

# **COMRA activity about Polymetallic sulfide Areas in Mid-ocean Ridge of Indian Ocean and Atlantic Ocean**

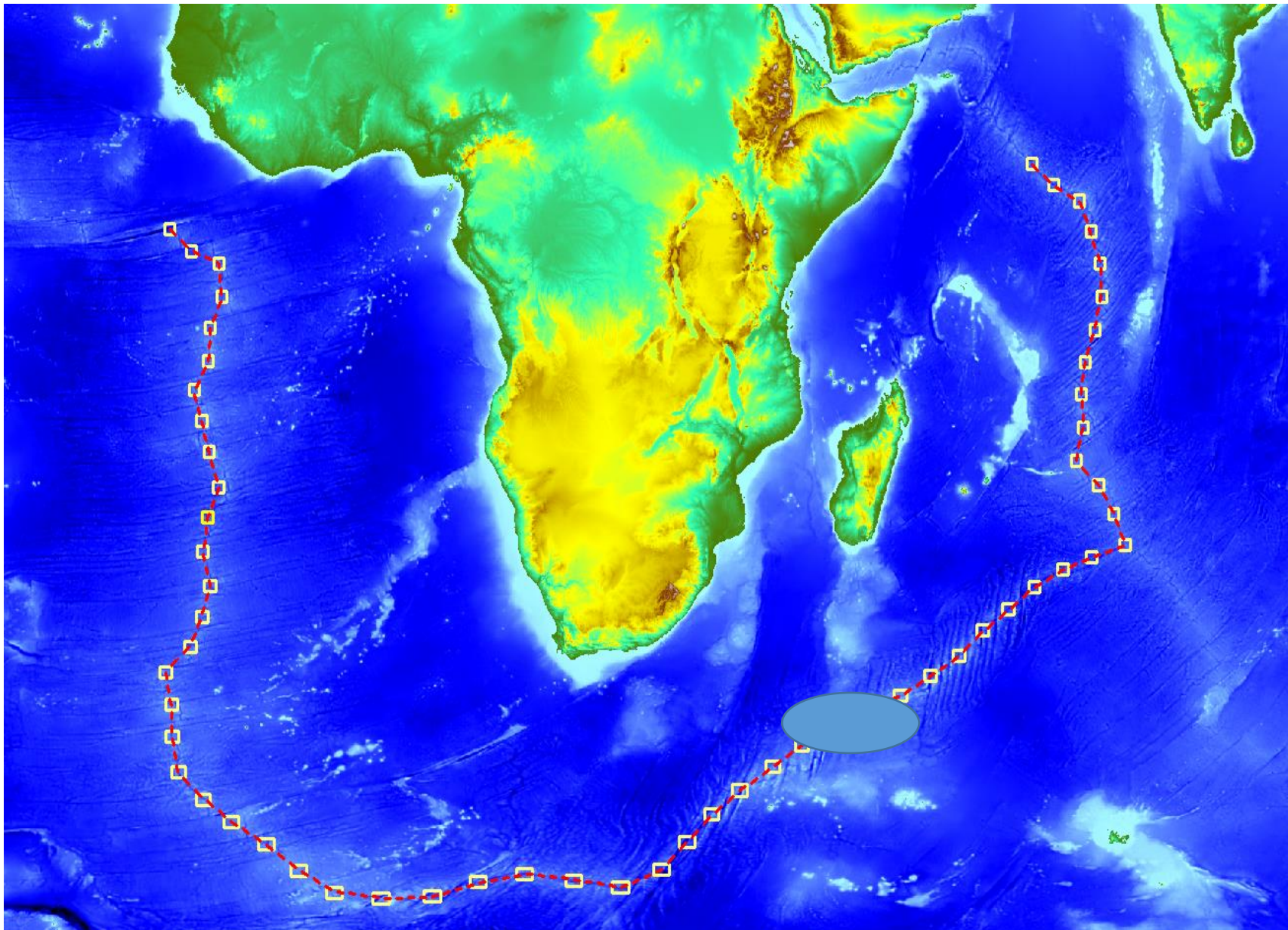
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**Dr. Chengbin Song**

**China Ocean Mineral Resource Research & Development Association (COMRA)**

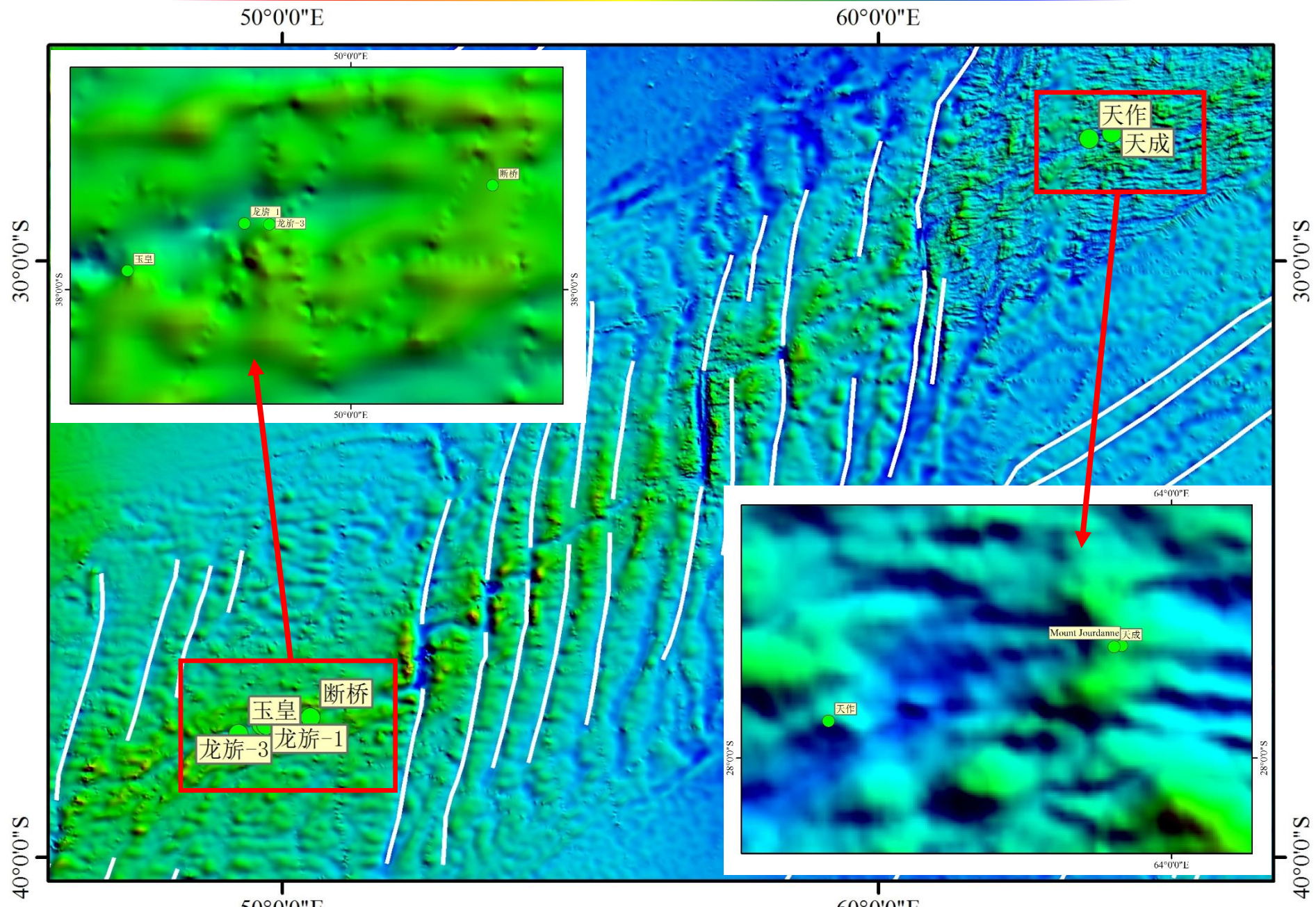
**Beijing, China**

# COMRA's current areas of interest





# Hydrothermal Activity along the SWIR



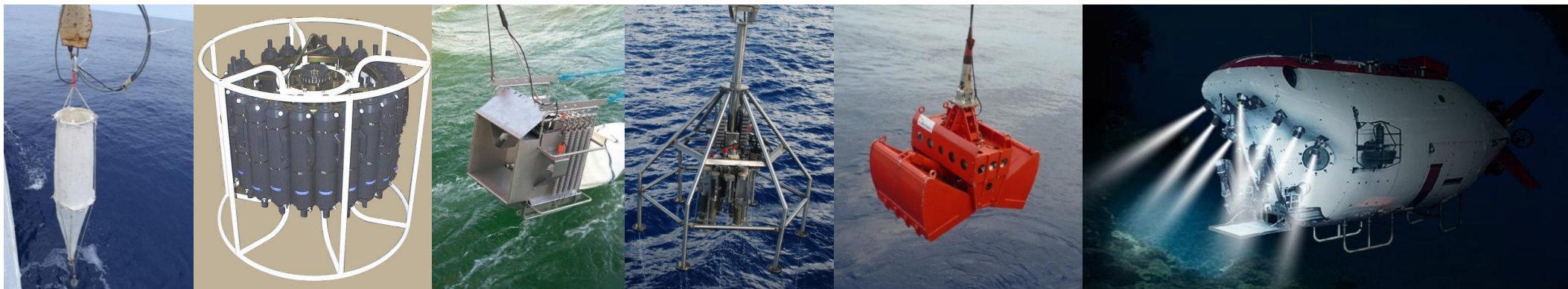
# Biological baseline

## Biological sampling on SWIR 2013 – 2018

Elements	No. of stations	Tools
Chl <i>a</i>	40	CTD
Phytoplankton	16	CTD/WP2
Zooplankton	15	WP2/Bioness/Multinet
Microbenthos	8	Multicore
Macrobenthos	22	TV Grab
Megabenthos	50	HOV <i>Jiaolong</i> /ROV Hailong II/ TV Grab

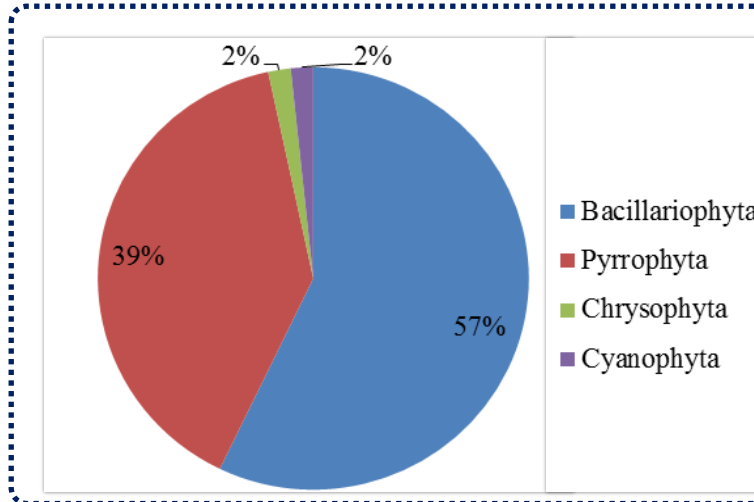
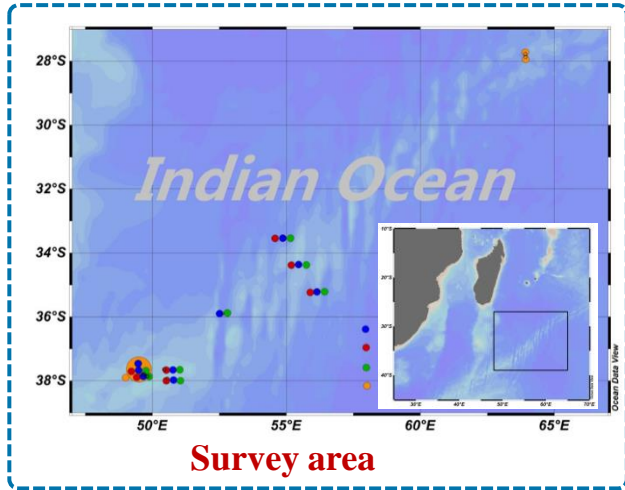
## Biological sampling on NWIR 2013 – 2017

