Final Report

USSSP Workshop "Gulf of Papua Drilling"

Biosphere 2 Oracle AZ

March 14-17, 2023

Convenors: Yair Rosenthal, Larry Peterson, Samantha Bova

Participants of the GoP meeting

PARTICIPANTS

last Name	first name	Institute	Country	rank	Interests
USA					
Aiello	Ivano	Moss Landing	USA	Professor	sedimentology
Bentley	Samuel	LSU	USA	Professor	sedimentology
Berke	Melissa	U Notre Dame	USA	associate prof	climate / biomarkers
Bova	*Samantha*	*SDSU*	*USA*	*assistant prof*	*paleoclimatology*
Bührig	Laura	Texas Tech U.	*USA*	Researcher	sedimentology
Clementi	*Vincent*	*Rutgers*	*USA*	*postdoc*	*diagenesis*
Clift	Peter	LSU	USA	Professor	isotope geology
Droxler	Andre	Rice	USA	professor	marine geology
Du	*Xiaojing*	*Brown*	*USA*	*postdoc*	*paleoclimatology*
Harper	Brandon	private sector	USA	consultant	sedimentology
Hashim	*Mohammed*	*WHOI*	*USA*	*postdoc*	*diagenesis*

Hatfield	*Rob*	*U Florida*	*USA*	*assistant prof*	*paleomagnetism*
Kimble	*Kristin*	*Brown*	*USA*	*PhD student*	*climate*
Li	*Gen*	*UCSB*	*USA*	*assistant prof*	*weathering and climate*
Liu	*Xiaoqing*	*Purdue*	*USA*	*Postdoc*	*paleoclimatology*
Macdonald	Francis	UCSB	USA	Professor	geology
Pavloudi	*Christina*	*George Washington*	*USA*	*postdoc*	*geomicrobiology*
Peterson	Larry	U Miami	USA	professor	paleoceanography
Rahman	*Shaily*	*U Colorado*	*USA*	*assistant prof*	*diagenesis*
Rosenthal	Yair	Rutgers	USA	professor	paleoceanography
Si	*Weimin*	*Brown*	*USA*	*postdoc*	*weathering and climate*
Thiramulai	*Kaustubh*	*U Arizona*	*USA*	*assistant prof*	*paleoclimatology y*
Vetter	*Lael*	*U Arizona*	*USA*	*Research prof*	*paleoclimatology*
International					
Beaufort	Luc	CEREGE	France	professor	paleoclimatology
Gally	Albert	Université de Lorraine	France	professor	geochemistry
Lo	Li	NTU	Taiwan	assistant prof	paleoclimatology
Petrick	Benjamin	Kiel Univ	Germany	postdoc	paleoclimatology
Tachikawa	Kazuyo	CEREGE	France	researcher	paleoceanography
Online					
Bayon	Germain	IFRAMER	France	researcher	geochemistry
Webster	Jody	U. Sydney	Australia	Prof	Coral reefs
Dickens	Gerald	Trinity College	Ireland	professor	marine geology
Jorry	Stephan	IFRAMER	France	researcher	marine geology

**Italics mark ECR participants*

WORKSHOP OBJECTIVES

This workshop aimed to promote IODP research opportunities in the Gulf of Papua (GoP; Fig. 1), which to date, has not been explored by scientific ocean drilling programs. The Gulf of Papua, located off the southeastern margin of Papua New Guinea (PNG) on the southeaster side of the Western Pacific Warm Pool (WPWP), is uniquely situated to address key questions related to the evolution of Cenozoic climate including:

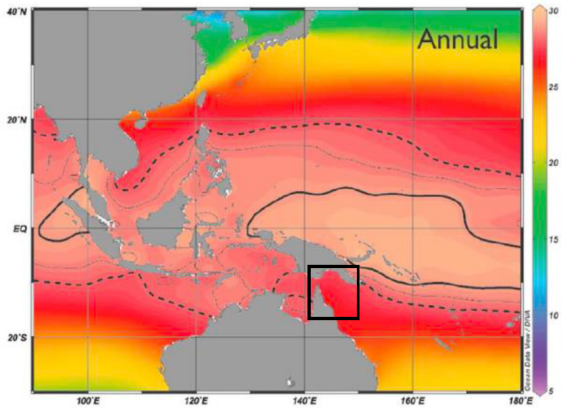

Figure 1: Sea Surface temperature map of the Western Pacific Warm Pool showing the general location of the GoP

