monsoon

3 VOTES

Anonymous • 06 Apr 2019 09:34

Interplay between deep earth processes (lips, tectonics) and ocean and climate (ocean currents, composition...)

3
VOTES

Anonymous • 06 Apr 2019 09:42

Palaeoecosystem Climate interaction

1 Comments:

Anonymous • Allowed on 06 Apr 2019, 09:52 • Allowed

This topic interacts with the Ecosystem response topic of the Biosphere Frontiers plan; is also in line with current focus on biodiversity in H2020 plan and sustainability topics in UN agenda.

0 Upvotes | 0 Downvotes

1
VOTES

Anonymous • 06 Apr 2019 09:39

How can contribute to change climate change.

Q&A

Plenary Session - Our Progress Towards Achieving the Challenges of the Science Plan: Earth Connections, Chris MacLeod

06 Apr 2019, 09:30 - 08 Apr 2019, 06:53

92	147	13	0
Participants	Total votes	Questions	Questions answered
192	35	13 Allowed / 0 Blocked	0 Ratings / None Top rating
Interactions*	Highest vote		

* Interactions include the total number of questions, votes, comments and answer ratings

13 Questions Allowed

35
VOTES

Anonymous • 06 Apr 2019 09:42

Do we need a better name than Eart Connections?

5 Comments:

Anonymous • Allowed on 06 Apr 2019, 09:47 • Allowed

Also, this theme overlaps so much with Earth in motion that they should be one theme

5 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 09:49 • Allowed

This theme is too focused toward MOR processes.

2 Upvotes | 4 Downvotes

Anonymous • Allowed on 06 Apr 2019, 09:54 • Allowed

This is a two-fold issue: on the one hand, a scientifically defined challenge is needed; on the other hand, a layperson-friendly terminology is also needed - especially when thinking about funding and public outreach & education.

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 09:57 • Allowed

All four themes need to be renamed for simplicity and outreach, as on the cover of the current science plan.

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 13:49 • Allowed

its all the Earth System

0 Upvotes | 0 Downvotes

22
VOTES

Anonymous • 06 Apr 2019 09:47

Would hard rock Earth Connections drilling benefit from greater flexibility over length of expeditions and scheduling in the next phase (I.e move away from fixed two month duration)?

7 Comments:

Anonymous • Allowed on 06 Apr 2019, 09:48 • Allowed

Absolutely, yes

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 09:49 • Allowed

The Chikyu already does that

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 09:50 • Allowed

This discussion comes up a lot, but realities are that 2 months is a choice dictated by crew rotation, endurance etc. Of course Chikyu already shows how longer running efforts can be managed by transferring science teams.

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 09:52 • Allowed

looks like this would be a request to have LONGER expeditions - puts stress on the remainder of the program and will multiply the logistical effort to be made. So, while there are compelling scientific reasons, the science operators would have to be involved into the process of program planning.

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 09:57 • Allowed

In some places near to port a short expedition added to a longer one might be advantageous. The current APL system tends to take time away from an existing expedition

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 10:04 • Allowed

2 legs for South Atlantic Transect is a move in this direction

0 Upvotes | 0 Downvotes

Ceuleneer • Allowed on 06 Apr 2019, 10:12 • Allowed

It could transform scheduling into a nightmare, but it would be of great benefit for science. Too many expeditions ended before the main objectives were reached although we were about to reach them.

0 Upvotes | 0 Downvotes

17
VOTES

Anonymous • 06 Apr 2019 09:57

Are we missing a trick in not seeking stronger Earth Connections links with space agencies? Planetary geologists need Earth analogs!

4 Comments:

Anonymous • Allowed on 06 Apr 2019, 09:59 • Allowed

Absolutely! This should be explicitly stated in the “tweaked” science plan

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 10:04 • Allowed

Indeed, and this was greatly shown to work by the involvement of i.e. NASA (NAI) in ICDP Omand DP

0 Upvotes | 0 Downvotes

Andrew McCaig • Allowed on 06 Apr 2019, 10:07 • Allowed

There is a strong potential link for IODP with Astrobiology and the origin of life and prebiotic geochemistry which is missing from the current science plan. Whether it fits in Earth Connections is not clear but the links with fluids and with mineralogy are clear

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 10:07 • Allowed

This also includes the biosphere and connections to Exobiology as well as life n Early Earth.

0 Upvotes | 0 Downvotes

14
VOTES

Anonymous • 06 Apr 2019 09:53

Should rifting be back in this theme?

1 Comments:

Andrew McCaig • Allowed on 06 Apr 2019, 10:03 • Allowed

Yes, rifting and continental margin tectonics not currently well addressed, although they are an active part of the program

0 Upvotes | 0 Downvotes

14
VOTES

Anonymous • 06 Apr 2019 09:54

Could we consider that some expeditions be implemented by two Platform Providers ?

3 Comments:

Anonymous • Allowed on 06 Apr 2019, 09:59 • Allowed

This was already planned for the old IODP, and should be included in any new program.

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 10:00 • Allowed

In reality this is difficult to implement given the current structure of independent Facility Boards ...

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 10:13 • Allowed

No, it is already too difficult to have one operator putting a single expedition together. Two operators will create too much of a logistical nightmare.

0 Upvotes | 0 Downvotes

12
VOTES

Anonymous • 06 Apr 2019 09:52

If there is so much overlap between earth connections and earth in motion do these themes need merging, or do the challenges need re-wording

3 Comments:

Anonymous • Allowed on 06 Apr 2019, 09:53 • Allowed

Rewording. The topics covered by both are too diverse and complex to fit into one theme.

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 09:53 • Allowed

I totally agree!

0 Upvotes | 0 Downvotes

Andrew McCaig • Allowed on 06 Apr 2019, 10:00 • Allowed

They cannot be merged in my view. The balance on fluids might be looked at

0 Upvotes | 0 Downvotes

10
VOTES

Anonymous • 06 Apr 2019 09:58

Oceanic crustal architecture - an important theme for the new plan (not addressed in recent years)?

2 Comments:

Anonymous • Allowed on 06 Apr 2019, 09:59 • Allowed

Broader challenges are required in the new science plan oceanic spreading being only one of them.

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 10:01 • Allowed

Connections to hydrothermal processes, tectonics, the limits of life, geochemical cycles in the subsurface ...

2 Upvotes | 0 Downvotes

8
VOTES

Anonymous • 06 Apr 2019 09:49

Where do strike slip faults fit in this theme?

5 Comments:

Anonymous • Allowed on 06 Apr 2019, 09:50 • Allowed

Or rifting? Hot spots?

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 09:52 • Allowed

Or LIPs? Or microcontinents?

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 09:56 • Allowed

Transform faults and SSFs are the big missing topics

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 10:02 • Allowed

new topic for an oceanic crustal architecture theme?

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 10:03 • Allowed

Agree - transform faults important future targets. Complex sedimentary, magmatic and tectonic environments that we know very little about

0 Upvotes | 0 Downvotes

---

6 VOTES

Anonymous • 06 Apr 2019 09:51

Could links between subduction initiation, forearc spreading and ophiolite formation/emplacement be a compelling future challenge?

2 Comments:

Anonymous • Allowed on 06 Apr 2019, 09:53 • Allowed

Too specific?

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 10:03 • Allowed

Major topic recently: see IBM expeditions, Tasman subduction frontier, Oman drilling ...

0 Upvotes | 0 Downvotes

---

4 VOTES

Anonymous • 06 Apr 2019 10:05

Should LIPs resurface in this theme?

---

2 VOTES

Anonymous • 06 Apr 2019 10:03

Effects of.Subduction-related processes on lithosphere going back in the mantle should be addressed?

---

2 VOTES

Anonymous • 06 Apr 2019 10:05

Can challenge 8 include fluxes and larger cycles - dynamics of the mantle, glaciers, iso static rebound, etc?

---

1 VOTES

Anonymous • 06 Apr 2019 14:27

Is the close link between hydrothermal systems in IODP and the exploration of trace metal fluxes (i.e. ocean chemistry) and biosphere fully realised?

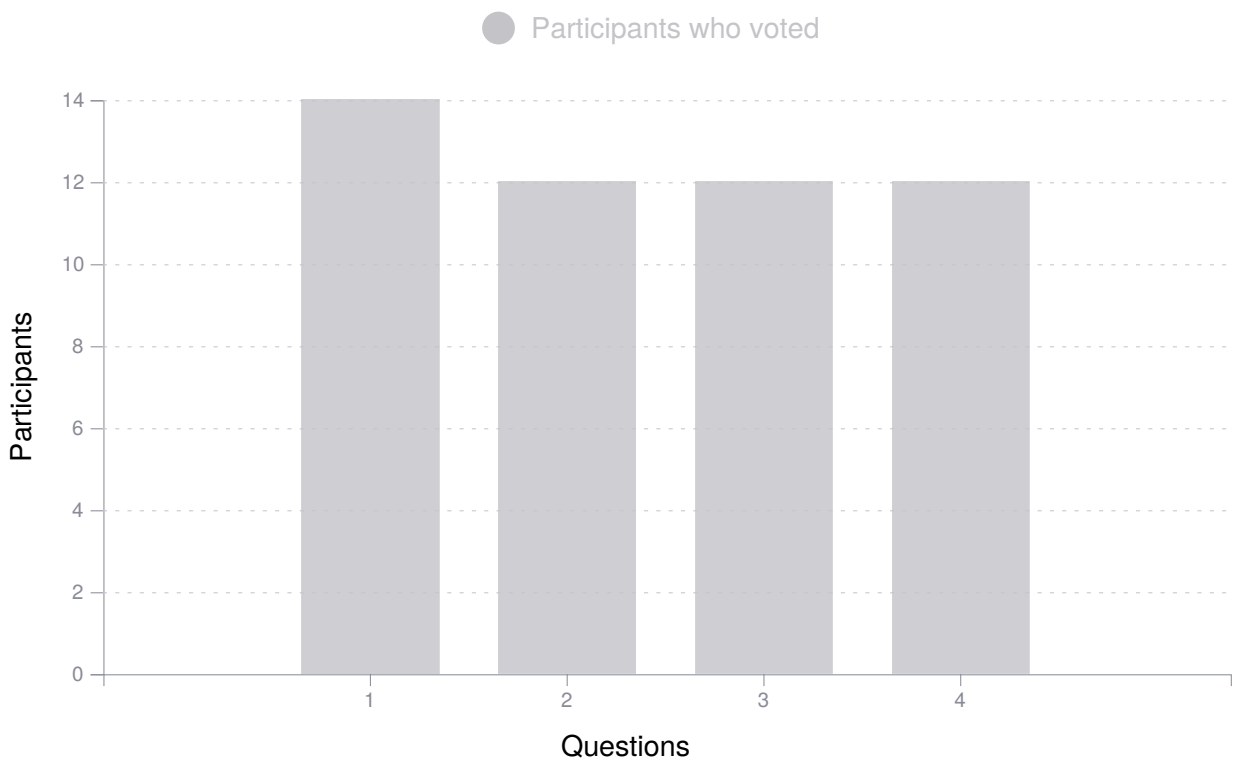
Poll (Multiple Choice)

In your opinion, how far have we progressed each of the Challenges under the Earth Connections Theme? (enter poll to rate each Challenge)

06 Apr 2019, 09:50 - 08 Apr 2019, 06:55

22 Participants	50 Total votes

Questions



Q1: What are the composition, structure, and dynamics of Earth's upper mantle?