Elements	No. of stations	Tools
Chl <i>a</i>	4	CTD
Phytoplankton	3	CTD/WP2
Zooplankton	13	WP2/Multinet
Microbenthos	3	Multicore
Macrobenthos		TV Grab
Megabenthos	17	HOV <i>Jiaolong</i> /ROV Hailong II/ TV Grab



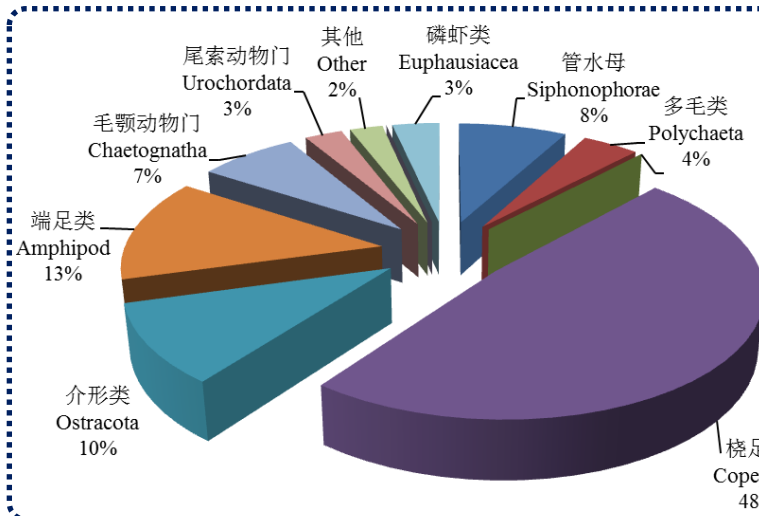


# Biological baseline – Organisms in water column of SWIR



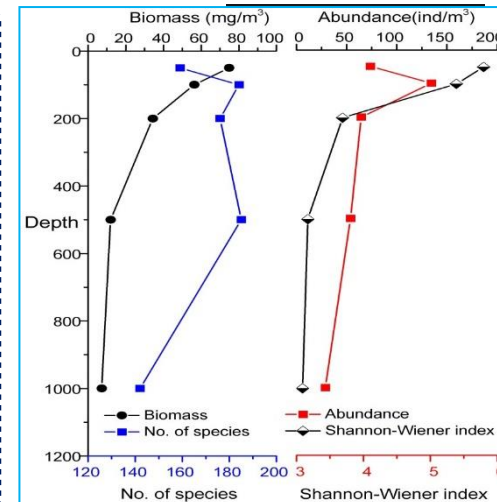
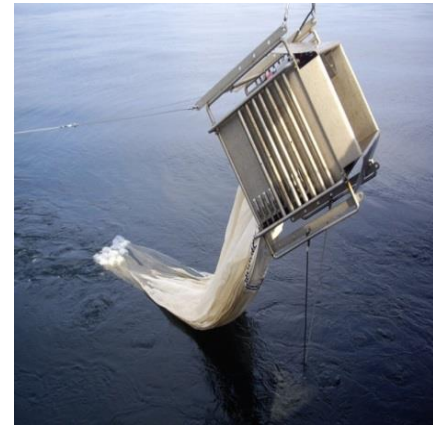
## Phytoplankton

- 119 species
- Bacillariophyta : 68
- Pyrrophyta : 47
- Chrysophyta: 2
- Cyanophyta: 2

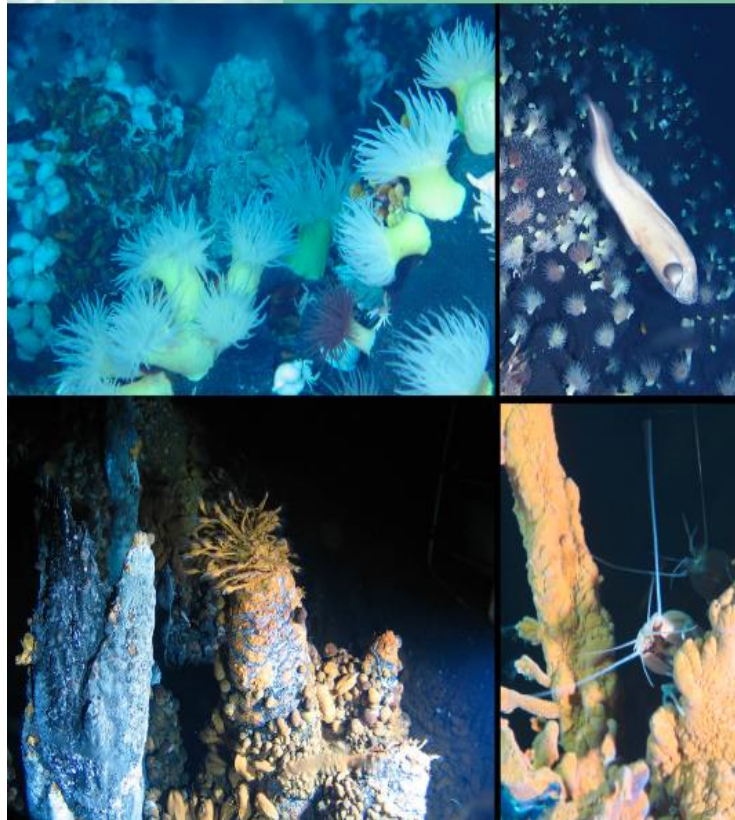


## Zooplankton

- 290 species
- Copepod: 140
- Amphipod: 39
- Ostracoda: 30
- Siphonohore: 23
- Chaetognatha: 21



# Biological baseline – Benthos at three vent fields of SWIR



Characterization of vent fauna at three hydrothermal vent fields on the Southwest Indian Ridge: Implications for biogeography and interannual dynamics on ultraslow-spreading ridges

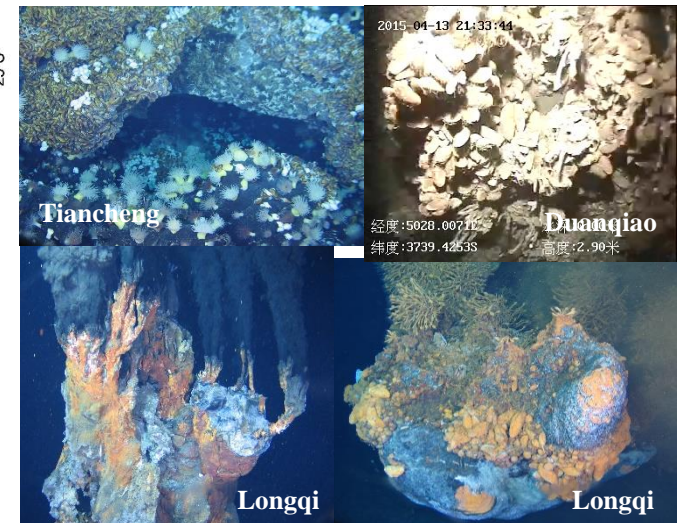
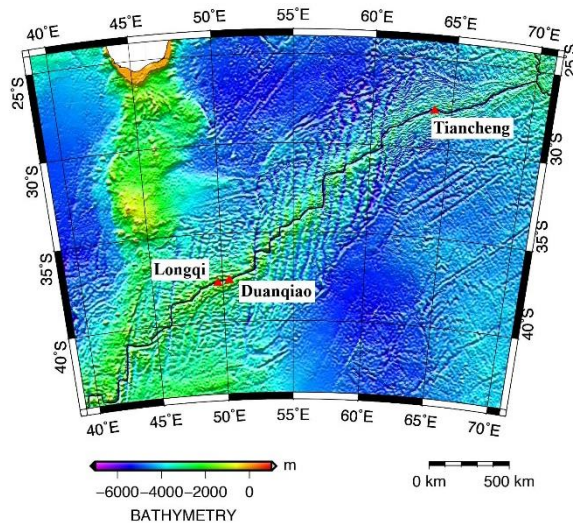
Yadong Zhou<sup>a</sup>, Dongsheng Zhang<sup>a</sup>, Ruiyan Zhang<sup>a</sup>, Zhensheng Liu<sup>a</sup>, Chunhui Tao<sup>b</sup>, Bo Lu<sup>a</sup>, Dong Sun<sup>a</sup>, Peng Xu<sup>a</sup>, Rongcheng Lin<sup>c</sup>, Jianjia Wang<sup>c</sup>, Chunsheng Wang<sup>a,d,\*</sup>

<sup>a</sup> Key Laboratory of Marine Ecosystem and Biogeochemistry, Second Institute of Oceanography, State Oceanic Administration, Hangzhou 310012, China

<sup>b</sup> Key Laboratory of Submarine Geosciences, Second Institute of Oceanography, State Oceanic Administration, Hangzhou 310012, China

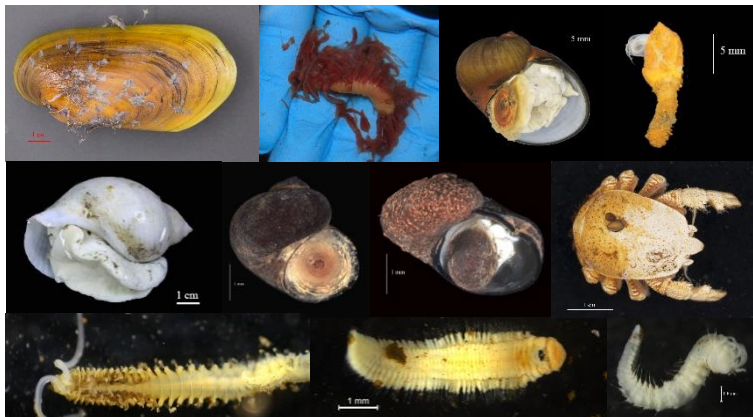
<sup>c</sup> Laboratory of Marine Biology and Ecology, Third Institute of Oceanography, State Oceanic Administration, Xiamen 361005, China

<sup>d</sup> State Key Laboratory of Satellite Ocean Environment Dynamics, Second Institute of Oceanography, State Oceanic Administration, Hangzhou 310012, China