- Reconstruction of hydroclimate variability at the southeastern edge of the IPWP
- Source-to-sink studies to improve our understanding of the uplift of the Papuan fold belt and implications for climate
- Organic matter burial and diagenesis in a mixed sedimentary system
- Study of Miocene age large drowned carbonate platforms in the Pandora Trough and timing of the Ashmore and Eastern Fields Atoll formation

AGENDA

Tuesday March 14, 2023

Ice breaker

Wednesday March 15, 2023

Morning talks: Defining the goals of the meeting (Yair Rosenthal); Geological history of the Gulf of Papua (Andre Droxler); Source to sink: late Pleistocene to Holocene sediments delivery (Samuel Bentley); Source-to-sink deposition: the organic carbon component, with changes in supply and spatial deposition (Gerald Dickens); Bundled carbonate and siliciclastic turbidite deposition in the central Pandora Trough (Gulf of Papua): Linking sediment nature and accumulation to sea level fluctuations at millennial timescale (Stephen Jorry (Remote talk); Exhumation history of New Guinea (Francis Macdonald); -

Tour of Biosphere 2 with Dr Joost van Haren

Afternoon talks: paleoclimate studies in the Gulf of Papua and Western Pacific Warm Pool (Luc Beaufort/ Kazuyo Tachikawa); Glacial-deglacial record in the Gulf of Papua (Brandon Harper); Tips for preparing successful IODP proposal (Yair Rosenthal)

Discussion of potential proposals and the formation of groups of shared interests

Evening: Posters session

Thursday March 16, 2023

Morning talks: A synthesis of monsoon expeditions in Asian marginal seas (Peter Clift); Results from IODP Expedition 363 (Samantha Bova)

Split sessions: Formed working groups to discussed three proposal themes and developing goals and strategies for potential drilling proposals:

Theme 1: Drilling the shelf and deep basin. source-to-sink

Theme 2: Drilling the deep basin: Paleoclimate records from the GoP

Theme 3: Ocean health - coral reefs in a world of rising temperature, acidification, and sea level

Afternoon talks: discussion of potential proposal in breakout groups

Evening talks:

Larry Krissek (Remote talk): report from JRFB

Kevin Johnson (Remote talk): NSF report

Friday March 17, 2022

Write a preliminary summary of the proposal including hypotheses, objectives and proposed coring or drilling sites as part of the workshop report

Open discussion of ECRs issues with IODP proposals and expeditions

Saturday March 18, 2022 - OPTIONAL

Field trip to Mt. Lemmon guided by Profs. George Gehrels and Peter DeCelles from U. Arizona

WORKSHOP OUTCOME

We developed the seeds to three projects that can be accomplished by two expedition, one MSP to drill on the shelf, and the second for deep sea drilling.

Theme 1: Source-to-Sink. Drilling the shelf and deep basin to constrain sediment and chemical fluxes from PNG to GoP.

Proponents: Ivano Aiello, Samuel Bentley,Peter Clift, Vincent Clementi, Albert Galy, Gen Li Francis MacDonald, Shaily Rahman Yair Rosenthal, Weimin Si

In this theme we have sought to constrain the net impact of PNG orogeny on atmospheric CO_2 sequestration by implementing a comprehensive scientific ocean drilling campaign in the Gulf of Papua (to test the hypothesis that chemical weathering of PNG was a major global CO_2 sink in the past. This will be done by obtaining an accurate sediment and ion budgets using cores in the GoP, which can offer an estimate on the efficiency of Enhanced Chemical Weathering (ECW) for reducing atmospheric pCO_2 past and future. In addition, the possibility of developing land2Sea program whereby the marine archives will be linked to records from PNG has been briefly discussed.

Theme 2: Paleoclimate - A view of warming ocean from the Gulf of Papua on the southern side of the Western Pacific Warm Pool (WPWP)

Proponents: Luc Beaufort, Melissa Berke, Samantha Bova, Xiaojing Du, Rob Hatfield, Kristin Kimble, Li Lo, Xiaoqing Liu, Larry Peterson, Kazuyo Tachikawa, Thirumalai, Lael Vetter

The GoP receives large amounts of sediment from Papua New Guinea, which coupled with excellent biogenic carbonate preservation permits high resolution paleoceanographic and paleoclimatic reconstructions of WPWP dynamics on sub-orbital to secular timescales. Drilling in the GoP will offer the opportunity to address a few major hypotheses including:

1: Warm pool dynamics and energetics (volume + temperature, heat content) are more variable under high-CO_2 worlds.

2: Global changes drive hydroclimate reorganization in the core of the deep tropics.

3: Reduced seasonality in deep tropics persisted across geological warm world climates.

4: Fluctuations in warm pool size and intensity altered tropical-extratropical heat transport.

