

## Report of the Haiti-Drill MagellanPlus SSC workshop held May 20-22, 2019

### Organizers

Chastity Aiken, [chastity.aiken@ifremer.fr](mailto:chastity.aiken@ifremer.fr)

Walter R Roest, [wroest@ifremer.fr](mailto:wroest@ifremer.fr)

Frauke Klingelhofer, [Frauke.Klingelhofer@ifremer.fr](mailto:Frauke.Klingelhofer@ifremer.fr)

### Proponents

Milene Cormier, [mhcormier@uri.edu](mailto:mhcormier@uri.edu)

Richard Wessels, [r.j.f.wessels@uu.nl](mailto:r.j.f.wessels@uu.nl)

### 1. Short summary

The workshop was held in Plouzané, France. Thirty-four people attended the workshop from 9 different countries, with 4 participants being early career researchers. The workshop was aimed to deliver a science-driven and exciting amphibious proposal for drilling active onshore and offshore faults in the Haiti area. Pre-proposals were first submitted in 2015; However, a clear scientific link was missing between the objectives and drilling sites onshore and offshore. With this workshop, we sought to identify that scientific link of global importance and uniqueness and, if necessary, change the objectives and drilling sites. We also used the workshop as an opportunity to learn about the management, technicalities, and policies of drilling projects both onshore and offshore. The full program can be found at [this link](#). Implications of recent results - onshore and offshore Haiti - were discussed, and 2 scientific questions were posed as potential overarching goals for the project - 1) age and maturity of the faults and 2) slip rates of the faults. Drilling sites would change depending on which question we choose to focus on. If age and maturity, we would drill through the faults. If slip rates, we would like to have drilling sites perpendicular and parallel to the faults. Overall, workshop participants were in agreement that more research needs to be done to gain a deeper understanding of dual transform fault systems before developing a full proposal. Due to certain difficulties, it was also agreed that future small projects - either onshore or offshore - conducted in support of drilling should be worked separately on their own timescales, for the time being. Goals and timelines were set during the workshop to outline a long-term path towards developing a full drilling proposal. Future plans include requesting grants for future research, finishing and publishing on-going research, advertising help needed to analyze existing data, and involving local Haitian scientists and students.

### 2. Objectives

During this workshop, we aimed to clarify and/or redefine our objectives to make a clear link between the IODP and ICDP portions, to discuss the implications of recent results in the context of our original pre-proposal submissions in 2015, and to identify the key participants in the development of the proposals. We also wanted to gain a deeper understanding of management, technicalities, and policies required for an amphibious project through keynote speakers who have participated in IODP and ICDP projects.

Thus, we had 5 objectives for this workshop:

- a) How can we make a stronger science connection between onshore and offshore sites?

- b) Should the scientific objectives for drilling be changed?
- c) Are the drilling sites appropriate to address the scientific objectives?
- d) How is drilling managed, how are data shared among scientists, how to obtain funding, etc.?
- e) What is needed to conduct the drilling and obtain the objectives?

### 3. Program

Session 1: Proposal and project setting		
9:00		<b>Welcome</b>
9:30	Chastity Aiken	The Haiti-DRILL amphibious drilling proposal and its history
10:00	Bernard Mercier de Lépinay	Geologic Evolution of the North Caribbean Plate Boundary Zone, from Cretaceous to Present.
10:30		<b>Coffee break</b>
10:45	Eric Calais	Current tectonics and fault activity in the northern Caribbean plate boundary: What do we know, what do we need?
11:15	Sylvie Leroy et Frédérique Rolandone	Results of Haiti-Sis & Heat Flow in the North Caribbean
11:45	Jordane Corbeau	Results of Transhaiti and northern limit of the Caribbean plate
12:15		<b>Lunch</b>
14:00	Andreina Garcia-Reyes	New marine magnetic anomalies in the Northern Caribbean: Understanding a complex tectonic setting
Session 2: Recent results		
14:30	Anne Battani	Geochemistry of fluids along faults in Haiti
15:00	Richard Wessels	Geological evolution and paleo-fluid circulation of the Southern Peninsula and EPGFZ, Haiti
15:30		<b>Coffee break</b>
15:45	Milène Cormier	Preliminary results from the Lake Azuei project: Active structures and Late Holocene stratigraphy
16:15		Video conference with Haiti
16:45		Discussion - Do we need to change the objectives? - Are the current drilling sites appropriate? - etc.
18:00		<b>Wrap</b>
Session 3: Learning from past drilling experiences		
8:30	Marianne Conin	Thrilling advances in the understanding of the up-dip limit of subduction zones through scientific drilling
9:00	Sanny Saito	Drilling management and fluid recovery during drilling, results from IODP expeditions
9:30	Anders Noren	Onshore and Lake Drilling: The ICDP and LacCore/CSDCO Perspective
10:00		<b>Coffee break</b>
10:15	Vincent Maury	Lessons from boreholes: Maintaining integrity and measuring crucial parameters to understand the relationship between slow slip events and earthquakes