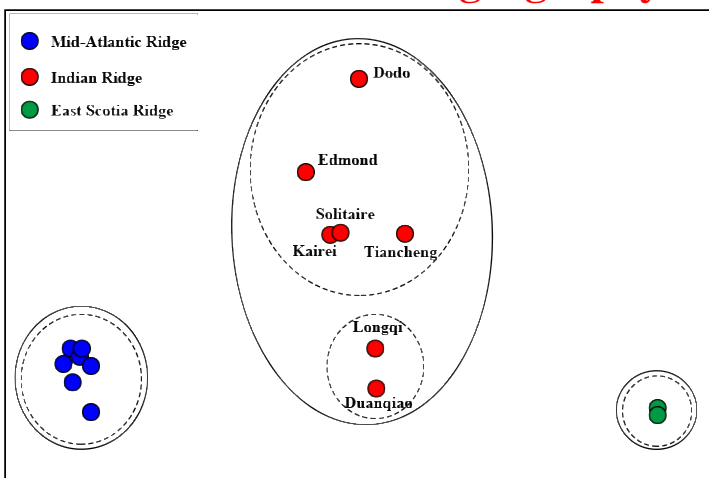
# Biological baseline – Biogeography, spatial & temporal variations



## Vent Fauna

- 39 species in total ;
- Longqi 31 species
- Duanqiao 13 species
- Tiancheng 11 species
- ~50% undescribed;
- 10 species may be endemic to SWIR;

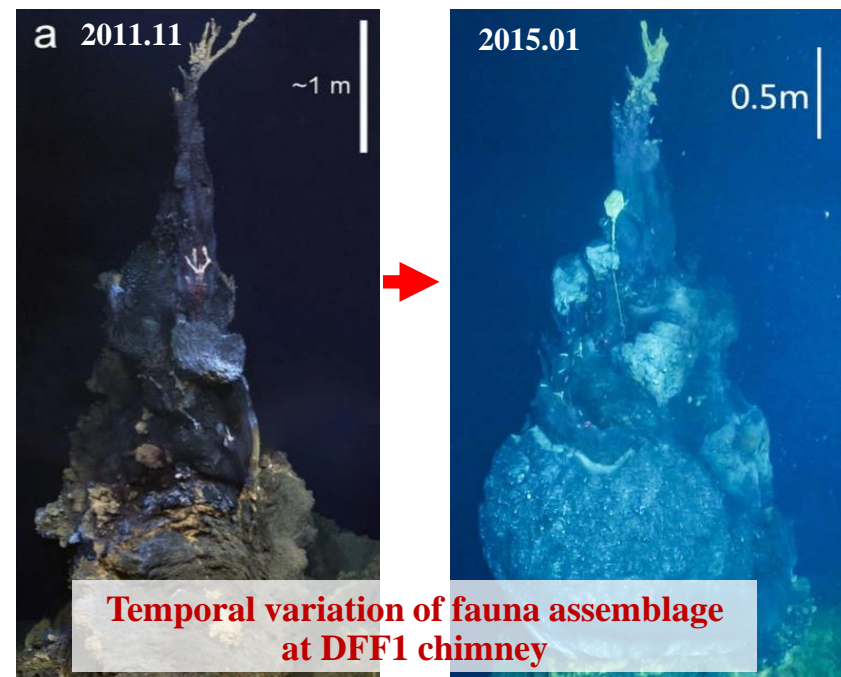
## Biogeography



nMDS plot of inter-field similarities on CIR, SWIR, ESR and MAR at species level

- High variation in Indian Ocean;
- SWIR communities divided into 2 clusters;
- SWIR communities placed between CIR, MAR and ESR

## Interannual dynamics

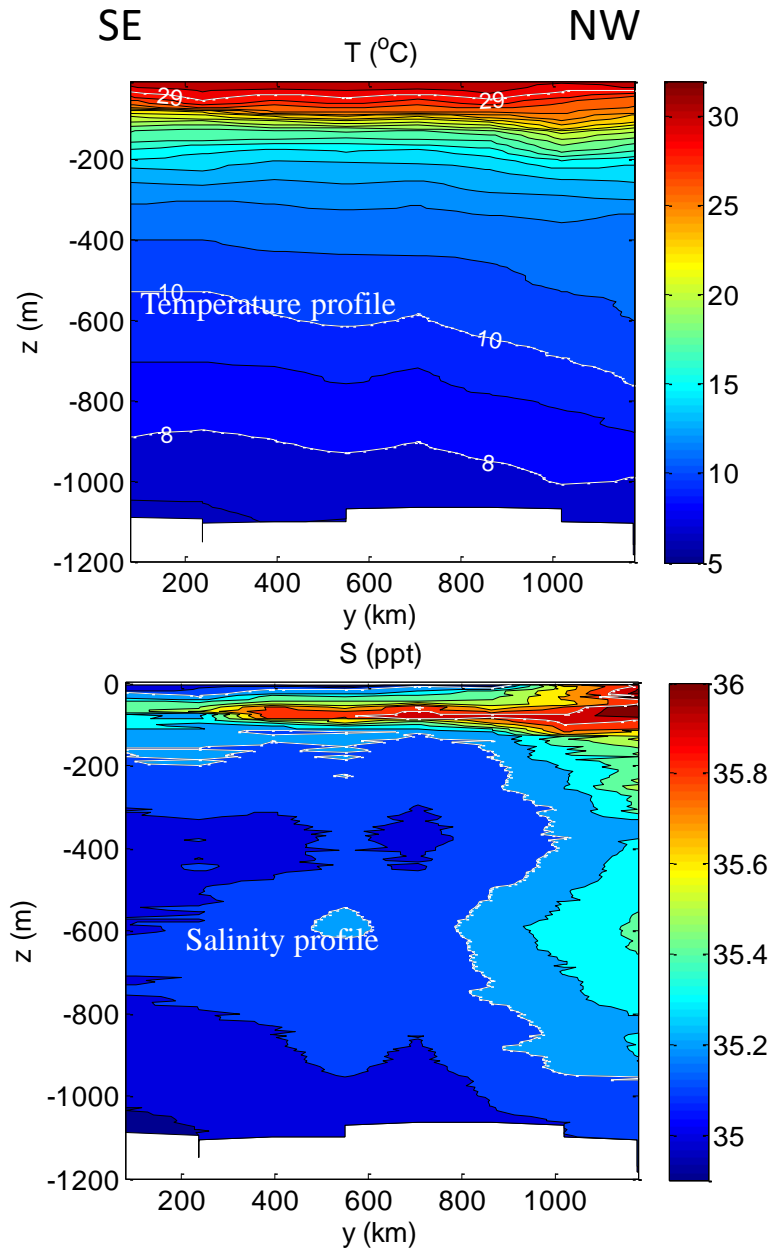


Temporal variation of fauna assemblage at DFF1 chimney

<i>Rimicaris kairei</i>	++	++
<i>Lepetodrilus n. sp.</i>	+++	++
<i>Chrysomallon squamiferum</i>	+++	+++
<i>Mirocaris indica</i>	++	+
<i>Kiwa n. sp.</i>	+	
<i>Gigantopelta aegis</i>	+	++
<i>Bathymodiolus marisindicus</i>		+++
<i>Neolepas sp.</i>		++
<i>Dracogyra subfuscus</i>		+++
<i>Lirapex politus</i>		++

# Hydrology of NW Indian Ocean

Stations



- The intermediated water mass in the NW part is warmer than that in the SE part.
- The influence of the high saline water from the Red Sea can be detected at even in 2° N.





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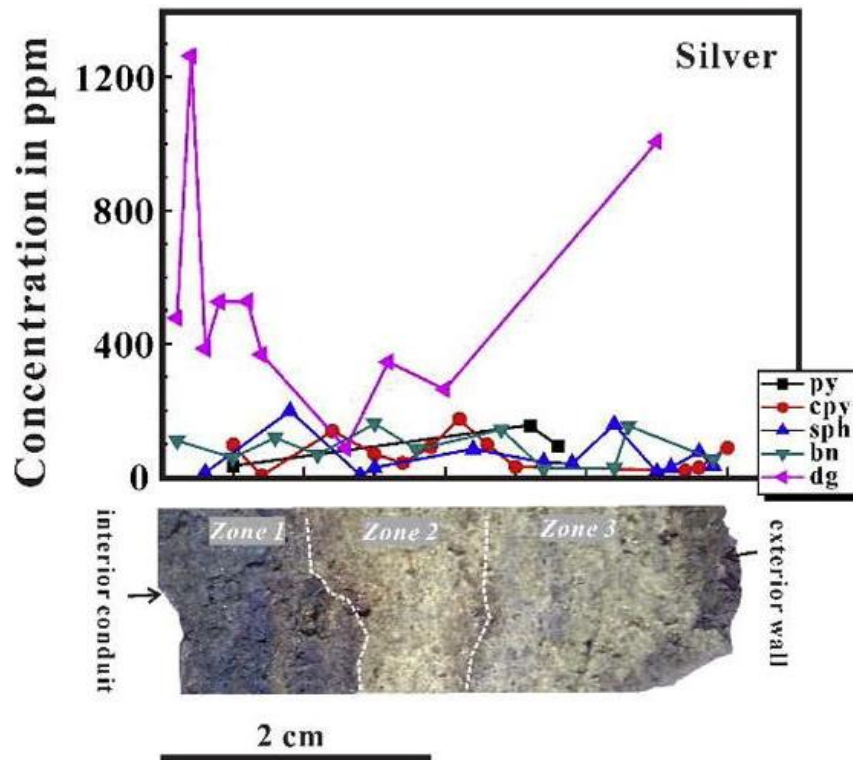
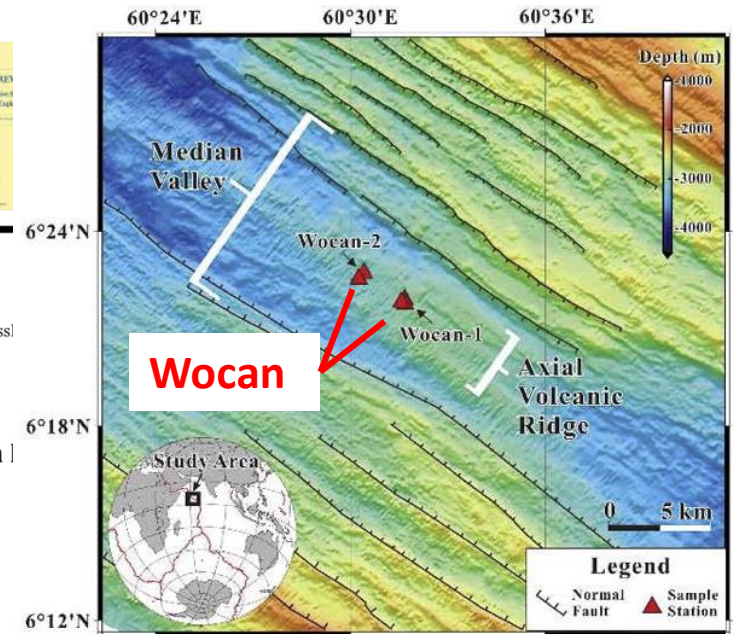
## Mineralogy and trace element geochemistry of sulfide minerals from the Wocan Hydrothermal Field on the slow-spreading Carlsberg Ridge, Indian Ocean

Yejian Wang<sup>a</sup>, Xiqu Han<sup>a,\*</sup>, Sven Petersen<sup>b</sup>, Matthias Frische<sup>b</sup>, Zhongyan Qiu<sup>a</sup>, Huaiming Li<sup>a</sup>, Honglin Zhaocai Wu<sup>a</sup>, Ruyong Cui<sup>c</sup>