Theme 3: Ocean health - coral reefs in a world of rising temperature, acidification, and sea level

Proponents: Mohammed Hashim, Laura Bührig, André Droxler, Brandon Harper, Stéphan Jorry, Benjamin Petrick, Christina Pavloudi, Jody Webster

The Gulf of Papua is a unique setting located at the northern part of the Coral Sea, at the northern extremity of the Great Barrier Reef. Multiple coral reefs in a variety of environments exist within the Gulf of Papua, with probably more than 500 species of stony corals. Research has shown that in the past, numerous reefs existed at different geological time periods, thrived and then drowned in the GoP; many of these intervals were associated with temperatures and CO_2 levels that were similar or higher than today, such as the mid Miocene, the mid Pliocene and Pleistocene MIS-11. Seismic data show that many of these coral reef sites are easily accessible through ocean drilling, yet, they have not been drilled before. Hence, the GoP constitutes a unique opportunity to study climate effect (e.g., temperature and acidification) on coral reefs and what causes them to thrive and die in warmer periods. Theme 3 is directly linked to, and will benefit from knowledge obtained in Theme 2.

The three proposed themes align with the IODP Strategic Objectives in the 2050 Science Framework, including Objective 3 (Earth's Climate System), Objective 4 (Feedbacks in the Earth's System), as well as Flagship Initiatives 1 (Ground Truthing Future Climate Change) and 4 (Diagnosing Ocean Health) and possibly the development of Land2Sea program. To advance these ideas, each group wrote a letter of intent, presenting the hypotheses and objectives for each of the themes. Also, we have identified target areas for drilling, which can be accomplished using two drilling campaigns, one on the shelf and the other in the deep basins.

SUMMARY

This workshop has achieved its objectives. First, the workshop has brought together a diverse group of experts with regional experience and interests who identified several key themes and objectives that could be potentially addressed using existing and hoped for future platforms. Despite the fact that we have been informed, a couple of days before the workshop, of the immanent termination of the IODP program and the availability of the *D/V Joides Resolution* for deep sea drilling, we have decided to continue with the original goals of the workshop and developed ideas for 3 research themes as discussed above. These themes can be pursued with alternative platforms and are currently in the initial stages of proposal preparation. The workshop has offered a great opportunity for senior scientists to convey their knowledge to the many early career participants, which is critical for this part of the world, which helps some of the ECRs who are now preparing drilling proposal based on the workshop themes.