14 Participants

Little progress made	85.7%	12 Votes
Significant progress, but work still to be done	7.1%	1 Vote

Challenge well progressed

7.1% 1 Vote

Q2: How are seafloor spreading and mantle melting linked to ocean crustal architecture?

12 Participants

Little progress made

66.7% 8 Votes

Significant progress, but work still to be done

25.0% 3 Votes

Challenge well progressed

8.3% 1 Vote

Q3: What are the mechanisms, magnitude, and history of chemical exchanges between the oceanic crust and seawater?

12 Participants

Little progress made

25.0% 3 Votes

Significant progress, but work still to be done

75.0% 9 Votes

Challenge well progressed

0.0% 0 Votes

Q4: How do subduction zones initiate, cycle volatiles, and generate continental crust?

12 Participants

Little progress made

33.3% 4 Votes

Significant progress, but work still to be done

58.3% 7 Votes

Challenge well progressed

8.3% 1 Vote

Pigeonhole Live

Open-text Poll

What new Challenges should be added under the Earth Connections Theme?

06 Apr 2019, 09:50 - 08 Apr 2019, 06:55

18	2	7
Participants	Total votes	Answers
9	2	7 Allowed / 0 Blocked
Interactions*	Highest vote	

* Interactions include the total number of questions, votes, comments and answer ratings

Answer status breakdown:

Q: What new Challenges should be added under the Earth Connections Theme?

7 Answers Allowed

2 VOTES
Anthony Koppers • 06 Apr 2019 10:53
What are the roles of plate tectonics, far-field changes in plate motion, and the impingement of mantle plumes in triggering the formation of new subduction zones and new ocean basins?

0 VOTES
Anonymous • 06 Apr 2019 10:04
The question of material and volatile cycling of subduction zones, and especially forearms has not been well addressed in the present science plan.

0 VOTES
Anthony Koppers • 06 Apr 2019 10:44
How does oceanic crust mature over tens of millions of years? How does alteration of deep oceanic crust contribute to microbial life in shallower habitat (and vice versa)?

0
VOTES

Anthony Koppers • 06 Apr 2019 10:49

Has Earth experienced true polar wander via a sudden tilt of its rotation axis? How does the chemistry of the mantle and its related oceanic volcanism evolve over geological time?

0
VOTES

Anthony Koppers • 06 Apr 2019 10:53

And how does mantle convection work not only at large scales but also at smaller scales, when mantle plumes form at the core-mantle boundary?

0
VOTES

Anthony Koppers • 06 Apr 2019 10:53

What have been the environmental effects of large outpourings of magma during the formation of large igneous provinces?

0
VOTES

Anthony Koppers • 06 Apr 2019 10:53

Do these eruptions indeed prompt global anoxic events and potentially extinction events?

Pigeonhole Live

Q&A

Breakout Session A Report 30 min

06 Apr 2019, 12:02 - 08 Apr 2019, 06:53

60	34	4	0
Participants	Total votes	Questions	Questions answered
45	18	4	0
Interactions*	Highest vote	Allowed	Ratings
		0	None
		Blocked	Top rating

* Interactions include the total number of questions, votes, comments and answer ratings

4 Questions Allowed

18 VOTES

Anonymous • 06 Apr 2019 12:34

Earth Connections could be an emphasis/subtitle of the whole new science plan, highlighting the importance of understanding all Earth Systems for new proposals

2 Comments:

Anonymous • Allowed on 06 Apr 2019, 12:40 • Allowed

Or as "The Connected Earth System"

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 12:41 • Allowed

The "new" thing was deep biosphere in the 1st IODP science plan; Earth in Motion (geohazards) in the 2nd one. Could the planet Earth (emphasizing the connections between all the themes that were so far presented as distinct boxes) be the next one? key words : habitability; sustainability (sustainable development, energy transition, sustainable use of resources, etc.)

0 Upvotes | 0 Downvotes

6
VOTES

Anonymous • 06 Apr 2019 12:29

Apart from tectonic gateways, in what other ways can we develop links between O&C and other parts of IODP science (EC, EinM and BF)?

2 Comments:

Anonymous • Allowed on 06 Apr 2019, 12:37 • Allowed

Evolution and resilience of marine ecosystems – biodiversity, ocean circulation (incl. tectonics) and ocean chemistry. Feedbacks between e.g. (deep) marine biosphere and ocean chemistry.

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 12:39 • Allowed

Long-term drivers of CO2; chemistry of the oceans -> trace metal cycling and controls on productivity

1 Upvotes | 0 Downvotes

6
VOTES

Anonymous • 06 Apr 2019 12:39

Following the feedback from the breakout groups, will there be another chance for the wider community to comment on the new areas, or new descriptions of themes and chalets proposed

---

4
VOTES

Anonymous • 06 Apr 2019 12:40

A recurring theme of planetary habitability is emerging, not just here but at the J-DESC meeting too. Comments??

3 Comments:

Anonymous • Allowed on 06 Apr 2019, 12:42 • Allowed

Links between ocean drilling and space exploration, especially potential tie-ups, need to be explored. Earth systems as proxies for extraterrestrial processes.

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 12:43 • Allowed

habitability is an important topic, but not solely focused in planets. currently a major focus is i.e. on icy moons (Europe, Enceladaus, ...) with NASA missions in the planning. Key word here is "ocean worlds"

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 12:28 • Allowed

The Earth System approach and planetary boundaries may involve this topic

0 Upvotes | 0 Downvotes

Q&A

Plenary Session - Our Progress Towards Achieving the Challenges of the Science Plan: Biosphere Frontiers, Verena Heuer

06 Apr 2019, 13:45 - 08 Apr 2019, 06:53

67 Participants	56 Total votes	7 Questions	0 Questions answered
77 Interactions*	20 Highest vote	7 Allowed / 0 Blocked	0 Ratings / None Top rating

* Interactions include the total number of questions, votes, comments and answer ratings

7 Questions Allowed

20
VOTES

Anonymous • 06 Apr 2019 14:05

How can we build bridges to encourage the astrobiology research community to engage with IODP through its Biosphere Frontiers theme (or its successor in a new Science Plan)?

7 Comments:

Anonymous • Allowed on 06 Apr 2019, 14:06 • Allowed

Life on Early Earth

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 14:11 • Allowed

systems independent from photosynthetic biosphere

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 14:13 • Allowed

...but how do we get that community to be interested in what we do?

0 Upvotes | 0 Downvotes

Anthony Koppers • Allowed on 06 Apr 2019, 14:13 • Allowed

Live on Earth and other planets, in relation to tectonics, volcanism and the presence of water. Also any issues with human degradation of Earth environment?

0 Upvotes | 0 Downvotes

Andrew McCaig • Allowed on 06 Apr 2019, 14:16 • Allowed

Serpentinising environments are good analogues for icy worlds, but more accesible

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 14:19 • Allowed

One of the major themes within NASA astrobiology is now Ocean Worlds. There is the increasing notion within NASA that there are numerous potentially habitable environments where liquid water exists and e.g. oceans exist that contact mantle rocks etc. ... Analogues are required to study potential habitability

0 Upvotes | 0 Downvotes

DT • Allowed on 06 Apr 2019, 14:20 • Allowed

Note that NASA Astrobiology "Rock Powdered Life" group led by Alexis Templeton is very heavily involved in the Oman Drilling Project - that is very IODP-like in tackling challenges related to the formation and evolution of the ocean crust and the ancient and modern fluid-rock hydration-oxidation-carbonation serpentinisation reactions that occur when mantle rocks reaction with surface fluids

1 Upvotes | 0 Downvotes

9
VOTES

Anonymous • 06 Apr 2019 14:06

What is the next big question for the biosphere community?

3 Comments:

Anonymous • Allowed on 06 Apr 2019, 14:25 • Allowed

where is the frontier between life and death? How slow can life be and still be alive? is that decision determined only by our ability to measure (or model) this?

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 14:31 • Allowed

Regarding contamination of the oceans with plastic and subsequently the sediments with micro- or nano plastics ... how is the biosphere is affected? How (bio)degradable are these nano-particles? Large parts of the subsurface microbial community is still unknown. Is the someone that can handle (end help with removing/degrading) such pollutants?

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 14:46 • Allowed

and before this question - what expertise should our community seek within other disciplines, e.g biosciences, to truly address marine biodiversity questions and modern-day "bench marking" of ecosystems (benthic and planktonic alike)?

0 Upvotes | 0 Downvotes

9
VOTES

Anonymous • 06 Apr 2019 14:14

What are the links between IODP Biosphere and (Bio)Geotraces (i.e. community doing that work in the modern water column and at the sediment/seawater interface)?

8
VOTES

Anonymous • 06 Apr 2019 14:14

What progress has been made in the other aspect of biosphere frontiers, like ecosystem change (challenge 7)?

1 Comments:

Anonymous • Allowed on 06 Apr 2019, 14:37 • Allowed

although this challenge may seem under-represented thus far (but several upcoming), note that macroevolutionary studies are increasingly relying on micropaleontological data (existing "big data"; e.g. Neptune database) collected routinely in IODP; probing these data with new evolutionary and ecological models and statistical approaches.

0 Upvotes | 0 Downvotes

5
VOTES

Anonymous • 06 Apr 2019 13:57

Are we still at Biosphere Frontiers?

3 Comments:

Anonymous • Allowed on 06 Apr 2019, 14:00 • Allowed

Yes

3 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 14:12 • Allowed

No

0 Upvotes | 0 Downvotes

Andrew McCaig • Allowed on 06 Apr 2019, 14:13 • Allowed

Not just methane, formates, acetates and amino acids. Building blocks

0 Upvotes | 0 Downvotes

5
VOTES

Anonymous • 06 Apr 2019 14:07

Production of abiotic methane could be an interesting topic?

0
VOTES

Michael EB • 06 Apr 2019 14:17

What is the role of the deep biosphere for slow mineral (trans)formations, and vice versa?