10:45	M. Conin S. Saito A. Noren V. Maury	Panel Discussion - How are data managed (ICDP vs. IODP)? - How are data shared (ICDP vs. IODP)? - What are the publication policies? - What makes up the annex of the ICDP proposal? - What difficulties should we expect with drilling? - etc.
12:15		<b>Lunch</b>
<b>Session 4: Perspectives</b>		
14:00	Pierre Henry	Coring results and drilling proposals in the Sea of Marmara
14:30	Chastity Aiken	Evidence of onshore slow slip and the potential for slow slip offshore Haiti
15:00	Walter Roest	Haiti-LIMITS cruise proposal: Deep crustal seismic survey
15:30		<b>Coffee break</b>
15:45		Discussion - How can we make a stronger SCIENCE connection between on-shore and off-shore sites? - What is needed to conduct the drilling and obtain the objectives? - etc.
17:00		<b>Wrap</b>
<b>Session 5: Future of the Amphibious Drilling Proposal</b>		
9:00		<b>Thematic working groups</b> <b>Group 1 - Offshore drilling</b> <b>Group 2 - Onshore drilling</b>
11:00		Reports of thematic working groups
11:30		Restitution of reports, key participants in proposal writing - organization chart, agenda and future GANT
12:00		<b>Conclusion</b>

#### 4. Outcome

Several scientific questions were developed during the workshop surrounding the dual transform fault system. For example, how deeply rooted are the OSFZ and EPGFZ? What is the structure and location of the EPGFZ terminus and is it still active? What do paleoseismic records of the EPGFZ and OSFZ near Haiti tell us about past seismic activity? How do the relative ages, maturity, and lithologies of the dual transforms compare? How do present day stress fields compare to paleostress fields? Are the stress fields at depth for the EPGFZ and OSFZ similar, confirming the existence of a Gonâve microplate? What is the source of gas/fluids and their pathways, and how do they influence seismicity? Why do both transform faults move? Is there a remnant slab beneath Haiti or evidence of a double crust? Did a seaway closure onshore Haiti occur during the formation of the Cayman Basin? We reduced these to 2 broader scientific questions:

##### 1) *What are the ages and maturity of the OSFZ and EPGFZ?*

The age of these fault zones offshore Haiti has never been explored, and the age and maturity of the EPGFZ terminus is not known. Knowing the age of these fault zones gives insight into the geodynamics of the northern Caribbean Plate boundary. Knowing the maturity of these fault

zones provides clues on how stress is released on a fault, e.g. maximum displacement and rupture velocity. In addition, fault maturity provides insight to fracture networks that act as fluid and gas pathways. Addressing this question requires drilling across faults both onshore and offshore.

2) *How do slip rates vary between the fault zones, as compared to the EPGFZ terminus?*

Some of the target areas have no record of seismic slip, while others do. Answering questions about slip rates will provide clues about how stress is accommodated, partitioned, and orientated at different segments of the fault zones and also around the proposed boundary of the Gonâve microplate. It also is a topic that can be easily compared to other strike-slip faults, e.g. San Andreas Fault. Transects of drilling sites with incremental depth increase parallel and perpendicular to fault zones could be utilized to image the stress field. However, this would require more drilling sites and would not necessarily drill across a fault at depth (as would be required in question 1).