<sup>a</sup> Key Laboratory of Submarine Geosciences & Second Institute of Oceanography, State Oceanic Administration, Hangzhou 310012, China

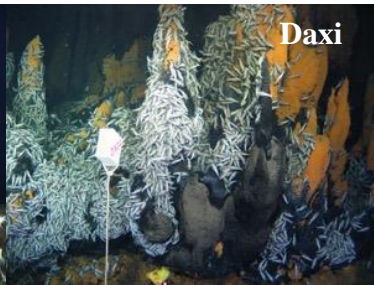
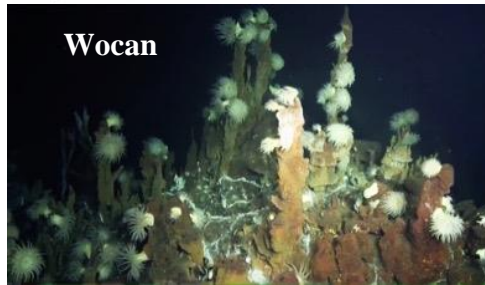
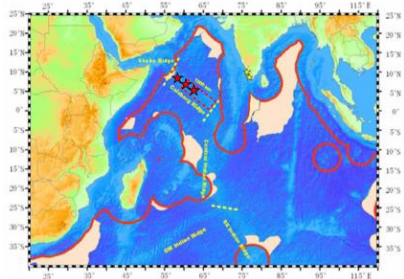
<sup>b</sup> GEOMAR, Helmholtz Centre for Ocean Research Kiel, 24148 Kiel, Germany

<sup>c</sup> Qingdao Institute of Marine Geology, Qingdao 266071, China

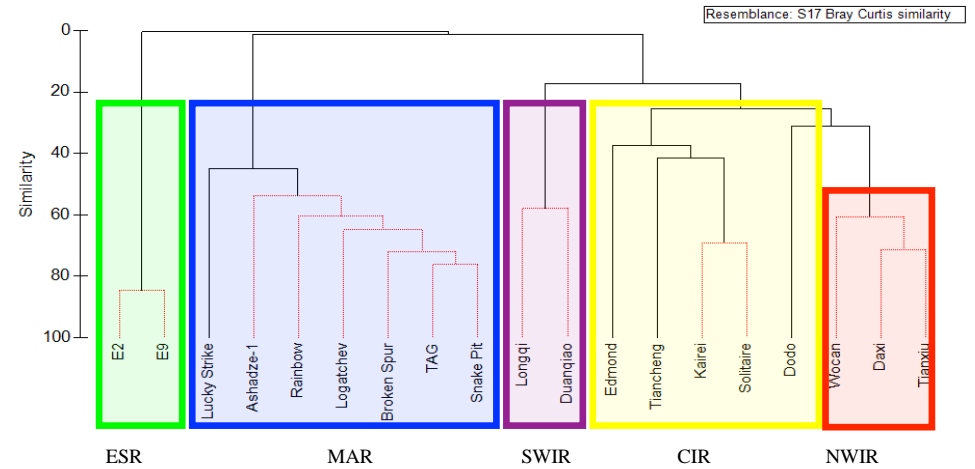


- First present seafloor hydrothermal mineralization processes on the slow-spreading Carlsberg Ridge.
- The Cu-rich chimneys were formed at slightly lower temperatures than Cu-rich and Fe-rich massive sulfides.
- The main Ag-carriers were both late-stage Cu sulfides and Fe sulfides.
- Mixing of hydrothermal fluids with seawater might result in significant redistributions of trace elements.

# Biological baseline – Benthos at three vent fields of NWIR

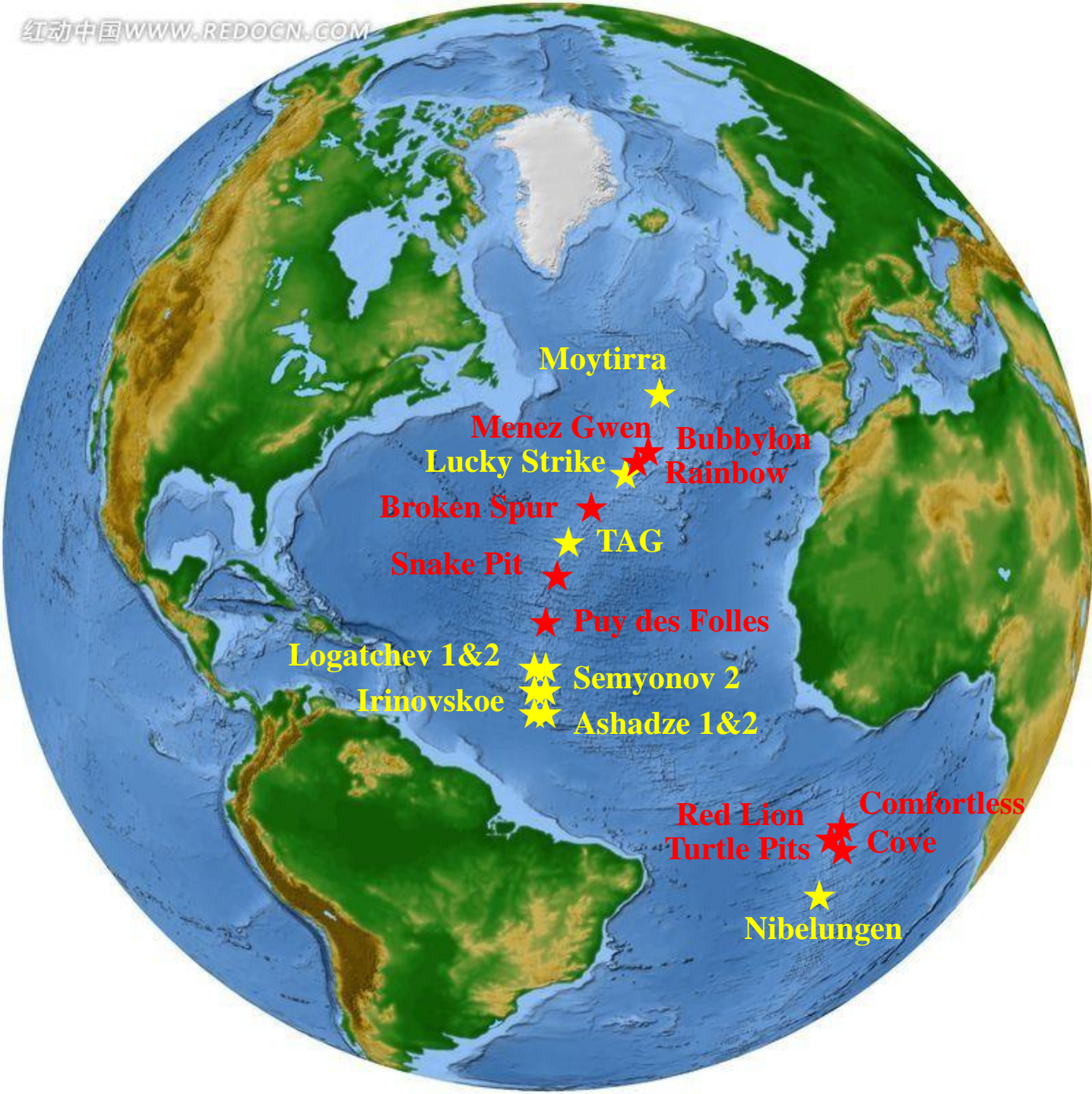


- ~ 20 species were identified from three vent fields at NWIR;
- Tube worms *Paralvinella* sp. are common at both NWIR and CIR;
- Dominant species: *Rimicaris kairei* and *Alviniconcha* sp.
- NWIR has highest similarity with CIR.



Phylum	Family	Species	Daxi	Wocan	Tianxiu	
Cnidaria	Actinostolidae	Actinostolidae sp.	++	++	++	
		Small sea anemone		++	++	
Annelida	Polynoidae	<i>Branchipolynoe longqiensis</i>		+		
		Polynoidae sp.	+	+	+	
		<i>Hesiolyra</i> sp.		+		
		Ampharetidae	<i>Amphisamytha</i> sp.		+	
		Amphinomidae	<i>Archinome</i> sp.		+	
		Alvinellidae	<i>Paralvinella</i> sp.	+	+	
	Mollusca	Neolepetopsidae	<i>Eulepetopsis</i> sp.		+	
Provannidae		<i>Alviniconcha</i> sp.		+	+	

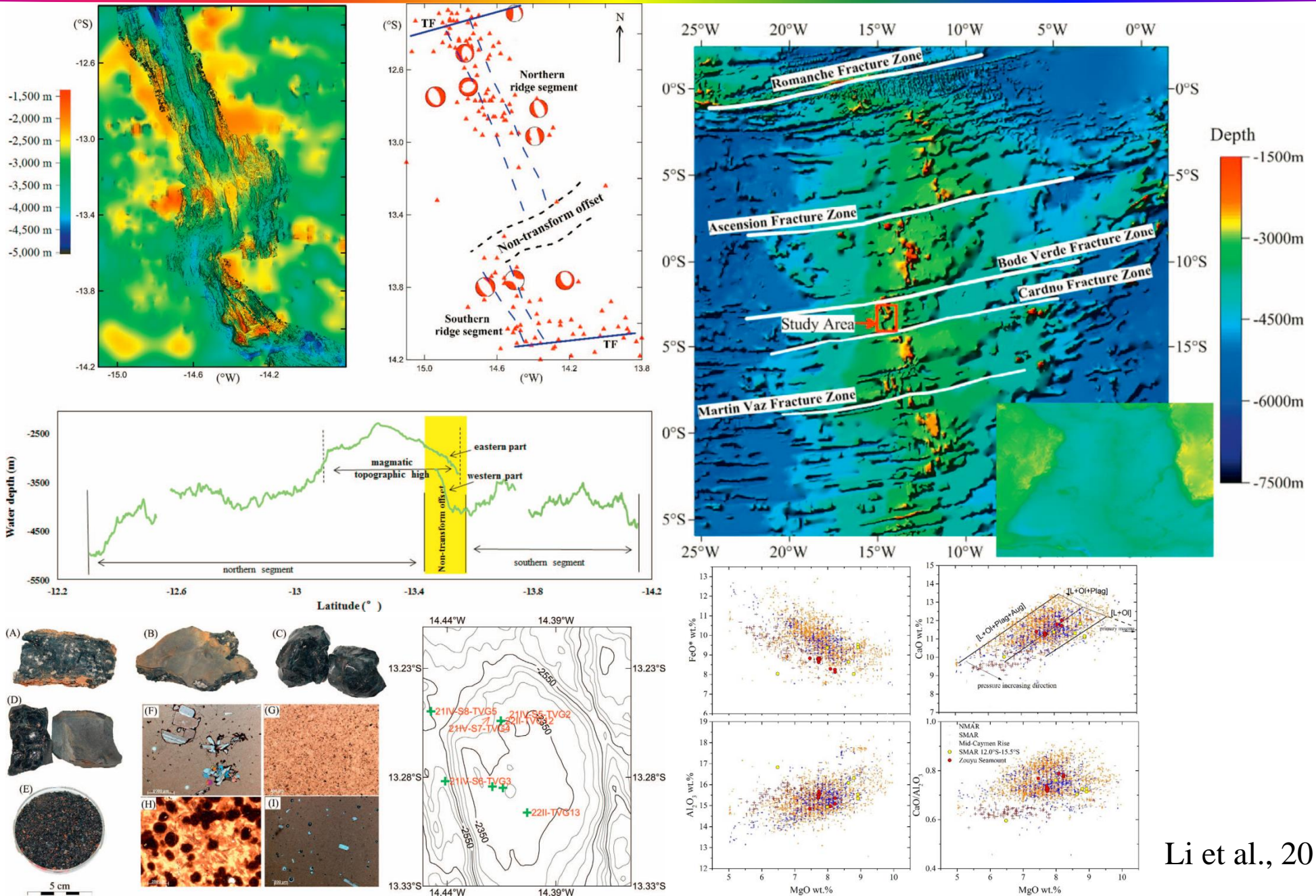




- **>550 hydrothermal sites have been identified along the 70,000 km long Middle Ocean Ridge**
- **about ~14% are along the Atlantic Ocean Ridge System**