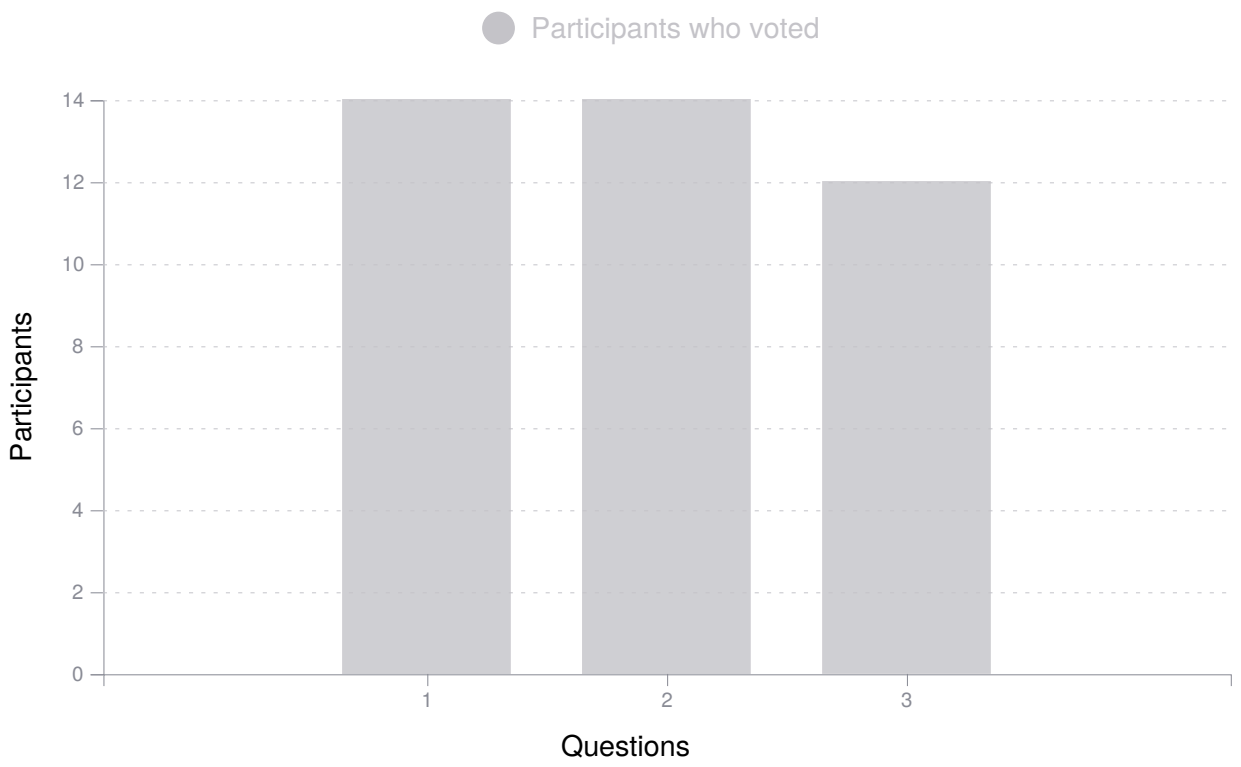
Poll (Multiple Choice)

In your opinion, how far have we progressed each of the Challenges under the Biosphere Frontiers Theme? (enter poll to rate each Challenge)

06 Apr 2019, 14:00 - 08 Apr 2019, 06:56

23 Participants	40 Total votes

Questions



Q1: What are the origin, composition, and global significance of deep subseafloor communities?

14 Participants

Little progress made — 14.3% — 2 Votes

Significant progress, but work still to be done

71.4% 10 Votes

Challenge well progressed

14.3% 2 Votes

Q2: What are the limits of life in the subseafloor realm?

14 Participants

Little progress made

28.6% 4 Votes

Significant progress, but work still to be done

57.1% 8 Votes

Challenge well progressed

14.3% 2 Votes

Q3: How sensitive are ecosystems and biodiversity to environmental change?

12 Participants

Little progress made

66.7% 8 Votes

Significant progress, but work still to be done

25.0% 3 Votes

Challenge well progressed

8.3% 1 Vote

Pigeonhole Live

Open-text Poll

What new Challenges should be added under the Biosphere Frontiers Theme?

06 Apr 2019, 14:00 - 08 Apr 2019, 06:56

17	0	1
Participants	Total votes	Answers
1	0	1 Allowed / 0 Blocked
Interactions*	Highest vote	

* Interactions include the total number of questions, votes, comments and answer ratings

Answer status breakdown:

Q: What new Challenges should be added under the Biosphere Frontiers Theme?

1 Answers Allowed

0 VOTES

Anonymous • 06 Apr 2019 14:05

Where will deep microbial life take us? Application, evolution or von Humboldt?

Q&A

Plenary Session - Our Progress Towards Achieving the Challenges of the Science Plan: Earth in Motion, Lisa McNeill

06 Apr 2019, 14:07 - 08 Apr 2019, 06:53

71	77	11	0
Participants	Total votes	Questions	Questions answered
91	16	11 Allowed / 0 Blocked	0 Ratings / None
Interactions*	Highest vote		Top rating

* Interactions include the total number of questions, votes, comments and answer ratings

11 Questions Allowed

16 VOTES

Anonymous • 06 Apr 2019 14:22

Should gehazards be expanded to all natural hazards? Including volcanism and global change ...

2 Comments:

Anonymous • Allowed on 06 Apr 2019, 14:24 • Allowed

linkages like this should be part of the next drilling plan

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 14:42 • Allowed

GLOBAL CLIMATE CHANGE

0 Upvotes | 0 Downvotes

10 VOTES

Anonymous • 06 Apr 2019 14:28

Should the Earth in Motion theme be broadened to look at processes and hazards beyond human timescales (current title)

10 VOTES

Anonymous • 06 Apr 2019 14:36

Is the close link between hydrothermal systems in IODP and the exploration of trace metal fluxes (i.e. ocean chemistry) and biosphere fully realised?

9 VOTES

Anonymous • 06 Apr 2019 14:31

Emphasis on subduction zones and rifts. Any proposals in the system or progress made with strike-slip earthquakes and tsunamis, or tsunamigenic landslides?

1 Comments:

Holly Given • Allowed on 06 Apr 2019, 14:37 • Allowed

Active proposals (with their abstracts) are listed on www.iodp.org/proposals/active-proposals

0 Upvotes | 0 Downvotes

---

8 VOTES

Anonymous • 06 Apr 2019 14:34

Deep drilling is our frontier: what did and did not work for Nankai?

---

7 VOTES

Anonymous • 06 Apr 2019 14:24

Could we bring bridges with Engineering /Applied sciences ?

---

5 VOTES

Anonymous • 06 Apr 2019 14:26

Which other seismogenic zone should be monitored to compare with the Nankai?

---

4 VOTES

Anonymous • 06 Apr 2019 14:30

Link to deep biosphere?

---

4 VOTES

Anonymous • 06 Apr 2019 14:37

Should we make a better link between Earth in Motion and climate?

---

3 VOTES

Anonymous • 06 Apr 2019 14:37

Earth in motion: Fluid flow, geochemical recycling and large-scale changes in ocean chemistry?

---

1 VOTES

Anonymous • 06 Apr 2019 14:38

Is there a plan to use data from the current and future installations to generate forward analytics in order to predict future earthquakes?

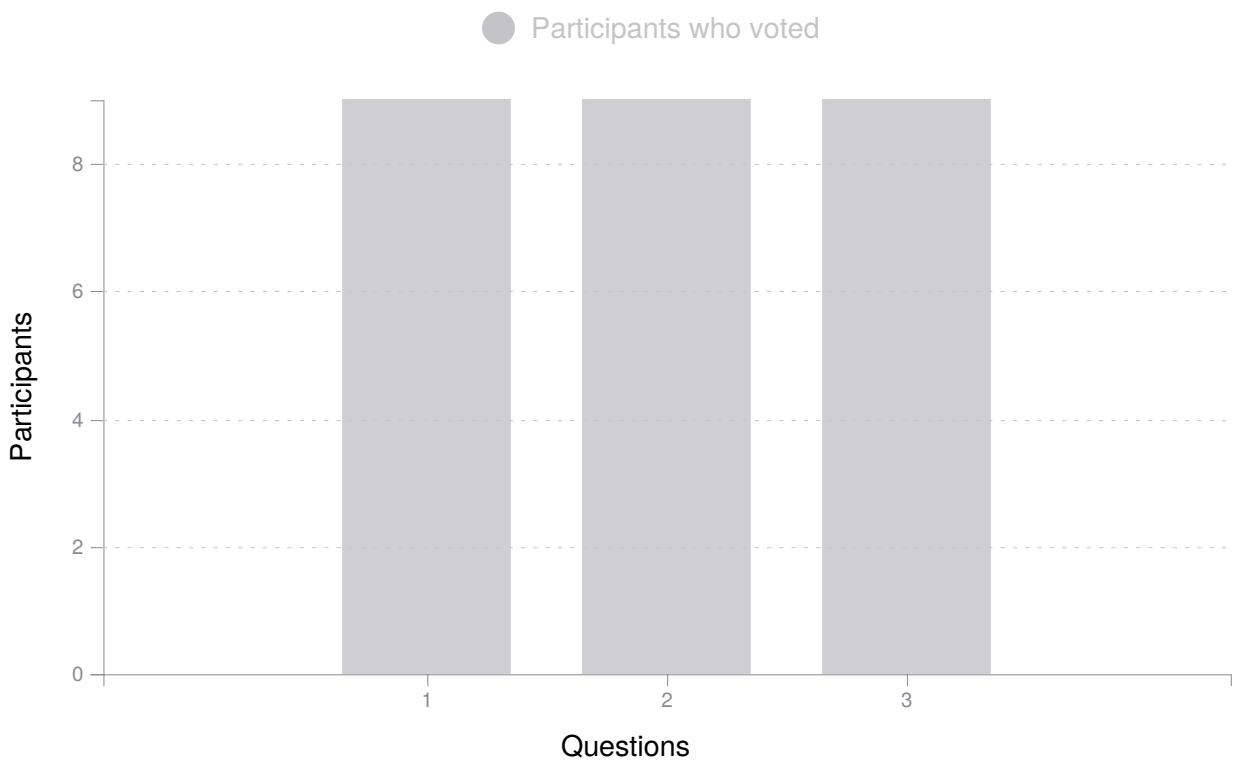
Poll (Multiple Choice)

In your opinion, how far have we progressed each of the Challenges under the Earth in Motion Theme? (enter poll to rate each Challenge)

06 Apr 2019, 14:22 - 08 Apr 2019, 06:56

12 Participants	27 Total votes

Questions



Q1: What mechanisms control the occurrence of destructive earthquakes, landslides, and tsunami?