We also discussed (via video conference) the drilling project idea with Dominique Boisson, Roberte Momplaisir, and Louis Honoré, leading geoscientists in Haiti. It was clear that to have their support in a future drilling project, we must include Haitian students in field work and research, i.e. learning opportunities should be a part of any and all projects.

Keynote speakers discussed different aspects of drilling - from developing ideas/proposals to the organization and technicalities of drilling. We learned the importance of developing a global scientific question(s) for robust drilling proposals. We learned that developing proposals requires multiple stages of work - beginning with surface work and later stages of deeper coring prior to deep drilling. We learned how to identify faults while drilling and how to best sample fluids both onshore and offshore. We learned about different monitoring tools that could be used onshore or offshore and about organizing and funding onshore drilling.

It was decided that a database is necessary to encourage participation in the development of a full proposal(s).

We were hopeful that perhaps a full amphibious drilling proposal could be submitted in the coming years. However, it was conferred by all that the onshore and offshore projects should be separated at the moment because the onshore and offshore projects are on a different schedule in organization. That includes surveys and science that needs to be done, ship scheduling, financing pre-drilling projects, data management, funding schemes, etc.

Given the decision to split into two projects for the time being, the thematic working groups were charged to focus on long-term goals for onshore and offshore drilling. The thematic working groups were asked to answer 3 questions:

a) What are the scientific questions, objectives, and targets for drilling?

- b) What data exist and what data are needed before drilling?
- c) Create a timeline for the stages leading up to a full proposal and identify participants, if possible.

The thematic working group reports (made available to all participants) are long and detailed regarding a) and b), and therefore, we highlight only the timelines established for the onshore and offshore projects.

### **Onshore project timeline**

- i. Report outcome of workshop to Haitian scientists
- ii. Build database with available (meta)data
- ii. Determine research interests of Haitian scientists. To ensure the success of this project, it would be critical to budget for training young Haitian scientists with sedimentology, ideally through the funding of one or more PhD students, co-advised between the State University of Haiti and other institutions.
- iii. Enlarge science team:
  - a. Identify key scientific participants from Haiti
  - b. Reach out to core specialists and let them look at the cores, send them samples for initial analyses
  - c. Solicit interest in the existing data sets (fluids, seismic, cores, etc.)
  - d. Are there Haitian students for projects and analyzing existing data?
  - e. Listservs and direct email list from CSDCO / LacCore would provide a great resource for advertising the Haiti-Drill project and enlist other scientists: use for announcements!
- iv. Publish existing data/results
- v. Conduct additional research and publish it
  - a. Apply for funds (if needed)
  - b. Conduct local projects that involve Haitian community (fluid samples, gravity, raspberry shake/ IRIS nodal array, geological mapping)
- vi. Submit a proposal for ICDP workshop, invite the broader team
- vii. Pre-proposal and/or full drilling proposal

### **Offshore project timeline**

The ideal scenario would be to write a pre-proposal for September 2019, and based on the feedback received from the IODP SEP, in early 2020, develop the full proposal within the year that follows. This scenario would potentially allow the drilling to take place before the JR might be off to the Pacific in 2022/23, and its eventual replacement by another drill ship, currently under discussion.

However, there is considerable uncertainty in the schedule of the JR, and several proposals in the

Mediterranean Sea and the Atlantic may keep the JR in the Atlantic until early 2024.

On the other hand, it may not be realistic to develop a credible pre-proposal, given the amount of preparation needed, the exploitation of existing data, and the need for additional site survey data.

The immediate priority of the team is to resubmit the Haiti-Limits cruise by the end of September 2019, which aims to better understand the crustal structure around the fault zones and provide side-survey information for the future drilling targets.

## 5. Future plans

For data sharing, we will use the osf.io website which is a free, openly accessible website for sharing data for specific projects.

It is necessary to work and communicate with the research/scientific/community outreach needs with Haitian scientists and students starting now. Small projects are a good solution to bring more participation for Haitian students that could be coupled with short courses at the university. Co-advised graduate students could be shared among universities in UK/France and Haiti.