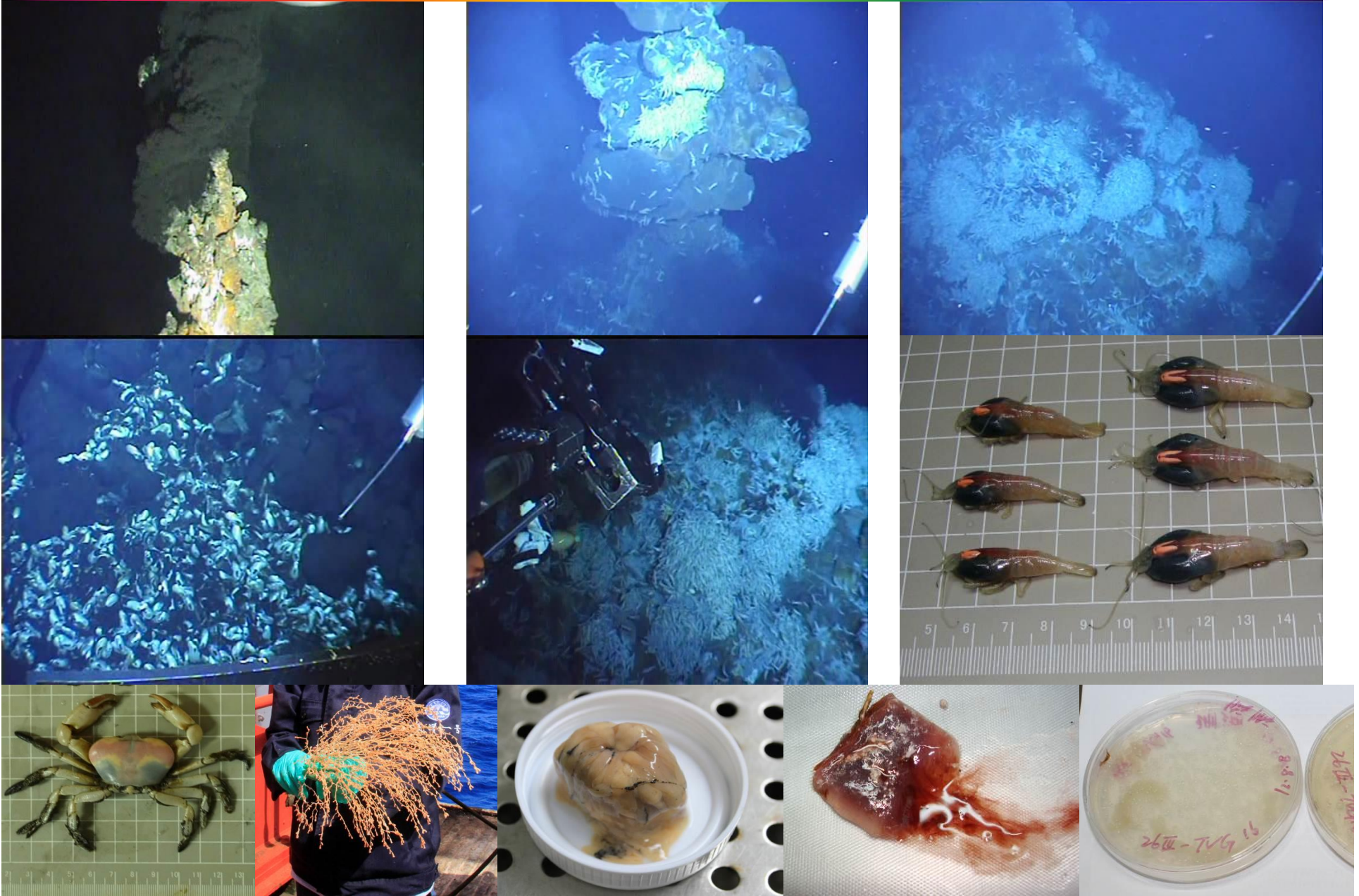


# Potential hydrothermal fields along the South Atlantic





# COMRA Cruise at the Mid-Atlantic Ridge



# **Mid-ocean Ridge Regional Environmental Management Plan” COMRA’s Position**

**Prof. Pei-Yuan Qian**

**Chair Professor and Acting Head, Department of Ocean Science**

**Chair Professor, Division of Life Science**

**Hong Kong University of Science and Technology, HKSAR, China**

**Chief Scientist for u-loop project, COMRA**

**Distinguished Research Fellow, The First Institute of Oceanography, SOA**



# To mine or To conserve

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- **Strike a balance between economic gain and environmental lose**
- **Economic value:** resource deposit x market value/unit
- **Environmental value:** more difficult to calculate
  - **Biodiversity value:** too early to be defined as <15% of marine species have been described.
  - **Ecosystem service value:** can't be defined until we understand the ecosystem
  - **Social & culture value:** even harder to be defined due to different culture backgrounds of nations

**We do not have enough information to see Yes or no for most “areas” at this point!!!**



# REMP workshop of NWP (sea mounts). May 27-29, 2018, Qingdao, China

## Steering committee (SC)

### Chairman



Michael Lodge  
Secretary-General  
International Seabed  
Authority  
Jamaica



Feng Liu  
Secretary-General  
China Ocean Mineral  
Resource R&D  
Association  
China

### Steering Committee



Xue-Wei Xu  
Second Institute of  
Oceanography, State  
Oceanic Administration  
China



Sandor Mulsow  
International Seabed  
Authority  
Jamaica



Irina Ponomareva  
JSC Yuzhmoregeologiya  
Russia



Yoshiaki Igarashi  
Japan Oil, Gas and  
Metals National  
Corporation  
Japan



Sang Joon Pak  
Korea Institute of Ocean  
Science & Technology  
South Korea



Malcolm Clark  
National Institute for  
Water and Atmospheric  
Research  
New Zealand



Pei-Yuan Qian  
Hong Kong University of  
Science and Technology  
China



## Focal points:

- **REMP's legal & Scientific framework**
- **Habitats of cobalt-rich "Areas"**
- **Suggestion and future perspectives of REMPs**

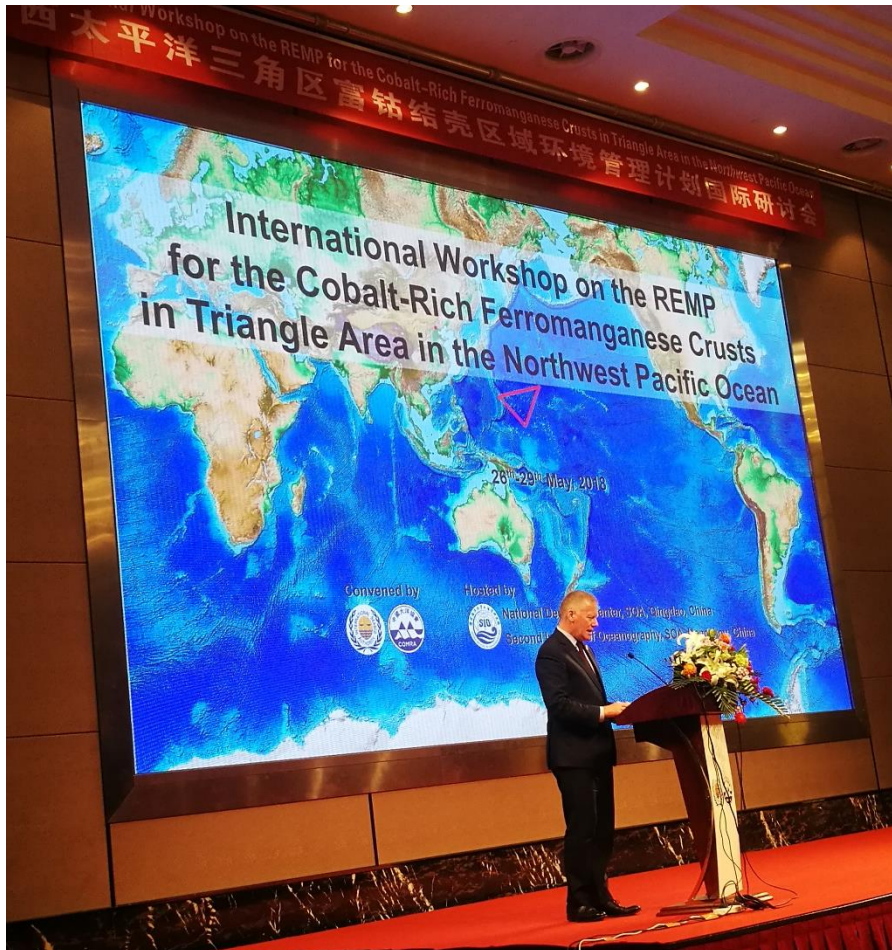
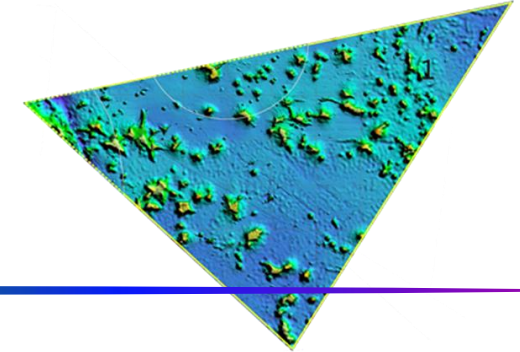
**Three working groups  
for 45 questions**





# Opening remarks

## — M Lodge

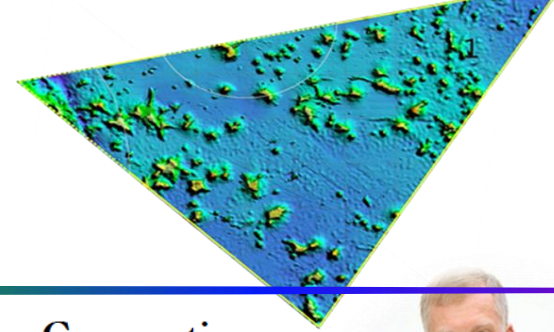


### Three Key Points:

- In designing a REMP for the Triangle area, many lessons might be drawn from the existing CCZ-REMP, including the guiding principles, implementation methodology, design principles for APEIs, etc;
- The Authority must provide guidelines on the assessment and archiving of data and information on baseline studies;
- The designing of REMPs relies on the cooperation of stakeholders.