9 Participants

Little progress made

22.2% 2 Votes

Significant progress, but work still to be done

55.6% 5 Votes

Challenge well progressed

22.2% 2 Votes

Q2: What properties and processes govern the flow and storage of carbon in the subseafloor?

9 Participants

Little progress made

88.9% 8 Votes

Significant progress, but work still to be done

11.1% 1 Vote

Challenge well progressed

0.0% 0 Votes

Q3: How do fluids link subseafloor tectonic, thermal, and biogeochemical processes?

9 Participants

Little progress made

33.3% 3 Votes

Significant progress, but work still to be done

66.7% 6 Votes

Challenge well progressed

0.0% 0 Votes

Pigeonhole Live

Open-text Poll

What new Challenges should be added under the Earth in Motion Theme?

06 Apr 2019, 14:22 - 08 Apr 2019, 06:56

8	0	1
Participants	Total votes	Answers
1	0	1 Allowed / 0 Blocked
Interactions*	Highest vote	

* Interactions include the total number of questions, votes, comments and answer ratings

Answer status breakdown:

Q: What new Challenges should be added under the Earth in Motion Theme?

1 Answers Allowed

0 VOTES

Anonymous • 06 Apr 2019 14:27

Link to deep biosphere?

Pigeonhole Live

Q&A

Breakout Session B Report 30 min

06 Apr 2019, 16:30 - 08 Apr 2019, 06:53

60 Participants	**72** Total votes	**5** Questions	**0** Questions answered
89 Interactions*	**28** Highest vote	**5** Allowed / **0** Blocked	**0** Ratings / **None** Top rating

* Interactions include the total number of questions, votes, comments and answer ratings

5 Questions Allowed

28
VOTES

Anonymous • 06 Apr 2019 16:50

Are we trying to fit new challenges into an existing framework for the sake of keeping that framework. Should we start with what science we want the plan to represent and then see if themes stand out

8 Comments:

Anonymous • Allowed on 06 Apr 2019, 16:51 • Allowed

Yes! This would be a way to move forward!

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 16:53 • Allowed

I agree: dividing working groups in the 4 old themes does not help the process.

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 16:54 • Allowed

Yes, make the four themes disappear. Just talk about the challenges, explain their importance for the future of humankind, then list the basic scientific questions to be addressed

6 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 16:56 • Allowed

Good idea - make the themes disappear and present a series of key questions - this would open up more possibilities for questions at the interfaces of the current themes

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 16:58 • Allowed

What if the new themes are created by the boundaries between the old themes? Encourages interdisciplinary science.

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 16:58 • Allowed

It might be a good idea to address the old themes and show what kinds of results and outcomes were found, but then use this as a springboard into a new science plan with new “Big Questions”.

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 17:00 • Allowed

Agreed. It is seems that the themes are limiting the discussions and the integration of processes that participants put forward during break out session.

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 17:11 • Allowed

agree - and also key to encourage genuine collaborations across the disciplines; this is where the next set of major advances will come from

0 Upvotes | 0 Downvotes

16
VOTES

Anonymous • 06 Apr 2019 16:52

Moving away from a linear SP - could this be based around an easily understood infographic showing all the linkages between our science? A bit like in the style of a rock cycle diagram?

3 Comments:

Anonymous • Allowed on 06 Apr 2019, 16:54 • Allowed

The infographic idea would work well for funders and non specialists with an accompanying document for science community

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 16:55 • Allowed

Nice idea! With planet Earth right in the middle, and all the science objectives connected to it

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 16:58 • Allowed

He whole thing could be electronic, linked, searchable, tagged w keywords so one could construct custom themes ... with a shorter printed document (executive summary) for the founders and administrators

2 Upvotes | 0 Downvotes

14
VOTES

Anonymous • 06 Apr 2019 16:58

A new sp needs simple, overarching (multidisciplinary) themes easly depicted in a cartoon, that we can use as a virtual map with highlights to be easly updated

1 Comments:

Anonymous • Allowed on 06 Apr 2019, 17:02 • Allowed

Overarching (multidisciplinary) themes are vital, even the word 'theme' could need to be changed.

1 Upvotes | 0 Downvotes

13
VOTES

Anonymous • 06 Apr 2019 17:05

It looks like even though the challenges are still relevant, the overall structure needs rethinking: questions instead of themes, more multidiplinary, possibly using infographics/cartoons.

1
VOTES

Anonymous • 07 Apr 2019 15:15

What Oceans tell us ? Past present and future of a Dynamic earth

---

Pigeonhole Live

Q&A

Plenary Session - Introduction to Day 2: Future Platforms, Technology, Opportunities & IODP Management (4 presentations, 1 Q&A session)

06 Apr 2019, 17:00 - 08 Apr 2019, 06:53

(1) SOD+23: The Potential New US Facility Beyond 2023, Anthony Koppers and Jim Wright (2) J-DESC PROCEED: Workshop Summary Report, Masa Kinoshita (3) MSP Opportunities Beyond 2023, Dave McInroy (4) IODP China Opportunities Beyond 2023, Shouting Tuo (5) Q&A session

95	62	6	0
Participants	Total votes	Questions	Questions answered
88	45	6	0	None
Interactions*	Highest vote	Allowed	Blocked	Ratings	Top rating

* Interactions include the total number of questions, votes, comments and answer ratings

6 Questions Allowed

45 VOTES

Anonymous • 06 Apr 2019 18:03

Anyone for a beer?

3 Comments:

Anonymous • Allowed on 06 Apr 2019, 18:06 • Allowed

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 18:07 • Allowed

Does a bear sh*t in the woods? Is the Pope Catholic?

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 18:08 • Allowed

0 Upvotes | 0 Downvotes

6
VOTES

Anonymous • 06 Apr 2019 17:23

The Chikyu doesn't really travel to the Atlantic. Why not replace the JR with a riser system?

8 Comments:

Anonymous • Allowed on 06 Apr 2019, 17:25 • Allowed

Money?

4 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 17:27 • Allowed

We need riser drilling to be available in other parts of the oceans other than around Japan

4 Upvotes | 2 Downvotes

Anonymous • Allowed on 06 Apr 2019, 17:28 • Allowed

Most of our science doesn't need a riser system, so better to keep the flexibility of riserless vessel

3 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 17:28 • Allowed

This will not only increase the building costs significantly, but consequently also the cost of hiring the vessel. By far not all expeditions will need riser drilling. Those would become unnecessary expensive...

5 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 17:31 • Allowed

Actually, Chikyu will most likely also operate elsewhere in the future. It's a matter of funding..

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 17:31 • Allowed

The option to drill with a riser in multiple ocean basins is surely better for science as a whole?

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 17:32 • Allowed

Not only a matter of funding for Chikyu - crews have to change every two weeks, so expeditions beyond the reach of a helicopter aren't possible at present

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 17:41 • Allowed

Can a Riser vessel (chikyu or industry vessel) be a MSP?

2 Upvotes | 0 Downvotes

6
VOTES

Andrew McCaig • 06 Apr 2019 17:49

Can we hire a riser ship for an MSP in the Atlantic region?

3 Comments:

Anonymous • Allowed on 06 Apr 2019, 17:50 • Allowed

If there is the budget, then yes

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 17:56 • Allowed

This would use all of the ECORD operational budget in one hit

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 18:02 • Allowed

It needs to collaborate with industry and/or IKC.

0 Upvotes | 0 Downvotes

3
VOTES

Anonymous • 06 Apr 2019 17:41

Instead of getting rid of the JR, can we re-use it as a MSP ?

3 Comments:

Anonymous • Allowed on 06 Apr 2019, 17:43 • Allowed

A major reason for MSPs is that they can do things that JR can’t do (shallow water; ice)

4 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 17:43 • Allowed

I think that would have the same limits that the JR already have (bridges, water depth...) without having anymore the advantage of having all the labs on board.

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 17:48 • Allowed

The power of the current concept is its diversity! The individual needs of the sciences/expeditions are so different and can best be accommodated by a flexible system involving diverse DIFFERENT options. JR should not become a Chikyu "copy" and MSPs not a JR "copy"...

1 Upvotes | 0 Downvotes

2
VOTES

Anonymous • 07 Apr 2019 09:38

Any new technologies and/or techniques for improving recovery of alternating soft (e.g., chalk) / hard (e.g., chert) lithologies that characterize the Eocene and older Pacific sedimentary section?

0
VOTES

Anonymous • 06 Apr 2019 18:00

Any thoughts yet on potential names for the JR replacement vessel??

3 Comments:

Anonymous • Allowed on 06 Apr 2019, 18:01 • Allowed

JR Jnr

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 06 Apr 2019, 18:04 • Allowed

It will be bigger, cannot be a Junior!

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 11:33 • Allowed

JOIDES Revolution

0 Upvotes | 0 Downvotes

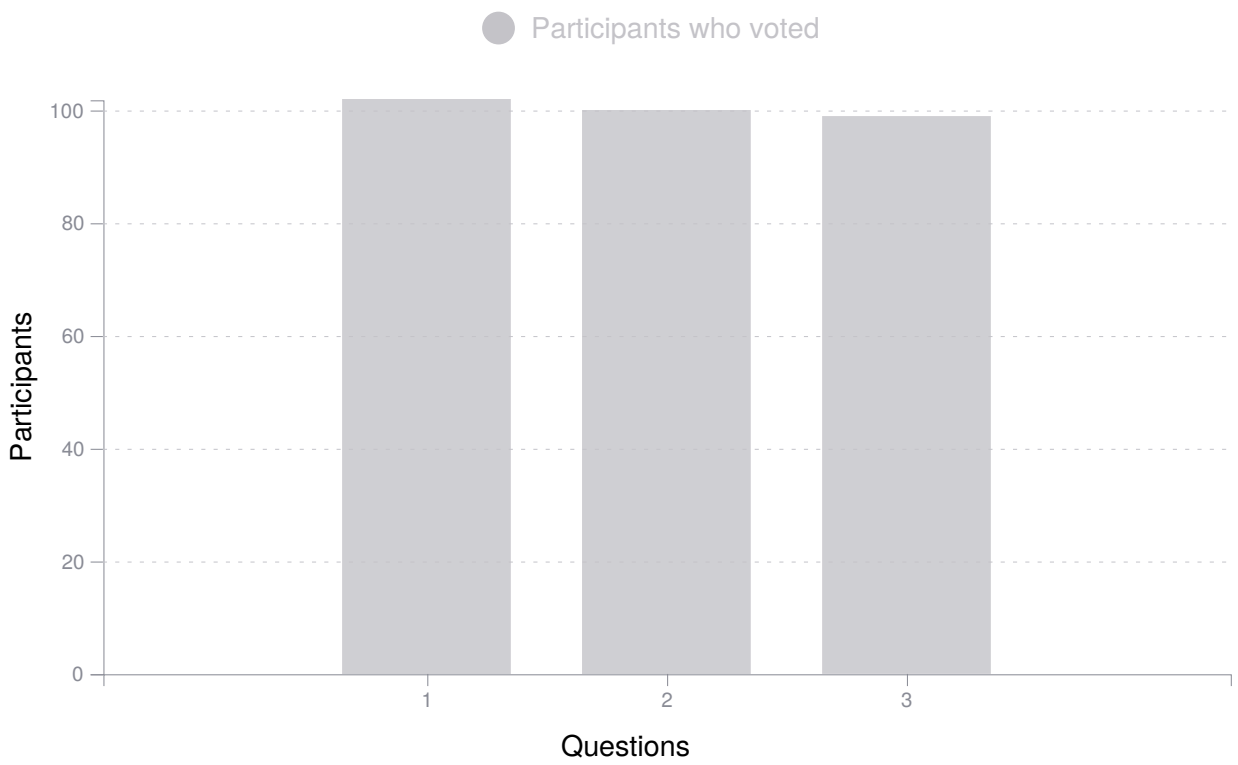
Poll (Multiple Choice)

What are your opinions on the content and architecture of a New Science Plan?