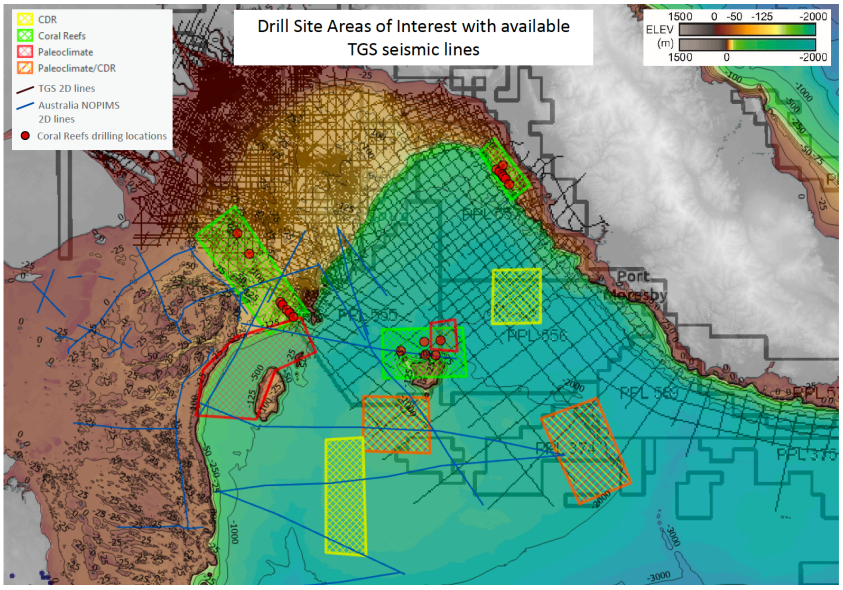

Figure 2: Proposed drill areas on the shelf and in the deep basins

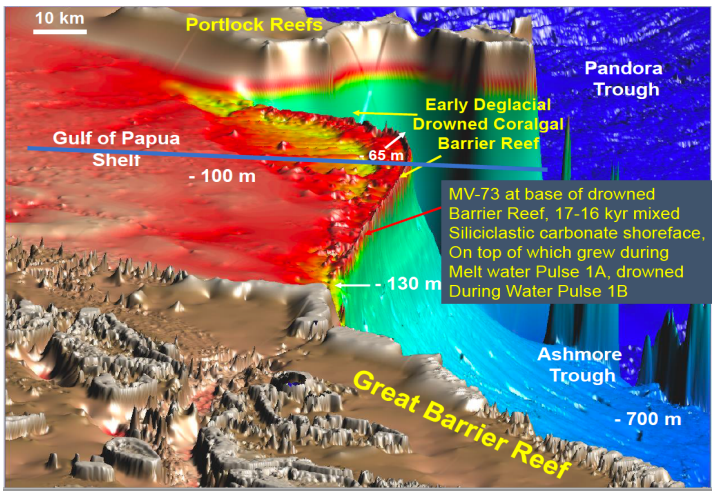

Figure 3: Top- NW shelf platform with a line marking the seismic section of drawn reefs shown in the bottom panels. Potential sites are shown with red vertical lines. Drilling this section would support addressing Themes 1&3.

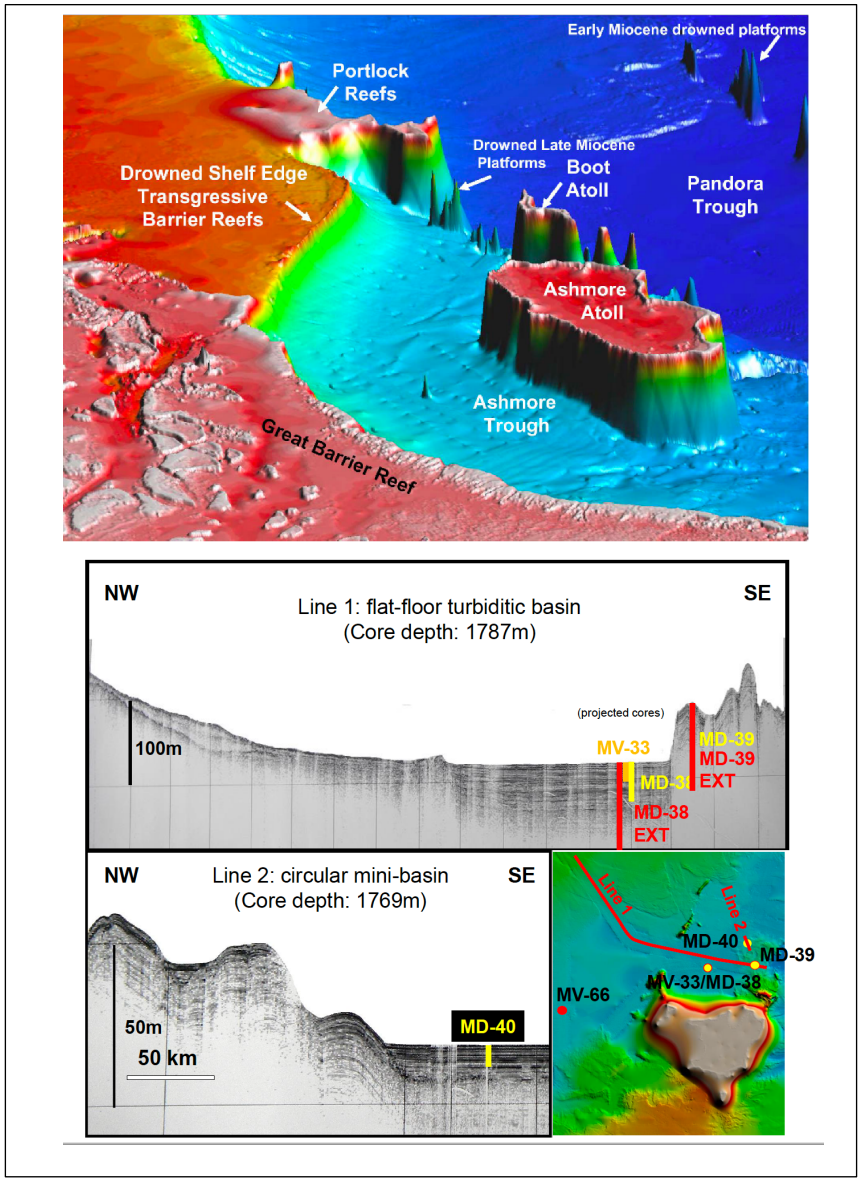

Figure 4: Top- NE shelf platform with; Bottom- NW-SE seismic section along the Pandora Trough north of the Ashmore Atoll. Potential sites are shown with red vertical lines. Drilling this section would support addressing Themes 1&3.