# Potential impacts —— M Lodge



Twenty-eighth Meeting of States Parties to the United Nations Convention on the Law of the Sea

UN Headquarters, 11-14 June 2018



*Statement by H. E. Michael W. Lodge, Secretary-General, International Seabed Authority under agenda item 9:  
Information reported by the Secretary-General of the International Seabed Authority*

11 June 2018

- ❑ Article 154 Review and the Strategic Plan
- ❑ Development of the Mining Code
- ❑ **REMPs**
- ❑ Contracts for exploration
- ❑ Twenty-fourth session of the Authority
- ❑ Cooperation with other institutions set up by the Convention and with DOALOS
- ❑ Relationship with the host Government

That is why is **significant** that two weeks ago, in Qingdao, China, a scientific workshop was held and co-hosted by COMRA to explore how to develop a REMP in the North-West Pacific, where contractors from China, South Korea, Russia and Japan are carrying out exploration for cobalt crusts.

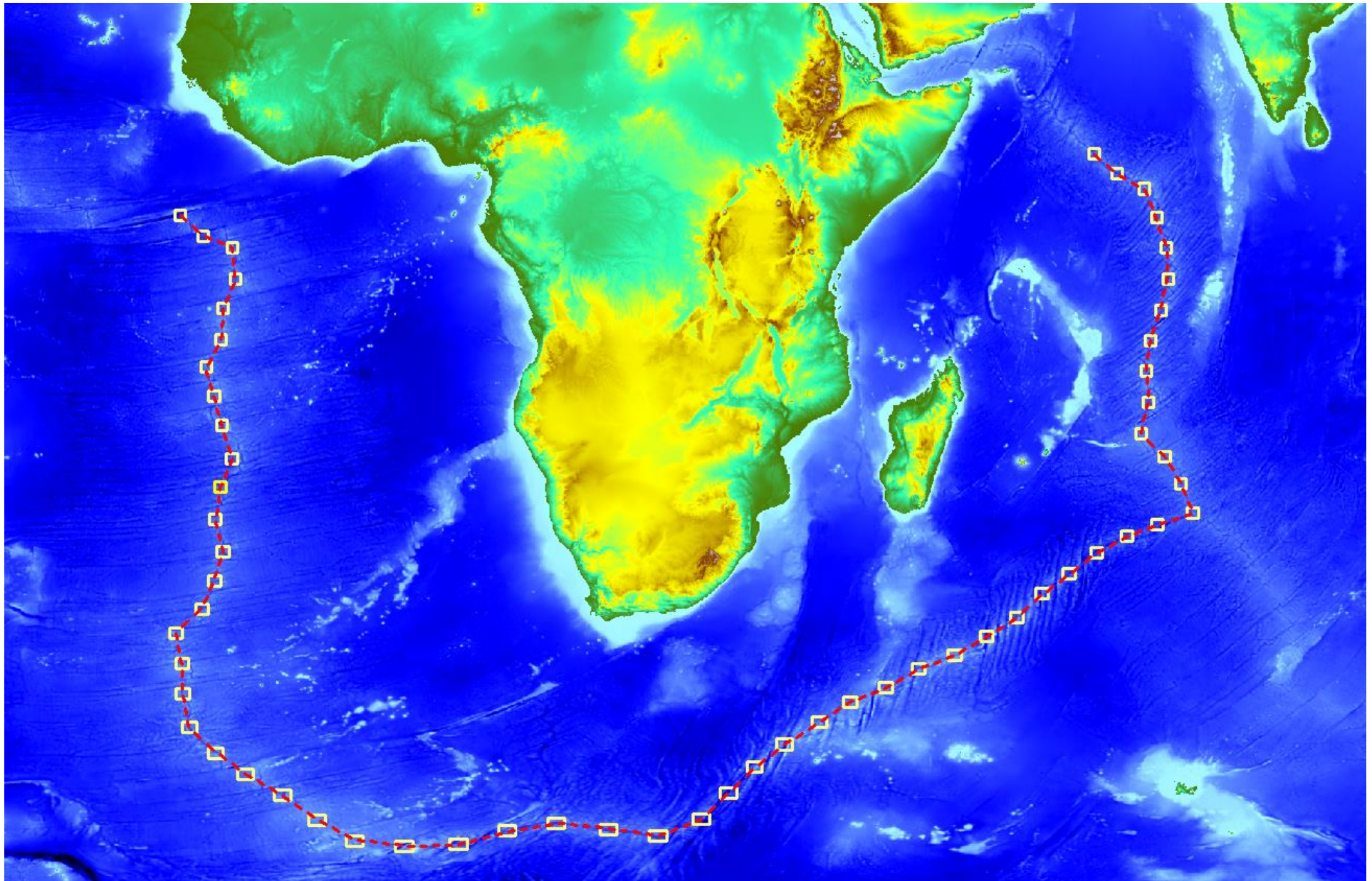


# COMRA's position on REMPs

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- COMRA strongly supports ISA's effort in developing REMP network for the 'Areas' and took an initiative in REMPs development of West Pacific Sea Mounts;
- COMRA is indeed to strike for a **balanced resource development with conservation**;
- COMRA strongly supports the idea of developing REMPS networks for the U-loop area;
- COMRA suggests to take an corporative, **inclusive (all stakeholders) /holistic** approach in developing REMPs/MPAs.

# u-loop Area where REMPs can be developed

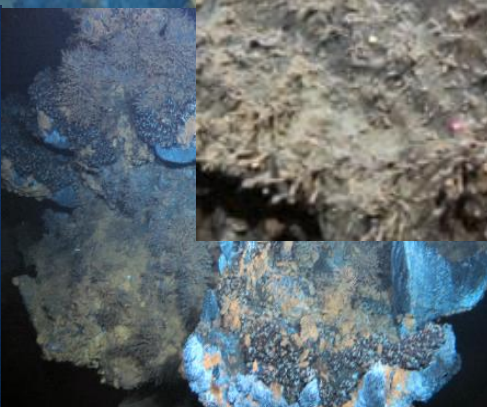
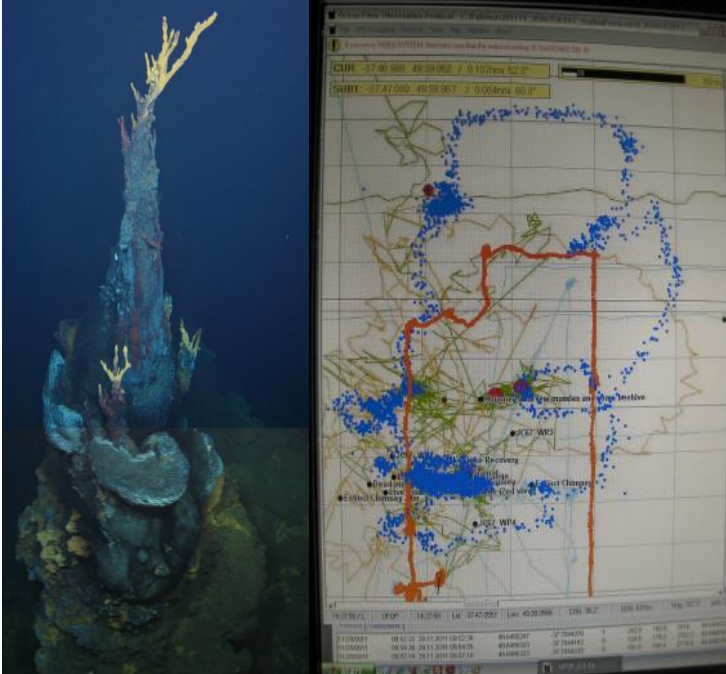




# Why U-loop area?

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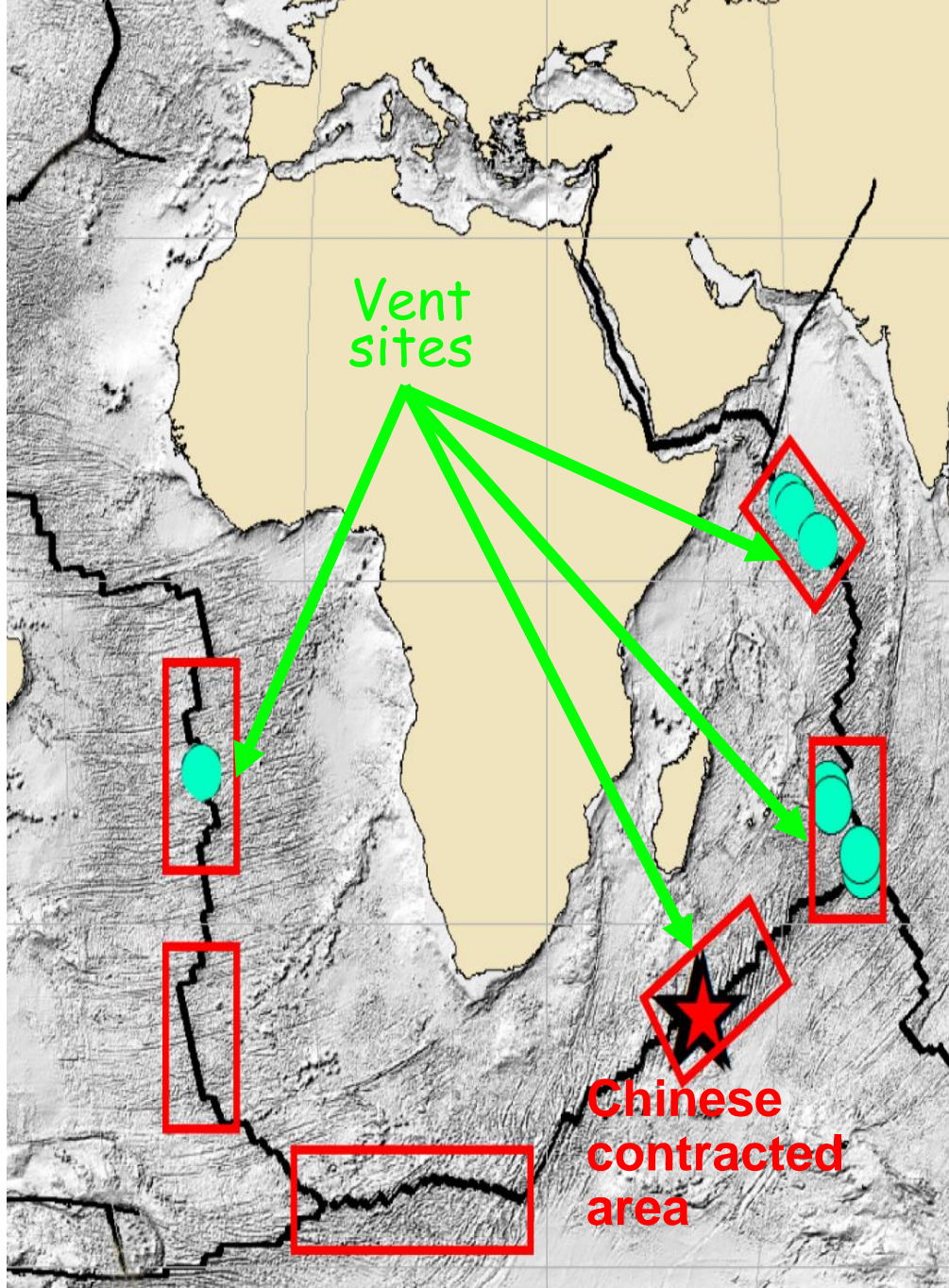
- A number of contractual areas;
- More and more active vent sites to be discovered;
- Great scientific interest;
- Much less understood ecosystems.