07 Apr 2019, 09:00 - 08 Apr 2019, 06:54

110 Participants	301 Total votes

Questions



Q1: Is the current IODP Science Plan for 2013-2023 still appropriate to guide scientific ocean drilling beyond 2023?

102 Participants

Yes	57.8%	59 Votes

No

42.2% 43 Votes

Q2: Is the scientific content of the current Science Plan still relevant?

100 Participants

Yes

94.0% 94 Votes

No

6.0% 6 Votes

Q3: Do we need a new architecture for the new Science Plan?

99 Participants

Yes

92.9% 92 Votes

No

7.1% 7 Votes

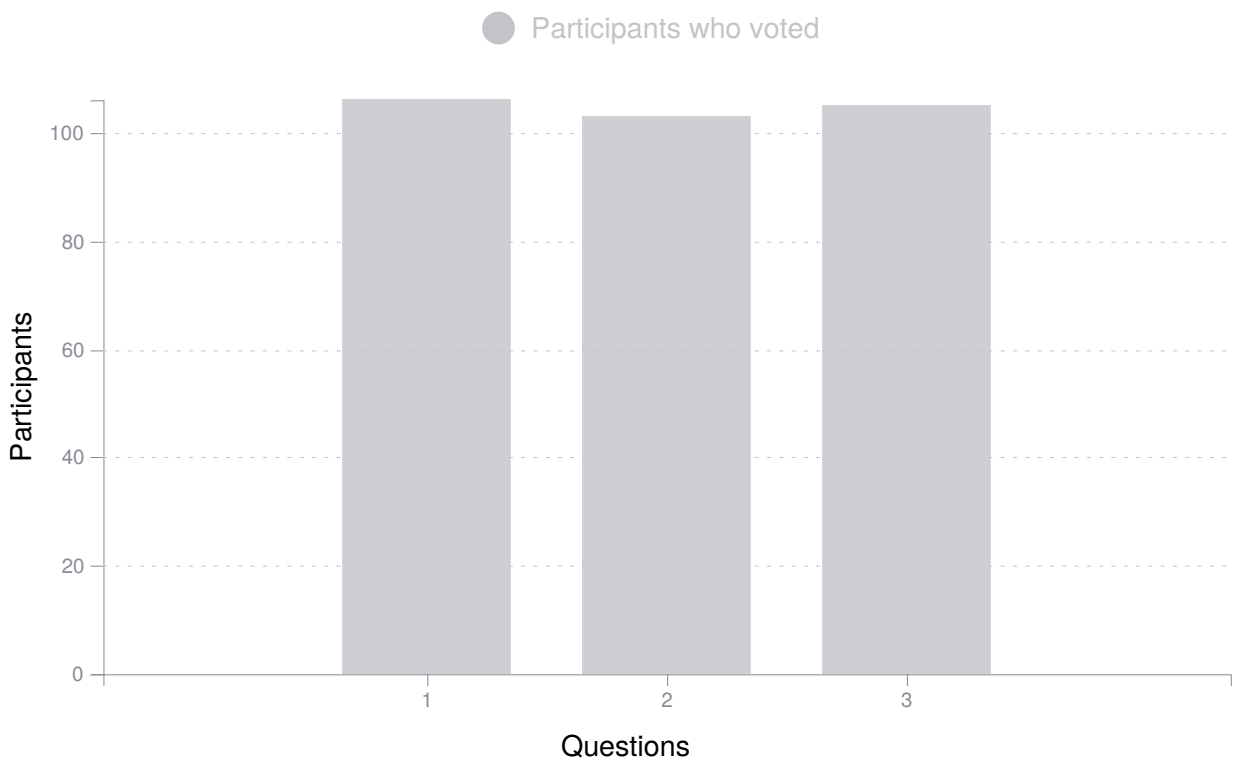
Poll (Multiple Choice)

How do you perceive the need for each of the IODP vessels in resolving the outstanding or emerging challenges in scientific ocean drilling?

07 Apr 2019, 09:00 - 08 Apr 2019, 06:54

108	314
Participants	Total votes

Questions

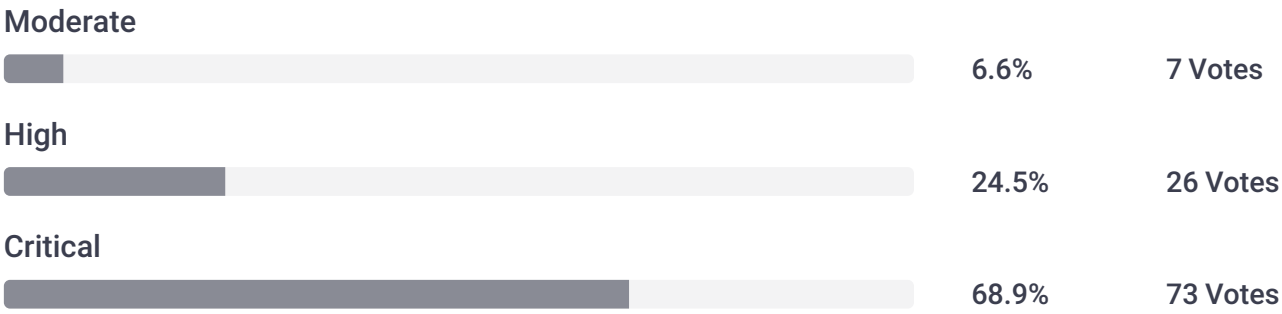


Q1: How do you perceive the need for a JR-like vessel replacement in resolving the outstanding or emerging challenges in scientific ocean drilling?

106 Participants

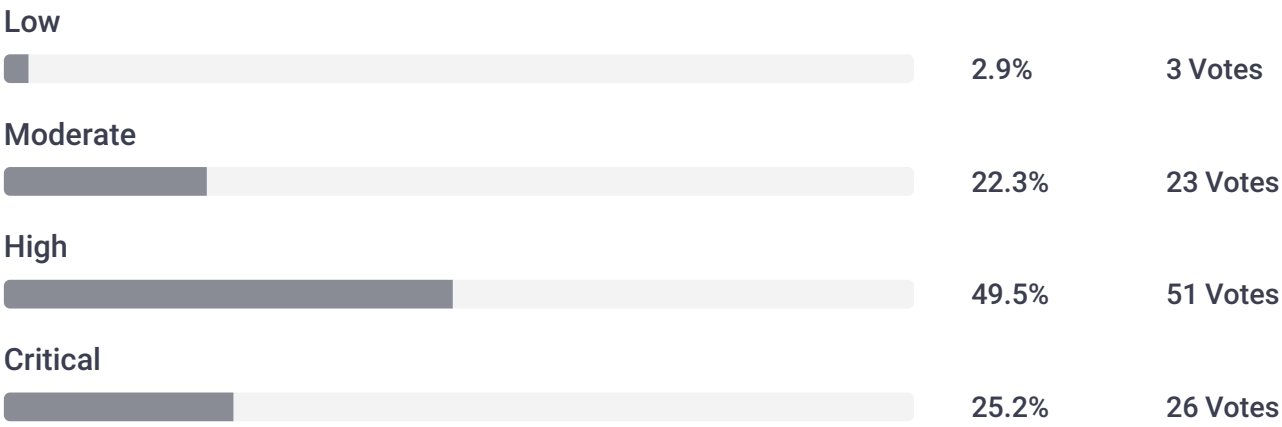
Low

0.0% 0 Votes



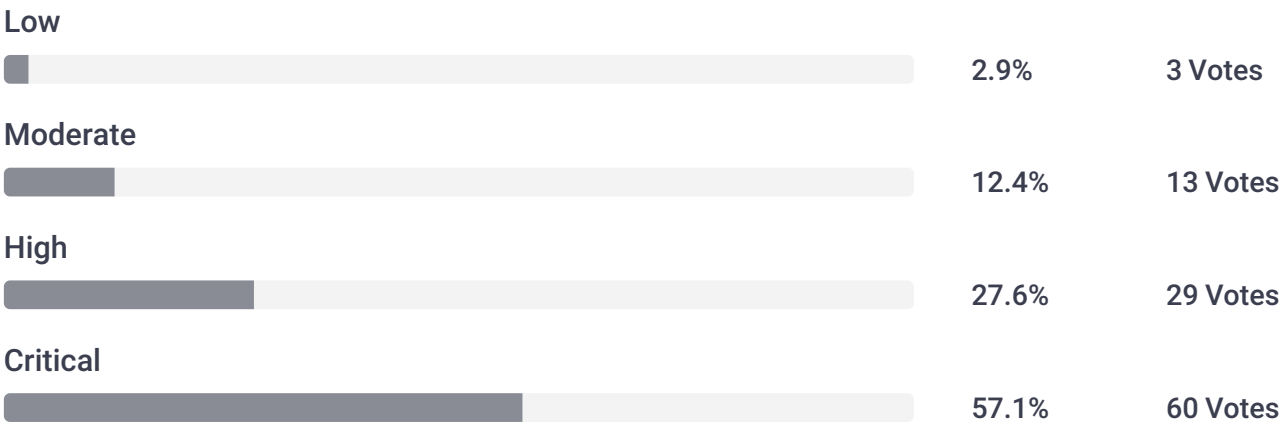
Q2: How do you perceive the need for the Chikyu in resolving the outstanding or emerging challenges in scientific ocean drilling?

103 Participants



Q3: How do you perceive the need for MSPs in resolving the outstanding or emerging challenges in scientific ocean drilling?

105 Participants



Open-text Poll

What are the new Big Ideas for a new scientific ocean drilling program?