There is a need to publish existing results/data, further investigate existing data, and also conduct more scientific surveys both onshore and offshore prior to submitting a full proposal(s). It may be necessary to advertise the existing data and research needed to further develop the project. If small projects are developed and completed in the coming years are successful, then a full proposal(s) could be submitted in the long-term (< 10 years). The immediate priority of the offshore team is to resubmit the Haiti-Limits cruise by the end of September 2019 for a deep crustal survey offshore Haiti. It is still undecided if an amphibious drilling project is possible. The possibility to have an amphibious proposal will become more clear as onshore and offshore projects develop in time.

Chastity AIKEN (current IODP/ICDP leader of the Haiti-Drill project) will continue to check in with participants of both projects every 6 months or so to continue engagement in the development of a full proposal(s).

## 6. List of participants

Early Career	Name	Continental or oceanic interest?	Email
	Louis Geli	oceanic	<a href="mailto:louis.geli@ifremer.fr">louis.geli@ifremer.fr</a>
	Livio Ruffine	oceanic	<a href="mailto:livio.ruffine@ifremer.fr">livio.ruffine@ifremer.fr</a>
	Mikael Evain	oceanic	<a href="mailto:mikael.evain@ifremer.fr">mikael.evain@ifremer.fr</a>
X	Andreina Garcia-Reyes	oceanic	<a href="mailto:agarcia@ipgp.fr">agarcia@ipgp.fr</a>
	Jacques Deverchere	oceanic	<a href="mailto:jacdev@univ-brest.fr">jacdev@univ-brest.fr</a>
	Marianne Conin	oceanic	<a href="mailto:marianne.conin@univ-lorraine.fr">marianne.conin@univ-lorraine.fr</a>
	Milene Cormier	continental	<a href="mailto:milenecormier2@gmail.com">milenecormier2@gmail.com</a>

	Anders Noren	continental	noren021@umn.edu
X	Richard Wessels	continental	rjfwessels@gmail.com
X	Chastity Aiken	continental/oceanic	chastity.aiken@ifremer.fr
	Frauke Klingelhoef	continental/oceanic	frauke.klingelhoef@ifremer.fr
	Walter Roest	continental/oceanic	walter.roest@ifremer.fr
	Julie Perrot	oceanic	jperrot@univ-brest.fr
	Frederique Rolandone	oceanic	frederique.rolandone@upmc.fr
	Sanny Saito	oceanic	saito@jamstec.go.jp
	Boris Marcaillou	oceanic	boris.marcaillou@geoazur.unice.fr
	Jeffrey Poort	oceanic	jeffrey.poort@upmc.fr
	Sylvie Leroy	oceanic	sylvie.leroy@upmc.fr
	Nicolas Bellahsen	continental/oceanic	nicolas.bellahsen@sorbonne-universite.fr
	Eric Calais	continental/oceanic	eric.calais@ens.fr
	Bernard Mercier de Lepinay	oceanic	bmercier@geoazur.unice.fr
	Elena Spagnuolo	continental/oceanic	elena.spagnuolo@ingv.it
	Pierre Henry	oceanic	henry@cerege.fr
	Marc-Andre Gutscher	oceanic	gutscher@univ-brest.fr
	Antonio Cattaneo	continental/oceanic	antonio.cattaneo@ifremer.fr
	Stéphanie Dupré	oceanic	stephanie.dupre@ifremer.fr
	Anne Battani	continental/oceanic	anne.battani@glasgow.ac.uk
	Jose-Luis Granja-Bruna	oceanic	jlganja@ucm.es
	Paola Vannucchi	oceanic	paola.vannucchi@rhul.ac.uk
	Vincent Maury	continental	vincent.maury2@wanadoo.fr
X	Jordane Corbeau	continental/oceanic	corbeau@ipgp.fr
	Martin Patriat	oceanic	martin.patriat@ifremer.fr
	Stéphanie Cuvén	--	stephanie.cuven@get.omp.eu
	Adélie Delacour	--	adelie.delacour@univ-st-etienne.fr