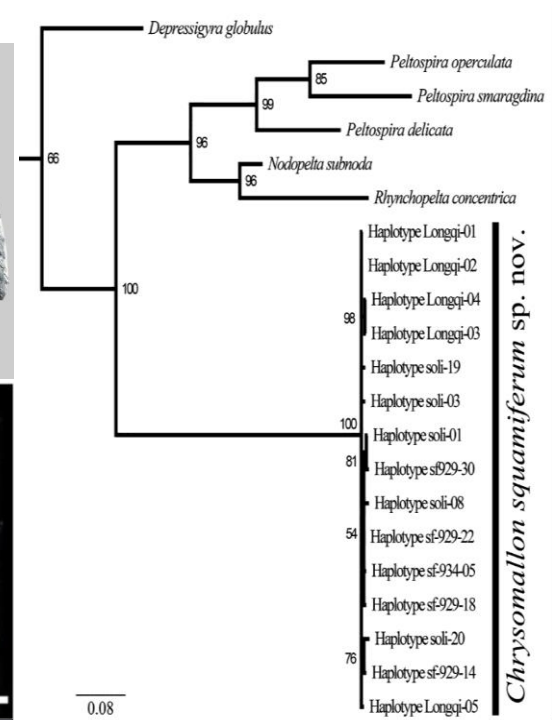
2011, UK colleagues surveyed Longqi site SWIR and found there are **17 species**. Probably **2-3 are new to science**

(Copley et al., 2016 Sci Rept)





Scaly-foot gastropod



Peltoispiridae

Chen et al., 2015, J M R

They are the **same species** cross the whole Indian Ocean Ridge based on molecular phylogeny!

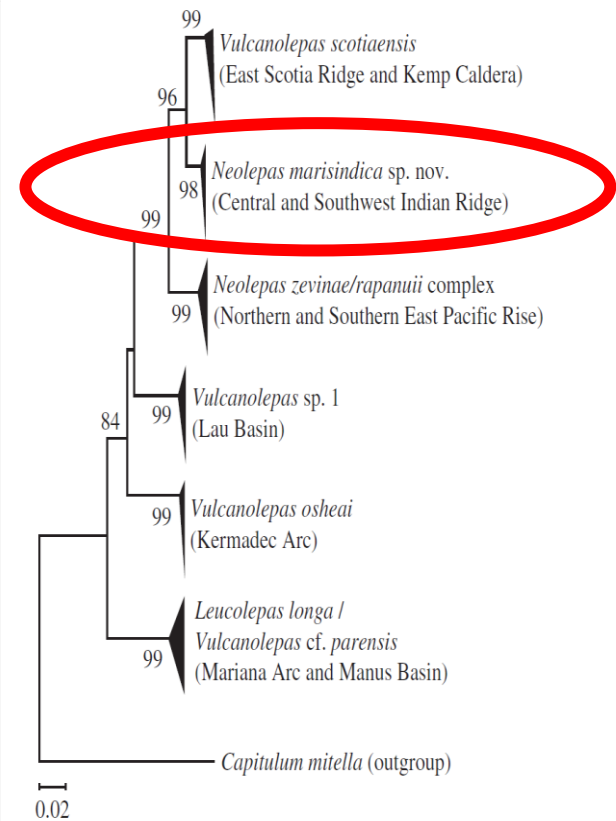
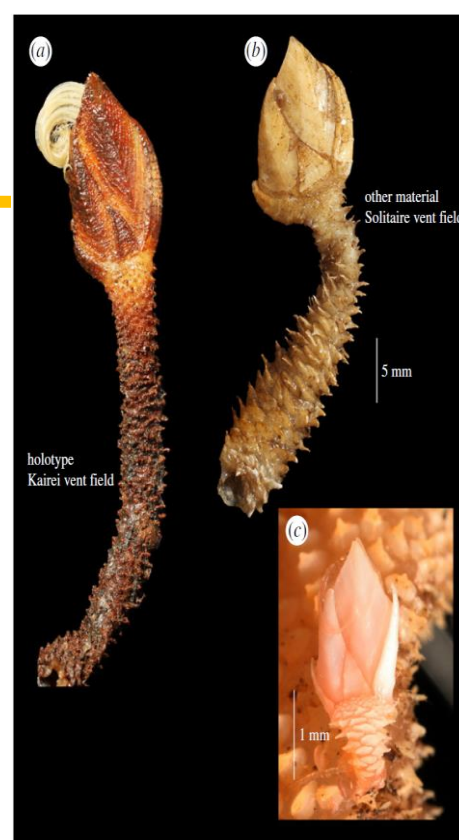
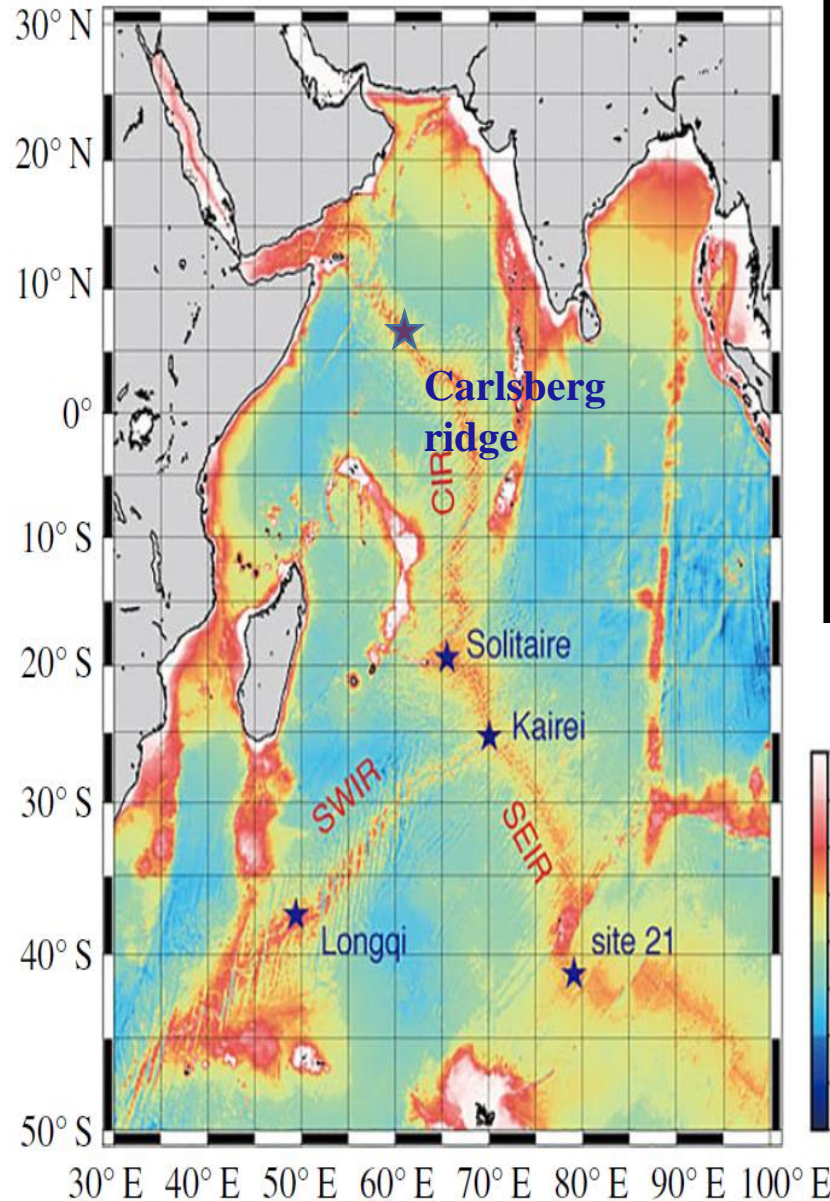
**新种**

VS

— 特有种？



# Stalk barnacle: *Neolepas marisindica*



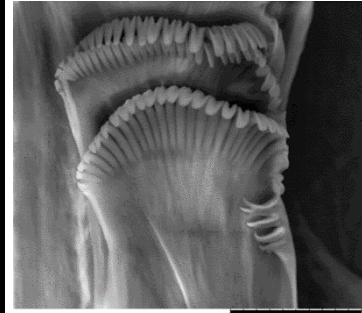
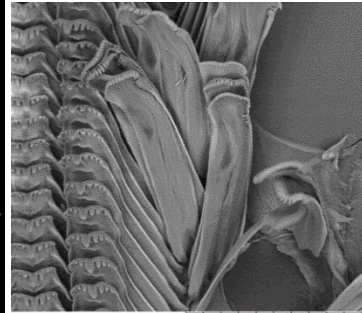
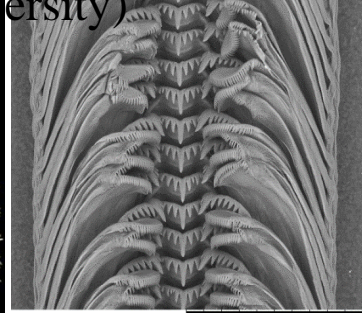
They are the **same species (also new species)**, based on morphology and phylogeny, that are distributed in **Southwest Indian Ridge, Central Indian Ridge, Southeast Indian Ridge, and also Carlsberg Ridge.**



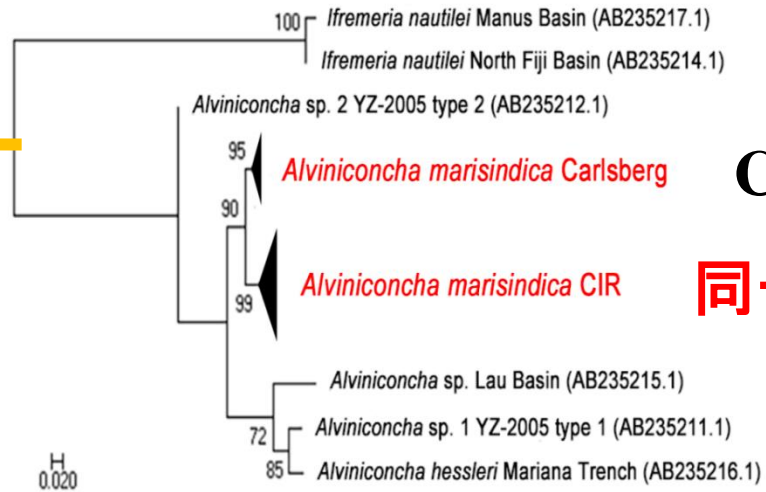
# Another snail: *Alviniconcha marisindica* (Yang et al,

unpublished)

(Johnson et al, 2015 Systematic & Biodiversity)