07 Apr 2019, 09:00 - 08 Apr 2019, 06:54

86	130	29
Participants	Total votes	Answers
160	18	29 Allowed / 0 Blocked
Interactions*	Highest vote	

* Interactions include the total number of questions, votes, comments and answer ratings

Answer status breakdown:

Q: What are the new Big Ideas for a new scientific ocean drilling program?

29 Answers Allowed

18 VOTES
Anonymous • 07 Apr 2019 09:11
Archiving and synthesis of POST-MORATORIUM science data; dynamic linking of age models to data - demonstrate efficient and open use of existing and future data. Build capability for "4D ocean" studies

17 VOTES
Anonymous • 07 Apr 2019 09:15
Science and society - "theme" on Science that is immediately relevant to society now and in the future

11 VOTES
Andrew McCaig • 07 Apr 2019 09:16
Building and maintaining a habitable planet

10 VOTES

Anonymous • 07 Apr 2019 09:16

Planet Earth in a warmer Climate, Earth System Sensitivity, Orbital cycles, Ocean circulation, orbital tuning, Paleogene, Deep time

---

7 VOTES

Volkhard Spiess • 07 Apr 2019 09:21

connectors: like ocean gateways, cross-ocean strategic studies allowing to be spread over various drillling proposals

---

6 VOTES

Anonymous • 07 Apr 2019 09:18

Ocean Circulation, modern deep biosphere in relation to sediments, marine paleoecosystem evolution, mantle

---

6 VOTES

Anonymous • 07 Apr 2019 09:20

The Ocean-Earth System, encompassing a Habitable Planet, Ocean Health, and Ocean Planet

---

5 VOTES

Anonymous • 07 Apr 2019 09:15

Ecosystem Sensitivity and Responses: historic data to understand combined impacts from elevated temperatures, reduced O2, perturbed nutrient dynamics and biogeochemical cycles.

---

4 VOTES

Anonymous • 07 Apr 2019 09:13

Elemental flux through the oceanic crust including but not limited to resources

---

4 VOTES

Anonymous • 07 Apr 2019 09:17

The Anthropocene ocean frontier - from measuring anthropogenic Impact to planetary stewardship

1 Comments:

Anonymous • Allowed on 07 Apr 2019, 09:19 • Allowed

a more Earth System Approach Needs to be established, away from "Research communities" to a more holistic and integrated Research platform

0 Upvotes | 0 Downvotes

---

4 VOTES

Volkhard Spiess • 07 Apr 2019 09:17

Interfaces: like shoreline in a changing world and others targeting work on both sides (land-sea), ice margins etc.

---

4 VOTES

Anonymous • 07 Apr 2019 09:21

Whole earth dynamics, natural Hazards, ecosystems, habitable planet

4 VOTES
Anonymous • 07 Apr 2019 09:23
Planet Earth: habitability and resources

3 VOTES
Anthony Koppers • 07 Apr 2019 09:18
Planet Habitilty, Far-field tectonic forcing, Volcanism and the environment, Geodynamics of the Deep Earth

3 VOTES
Camoin • 07 Apr 2019 09:24
Planet Earth: habitability resources and hazards

3 VOTES
Anonymous • 07 Apr 2019 09:24
Marine ecosystem dynamics (forcing of and response to paleoceanographic and paleoclimatic change), land-ocean transects, increased spatial and temporal resolution in deep time (pre-Quaternary)

3 VOTES
Anonymous • 07 Apr 2019 09:25
Understanding how ocean and ocean-floor ecosystems react to environmental changes

3 VOTES
Lucas Lourens • 07 Apr 2019 09:38
Monitoring the stage of the earth through observatories and integration of data from IODP/ICDP and other marine expeditions. Define a few target missions such as MSC, Arctic, MMCO, MOHO, Early Life

2 VOTES
Anonymous • 07 Apr 2019 09:21
Natural resources hidden below the ocean floor for global sustainable economic development

2 VOTES
Anonymous • 07 Apr 2019 09:25
Understanding the global water cycle linked to biogeochemistry via investigating subterrestrial fluid flow and associated processes

2 VOTES
Anonymous • 07 Apr 2019 09:25
Big data (database with curated splice/age model data); Climate tectonics (linking tectonics, gateways, ocean currents, climate), Matter/Energy fluxes and deep biosphere interactions; 4D ocean/ecology

2 VOTES

Anonymous • 07 Apr 2019 09:32

Identify key areas sensitive to anthropogenic impacts - study them in a concerted manner with united IODP expertise: e.g. Arctic Ocean & impact of climate change; Hydrothermal Systems & DeepSea Mining

---

2 VOTES

Anonymous • 07 Apr 2019 10:28

Earths dynamic cryosphere. An integrated focus on ice sheets (sea level), ice shelves, sea ice and permafrost. Must address role in carbon cycle (etc) and climate change across timescales.

---

2 VOTES

Anonymous • 07 Apr 2019 10:51

ECORD doesn’t Pay its way, more than 40% of proposals but <20% of funding - this is not sustainable. How can we uplift (double?) ECORDs global contribution to scientific ocean drilling?

---

1 VOTES

Anonymous • 07 Apr 2019 09:24

Balancing the transfer of carbon and other elements between the ocean floor and seawater

---

1 VOTES

Anonymous • 07 Apr 2019 09:26

Developing scenarios for a ›warmer-than-present world‹ from ocean-floor climate archives

---

1 VOTES

Anonymous • 07 Apr 2019 10:20

Plate Tectonics, biogeochrmical cycle of elements, water-rock interaction and Planet Habitability

---

0 VOTES

Anonymous • 07 Apr 2019 12:26

Solve ice age mystery, develop better dating methods, cover Arctic ocean better, develop downhole tools that can resolve millennial climate variability

---

0 VOTES

Anonymous • 07 Apr 2019 11:58

IODP should address, for the first time since the seventies, the origin, evolution and global impact of short-lived oceanographic and ecological crises that lead to the deposition of salt giants.

Pigeonhole Live

Q&A

Wrap Up Session - Day 1 Summary and Introduction to Day 2: Future Platforms, Technology, Opportunities & IODP Management

07 Apr 2019, 09:00 - 23:00

60 Participants	0 Total votes	0 Questions	0 Questions answered
0 Interactions*	0 Highest vote	0 Allowed / 0 Blocked	0 Ratings / None Top rating

* Interactions include the total number of questions, votes, comments and answer ratings

Q&A

Plenary Session - Technologies and Opportunities to Expand IODP Science, A. Kopf (ICDP). Please continue to use for panel session.

07 Apr 2019, 09:17 - 23:00

90 Participants	159 Total votes	24 Questions	0 Questions answered
200 Interactions*	17 Highest vote	24 Allowed / 0 Blocked	0 Ratings / None Top rating

* Interactions include the total number of questions, votes, comments and answer ratings

24 Questions Allowed

17 VOTES

Anonymous • 07 Apr 2019 09:28

Improved recovery for hard rock drilling - any new technologies for this?

2 Comments:

Anonymous • Allowed on 07 Apr 2019, 09:35 • Allowed

New JR-replacement vessel meant to have active heave compensation and hence better control of weight-on-bit - should result in improved recovery during hard rock drilling

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 09:37 • Allowed

Is diamond coring still an option?

0 Upvotes | 0 Downvotes

15
VOTES

Anonymous • 07 Apr 2019 09:44

Would it be helpful to have a scientific "organisation", serving as a "umbrella" to unify the science of IODP and ICDP and speak with a joint voice ?

3 Comments:

Anonymous • Allowed on 07 Apr 2019, 09:56 • Allowed

"Earth Systems Drilling and Monitoring"

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 10:03 • Allowed

Think that we are organizing the science for 2023 - 2033 the science. Do we want to maintain the status-quo of to separate so separated organisations with the same scientific goals and plans for the next almost 15 years? How would we communicate this convincing to funding agencies and governments?

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 10:16 • Allowed

turn the question around - how would you convince funding agencies to pay for two parallel programs with the same scientific goals for an additional period of 10 years? This will be close to mission impossible.

0 Upvotes | 0 Downvotes

11
VOTES

Anonymous • 07 Apr 2019 09:24

Monitoring installations are very expensive, can we think about an IODP grant to access these technology also for the less rich?

2 Comments:

Anonymous • Allowed on 07 Apr 2019, 09:28 • Allowed

Development costs can be reduced by using standardized observatory structure and instruments

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 10:20 • Allowed

A grant does not mean a blank check and the potential explosion of costs, but a fixed pot of money to be granted on competitive basis, to help fostering ideas that are not always by the same people/groups that seems to have a monopoly for monitoring

0 Upvotes | 0 Downvotes

---

11 VOTES

Andrew McCaig • 07 Apr 2019 09:34

Are the industry seafloor drills more effective than the ones currently used by IODP (eg. Massive sulphide drilling by Nautilus mining)? If, so, why?

5 Comments:

Anonymous • Allowed on 07 Apr 2019, 09:36 • Allowed

This seems to be the case. Why? Probably higher levels of investment.

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 09:46 • Allowed

Their drilling is only very shallow ... a few metres at best. They are currently building a cheap equivalent to MeBo/Rockdrill but they are by no means better than our systems

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 10:10 • Allowed

see http://www.nautilusminerals.com/irm/PDF/1553_0/ExplorationCampaign Using ROVDrill3. 99 holes, total of 1475m recovery, back in 2010-11. There is a more detailed report somewhere - some holes reached >60mbsf. The ROV positioned the drill on the seafloor

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 10:24 • Allowed

http://www.nautilusminerals.com/irm/PDF/993_0/NautilusMineralsIntersectsMoreHighGradesatDepth sorry, >45mbsf.

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 10:45 • Allowed

We are not committed to using our 'in-house' academic drills (MeBo/RD2). For example, Hawaii was scheduled to use a commercial SFD.

1 Upvotes | 0 Downvotes

---

10 VOTES

Anonymous • 07 Apr 2019 09:30

Is the community aware of all high-tech borehole technology already available within the exploration industry?

1 Comments:

Anonymous • Allowed on 07 Apr 2019, 09:56 • Allowed

I think in many ways, yes. But the more sophisticated the tool, the more expensive it is.

0 Upvotes | 0 Downvotes

---

9 VOTES

Anonymous • 07 Apr 2019 09:23

What new sensors should be developed as part of future CORKs?

---

9 VOTES

Anonymous • 07 Apr 2019 09:43

improved coring technology for recovery in heterogeneous formations (e.g., chert, soft-rock)

---

8 VOTES

Anonymous • 07 Apr 2019 10:24

One of the biggest costs for IODP is fuel for the platforms (particularly the JR) - why can't industry provide fuel as an in-kind contribution in return for the free access they get to our data??