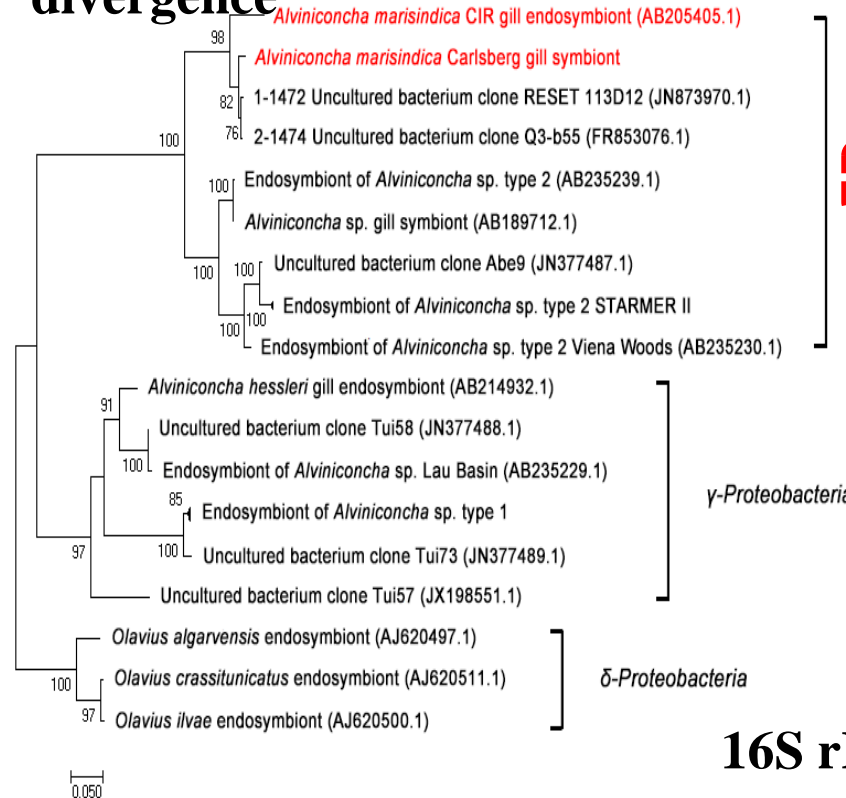
**Morphology: No difference!**



COI genes

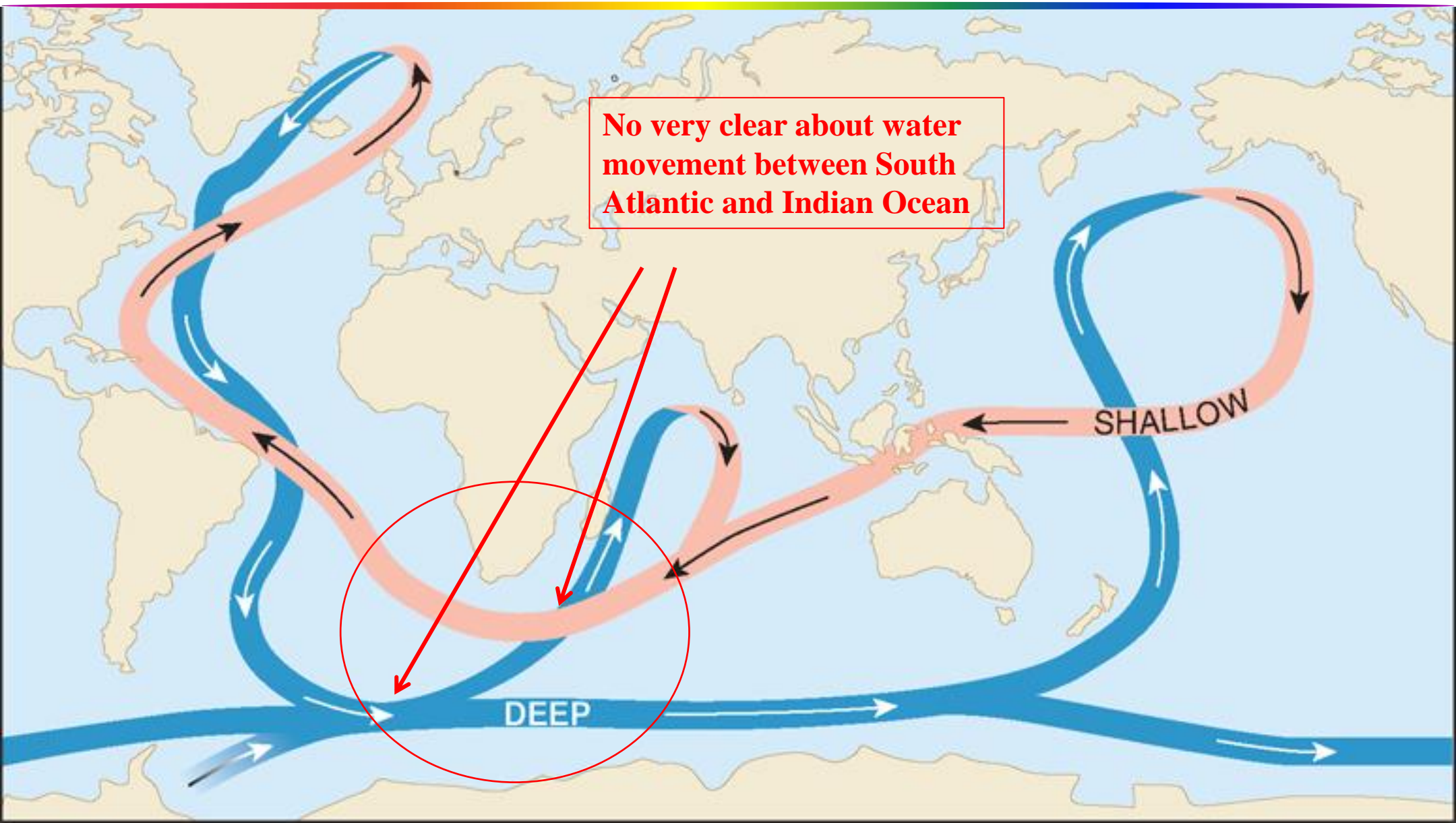
同一个物种!

**Molecular Phylogeny: Only 3.4% COI divergence**



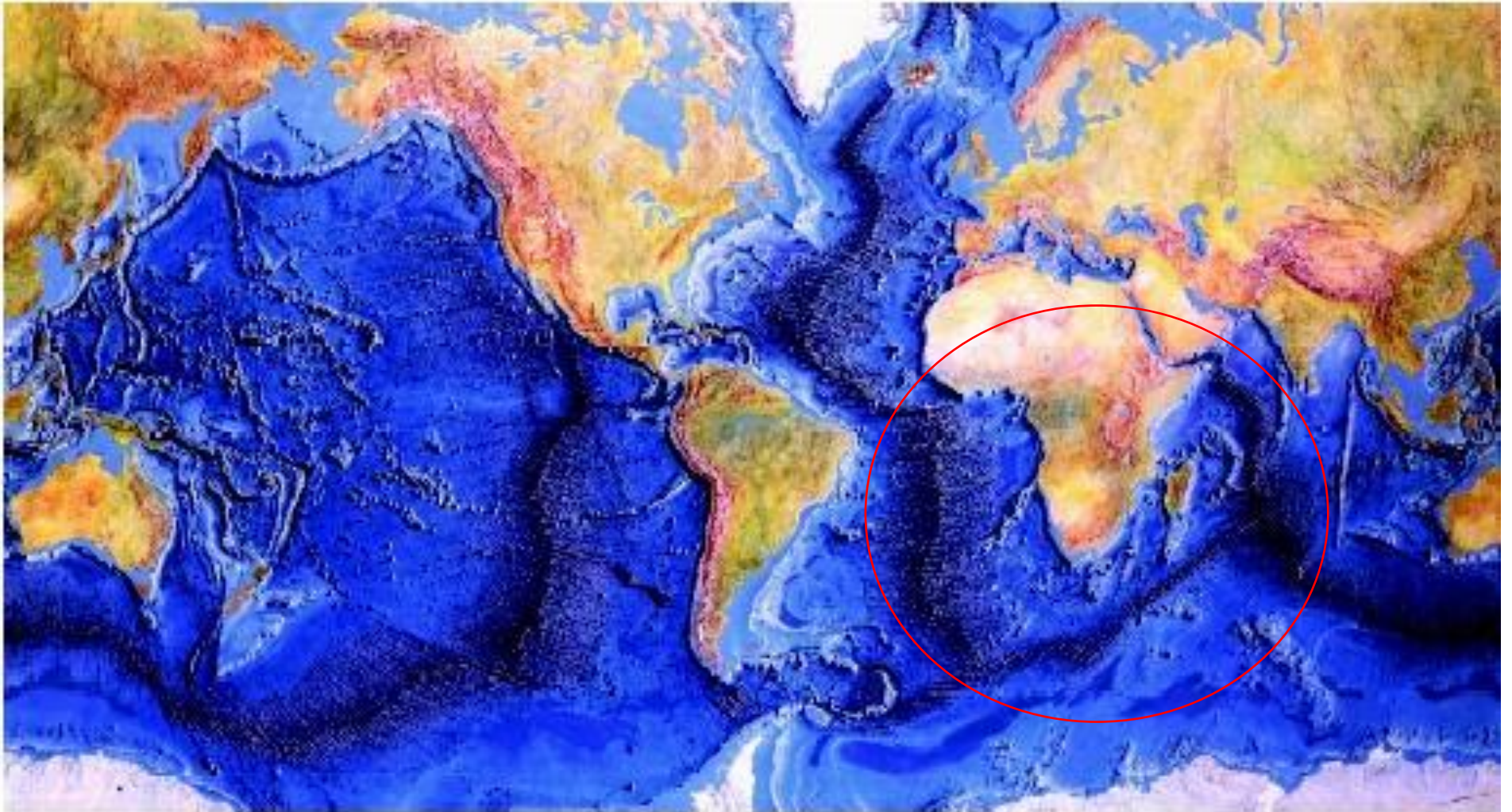
16S rRNA genes

# Big Question 1: Ocean flux and circulation between Atlantic and Indian and Pacific Oceans





## **Big Question 2: Floor spreading speed vs vent ecosystem development & distribution**



**South Atlantic (Slow low spreading zone) vs West Indian Ocean (Ultra slow spreading zone)**



# Big Question 3: Formation and succession of vent ecosystems





# Big Question 4: Connectivity and Diverge/converge of vent animals



# U-loop Regional Environmental Management Plan – road map



- Phase 1 (workshop 1): to develop REMP networks for the mid-ocean ridge of the West Indian Ocean Region
- Phase 2: to extend REMP region to the South Atlantic Ocean



## **Initial agreement between COMRA & ISA**

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- **ISA and COMRA cosponsor the first workshop on REMP design for the West Indian Ocean Ridge in Hong Kong in Spring 2019;**
- **Possibly the second workshop on REMP design for the South Atlantic Ocean at a later stage.**

# U-loop Regional Environmental Management Plan workshop 1

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- **Time:** Spring 2019
- **Venue:** HKUST IAS building and Conference Lodge
- **Sponsor/organizers:** ISA and COMRA
- **Participants:**
  - Relevant contractors in West Indian Ocean
  - Relevant states in the region concerned
  - NGO and other stakeholders



# **Expected outcomes of U-loop REMP workshop 1**

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- **To gain a general consensus on goals, objectives, and targets of REMPS in the areas;**
- **To identify information gaps of critical elements for identifying APEIs in contractual regions;**
- **To identify and agree on key elements to be considered for designing APEIs in mid-ocean ridge of West Indian Ocean;**

# **Expected outcomes of U-loop REMP workshop 1**

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- **To draw principles for area-based REMPs;**
- **To develop the template for mid-ocean ridge REMPS and APEIs;**
- **To propose the action plan and road map for developments of REMP network;**
- **To propose REMPs for the Legal and Technical Commission to consider in 2-3 years.**



**Thank you very much for your attention!**