---

7 VOTES

Anonymous • 07 Apr 2019 09:26

With increasing use of seabed rock drills on MSP expeditions, what progress has been made in developing slimline wireline and borehole monitoring tools that can be deployed in shallow, narrow holes?

1 Comments:

Anonymous • Allowed on 07 Apr 2019, 09:34 • Allowed

Downhole logging currently available: spectral gamma, magnetic susceptibility, dual-induction, optical imaging, acoustic imaging (all memory tools). Borehole monitoring: none, only borehole plugs to allow collection of borehole fluids later by ROV. There is high potential to develop new logging and monitoring tools for SFDs.

0 Upvotes | 0 Downvotes

---

7 VOTES

Anonymous • 07 Apr 2019 09:41

Any new technologies and/or techniques for improving recovery of alternating soft (e.g., chalk) / hard (e.g., chert) lithologies that characterize the Eocene and older Pacific sedimentary section?

---

7 VOTES

Anonymous • 07 Apr 2019 10:18

Site characterization data from industry can only be used if the data becomes open access. Will this happen from the industry side of the aisle?

---

6 VOTES

Anonymous • 07 Apr 2019 09:53

We need a closer link to icdp to maximise our efforts in many areas but how do w merge two very different operational / application processes?

---

6 VOTES

Anonymous • 07 Apr 2019 10:18

Should IODP really assist in industry oil extraction?

2 Comments:

Anonymous • Allowed on 07 Apr 2019, 10:21 • Allowed

Could ask the same the other way though - IODP use a great deal of industry expertise and personnel in EPSP, site review and drilling technology - without that expertise, getting sites drilled would be far more tricky and expensive.

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 11:18 • Allowed

no

0 Upvotes | 0 Downvotes

---

5 VOTES

Anonymous • 07 Apr 2019 10:19

We used to have an industry panel - what happened to it?

---

4 VOTES

Anonymous • 07 Apr 2019 09:22

What is the best place to install the next cabled monitoring? And why?

---

4 VOTES

Andrew McCaig • 07 Apr 2019 09:35

How about capability for sidewall coring in existing holes?

---

4 VOTES

Andrew McCaig • 07 Apr 2019 09:39

Can we realistically make installations more independent of cables? Buoys? Wave power?

---

4 VOTES

Anonymous • 07 Apr 2019 09:46

Would it help to send plans for observatory installations through a SEP system in order to increase chances for raising extermal funding?

---

4 VOTES

Anonymous • 07 Apr 2019 10:18

What happened to the ECORD industry panel?

---

3 VOTES

Anonymous • 07 Apr 2019 09:41

Where are with drilling into oceanic transform faults?

---

2 VOTES

Anonymous • 07 Apr 2019 09:37

What's the life-time of all these instruments ? Do we leave them on site or take them back once they're done ? Concerned by the ocean not being a garbage

---

2 VOTES

Anonymous • 07 Apr 2019 10:06

Can EJP funding be used to co-fund JR as a third party?

---

2 VOTES

Anonymous • 07 Apr 2019 10:25

Should IODP ship time be used for installation of observatories if this can now be done from other vessels?

1 Comments:

Anonymous • Allowed on 07 Apr 2019, 10:30 • Allowed

It depends on the objectives of the observatory. The more complex observatories (e.g., Hikurangi and NantroSEIZE) still require a drill ship.

0 Upvotes | 0 Downvotes

---

2 VOTES

Anonymous • 07 Apr 2019 10:33

Why isn't IOPD involved in the science of Carbon Capture and Storage? Or is it....?

Q&A

Breakout Session C - Future Technologies, Techniques, Methods and Opportunities. Followed by 30 mins report.

07 Apr 2019, 11:15 - 08 Apr 2019, 06:54

80 Participants	92 Total votes	13 Questions	0 Questions answered
117 Interactions*	22 Highest vote	13 Allowed / 0 Blocked	0 Ratings / None Top rating

* Interactions include the total number of questions, votes, comments and answer ratings

13 Questions Allowed

22 VOTES

Anonymous • 07 Apr 2019 12:12

Working to increase the funds available for ECORD contributions to IODP is key - ways to leverage EU funding?

16
VOTES

Jochen Erbacher • 07 Apr 2019 12:11

A new program should closely cooperate with ICDP. This should be visible in our (and ICDP's) new science plan and in the new structure. A "Scientific Deep Drilling Forum" would be great!

8 Comments:

Camoin • Allowed on 07 Apr 2019, 12:16 • Allowed

What would be the mission of this Forum ?

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 12:20 • Allowed

Drilling is not a public friendly term

0 Upvotes | 0 Downvotes

Jochen Erbacher • Allowed on 07 Apr 2019, 12:21 • Allowed

It could replace our current IODP Forum - including ICDP issues.

0 Upvotes | 0 Downvotes

Camoin • Allowed on 07 Apr 2019, 12:22 • Allowed

Agree

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 12:25 • Allowed

Discovery, not drilling!

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 12:29 • Allowed

Earth Systems Drilling and Monitoring

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 12:32 • Allowed

Could too much overlap / similarity between the IODP and ICDP science plans be a risk to both? from a funders perspective - might cause a sense that they're doing the same thing, so only need to fund one...

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 14:47 • Allowed

For exactly this reason it makes sense to have only one science plan. In such a document it is much easier to address the unique individual features of both programs and to identify topics that both have in common. Both programs should not compete for funds, but speak with one voice.

1 Upvotes | 0 Downvotes

12
VOTES

Anonymous • 07 Apr 2019 12:25

Shall the IODP (+ICDP?) community come together to define and agree (and publish as a white paper) about: '25 Unsolved Problems in ... (to be defined) - a community perspective' ?

10 VOTES

Anonymous • 07 Apr 2019 11:34

We understood IODP drilling in polar seas should be enhanced, but it is costly. Could we seek for collaborations with other programs (like e.g. EU for Arctic and SCAR for Antarctica)?

---

6 VOTES

Anonymous • 07 Apr 2019 12:19

IODP drilling technology proven to be not always successful for glacigenic sediments (very valuable for paleoclimatic and ice-sheet related topics). A technologic development would be helpful for this

1 Comments:

Anonymous • Allowed on 07 Apr 2019, 12:26 • Allowed

The same accounts for volcaniclastic material with highly heterogenous grain size ...

0 Upvotes | 0 Downvotes

---

6 VOTES

Anonymous • 07 Apr 2019 11:41

Do we need to reassess what are minimum and standard measurements for the new program as technology gives us more methods

---

5 VOTES

Anonymous • 07 Apr 2019 12:29

Should there be a pan-Europe task force to promote ECORD's unified successes and explore options for future European funding?

---

5 VOTES

Anonymous • 07 Apr 2019 12:37

The future of IODP and ECORD is bright when we have such talented ECRs in our community

---

4 VOTES

Anonymous • 07 Apr 2019 12:20

Has ICDP had more success than IODP in securing EU-level funding? Or do we both struggle equally...

---

2 VOTES

Anonymous • 07 Apr 2019 12:39

ECR support and training needs to be more prominent in the new SP. as they are the future and will ensure the continuation of IODP.

1 Comments:

Anonymous • Allowed on 07 Apr 2019, 13:23 • Allowed

Just to add, we are aware that there are already some great ECR opportunities (ECORD summer schools/training courses/ECORD Research Grant), and courses like the maghellan proposal writing workshop. Also we know ECRs are actively encouraged to sail to build future IODP. Our suggestions were additional things to look into, especially relating to levelling the expedition-related playing field and making ECRs more visible and involved in the ECORD structure and science plan.

0 Upvotes | 0 Downvotes

---

2 VOTES

Anonymous • 07 Apr 2019 12:16

Did the FUGRO sea devil actually work?

1 Comments:

Anonymous • Allowed on 07 Apr 2019, 12:19 • Allowed

Not on X381, it suffered from water ingress. But it has worked on other Fugro projects before X381.

0 Upvotes | 0 Downvotes

---

1 VOTES

Anonymous • 07 Apr 2019 12:18

Side wall coring will only answer a few of the major questions asked by projects that want to drill deep. MoHole can't be just about making a Hole!

---

1 VOTES

Anonymous • 07 Apr 2019 12:36

Although FBs work well for operations, they subdivide the impact of the science. Should outreach and engagement be pan-IODP with a centralised highly professional science led international team?

1 Comments:

Anonymous • Allowed on 07 Apr 2019, 14:47 • Allowed

The overreaching agency existed in the previous IODP. In the current program the respective science program office people meet regularly to discuss education & outreach.

0 Upvotes | 0 Downvotes

Open-text Poll

Which other programs could IODP link with? Please post your suggestions here.

07 Apr 2019, 13:30 - 08 Apr 2019, 06:54

38	8	6
Participants	Total votes	Answers
14	4	6 Allowed / 0 Blocked
Interactions*	Highest vote	

* Interactions include the total number of questions, votes, comments and answer ratings

Answer status breakdown:

Q: Which other programs could IODP link with?

6 Answers Allowed

VOTES		
4	Anonymous • 07 Apr 2019 13:38	The science plan should speak to the UN sustainable development goals where possible
2	Volkhard Spiess • 07 Apr 2019 13:49	Carbon Storage Programs of EU and US as well as on national level
2	Anonymous • 07 Apr 2019 13:50	NASA, ESA, ... (space agencies)

0
VOTES

Volkhard Spiess • 07 Apr 2019 13:50

Linking better any land-sea drilling transects with coastal research programs (National, intenational) and government interest

0
VOTES

Anonymous • 07 Apr 2019 14:46

ESA, NASA, volcano, climate programs

0
VOTES

Anonymous • 07 Apr 2019 16:05

Connect somehow with United Nations ?

Pigeonhole Live

Q&A

Breakout Session D - Expanding the Frontiers of IODP. What should the design of the new Science Plan be? Followed by report and wider group discussion

07 Apr 2019, 13:45 - 08 Apr 2019, 06:54

107 Participants	172 Total votes	44 Questions	0 Questions answered
243 Interactions*	24 Highest vote	44 Allowed / 0 Blocked	0 Ratings / None Top rating

* Interactions include the total number of questions, votes, comments and answer ratings

44 Questions Allowed

24
VOTES

Anonymous • 07 Apr 2019 14:39

Idea for a title of the science plan: Our dynamic earth: Living on a changing planet.

6 Comments:

Anonymous • Allowed on 07 Apr 2019, 14:40 • Allowed

Great idea!

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 14:42 • Allowed

next acronym ... ODE?

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 14:44 • Allowed

Mission Earth?

0 Upvotes | 1 Downvotes

Anonymous • Allowed on 07 Apr 2019, 14:54 • Allowed

Title does not reflect that this is a marine program; also sounds like the title of an undergraduate textbook

4 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 14:56 • Allowed

The ODP long range plan was Our Dynamic Earth.

3 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 14:57 • Allowed

Great: What about „Our dynamic planet - etc“ We could call this ODP again ;-)

0 Upvotes | 0 Downvotes

15
VOTES

Anonymous • 07 Apr 2019 15:04

What about an executive summary in pictorial form (as suggested by ECRs) with 10-15 ‘Grand Challenges’ similar to the UN sustainable development goals

1 Comments:

Anonymous • Allowed on 07 Apr 2019, 15:54 • Allowed

Infographic have come up in a number of conversations as an eye catching quick way to communicate basic goals to interested parties who are non specialists

0 Upvotes | 0 Downvotes

12
VOTES

Anonymous • 07 Apr 2019 14:57

Within the Science Plan clearly identify the knowledge that we CAN ONLY GAIN THOUGH OCEAN DRILLING / DISCOVERY in the different areas

---

10 VOTES

Anonymous • 07 Apr 2019 14:45

How do we get ECORD countries to pay their fair share?

5 Comments:

Anonymous • Allowed on 07 Apr 2019, 14:51 • Allowed

What do you mean?

2 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 14:54 • Allowed

Approx 15% of funding but ~40% proposals

0 Upvotes | 5 Downvotes

Anonymous • Allowed on 07 Apr 2019, 14:55 • Allowed

Need to make sure that we have key topics / major big idea focus on subjects that might be attractive to EU / and EU country funders - Arctic sensitivity? shelf-to-ocean drilling and carbon fluxes across Arctic shelves? Link to ICDP? Ways of packaging MSP activity in ways more likely to attract funding

1 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 14:56 • Allowed

IODP should be happy for the ECORD role in proposal writing

4 Upvotes | 2 Downvotes

Anonymous • Allowed on 07 Apr 2019, 15:06 • Allowed

ECORD promotes IODP in all partner countries through its outstanding role in proposal submission and high profile MSP expeditions

6 Upvotes | 1 Downvotes

---

9 VOTES

Anonymous • 07 Apr 2019 14:45

The possible big idea names are going by too fast to write down - are these notes going to be distributed?

---

8 VOTES

Anonymous • 07 Apr 2019 14:46

The ocean record of a dynamic planet?

---

8 VOTES

Anonymous • 07 Apr 2019 14:47

Past to Future: Understanding Our Dynamic Earth.

1 Comments:

Anonymous • Allowed on 07 Apr 2019, 15:08 • Allowed

PRUDENCE: Past to futuRe: UnDErstaNding our dynamiC Earth.

0 Upvotes | 0 Downvotes

---

7 VOTES

Anonymous • 07 Apr 2019 14:44

Monitoring the State of the Planet - modern / recent observation and processes; but also using the paleo record to "horizon scan" for sensitivities and tipping points in climate / biotic systems

---

7 VOTES

Anonymous • 07 Apr 2019 14:51

In addition to the great name voted to the top, communicate and build the program around buzz words: "Exploring, Monitoring and Sustaining - Climate, Life and Earth"

1 Comments:

Anonymous • Allowed on 07 Apr 2019, 14:56 • Allowed

Yes!

0 Upvotes | 0 Downvotes

---

6 VOTES

Anonymous • 07 Apr 2019 14:47

Mission Earth

---

6 VOTES

Anonymous • 07 Apr 2019 14:54

Design whole thing around an infographic with arrows connecting systems that act as hyperlinks to examples of science problems to be addressed

---

6 VOTES

Anonymous • 07 Apr 2019 15:26

Put indicators of our success such as the training of new generations of scientists, diversity of institutes involved etc right upfront

---

4 VOTES

Anonymous • 07 Apr 2019 14:51

We heard the concept of monitoring as being the new big idea: monitoring is a tool!

1 Comments:

Anonymous • Allowed on 07 Apr 2019, 15:26 • Allowed

Sensing (sub)seafloor volumes over time may be a (multiple) methodology, but an innovative one with involvement of big data/artificial intelligence which could be designed for almost any scientific challenge or geological scenario if you pick the right approach/sensors. If we do not make this move forward, we will be dead in the water. In that sense it is maybe not necessarily "a big idea", but definitely a good idea...

0 Upvotes | 0 Downvotes

4
VOTES

Anonymous • 07 Apr 2019 15:07

“From Ocean to Mantle: Understanding our Dynamic Earth with Scientific Drilling”. (Short title, Ocean to Mantle)

1 Comments:

Anonymous • Allowed on 07 Apr 2019, 15:20 • Allowed

Sounds a lot like R2K ‘from mantle to microbes’

0 Upvotes | 0 Downvotes

4
VOTES

Anonymous • 07 Apr 2019 15:11

Ocean, Earth, and Life

2 Comments:

Anonymous • Allowed on 07 Apr 2019, 15:16 • Allowed

Congratulations, that was the title of the Integrated Ocean Drilling Program Science Plan !

3 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 15:26 • Allowed

No, the IODP ISP's title was Earth, Oceans, and Life...

0 Upvotes | 0 Downvotes

4
VOTES

Anonymous • 07 Apr 2019 15:21

Earth in Flux.... covers most/all of what we do

1 Comments:

Anonymous • Allowed on 07 Apr 2019, 15:28 • Allowed

It’s difficult to understand for the public, so not too effective

0 Upvotes | 0 Downvotes

3
VOTES

Anonymous • 07 Apr 2019 14:44

Hazards overarching topic (right word?) - threats from multiple systems - climate, volcanic, seismic, (damage to) biosphere

1 Comments:

Anonymous • Allowed on 07 Apr 2019, 15:00 • Allowed

Those hazards are what makes the planets alive and our life possible...

0 Upvotes | 0 Downvotes

3
VOTES

Anonymous • 07 Apr 2019 14:46

Would we need themes at all? Would we be better off to stick with the challenges?

3 Comments:

Anonymous • Allowed on 07 Apr 2019, 14:48 • Allowed

I think there need to be themes (specifying general areas) because otherwise Challenges will look like a big jumble.

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 14:52 • Allowed

Devil's advocate: a "challenge" could run into semantic trouble as well - once "challenges" are not addressed within 10 years, they can be perceived as "insurmountable problems"?

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 14:56 • Allowed

An equivalent to the Themes is needed, but not for categorising what were known as Challenges. I'd like to see a large set of floating topics (or approaches?), with each topic contributing to 1 or more high level objectives.

0 Upvotes | 0 Downvotes

3
VOTES

Anonymous • 07 Apr 2019 15:11

What do we mean by challenges? Are these short term achievable goals or longer term more nebulous aspirations?

3
VOTES

Anonymous • 07 Apr 2019 15:18

What Oceans tell us ? Past present and future of a Dynamic earth

---

3
VOTES

Anonymous • 07 Apr 2019 15:20

Our Ocean Planet: Past, Present, and Future

3
VOTES

Anonymous • 07 Apr 2019 15:24

Get Roz Coggon to give her “What has scientific ocean drilling done for you” talk....

2 Comments:

Anonymous • Allowed on 07 Apr 2019, 15:26 • Allowed

Yes! That was great!

0 Upvotes | 0 Downvotes

Anonymous • Allowed on 07 Apr 2019, 15:32 • Allowed

Agreed

0 Upvotes | 0 Downvotes

---

2 VOTES

Anonymous • 07 Apr 2019 14:41

Dynamics of the Earth could be another one?

---

2 VOTES

Anonymous • 07 Apr 2019 14:47

Sustaining a Habitable Planet? Risks to a Habitable Planet?

---

2 VOTES

Anonymous • 07 Apr 2019 14:54

Earth’s habitability: limits, evolution, threats

---

2 VOTES

Anonymous • 07 Apr 2019 14:58

Ice-water-rock-life

1 Comments:

Anonymous • Allowed on 07 Apr 2019, 15:05 • Allowed

Ocean Frontiers

0 Upvotes | 0 Downvotes

---

2 VOTES

Anonymous • 07 Apr 2019 15:07

Ocean Frontier

---

2 VOTES

Anonymous • 07 Apr 2019 15:15

Life Cycle of the Plate

---

2 VOTES

Anonymous • 07 Apr 2019 15:17

Making and Sustaining a Habitable Planet

---

2 VOTES

Anonymous • 07 Apr 2019 15:19

Planet Ocean

---

1 VOTES

Anonymous • 07 Apr 2019 14:50

Boundary Conditions of a Dynamic Earth: tectonic / gateway controls on oceanography; climate forcing; chemical cycles -> how these influence dynamics and sensitivities in the system

---

1 VOTES

Anonymous • 07 Apr 2019 15:21

What about more broad themes: Geosphere, Biosphere and Hydrosphere. This would make an multi disciplinary approach easier

---

1 VOTES

Anonymous • 07 Apr 2019 15:31

What about outreach and education? (not directly about science themes and challenges but important for the program)

---

1 VOTES

Anonymous • 07 Apr 2019 15:34

IODP Frontiers => links to other programs (european, international)

---

0 VOTES

Anonymous • 07 Apr 2019 14:58

Pulse of the Planet

---

0 VOTES

Anonymous • 07 Apr 2019 15:02

Changing Oceans

---

0 VOTES

Anonymous • 07 Apr 2019 15:11

Source2sink?

1 Comments:

Anonymous • Allowed on 07 Apr 2019, 15:19 • Allowed

This is incomprehensible to the non-specialist (public or funding people) so not a good title.

0 Upvotes | 0 Downvotes

---

0 VOTES

Anonymous • 07 Apr 2019 15:14

Themes coming up:

---

0 VOTES

Anonymous • 07 Apr 2019 15:15

Ocean scientific drilling: revelations of Earth secrets from deep to surface

---

0 VOTES

Anonymous • 07 Apr 2019 15:15

Monitoring the State of the Planet

---

0 VOTES

Anonymous • 07 Apr 2019 15:16

Hazards - in broad sense - tectonic, cryosphere, climate

---

0 VOTES

Anonymous • 07 Apr 2019 15:17

Dynamic Ocean Margins

0
VOTES

Anonymous • 07 Apr 2019 15:33

A chance to extend opportunities to those scientists who do not live in the rich countries- a radical Influence / change of culture

0
VOTES

Anonymous • 07 Apr 2019 16:14

Challenges ODP-IODP: which ones die we actieve, which ones are still open and which ones are new?

Pigeonhole Live

Q&A

Plenary Session - Discussion continued , summary of the PROCEED survey and open scientific questions, comments, ideas and wrap up

07 Apr 2019, 16:15 - 08 Apr 2019, 06:54

21 Participants	0 Total votes	0 Questions	0 Questions answered
0 Interactions*	0 Highest vote	0 Allowed / 0 Blocked	0 Ratings / None Top rating

* Interactions include the total number of questions, votes, comments and answer ratings